# AN ALTERNATIVE TO THE IS-LM-AD-AS: THE IS-MR-AD-AS MODEL

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Abstract

The traditional IS-LM-AD-AS model should be put aside in the teaching of macroeconomics. First, because economies do not automatically return to equilibrium after being hit by an outside shock. Second, because central banks control interest rates, not the money supply. And third, because the important issue is not the price level but the inflation rate.

Lately, several models dealing with these three questions have been published, but none of them have managed to displace the traditional model from the undergraduate teaching of macroeconomics.

In this article, we present an alternative model, IS-MR-AD-AS. This model is as simple and flexible as the traditional one, but solves the main question, which is that central banks control interest rates, not the money supply. Its flexibility allows it to deal with more complex issues such as the short term, stationary equilibrium, the stationary equilibrium transition dynamics, and rational expectations.

JEL Code: E32, E52
Keywords: IS-LM-AD-AS model, alternative to IS-LM-AD-AS model, monetary policy, monetary policy rule.

## INTRODUCTION

According to Blanchard (2016), the traditional aggregate demand and aggregate supply model, supported by the IS-LM model along with the supply curve that relates the price level with the output gap, should be left out of undergraduate-level macroeconomics teaching.

The main reasons behind this proposal are threefold. First, because economies do not return automatically to equilibrium after a shock distances them from it. Second, because

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central banks do not operate by controlling monetary aggregates but by administering a short-term interest rate, as Taylor (1993) showed us so long ago. Third, because the most visible variable - and the one that we focus on here - is inflation, and not price level.

In recent years, a number of models raising these three issues have been published. Taylor (2000), Romer (2000, 2013), Walsh (2002), Carlin and Soskice (2005, 2015), and Sorensen and Whitta-Jacobsen (2009), among others, are the most visible examples.

The new models, however, lack the appeal and simplicity of the traditional IS-LM-AD-AS model. Therefore, this model, now over 80 years old, is still the most popular in the teaching of macroeconomics at undergraduate level around the world (De Araujo, O'Sullivan and Simpson, 2013). According to Colander (2006), its "strange persistence" is down to i) inertia, facilitated by its simplicity and an appropriate level of mathematics for a bachelor's degree; ii) its presentation in a supply-and-demand format that is very comfortable for students; iii) its highly user-friendly graphical presentation for discussing complex questions related to macroeconomic policy; iv) the hypotheses that can be confronted with the empirical evidence; and v) its elegance masking the profound theoretical foundations of macroeconomics.

In this article, we present an alternative model, the IS-MR-AD-AS[2]. This model is as simple as the traditional one in that it replicates the general equilibrium scheme, it contains a reasonable measure of mathematics and graphical treatment, and provides a simple connection between predictions and facts; but it is also useful in analyzing the main issues of interest. In addition, and most importantly, the device is as flexible as the traditional one, so it can be extended to deal with more complex matters.

This model is an adaptation of the traditional model presented in Mendoza (2015, Chapter 9). The main adaptations are twofold. First, the alternative model places emphasis on monetary policy, to reflect current practice by central banks. Central banks do not control the money supply, as assumed by the IS-LM model, but the interest rate, which is what the

[2] A more advanced alternative that retains the spirit of the traditional model, and which raises the three issues set out above, is presented in Mendoza (2017).

IS-MR model presented here will reflect. Second, this presentation includes the wealth effect in the consumption function, because it is important in empirical terms and because it is necessary to guarantee the model's stability.

The model is versatile, like the traditional one, and allows for tackling the short term, the stationary equilibrium, the stationary equilibrium transition dynamics, and rational expectations. The aim is for it to supersede the traditional model in the teaching of macroeconomics at undergraduate level.

The article is divided into six sections. In the first, aggregate demand is obtained from the IS-MR model. Section 2 presents aggregate supply. The third section concerns aggregate supply and demand and the short-term subsystems, the stationary equilibrium, and the stationary equilibrium transition dynamics. Section 4 corresponds to the aggregate supply and demand model with rational expectations. Section 5 records the model's predictions in the presence of expansionary macroeconomic policies and a negative supply shock. Finally, Section 6 sets out the conclusions.

## 1. THE IS-MR MODEL AND AGGREGATE DEMAND

In this section, we present the IS-MR model, a substitute for the IS-LM model created by John Hicks (1937).

The IS-MR model, just like the IS-LM, contains three markets: goods, money, and short-term bonds. Because of Walras' Law[3] we can do away with one of them and restrict ourselves to dealing with two markets. In keeping with tradition, we overlook the short-term bonds market.

The goods market, besides the incorporation of the wealth effect in the consumption function, is similar to the traditional model. The substantive difference lies in the money

[3] If in an economy there are n markets, and n-1 of them are in equilibrium, the residual market, the n-th, is also in equilibrium. In the context of a model with several markets, this artifice allows one of them to be dispensed with.

market. Here, the central bank sets the short-term interest rate, with which the money supply is transformed into an endogenous variable.

From the goods market equilibrium (the IS) and the monetary policy rule imposed on the money market (MR), the aggregate demand of this economy is obtained. That is the IS-MR-AD model.

### 1.1 Equilibrium in the goods market: the IS

In the goods market, reserves of installed capacity are assumed to exist such that production ($Y$) can adjust to the level of demand ($D$). This is one of the most powerful ideas bequeathed by J.M. Keynes. His predecessors, the so-called classical economists, had postulated that it was supply that determined demand (Say's Law).

Demand for goods in a closed economy is made up of private consumption, private investment, and public spending.

$$Y = D = C + I + G \tag{1}$$

As to consumption, we will assume it to be a direct function of available income, real wealth, and an autonomous component that contains the remaining influences. Available income is income net of taxes ($Y - T$), and since taxes are a fraction of income, $T = tY$, the available income is equal to $(1 - t)Y$. The wealth effect, also known as the Pigou effect after the economist who formulated it (Pigou 1943), is the positive effect that a fall in prices has on consumption through the increase in the real value of wealth. Real wealth is nominal wealth $(Q)$ deflated by the price level $(Q - P)$[4]. Therefore, the consumption function is given by,

$$C = C_0 + c_1(1 - t)Y + c_2(Q - P); 0 < c_1 < 1; 0 < t < 1;\ 0 < c_2 < 1. \tag{2}$$

[4] To keep the strictly linear character of this model, we use the following linear presentation, $\left(\frac{Q}{P} \cong Q - P\right)$.

Where $c_1$, $t$ and $c_2$ are the propensity to consume in relation to available income, the tax rate, and the propensity to consume in relation to wealth, respectively.

The wealth effect is of vast empirical importance at present. Farmer's (2017) impressive book argues theoretically and empirically that there is no way of explaining the Great Recession of 2009-2009 in the United States by abstracting the wealth effect. The Great Recession precipitated a crisis of confidence in the financial markets that caused the price of financial assets to fall. This price collapse pushed down the financial wealth of consumers, prompting a dramatic drop in consumption and, in consequence, of demand and production.

As well as the empirical aspect, the incorporation of the wealth effect in models of this type is of analytical importance because it allows a negatively-sloped aggregate demand curve to be obtained, as we will see later. Otherwise, as in Blanchard (2017, Chapter 6), aggregate demand would be vertical in terms of the price level and production. This is the aggregate demand that is obtained from combining the traditional IS with the fixed interest rate. This vertical aggregate demand, combined with an aggregate supply curve that is also vertical in the stationary equilibrium, would, as we will see, result in an unstable model; this is avoided here by considering the wealth effect.

