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THE THREE REGIMES OF THE IS-LM MODEL : A NON-WALRASIAN ANALYSIS

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1. - INTRODUCTION.

The purpose of this article is to use recent developments in non Walrasian analysis to show that the three different specifications of the IS-LM model generally found in the macroeconomic literature [1] are particular cases of a more general model, each specification appearing as a particular regime of this model. The standard IS-LM apparatus includes at least the two IS-LM equations, which will be described below. However these two basic equations are used in conjunction with three different types of assumptions concerning price and wage formation, and thus the state of excess demand or supply on the labor and goods markets : a first version assumes both price and wage rigid, and excess supply on the two markets. A second version assumes a rigid wage, but a flexible price clearing the goods market, so that excess supply appears only on the labor market. Finally, a third version assumes that both markets are cleared. The values of multipliers for monetary and fiscal policy are evidently quite different in these three cases, and so are the conclusions about economic policy.

So we shall develop in this paper a synthetic model which displays the three above cases as particular regimes of the same model. We shall use for that some concepts of non Walrasian analysis [2] and apply them to a simple monetary economy with four goods (labor, output, bonds and money) very close to that used in traditional macroeconomic models.

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(1) The original IS-LM model is due to Hicks (1937).

(2) See notably Benassy (1975), (1980), (1982), Drèze (1975).

Previous attempts at analyzing such four goods economies out of Walrasian equilibrium can be found in Barro-Grossman (1976), Gelpi-Younès (1977), Hool (1979). Applications to the IS-LM model can be found in Danthine-Peytrignet (1980), Sneessens (1981). However in these contributions the price and wage were assumed rigid, which made the results fairly different from some traditional macroeconomic models, notably as this introduced rationing on the goods market, a feature seldom found in the macroeconomic literature. We shall instead consider here a concept of non-Walrasian equilibrium where the price and wage are rigid downwards, but flexible upwards , which corresponds more to the implicit assumptions of Keynesian analysis. The resulting equilibria will turn out to correspond to the three specifications indicated above. Which particular regime the system is in will be determined by the values of various parameters, and notably the minimum price and wage, as we shall see below.

The IS-LM equations.

We shall give here briefly the two IS-LM equations which we shall subsequently obtain as particular cases of our model [(1)]. The IS equation is generally of the form :

$$y = C(y,r,p) + I(y,r,p) + g$$

where y is the level of transactions on the goods market, r the rate of interest, p the price level and g the level of government purchases, C(y,r,p) is the consumption function, I(y,r,p) the investment function.

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(1) The two equations which we give are actually a little more general than the ones usually found. This is done to accomodate a maximum number of specifications.

We shall often rewrite the IS equation in what follows as :

$$y = Z(y,r,p) + g$$

where $Z(y,r,p)$ is the total effective demand from the private sector. One usually assumes (1) :

$$0 < Z_y < 1 \qquad Z_r < 0 \qquad Z_p < 0$$

The LM function, meant to represent equilibrium on the "money market", is of the form :

$$L(y,r,p) = M$$

where $L(y,r,p)$ is the demand for money function and M the total quantity of money in the economy. One generally assumes :

$$L_y > 0 \qquad L_r < 0 \qquad L_p > 0$$

Taxes have been omitted from this basic model, because their treatment differs according to authors. Any particular specification can be trivially included, and this is left as an exercise to the reader.

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(1) Subscripts to a function denote partial derivatives, e.g. $Z_y = \partial Z/\partial y$.

2. - THE MODEL.

The basic structure.

We shall consider a simple aggregated monetary economy with three agents, household, firm and government, and four goods : output, labor, money and bonds. Accordingly there are three markets in this model : one on which output is exchanged against money at the price p , one on which labor is exchanged against money at the wage w , one on which bonds are exchanged against money at the price 1/r . The interest rate r is fully flexible and the bonds market is assumed to always clear. On the output and labor market however the price and wage are bounded below :

$$p \geq \bar{p} \qquad\qquad w \geq \bar{w}$$

Quantities exchanged on the output and labor market are denoted by y and ℓ respectively.

The agents.

The firm has a production function $F(\ell)$, such that :

$$F(0) = 0 \qquad F'(\ell) > 0 \qquad F''(\ell) < 0$$

We assume that the firm does not have any inventory, so that we shall always have $y = F(\ell)$. It maximizes its short-run profit $py - w\ell$. The firm also invests a quantity I . Its budget constraint is written (1) :

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(1) In order to lighten notation, we omit from all budget constraints the interest payments on outstanding bonds. These payments are assumed to be made at the beginning of the period, and thus included in the initial money holdings.

$$pI + m^f + \frac{b^f}{r} = U$$

Where b^f is the net flow acquisition of bonds by the firm (it will be negative if the firm borrows), m^f the net increase in the firm's money holdings and U denotes the undistributed profits of the firm, used for self-financing. Accordingly distributed profits to the household are equal to :

$$py - w\ell - U \quad \text{with} \quad U \leq py - w\ell$$

The household has a fixed supply of labor ℓ_o , actually sells ℓ , and receives a total income equal to py - U , with $w\ell$ coming from wages and $py - w\ell - U$ coming from profits. The household's budget constraint is :

$$pC + m^h + \frac{b^h}{r} = py - U$$

where b^h is the household's net acquisition of bonds on the bonds market, m^h the net increase in the household's money holdings and C the flow of consumption.