As regards private investment, we will assume it to depend negatively on the interest rate[5] and positively on an autonomous component that contains all elements that influence investment besides the interest rate.

$$I = I_0 - br \tag{3}$$

Finally, as to public spending $(G)$, we will assume, as in the textbooks, it to be exogenous.

[5] Strictly speaking, in the IS-LM model, the interest rate that must be present in the goods market is the real interest rate (the nominal interest rate adjusted for expected inflation), since it is that which affects investment; and in the money market, the relevant rate is the nominal interest rate, since it is that which affects the real demand for money. In our presentation, because it is assumed that expected inflation is null, the real interest rate does not differ from the nominal rate. Moreover, if we had two interest rates, the short term and long term, the long-term rate would have to be present in the goods market, and the short-term rate in the money market.

$$G = G_0 \quad (4)$$

By including (2), (3) and (4) in (1), we arrive at the equation that connects production with its determinants.

$$Y = k[A_0 - c_2P - br] \quad (5)$$

Where $A_0 = C_0 + I_o + G_0 + c_2Q$ is the autonomous component of demand and $k = \frac{1}{1-c_1(1-t)}$ is the Keynesian multiplier whose value is greater than the unit.

In this Keynesian conception of the economy, production depends on demand, which is a direct function of the components of autonomous spending and the propensity to consume, and an inverse function of the interest rate and the price level.

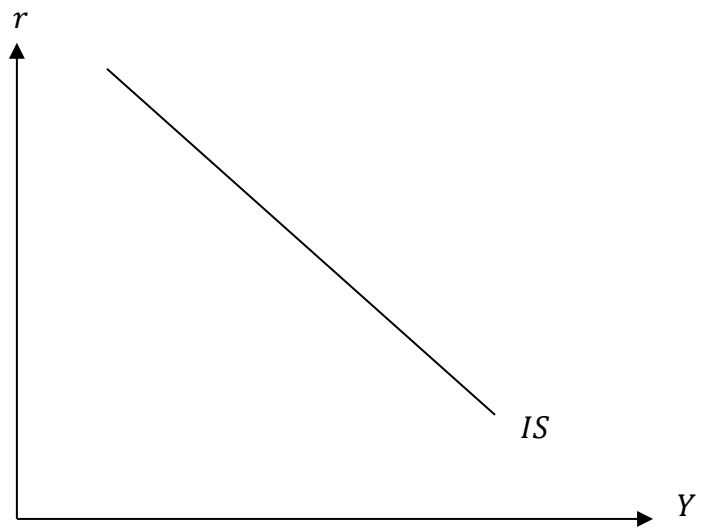
This equation can be rearranged to be plotted on the plane ($Y$ , $r$). In this way, we obtain the well-known IS equation, which shows the combinations of interest rates and production that keep the goods market in equilibrium.

$$r = \frac{A_0 - c_2P}{b} - \frac{Y}{kb} \quad (6)$$

Figure 1 shows the IS curve.

**Figure 1**

**The IS**



## 1.2 Equilibrium in the money market: the MR and the LM

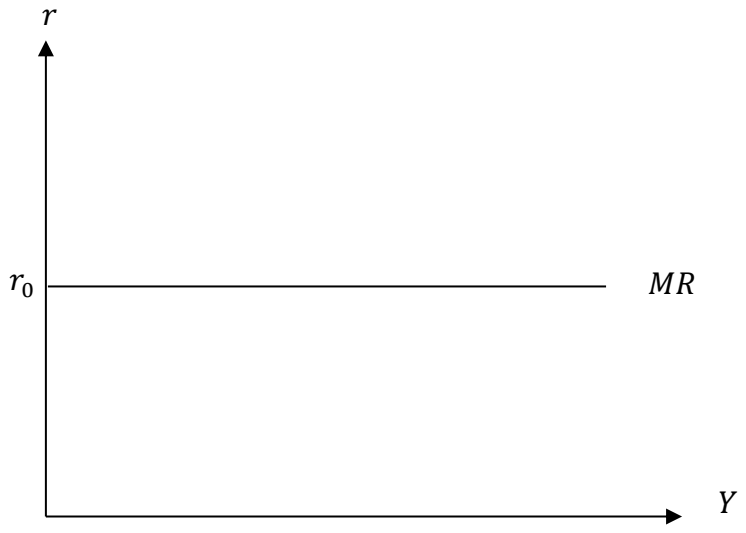
In this section, we introduce the fundamental change from the IS-LM model. In that model, the central bank controls the money supply, the money supply is exogenous, and the interest rate is the adjustment variable that keeps the money market in equilibrium. In our model, in line with what Taylor (1993) described almost 25 years ago, the central bank controls the interest rate; the interest rate is exogenous, and the adjustment variable for keeping the money market in equilibrium is the money supply. That is,

$$r = r_0 \qquad (7)$$

This is the interest rate set by the central bank, and we represent it as the MR line in Figure 2, the monetary-policy rule.

**Figure 2**

**MR**




It is not the case that the traditional model disappears, as would appear to be implied by Blanchard's (2017, Chapter 6) presentation. The money market cannot disappear. It is just

that where previously the interest rate was determined in that market, now the quantity of money is.

In the money market, as in the traditional model, real demand for money is a direct function of the level of economic activity (the higher the public's income, the greater their demand for money to carry out their transactions) and an inverse function of the interest rate (the higher the interest rate paid on bonds, the lower the public's demand for money). The real demand for money is therefore given by,

$$m^d = b_0 Y - b_1 r \tag{8}$$

The real money supply is the nominal money supply deflated by the price level [6].

$$m^s = M^s - P \tag{9}$$

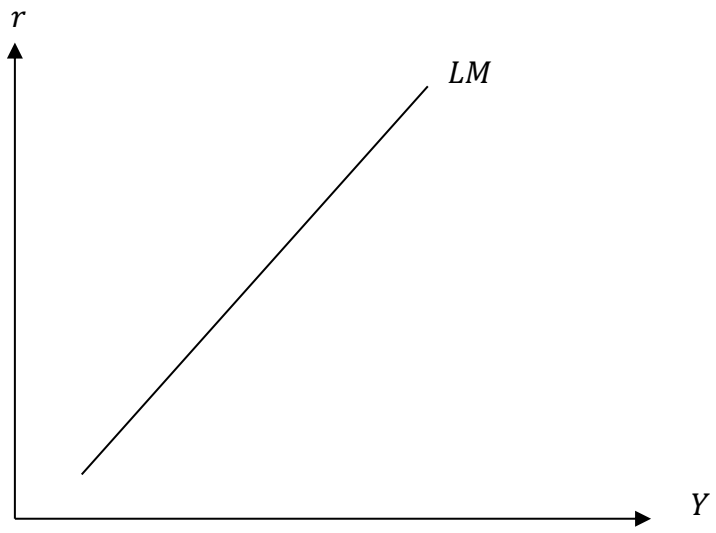
Equilibrium in the money market is reached when real money supply and demand equal each other. The well-known LM is taken from this equation, and is represented in Figure 3.

$$r = -\frac{M^s - P}{b_1} + \frac{b_0}{b_1} Y \tag{10}$$

[6] We use the following linear presentation, $m^s = \frac{M^s}{P} \cong M^s - P$.

**Figure 3**

**LM**




But the following expression can also be obtained from this equation, which shows us that the money supply is endogenous, and that its level is adjusted to demand, to keep the interest fixed.

$$M^s = P + b_0 Y - b_1 r_0$$

The quantity of money, then, goes up when prices or production increase, and goes down when the local interest rate is raised. This endogenous variable is determined in the money market, and graphically in the LM. In this model, the LM serves only for this, to determine the nominal money supply.

### 1.3 IS, MR, and aggregate demand

In this model, where the central bank controls the interest rate, the money supply has a secondary role as it has no effect on production. Therefore, to obtain the equilibrium value of production, the money market (Equation 9) can be disregarded and it is sufficient to insert the exogenous interest rate (Equation 7) into the goods-market equilibrium equation (Equation 5).

$$Y^{eq} = k[A_0 - c_2 P - br_0] \quad (11)$$

This is the aggregate-demand equation of this economy, as it shows us that when the price level rises, production falls. By replacing Equation (11) in Equation (10), we can obtain the nominal money supply of equilibrium.

$$M^{seq} = [1 - b_0 k c_2]P + b_0 k A_0 - [b_1 + b_0 k b] r_0 \quad (12)$$

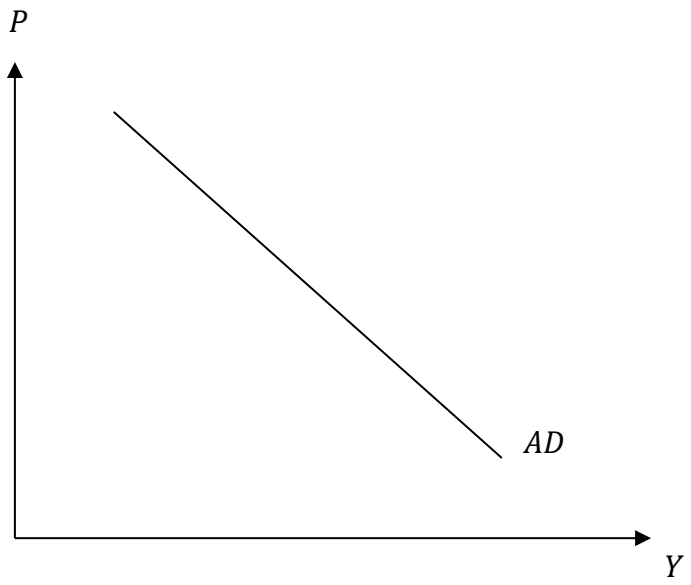
In this IS-MR model, which assumes that the price level is exogenous, the endogenous variables are production and the nominal money supply. In the IS-LM model, the endogenous variables are production and the interest rate.

Equation (11) also represents the aggregate demand of the economy. In the IS-MR framework, when prices increase, real wealth falls, consumption falls, and therefore, output falls. This gives rise to the negative relationship between the price level and production, and the corresponding negative slope of the aggregate demand curve. By rearranging Equation (11), to plot it on the plane ($Y$ , $P$), we obtain the economy's aggregate demand curve, represented in Figure 4.

$$P = \frac{A_0 - br_0}{c_2} - \frac{Y}{kc_2} \quad (13)$$

**Figure 4**

**Aggregate demand**



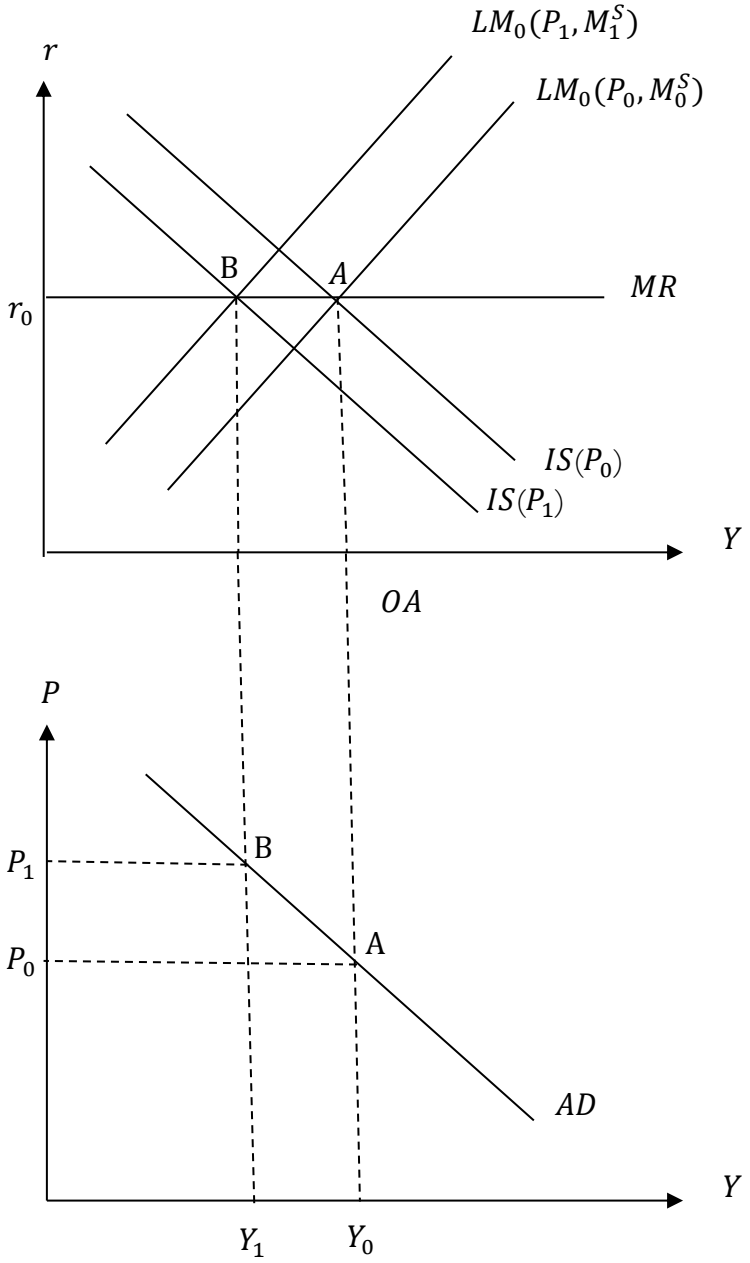
The slope of this curve is negative,

$$\left.\frac{dP}{dY}\right|_{AD} = -\frac{1}{kc_2} < 0$$

Figure 5 shows us how, from the IS-MR, we can obtain the aggregate demand curve by simulating an increase in the price level. In the initial equilibrium, in the upper part of the Figure, the economy is located at A. Then, when the price level increases, the IS shifts to the left because real wealth contracts, and the LM shifts to the left as a joint effect of the increase in the price level (LM to the left) and the change in the nominal money supply, and the economy shifts to point B, with a lower level of production. In the lower part of the Figure, because two points determine a line, the aggregate demand curve AD can be plotted from points A and B.

**Figure 5**

**IS-MR and aggregate demand**




In the next section, we will set out the assumption that the prices are fixed. When the price level is endogenized, we lead onto the aggregate supply curve.

## 2. AGGREGATE SUPPLY

In the above section, we obtained the aggregate demand curve from the behavior of consumers, businesses, the government, and the central bank, considering that the central bank sets the interest rate and the price level is constant.

In this section, we set out that assumption, as we endogenize the price level, introducing a traditional aggregate supply curve[7]. In this economy, the price level is a direct function of the expectations of employers and employees regarding the price level, and of the expansionary or contractionary phase that the economy is at, expressed in the output gap. The idea behind this supply curve is that the price level is associated with the unit labor cost and the nominal wage, and that this depends on price expectations and the state of the job market that can be approximated with the output gap [8].

In this way, our simplified version of the aggregate supply of this closed economy can be expressed using the following traditional linear equation.