The government purchases a quantity of goods g , sells an amount of bonds b , and emits a new quantity of money $m = M - M_o$ where M_o is the total quantity of money initially in the economy. These three quantities are related by the government's budget constraint, which is :

$$m = pg - \frac{b}{r}$$

Signals and behavioral equations.

We shall describe here some effective demand and supply functions for household and firm, which will help us below to build the equations of our model. As in any non Walrasian model, effective demand and supply functions will depend upon both price and quantity signals.

Let us consider to start with the effective demand function for labor by the firm. The objective of the firm is to maximize short-run profits $py - w\ell$ and it has a production function $F(\ell)$. Two cases can occur :

- If the goods market is cleared and the firm thus perceives no quantitative constraint on the goods market, the demand for labor has the "neoclassical" form $F'^{-1}(w/p)$

- If however the firm is constrained on the goods market (this will happen only when the price is blocked at its minimum $\bar{p}$) and the maximum quantity it can sell is y , the demand for labor will have the "Keynesian" form $F^{-1}(y)$.

The derivation of the other demand and supply functions, corresponding to C and b^h for the household, I and b^f for the firm, would be normally much more cumbersome, since the corresponding decisions involve intertemporal choices. Accordingly these functions should all depend upon current and *expected* price-quantity signals. If expectations are formed historically, one can derive from the original functions some indirect effective demand and supply functions which depend upon only current signals (Benassy 1975), and this is the form which we shall adopt here. We shall not give here their explicit derivation, but only concentrate upon the form of signals appearing in the effective demand and supply functions of each agent. We shall now describe them in turn.

The firm's net demands for investment and bonds, I and b^f , should naturally be function of the three price signals, p , r and w . As for the quantity signals, the firm is never constrained on the bonds market (which clears), nor on the labor market (where the firm is a demander and the wage is flexible upwards). But it may be constrained on the goods market where the quantity y it exchanges can be a constraint for the firm. We shall thus write :

$$\begin{cases} I = I(y,p,r,w) \\ b^f = b^f(y,r,p,w) \end{cases}$$

Note that these two functions should also have as arguments the firm's initial holdings of money, bonds and capital. Since all of these are given in the period considered, we omit them here. In order to fully describe the behavior of the firm, we have to describe its profit distribution behavior. We shall thus assume that U is function of the same signals and write :

$$U = U(y,r,p,w)$$

As for the household, it is never constrained on the bonds market (which clears), nor on the goods market (since the price is flexible upwards and the household is a demander). But it may be constrained on the labor market, with the result that realized income may be different from planned income. We shall thus assume that the consumption and net demand for bonds by the household are function of this realized income and of the price signals p , r and w (Clower 1965). Since household's disposable income is $py - U(y,r,p,w)$, the two functions can be written :

$$\begin{cases} C = C(y,r,p,w) \\ b^h = b^h(y,r,p,w) \end{cases}$$

The functions should also depend upon the household's initial holdings of money and bonds, but we again omit them here since they are given.

3. - THE CORE EQUATIONS AND IS-LM.

In the different regimes of the model which we shall study below, some equations will change and some will not. We shall give here briefly the ones that will remain throughout the analysis, and relate them below to the IS-LM equations.

An equation which will hold throughout is that giving the condition of equilibrium on the bonds market. Let us call :

$$b^d(y,r,p,w) = b^f(y,r,p,w) + b^h(y,r,p,w)$$

the net demand of bonds by the private sector. The equilibrium condition will be written :

$$b^d(y,r,p,w) = b$$

which, using the government's budget constraint $b = r(pg-m)$ can also be written :

$$b^d(y,r,p,w) = r(pg-m)$$

The second equation, which concerns the goods market, is not an equation of supply and demand equilibrium since the goods market may be in excess supply. It rather expresses that, since the price is flexible upwards, the level of transactions on this market is always equal to total demand, which we shall write as :

$$y = C(y,r,p,w) + I(y,r,p,w) + g$$

Relation with IS-LM.

We shall now specialize or rewrite the basic equations in such a way as to obtain the IS-LM equations as given above in the introduction. In order to obtain these, we first ignore, as in all Keynesian IS-LM models, the wage signal in the equations. We thus obtain the new system :

$$\begin{cases} y = C(y,r,p) + I(y,r,p) + g = Z(y,r,p) + g \\ b^d(y,r,p) = b = r(pg-m) \end{cases}$$

The first equation is now identical to the IS equation. We may note in this respect that a traditional interpretation of the IS equation as one of "equilibrium" on the goods market is erroneous. The IS equation only expresses that transactions on the goods market are always equal to effective demand, though not necessarily to effective supply.

Obtaining the LM equation will ask a bit more work since there is no such thing as a "market for money" in our model, because money is the medium of exchange. However, adding the firm's and household's budget constraints, we obtain (1) :

$$m^f + m^h = py - pZ(y,r,p) - \frac{1}{r}\, b^d(y,r,p)$$

So that the final quantity of money $M = M_0 + m^f + m^h$ will be given by :

$$M = M_0 + py - pZ(y,r,p) - \frac{1}{r} \cdot b^d(y,r,p)$$

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(1) See Hansen (1970) for a similar derivation.

We may take this as a "demand for money" and equate it to the Keynesian demand for money $L(y,r,p)$ (1). Reciprocally, we shall obtain the IS-LM system if we take in our model the net demand for bonds equal to the particular following form :

$$b^d(y,r,p) = r[M_0 - L(y,r,p) + py - pZ(y,r,p)]$$

which we shall do in all that follows.