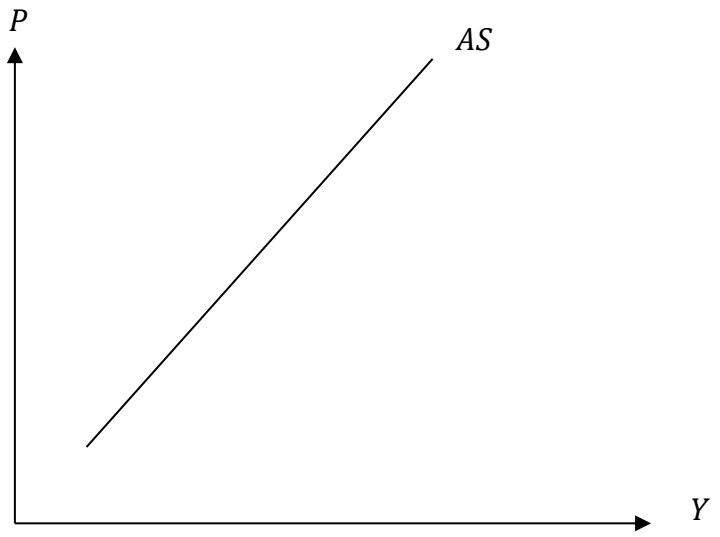
$$P = P^e + \lambda(Y - \bar{Y}) \qquad (14)$$

[7] Such as that of the classic edition of Dornbusch and Fischer (1994).

[8] Details on the aggregate supply equation can be found in Mendoza (2015, Chapter 9).

**Figure 6**

**Aggregate supply**




The slope of this aggregate supply curve is positive.

$$\left.\frac{dP}{dY}\right|_{AS} = \lambda > 0$$

## 3. AGGREGATE SUPPLY AND DEMAND IN A CLOSED ECONOMY

In this section, we combine aggregate supply and demand, and present the short-term subsystems, the stationary equilibrium, and the stationary equilibrium transition dynamics.

Our definition of the periods is analytical, not chronological. We define the short term as a situation in which the expected price is given, and is exogenous. In the stationary equilibrium, the expected price must be equal to the observed price. In the stationary equilibrium transition dynamics, the price expectations are in movement.

## 3.1 The short-term subsystem

In the short term, the expected price is exogenous ($P^e = P_0^e$). Our short-term macroeconomic system is given by the aggregate supply and demand equations obtained in the previous section, stipulating only the exogeneity of the expected price. In the short term, production is determined in the aggregate demand equation and the prices in the aggregate supply.

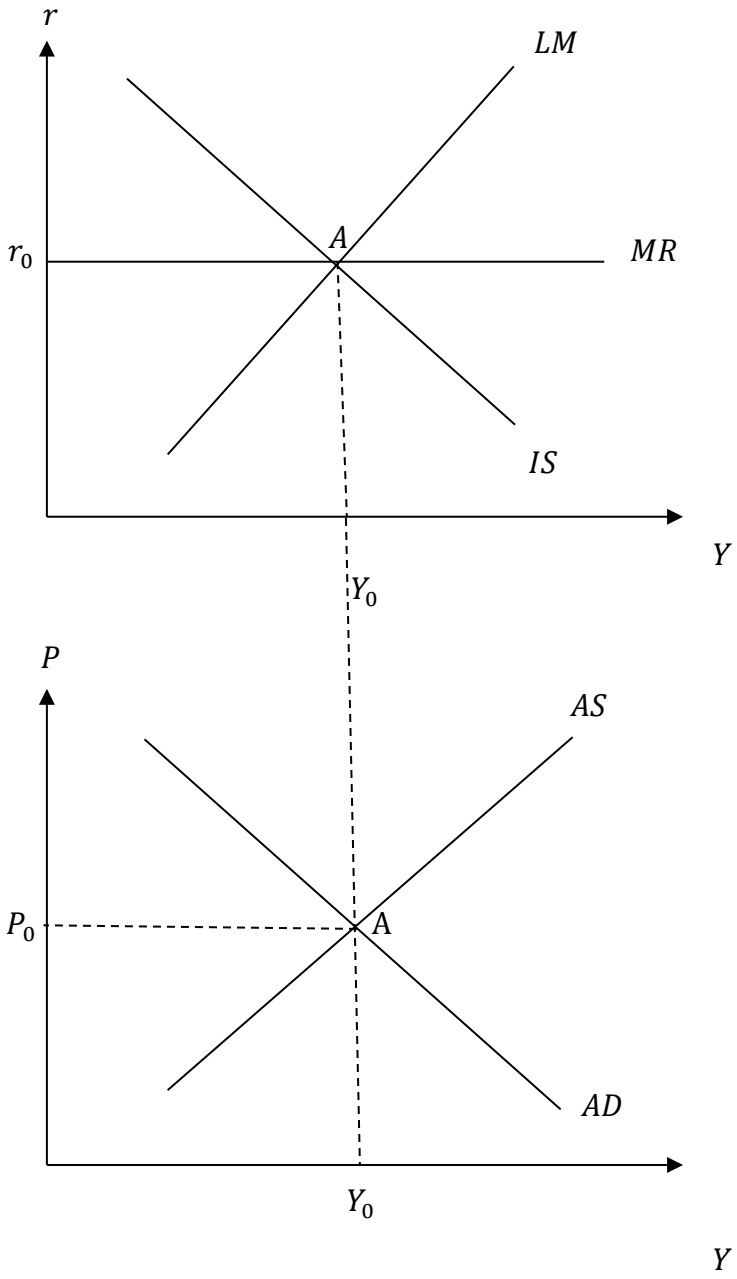
$$P = \frac{A_0 - br_0}{c_2} - \frac{Y}{kc_2} \quad (13)$$

$$P = P_0^e + \lambda(Y - \bar{Y}) \quad (14)$$

In Figure 7, we record the equilibrium between aggregate supply and demand, which determine production and the equilibrium price, as well as the IS-MR model. This is the IS-MR-AD-AS model.

**Figure 7**

**The IS-MR-AD-AS**




Upon solving equations (13) and (14), we obtain the equilibrium values of production and prices, in the short term.

$$Y^{eq} = \frac{k}{1+kc_2\lambda}[A_0 - br_0 - c_2P_0^e + c_2\lambda\bar{Y}] \qquad (15)$$

$$P^{eq} = \frac{1}{1+kc_2\lambda}[P_0^e + \lambda k(A_0 - br_0) - \lambda\bar{Y}] \quad (16)$$

Once the equilibrium values of production and the prices are known, the equilibrium value of the nominal money supply can be obtained using the LM equation, Equation (10).

## 3.2 The stationary equilibrium subsystem

The stationary equilibrium, under the terms of this model, is defined as a situation in which the effective price level does not differ from the expected price ($P = P^e$). Once this hypothesis is incorporated into the short-term aggregate supply equation (Equation 14), the stationary equilibrium aggregate supply curve is obtained.

$$Y = \bar{Y} \quad (17)$$

The macroeconomic system of the stationary equilibrium is given by the aggregate supply equation, Equation (17), and the aggregate demand equation, which continues to be Equation (13). In this subsystem, unlike that of the short term, production is determined in the supply and the prices are determined in the aggregate demand.

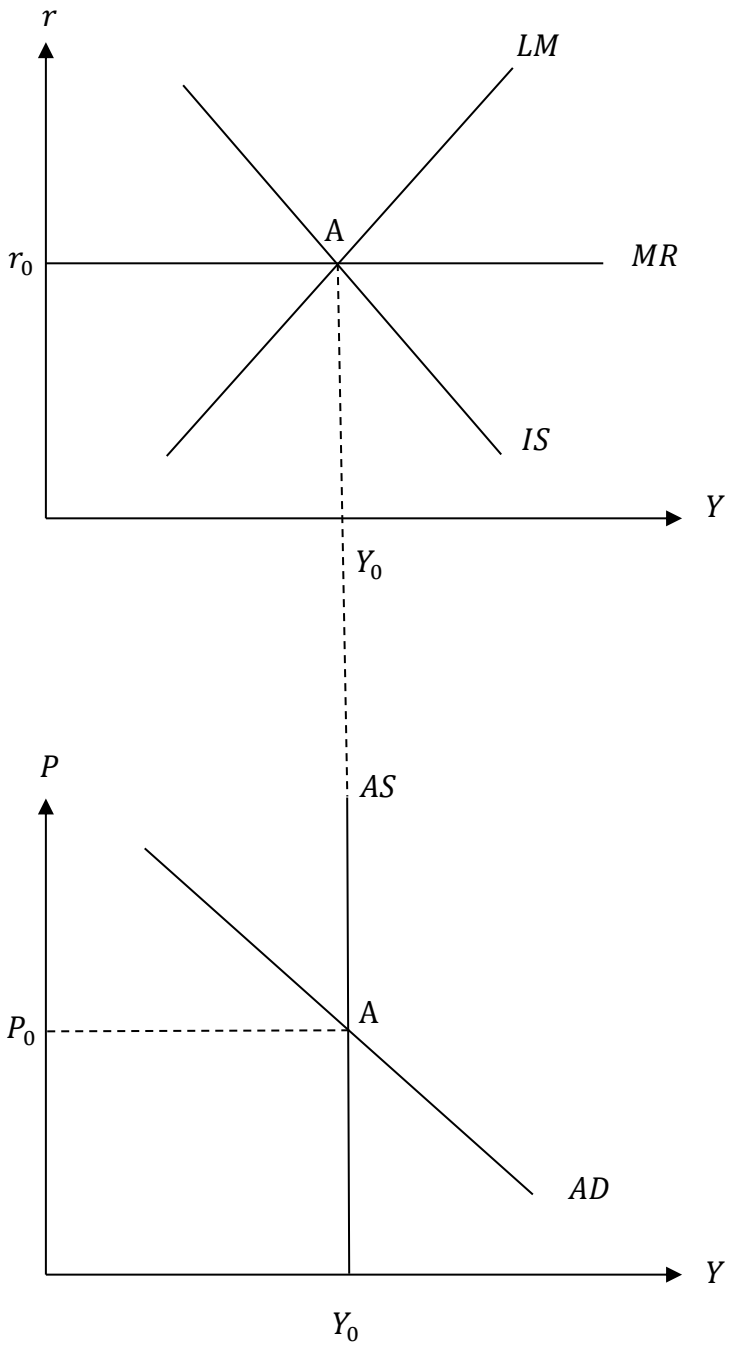
$$P = \frac{A_0 - br_0}{c_2} - \frac{Y}{kc_2} \quad (13)$$

$$Y = \bar{Y} \quad (17)$$

The stationary equilibrium subsystem is represented in Figure 8, in which the perfectly-inelastic aggregate supply stands out.

**Figure 8**

**The IS-MR-AD-AS in stationary equilibrium**



Once the above system is solved, the model can be obtained in its reduced form, which is given by,

$$Y^{seq} = \bar{Y} \tag{18}$$

$$P^{seq} = \frac{A_0 - br_0}{c_2} - \frac{\bar{Y}}{kc_2} \tag{19}$$

In the stationary equilibrium, therefore, production can only change if potential output does; and fiscal policy or monetary policy only affect the prices, not production.

### 3.3 The stationary equilibrium transition dynamics subsystem

The models presented in the above sections, both in the short term and in the stationary equilibrium, are static, in the sense that the endogenous variables refer to a single moment in time. Only comparative statics exercises can be carried out using these models. That is, we can inquire into what happens with the equilibrium values of production and the prices when the value of the exogenous variables is altered, in the short term or in the stationary equilibrium. These models do not allow the trajectory that the endogenous variables follow in the transition between the short-term equilibrium and the final equilibrium to be established.

In this section, we present a simple dynamic model, where the endogenous variables refer to two moments: the present, period $t$; and the past, period $t-1$. In this model, as well as being able to compare the initial equilibrium with the short-term equilibrium and the final equilibrium (a comparative statics exercise), we will also be able to determine the trajectory followed by the endogenous variables in the stationary equilibrium transition dynamics.

To this end, we assume that the price expectations are static; that is, that the public projects its expectations based only on the observation of the price level from the preceding period. [9].

$$P^e = P_{t-1} \tag{20}$$

[9] We omit the subindex $t$ from all variables pertaining to the present period.

If we include this hypothesis of expectations in the short-term aggregate supply curve, Equation (14), the dynamic supply and demand system is determined by,

$$P = \frac{A_0 - br_0}{c_2} - \frac{Y}{kc_2} \quad (13)$$

$$P = P_{t-1} + \lambda(Y - \bar{Y}) \quad (21)$$

In the context of this model, in the stationary equilibrium the price level must remain constant, due to which $P = P_{t-1}$ must be met. In consequence, as aggregate demand has not been altered, the stationary equilibrium system in the model with static expectations is given by the same system as the model with exogenous expectations.

We will now return to the stationary equilibrium transition dynamics. To deduce whether the stationary equilibrium transition dynamics are convergent or divergent, cyclical or non-cyclical, it is necessary to use the system made up of equations (13) and (21), which is a discrete-time first-order dynamical system. Upon solving these equations, we arrive at a system that allows the equilibrium values to be obtained, over time, of production and the price level.

$$Y^{eq} = \frac{k}{1 + kc_2\lambda}[A_0 - br_0 - c_2 P_{t-1} + c_2\lambda\bar{Y}] \quad (22)$$

$$P^{eq} = \frac{1}{1 + kc_2\lambda}[P_{t-1} + \lambda k(A_0 - br_0) - \lambda\bar{Y}] \quad (23)$$

There are several ways of discussing whether this model is dynamically stable; that is, whether the endogenous variables converge asymptotically to the stationary equilibrium.

We will assume the following first order differential equation,

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1}$$

Where, $\partial Y_t / \partial Y_{t-1} = \alpha_1$

There are two possibilities with respect to the value of $\alpha_1$[10]:

[10] If $\alpha_1 = 0$, then, $Y_t = \alpha_0$. There are no dynamics.

i) $|\alpha_1| > 1$, that is, $\alpha_1 > 1;\ \alpha_1 < -1$. The equation is unstable. If $\alpha_0$ changes, $Y_t$ never reaches a stationary equilibrium.

ii) $|\alpha_1| < 1$, that is, -1 $< \alpha_1 <$ 1. The equation is stable. If $\alpha_0$ changes, $Y_t$ reaches a new stationary equilibrium.

If we use these concepts in the differential equation (23), we can conclude that the aggregate supply and demand model presented is dynamically stable and that, moreover, the convergence to the stationary equilibrium occurs without cycles. The convergence is non-cyclical when the parameter in question is positive and less than one. This is the case of the model presented.

$$0 < \frac{\partial P}{\partial P_{t-1}} = \frac{1}{1 + kc_2\lambda} < 1$$

## 4. AGGREGATE SUPPLY AND DEMAND WITH RATIONAL EXPECTATIONS

In the early 1980s, a literature arose to demonstrate in analytical terms that, under certain conditions, macroeconomic policy - both fiscal and monetary - could be completely ineffective. The intellectual leaders of this current of thought were the Nobel laureates Robert Lucas and Tomas Sargent.

This result can occur when the public has rational expectations; that is, when it takes the future into consideration and utilizes the available information to predict it. In our presentation, we assume the expected price to be equivalent to the stationary equilibrium price expected on the basis of the aggregate supply and demand model. This is the version of rational expectations in a deterministic context: the version with perfect foresight.