The core equations.

In the following sections we shall study the various regimes of the model whose core equations are

$$\begin{cases} y = Z(y,r,p) + g \\ b^d(y,r,p) = b = r(pg-m) \end{cases}$$

Using the particular form of the bond demand chosen above, this system is now equivalent to the usual IS-LM system :

$$\begin{cases} y = Z(y,r,p) + g \\ L(y,r,p) = M_0 + m = M \end{cases}$$

and we make the usual assumptions, already given at the beginning of this article :

$$0 < Z_y < 1 \qquad Z_p < 0 \qquad Z_r < 0$$

$$L_y > 0 \qquad L_p > 0 \qquad L_r < 0$$

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(1) This shows in passing that the traditional form of the demand for money is valid only for some regimes.

The aggregate demand curve.

For the computations that will follow, it is useful to compute the solution in y to the two above equations. It will be function of the price level p as well as of the two policy parameters g and m . We shall denote it as K(p,m,g). Note that this function is very much akin to the aggregate demand function of traditional Keynesian IS-LM analysis. The partial derivatives of this function are easily computed as :

$$K_g = \frac{1}{1-Z_y+\frac{Z_r}{L_r} L_y} > 0$$

$$K_m = \frac{Z_r}{(1-Z_y)L_r+Z_rL_y} > 0$$

$$K_p = \frac{Z_pL_r-Z_rL_p}{(1-Z_y)L_r+Z_rL_y} < 0$$

Walrasian equilibrium.

For what follows, it will be also be useful to compute the values of the Walrasian equilibrium price and wage p_o and w_o associated to given values of m and g . Equilibrium on the labor market implies that the neoclassical demand for labor $F'^{-1}(w/p)$ equals the supply of labor ℓ_o , which yields :

$$\frac{w_o}{p_o} = F'(\ell_o)$$

Equilibrium on the goods market implies that the total demand for goods equals full employment production $F(\ell_o) = y_o$. Combined with the equation of equilibrium on the bonds market, this implies :

$$K(p_o,m,g) = y_o$$

We may remark that this equation needs not be satisfied for a finite price level. A necessary condition for a Walrasian equilibrium to exist is thus :

$$\lim_{p \to \infty} K(p,m,g) < y_o$$

In what follows we shall always assume this condition satisfied.

4. - THE THREE REGIMES.

As we shall see below, this model will have three different regimes :

- Excess supply on both markets (Regime A).
- Excess supply of labor, goods market cleared (Regime B).
- Both markets cleared (Regime C).

A fourth potential regime will turn out, as we shall see below, to be a degenerate one. We shall now describe in detail these regimes. In each case we shall compute the values p^* , w^* , y^* and ℓ^* of price, wage, output sales and employment in the non Walrasian equilibrium associated to the basic parameters $\bar{p}$, $\bar{w}$, m and g . We shall pay particular attention to the effects of the policy variables g and m , and show for which values of the parameters each situation holds.

Regime A : Excess supply on both markets.

With excess supply on both markets, the price and wage are blocked at their lower bounds :

$$p = \bar{p} \qquad\qquad w = \bar{w}$$

Since there is excess supply on the goods market, the level of output is given by total demand for goods :

$$y = Z(y,r,p) + g$$

The level of employment is given by the demand of labor. Since the firm is constrained on the goods market, this demand for labor is equal to $F^{-1}(y)$, i.e. the level of employment necessary to produce y and thus :

$$\ell = F^{-1}(y)$$

Finally, the rate of interest clears the bond market, which yields a fifth equation :

$$b^d(y,r,p,w) = b = r(pg-m)$$

The equilibrium values of the various variables are thus given by the following system :

$$\begin{cases} p = \bar{p} \\ y = Z(y,r,p) + g \\ w = \bar{w} \\ \ell = F^{-1}(y) \\ b^d(y,r,p) = r(pg-m) \end{cases}$$

Combining the IS equation and the bond market equation into the aggregate demand curve K(p,m,g) , we obtain that p^* , w^* , y^* and ℓ^* are solutions of the following simpler system :

$$\begin{cases} y^* = K(p^*,m,g) \\ y^* = F(\ell^*) \\ p^* = \bar{p} \\ w^* = \bar{w} \end{cases}$$

We thus find immediately the two policy multipliers :

$$\frac{\partial y^*}{\partial g} = K_g \qquad\qquad \frac{\partial y^*}{\partial m} = K_m$$

We may note that the multiplier K_g on public spending is already smaller here than the simplest traditional multiplier $1/(1-Z_y)$. This is because of an indirect crowding-out effect operating through the bond market : the increase in the interest rate necessary to finance the additional government purchases reduces private spending, and thus the multiplier.

In order for regime A to obtain, the set of parameters $\bar{p}$, $\bar{w}$, m , g must be such that the solution we found displays excess supply on the goods and labor market, which gives respectively the two following conditions :

$$\begin{cases} y^* \leq F[F'^{-1}(w^*/p^*)] \\ \ell^* \leq \ell_0 \end{cases}$$

Inserting the equilibrium values into these equations we find the following set of conditions :

$$\begin{cases} K(\bar{p},m,g) \leq F[F'^{-1}(\bar{w}/\bar{p})] \\ K(\bar{p},m,g) \leq F(\ell_0) = y_0 \end{cases}$$

These conditions can be shown graphically in a $(\bar{p},\bar{w})$ space, holding g and m constant (Figure 1). The corresponding region has been labeled A.