In consequence, the expected price ($P^e$) is equivalent to the price expected in the stationary equilibrium model ($P^{seqe}$), given the expected values of public spending, the tax rate, and the interest rate ($G^e, t^e, r_0^e$). From equation (19) we can establish that,

$$P^e = P^{seqe} = \frac{A_0^e - br_0^e}{c_2} - \frac{\bar{Y}}{k^e c_2} \quad (24)$$

Where $A_0^e = C_0 + I_0 + G_0^e + c_2 Q$ and $k^e = \frac{1}{1-c_1(1-t^e)}$

When this expression is replaced in Equation (14), which represents the short-term aggregate supply curve, we obtain the aggregate supply equation with rational expectations.

$$P = \frac{A_0^e - br_0^e}{c_2} - \frac{1+k^e c_2 \lambda}{k^e c_2}\bar{Y} + \lambda Y \quad (25)$$

In this way, the aggregate supply and demand system with rational expectations is made up of equations (13) and (25).

$$P = \frac{A_0 - br_0}{c_2} - \frac{Y}{kc_2} \quad (13)$$

$$P = \frac{A_0^e - br_0^e}{c_2} - \frac{1+k^e c_2 \lambda}{k^e c_2}\bar{Y} + \lambda Y \quad (25)$$

In the reduced form of this model, the equilibrium values of production and the prices are given by,

$$Y^{eq} = \frac{k}{1+\lambda k c_2}\left[(A_0 - A_0^e) - b(r_0 - r_0^e) + \frac{1+\lambda k^e c_2}{k^e}\bar{Y}\right] \quad (26)$$

$$P^{eq} = \frac{1}{1+\lambda k c_2}\left[\frac{A_0^e}{c_2} - \frac{br_0^e}{c_2} - \frac{(1+k^e \lambda c_2)\bar{Y}}{c_2 k^e} + \lambda k A_0 - \lambda k b r_0\right] \quad (27)$$

This presentation is highly useful in discerning the effects of fiscal and monetary policies, both anticipated and not. When the monetary or fiscal policy is anticipated[11], the movements in the macroeconomic policy instruments coincide with what the public anticipates: $dG_0 = dG_0^e$; $dt = dt^e$ $y$ $dr_0 = dr_0^e$. Conversely, when the macroeconomic policies are not anticipated, the public's expectations do not change. For example, an unexpected expansionary monetary policy means that $dr_0 < 0$, but that $dr_0^e = 0$.

[11] To ensure that the policy is anticipated, two conditions are required: that the policy be announced, and the announcement be credible.

In this presentation, only unexpected or unannounced fiscal policies have effects on production, while when the policies are anticipated, their effects on the level of economic activity are null. This gives rise to the hypothesis on the ineffectiveness of macroeconomic policies.

## 5. FISCAL POLICY, MONETARY POLICY, AND SUPPLY SHOCKS IN THE IS-MR-AD-AS MODEL[12]

What effect do macroeconomic policy and the supply shocks have on production and the price level? This is the question that we will answer in this section, through three comparative statics exercises. First, we will simulate an expansionary fiscal policy, increased public spending. Then, we will assume an expansionary monetary policy, a reduction in the interest rate. Finally, we will simulate the fall in potential output.

In each of these exercises, our starting point is stationary equilibrium. Production is at its potential level and the price level is equal to that of stationary equilibrium.

For a cleaner presentation of the graphics, we will leave the LM to one side. Because this curve has the quantity of money as a parameter, there will always be an LM that crosses the point of equilibrium between the IS and the MR. In the graphic, the LM will serve only to determine the quantity of money.

### 5.1 Expansionary fiscal policy

*Short term*

An expansionary fiscal policy, understood as a rise in public spending ($dG_0 > 0$), will push up demand in the goods market in the short term and, therefore, lead to an increase in production. The increase in output beyond that of full employment will result in an increase in the price level. The price increase will reduce real wealth and consumption, thereby weakening, but not eliminating, the expansionary effect of greater public

[12] To simplify the explanation of the exercises, no reference will be made to what happens with the nominal money supply, despite this being an endogenous variable of the model. The reason, as explained before, is that this variable is influenced by the remaining endogenous variables, but does not influence them in turn.

spending. As a result, a partial crowding out of public spending and private consumption occurs.

In sum, the higher public spending, in the short term or period of impact, revives the economy and increases the price level.

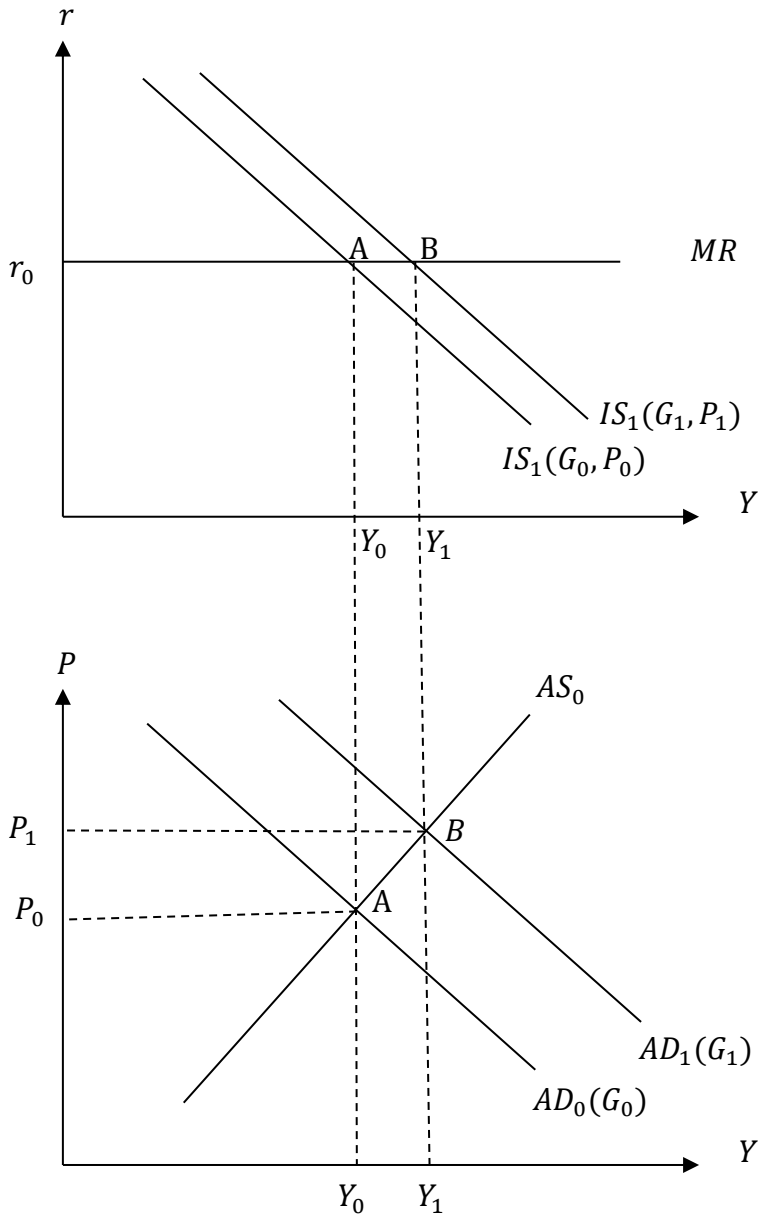
Figure 9 shows the effects of the fiscal policy in the short term or period of impact.