Figure 1

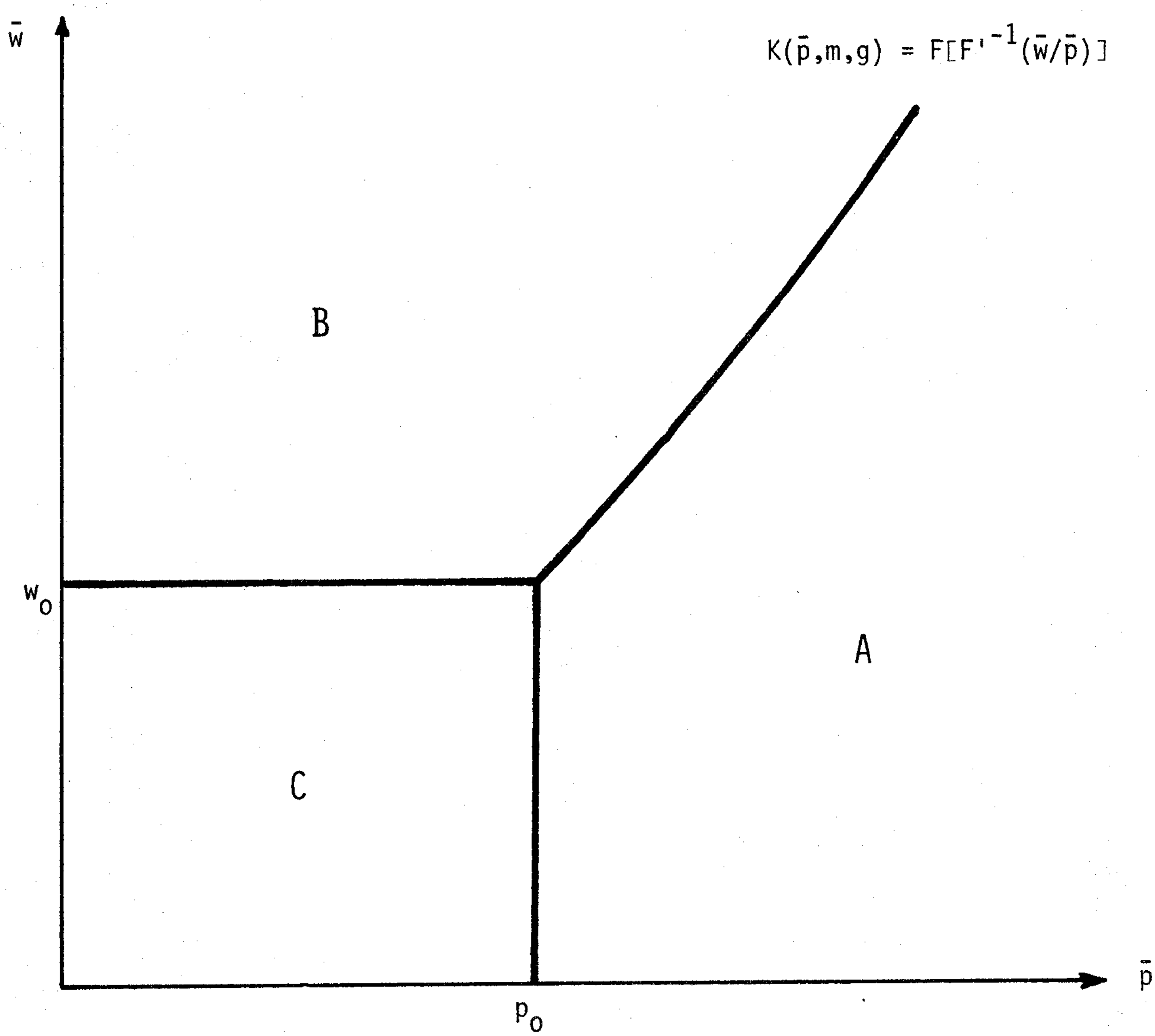

Figure 1

Regime B : Excess supply on the labor market, goods market cleared.

In this regime, the price is not anymore blocked at its minimum, but is determined by the equality of supply and demand on the goods market. Transactions on the goods market are still equal to the effective demand :

$$y = Z(y,r,p) + g$$

But we must replace the equation $p = \bar{p}$ by an equation indicating that transactions are equal to the effective supply of firms on the goods market. Since there is no constraint for the firm on the labor market, this effective supply is the neoclassical one, i.e. :

$$y = F\left[F'^{-1}\left(\frac{w}{p}\right)\right]$$

On the labor market the wage is equal to its minimum :

$$w = \bar{w}$$

Employment is determined by labor demand. Since the firm is unconstrained on the goods market, this demand is the "neoclassical" demand $F'^{-1}(w/p)$ and thus :

$$\ell = F'^{-1}\left(\frac{w}{p}\right)$$

Finally the equation for bond market equilibrium still holds :

$$b^d(y,r,p,w) = b = r(pg-m)$$

Equilibrium values of the variables are thus given by the following system of equations :

$$\begin{cases} y = Z(y,r,p) + g \\ y = F\left[F'^{-1}\left(\frac{w}{p}\right)\right] \\ w = \bar{w} \\ \ell = F'^{-1}\left(\frac{w}{p}\right) \\ b^d(y,r,p) = r(pg-m) \end{cases}$$

Or more simply, denoting :

$$F\left[F'^{-1}\left(\frac{w}{p}\right)\right] = S(p,w) \qquad S_p > 0 \qquad S_w < 0$$

The equilibrium values p^* , w^* , y^* , ℓ^* are solutions of the following simpler system :

$$\begin{cases} y^* = K(p^*,g,m) \\ y^* = S(p^*,w^*) \\ y^* = F(\ell^*) \\ w^* = \bar{w} \end{cases}$$

The economic policy multipliers are easily computed as :

$$\frac{\partial y^*}{\partial g} = \frac{S_p\ K_g}{S_p - K_p} < K_g$$

$$\frac{\partial y^*}{\partial m} = \frac{S_p\ K_m}{S_p - K_p} < K_m$$

We may note that, as compared to regime A studied above, the effects of both budgetary and monetary policies are weakened in this regime by the price movements which they induce : we can indeed compute that these two policies induce a price rise on the goods market :

$$\frac{\partial p^*}{\partial g} = \frac{K_g}{S_p - K_p} > 0$$

$$\frac{\partial p^*}{\partial m} = \frac{K_m}{S_p - K_p} > 0$$

This price rise reduces private spending, and thus the multipliers. We may note also that in this regime a reduction in the minimum wage $\bar{w}$ will result in an increase in production and employment, and a decrease in the price level :

$$\frac{\partial y^*}{\partial \bar{w}} = \frac{-K_p S_w}{S_p - K_p} < 0$$

$$\frac{\partial p^*}{\partial \bar{w}} = \frac{-S_w}{S_p - K_p} > 0$$

We shall now characterize the set of parameters for which the equilibrium will be of type B ; the equilibrium values w^* , p^* , y^* , ℓ^* must be such that there is excess supply on the labor market and that the equilibrium price is greater than the minimum :

$$\begin{cases} \ell^* \leq \ell_0 \\ p^* \geq \bar{p} \end{cases}$$

These two conditions are easily seen to be equivalent to the two following ones (1) :

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(1) These conditions are easily derived with the help of the graphical representation of Figure 3 below.

$$\begin{cases} K[\bar{w}/F'(\ell_o)\ ,\ m\ ,\ g] \leq y_o \\ K[\bar{p},m,g] \geq F[F'^{-1}(\bar{w}/\bar{p})] \end{cases}$$

The corresponding subregion in $(\bar{p},\bar{w})$ space has been depicted as region B in Figure 1.

Regime C : Both markets cleared.

In this case both the price and wage are determined by the conditions of equilibrium of supply and demand on the labor and goods markets. The two conditions for the goods market are the same as in regime B above :

$$y = Z(y,r,p) + g$$

$$y = F\left[F'^{-1}\left(\frac{w}{p}\right)\right]$$

For the labor market to be cleared the transaction ℓ must be equal to the effective supply ℓ_o , and to the effective demand, which has the neoclassical form $F'^{-1}(w/p)$, since the goods market is cleared :

$$\ell = \ell_o$$

$$\ell = F'^{-1}\left(\frac{w}{p}\right)$$

Finally the bonds market is again cleared :

$$b^d(y,r,p) = b = r(pg-m)$$

All variables are thus determined at equilibrium by the following system :

$$\begin{cases} y = Z(y,r,p) + g \\ y = F[F'^{-1}(\frac{w}{p})] \\ \ell = F'^{-1}(\frac{w}{p}) \\ \ell = \ell_o \\ b^d\ (y,r,p) = r(pg-m) \end{cases}$$

which reduces to the following set of equations in the equilibrium values p^* , w^* , y^* , ℓ^* :

$$\begin{cases} y^* = K(p^*,g,m) \\ y^* = F[F'^{-1}(\frac{w^*}{p^*})] \\ y^* = F(\ell^*) \\ \ell^* = \ell_o \end{cases}$$

We see that in this case both multipliers are equal to zero, since y^* is blocked at the full employment value y_o . All effects of budget or monetary policy are offset by the movements in price and interest rate. The equilibrium price and wage are given by :

$$\begin{cases} y_o = K(p^*,g,m) \\ w^* = p^*.F'(\ell_o) \end{cases}$$

From which one can compute :

$$\frac{\partial p^*}{\partial g} = - \frac{K_g}{K_p} > 0$$

$$\frac{\partial p^*}{\partial m} = - \frac{K_m}{K_p} > 0$$

The set of parameters for which one will be in this regime must be such that the equilibrium price and wage are both above their minimum levels :

$$\begin{cases} p^* \geq \bar{p} \\ w^* \geq \bar{w} \end{cases}$$

Using the above computed values, this yields :

$$\begin{cases} K(\bar{p},m,g) \geq y_0 \\ K[\bar{w}/F'(\ell_0),m,g] \geq y_0 \end{cases}$$

The "fourth" regime.

The fourth possible regime in this model would be one with an excess supply for goods and the labor market cleared. As we shall see, however, this regime reduces to a limit case between regime A and regime C.