The initial short-term equilibrium is shown at point A. In the lower part, the higher public spending shifts the aggregate demand curve to the right, and the equilibrium shifts to point B. In the upper part, the IS also shifts to the right as a net effect of the higher public spending (IS to the right) and the higher price level (IS to the left). In the short-term equilibrium, at B, production and prices are higher than in the initial situation, point A.[13]

[13] If we were to recover the LM, it would shift to the right as a net result of the increase in the price level (LM to the left) and the greater nominal money supply (LM to the right). The LM will always shift to reach the point where the IS and the MR intersect.

**Figure 9**

**Expansionary fiscal policy (short term)**




The mathematical responses for the short term are obtained from equations (15) and (16).

$$dY = \frac{k}{1+kc_2\lambda} dG_0 > 0$$

$$dP = \frac{\lambda k}{1+kc_2\lambda} dG_0 > 0$$

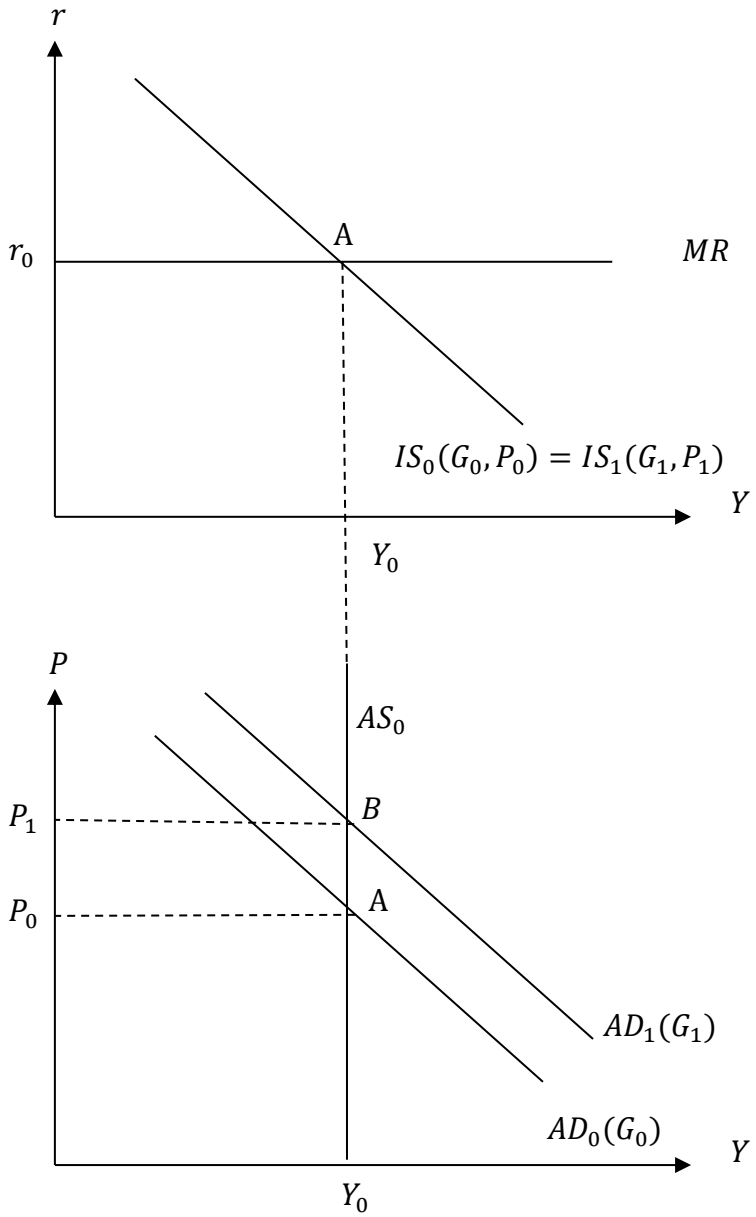
*The stationary equilibrium*

In the stationary equilibrium, production is determined in the aggregate supply and the prices in the demand. The higher public spending pushes up demand in the goods market, bringing about an excess of demand in this market, which translates into a rise in the price level. The increase in the price level reduces real wealth, which causes private consumption to fall. Because output is given, as it is at its potential level, the higher public spending shifts private consumption. There is a complete crowding out between public spending and private consumption.

Figure 10 illustrates the effects of the fiscal policy in the stationary equilibrium. The initial stationary equilibrium occurs at Point A. In the lower part of the Figure, the higher public spending shifts the aggregate demand curve to the right. Because the aggregate supply curve in the stationary equilibrium is perfectly inelastic, the higher demand only increases the price level and the equilibrium shifts to point B. In the upper part, the IS remains at its original level since the higher public spending shifts it to the right, but the rise in the price level shifts it to the left. In the new stationary equilibrium, point B of Figure 10, the price level is higher, but production stays the same.

**Figure 10**

**Expansionary fiscal policy (stationary equilibrium)**




To determine the mathematical effects in the stationary equilibrium, we revert to equations (18) and (19).

$$dY = 0$$

$$dP = \frac{1}{c_2} dG_0 > 0$$

*Stationary-equilibrium transition dynamics*

After the shock in the first period, what will happen in the following periods, in a world in which the public have static expectations regarding prices?

Since the price level has gone up in the first period, in the second period a rise in the expected price level will occur, which will lead to a new increase in the price level. This, in turn, reduces real wealth, causing consumption, demand, and production to fall.

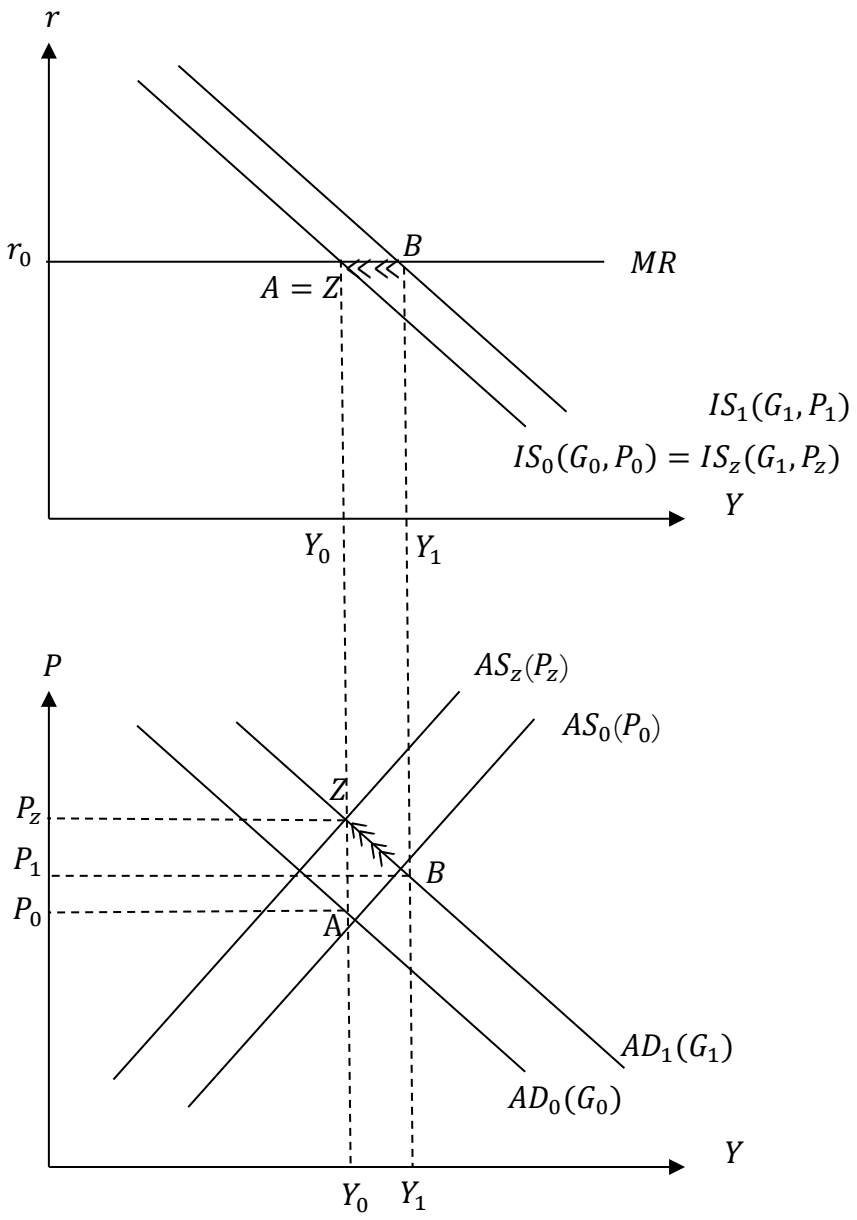
In the following periods, as the price level continues to rise, these dynamics of rising prices and falling production will continue, as a consequence of the decrease in real wealth. The dynamics will come to an end when the economy reaches a new stationary equilibrium, when production recovers its initial level and the price level reaches a higher level.