Since there is excess supply for goods, price and transaction on the goods market are determined by

$$p = \bar{p}$$

$$y = Z(y,r,p) + g$$

Since the market for labor is cleared, the level of employment is equal to both the supply and demand for labor. Because there is excess supply on the goods market, the demand for labor has here the Keynesian form :

$$\ell = \ell_0$$

$$\ell = F^{-1}(y)$$

Finally the interest rate clears the bond market :

$$b^d(y,r,p) = r(pg-m)$$

Combining again the IS and bond market equations, we obtain the following system :

$$\begin{cases} p^* = \bar{p} \\ y^* = K(p^*,m,g) \\ y^* = F(\ell^*) \\ \ell^* = \ell_0 \end{cases}$$

Note that the last three conditions yield $p^* = p_0$. Combined with the first condition this implies $\bar{p} = p_0$, which is a first restriction on the parameters. In order to belong to that regime, the parameters must in addition be such that there is excess supply on the goods market, and that the wage is above its minimum, i.e. :

$$\begin{cases} y^* \leq F[F'^{-1}(w^*/p^*)] \\ w^* \geq \bar{w} \end{cases}$$

These two conditions can be satisfied provided that

$$\bar{w}/p_0 \leq F'(\ell_0)$$

So that the set of parameters corresponding to that fourth regime is given by :

$$\begin{cases} \bar{p} = p_o \\ \bar{w}/p_o \leq F'(\ell_o) \end{cases}$$

It is easy to see graphically (Figure 1) that the subset to these conditions corresponds to the dividing line between region A and region C. This regime is thus degenerate and a local study of policy effects would be useless.

5. - A GRAPHICAL SOLUTION.

If one looks at the above equations, one sees that the equilibrium values p^* and y^* can be found at the intersection in (p,y) space of a "demand" and "supply" curve which we shall denote respectively as :

$$y = \hat{D}(p) \qquad \text{and} \qquad y = \hat{S}(p)$$

The "Demand" curve is simply the aggregate demand function which we constructed above :

$$\hat{D}(p) = K(p,m,g)$$

The "Supply" curve $\hat{S}(p)$ consists of three parts (Figure 2) : a vertical part corresponding to $p = \bar{p}$. A horizontal part corresponding to $y = y_0$. And a positively sloping part having for equation :

$$y = S(\bar{w},p) = F[F'^{-1}(\frac{\bar{w}}{p})]$$

Note that this positively sloping part may not exist if $\bar{w}/\bar{p} < F'(\ell_0)$.

Figure 2

We see immediately that the resulting equilibrium will be of type A if the two curves cut in the vertical part of the "supply curve" ; it will be of type B if they cut in the upward sloping part of the supply curve ; it will be of type C if they intersect in the horizontal part of the supply curve. Case B has been represented on Figure 3.

Figure 3

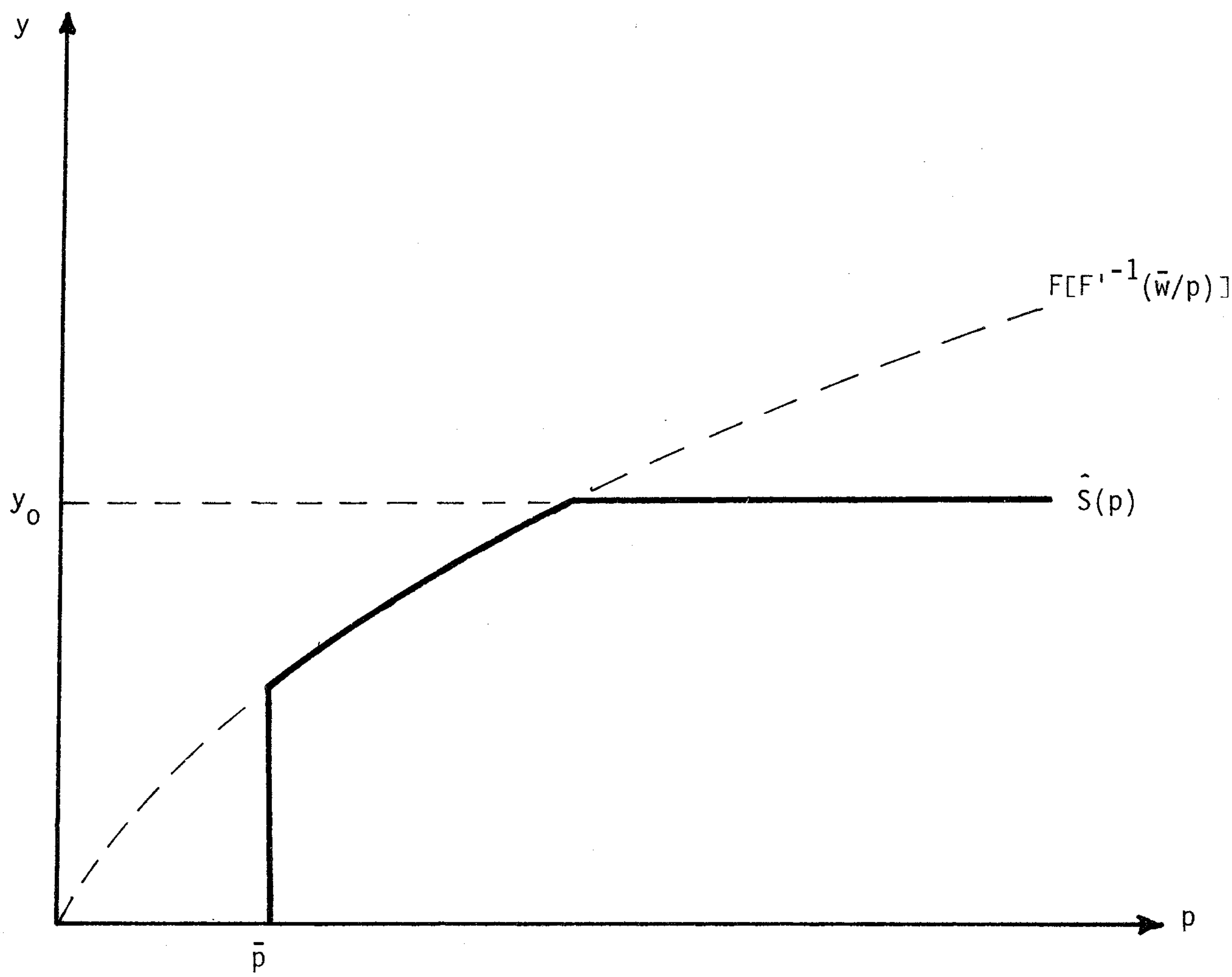
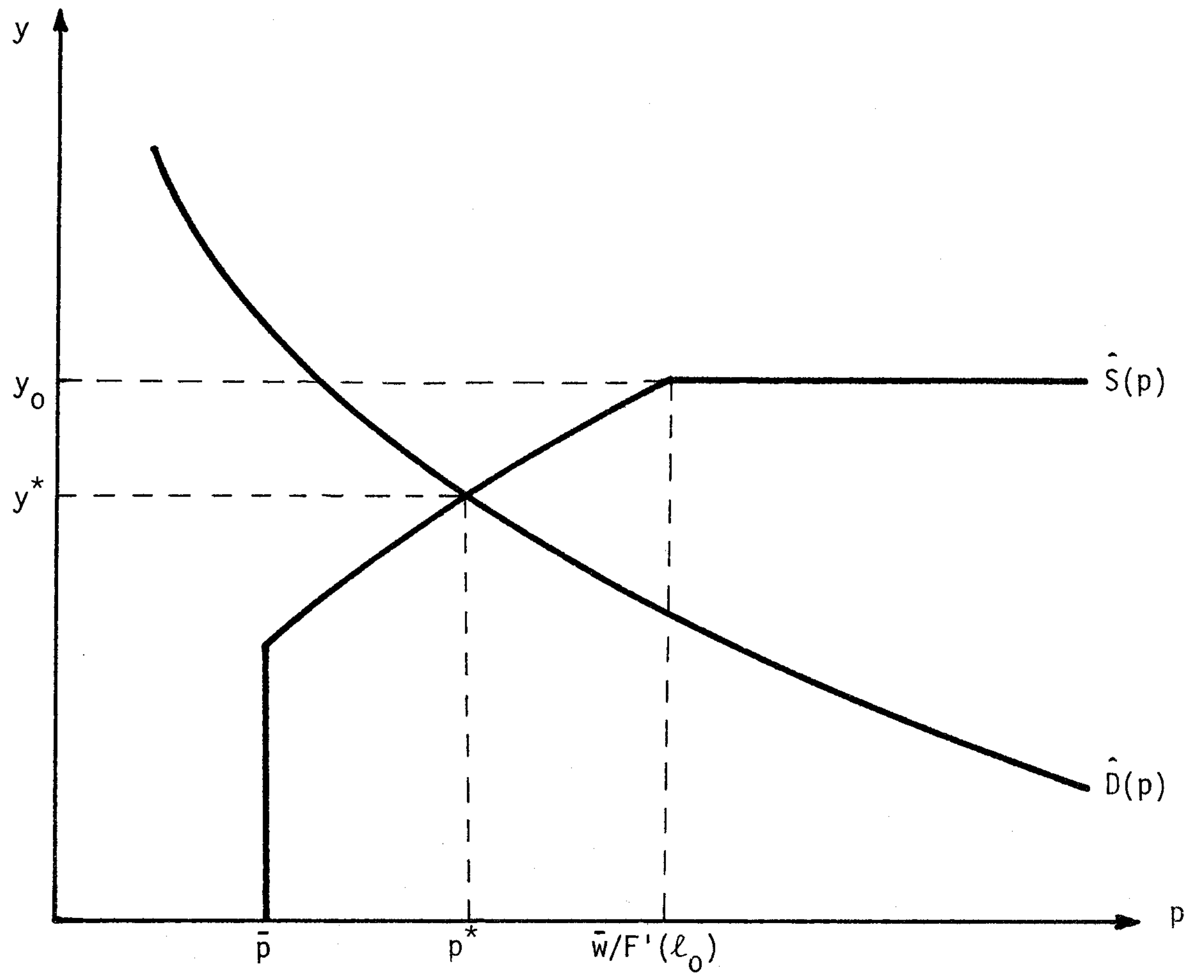


Figure 2



<u>Figure 3</u>

For given values of $\bar{p}$, $\bar{w}$, m , g , one can construct the curves $\hat{D}(p)$ and $\hat{S}(p)$ and find which of the three regimes prevails. Each of the three regimes corresponds to a subset of parameters ; these, which can be very easily found with the help of Figure 3, and the corresponding figures for cases A and C, are the following :

Regime A
$$\begin{cases} K(\bar{p},m,g) \leq F[F'^{-1}(\bar{w}/\bar{p})] \\ K(\bar{p},m,g) \leq y_0 \end{cases}$$

Regime B
$$\begin{cases} K[\bar{w}/F'(\ell_0),m,g] \leq y_0 \\ K(\bar{p},m,g) \geq F[F'^{-1}(\bar{w}/\bar{p})] \end{cases}$$

Regime C
$$\begin{cases} K[\bar{w}/F'(\ell_0),m,g] \geq y_0 \\ K(\bar{p},m,g) \geq y_0 \end{cases}$$

We may remark that an equilibrium need not exist (Figure 4). It is easily seen graphically that this corresponds to a case where a Walrasian short-run equilibrium does not exist either because there is excess demand at all prices, a case which we assumed away in our preceding analysis

Figure 4

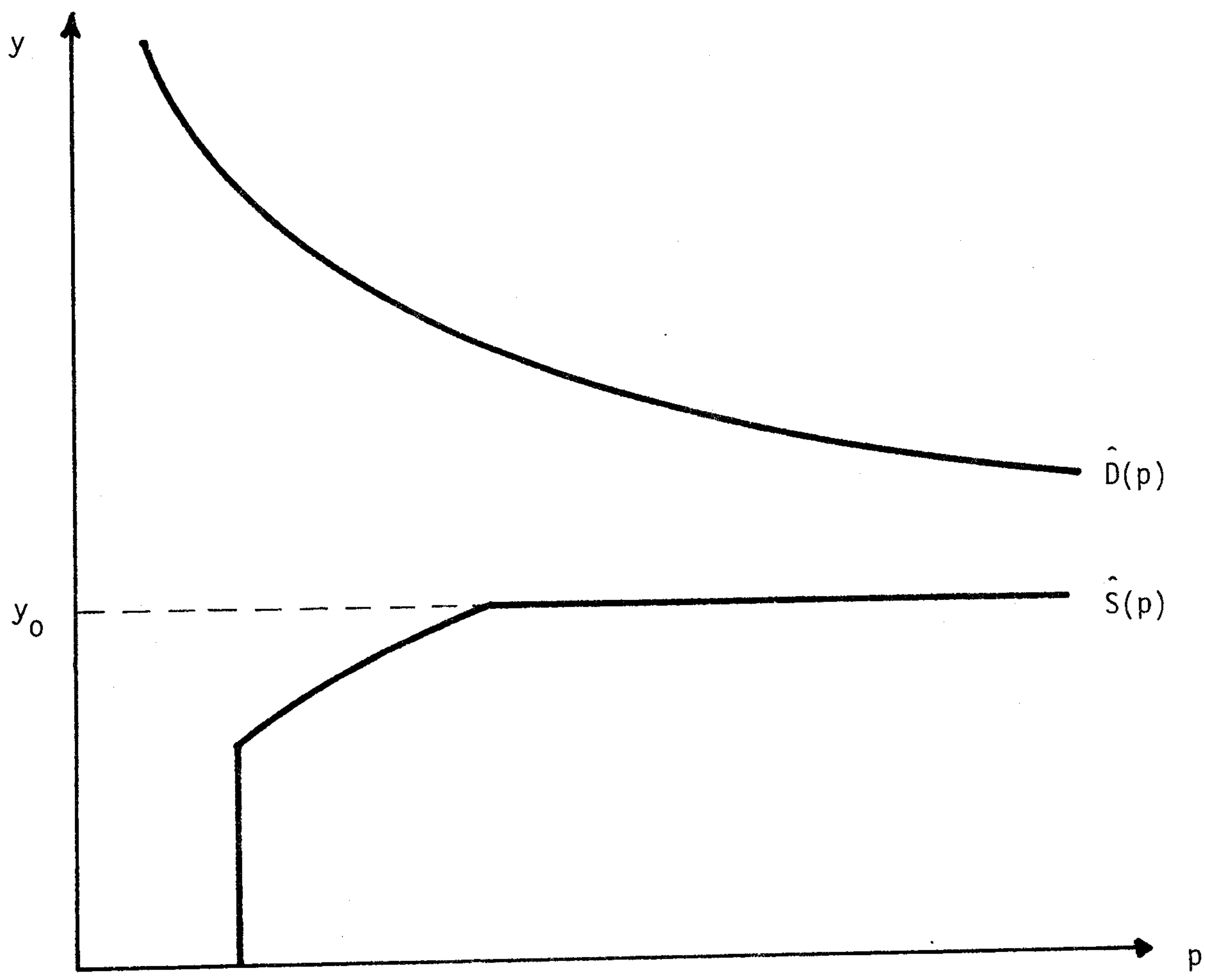


Figure 4

6. - CONCLUSIONS.

This paper formalized in a rigorous manner the implicit assumption of Keynesian models that the price and wage levels are rigid downwards but flexible upwards. We saw that the resulting non-Walrasian equilibria could be of three types, depending on the values of the minimum price and wage $\bar{p}$ and $\bar{w}$, and of government's fiscal and monetary policy parameters g and m . These three types correspond to the three versions of the IS-LM model generally found in the literature, which thus appear as particular regimes of our model. Each regime occurs for a specific subset of the parameters $\bar{p}$, $\bar{w}$, g , m , and the corresponding subregions in parameter space were computed. In each case we showed how production and employment were determined, and computed the policy multipliers for variations in g and m . These were found to be quite different in the three cases, which showed the importance of making precise the various regimes under which the IS-LM model could operate.

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