In the new stationary equilibrium, a complete, but peculiar, crowding out has occurred. Given that production has not changed, the higher public spending has gained a space in the aggregate demand at the expense of lower private consumption, due to the fall in real wealth.

In Figure 11, we plot the stationary equilibrium transition dynamics, which occur as a result of the sustained hike in the expected price level, prompting continual shifts to the left of the short-term aggregate supply curve. In the lower part of the Figure, the arrows in the section going from point B to point Z show the shifts, period after period, in the aggregate supply curve. In the upper part, the arrows between points B and Z signal the shifts that occur with the IS due the increase, also period after period, of the price level.

**Figure 11**

**Expansionary fiscal policy (stationary equilibrium transition dynamics)**




To arrive at the mathematical responses, we utilize equations (22) and (23) in which it is necessary to introduce the mathematical result concerning what occurs with the price level in the first period.

$$dY = -\frac{k^2 c_2 \lambda}{(1+kc_2\lambda)^2} dG_0 < 0$$

$$dP = \frac{\lambda k}{(1+kc_2\lambda)^2} dG_0 > 0$$

It should be noted that in the second period the price level keeps on going up, but with less force than in the first. It can also be demonstrated that the decline in output in the third period will be less marked than in the second. The stationary equilibrium transition dynamics are non-cyclical.

*With rational expectations*

What is the role of macroeconomic policy when the public has rational expectations, in the deterministic version of perfect foresight, and the policies are anticipated?

We will look, first, at the case of the anticipated fiscal policy.

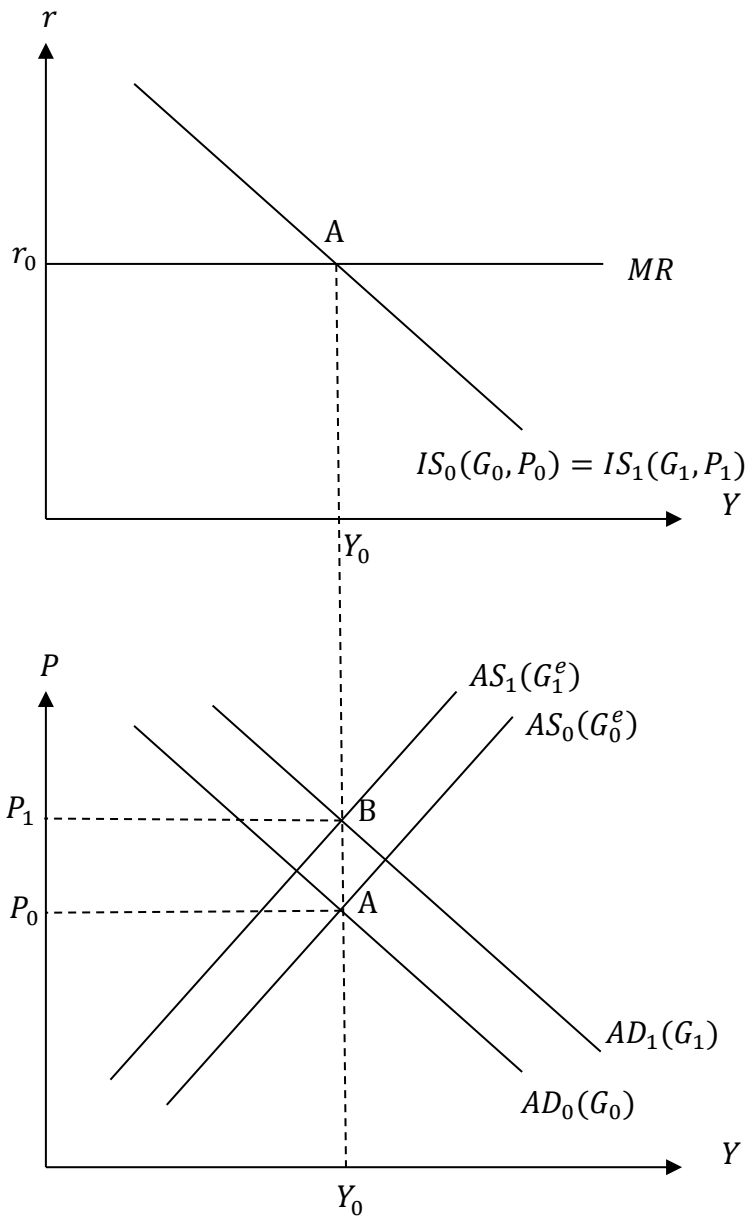
If public spending increases and this is anticipated, while constituting a favorable demand shock - which tends to push up production like in the short term - it also constitutes an adverse supply shock, as it pushes up the price level expected by the public. The higher level of expected prices causes an increase in the price level, which causes real wealth to fall. The lower real wealth causes consumption to fall, which is an unfavorable demand shock. The decrease in private consumption is exactly equal to the increase in public spending. That is, complete crowding out occurs.

In sum, higher anticipated public spending does not alter production, increases the price level, and causes a complete crowding out effect between private consumption and public spending.

The lower part of Figure 12 shows that the higher anticipated public spending is, simultaneously, a favorable demand shock and an adverse supply shock. The equilibrium shifts from its initial situation, point A in the Figure, to the final equilibrium, point B. In the upper part, the IS curve shifts to the right as a result of the higher public spending, but returns to its initial position because of the increase in the price level. The comparison of the results in Figure 12 with those of Figure 11 is left to the reader. Is there any similarity?

**Figure 12**

**Expansionary fiscal policy (rational expectations)**




The mathematical results are obtained from equations (26) and (27). If the higher public spending is anticipated, $dG_0 = dA_0 = dG_0^e = dA_0^e > 0$ will be fulfilled. In consequence,

$$dY = 0$$

$$dP = \frac{1}{c_2} dG_0 > 0$$

## 5.2 Expansionary monetary policy

Now, we will look at the effects of the expansionary monetary policy, which consists of a reduction in the short-term interest rate ($dr_0 < 0$). What is the effect of the expansionary monetary policy on production and the price level, in the short term, in the stationary equilibrium transition dynamics and the stationary equilibrium? As before, our starting point is the stationary equilibrium. Production is at its potential level and the price level is equal to that of stationary equilibrium.

*The short term*

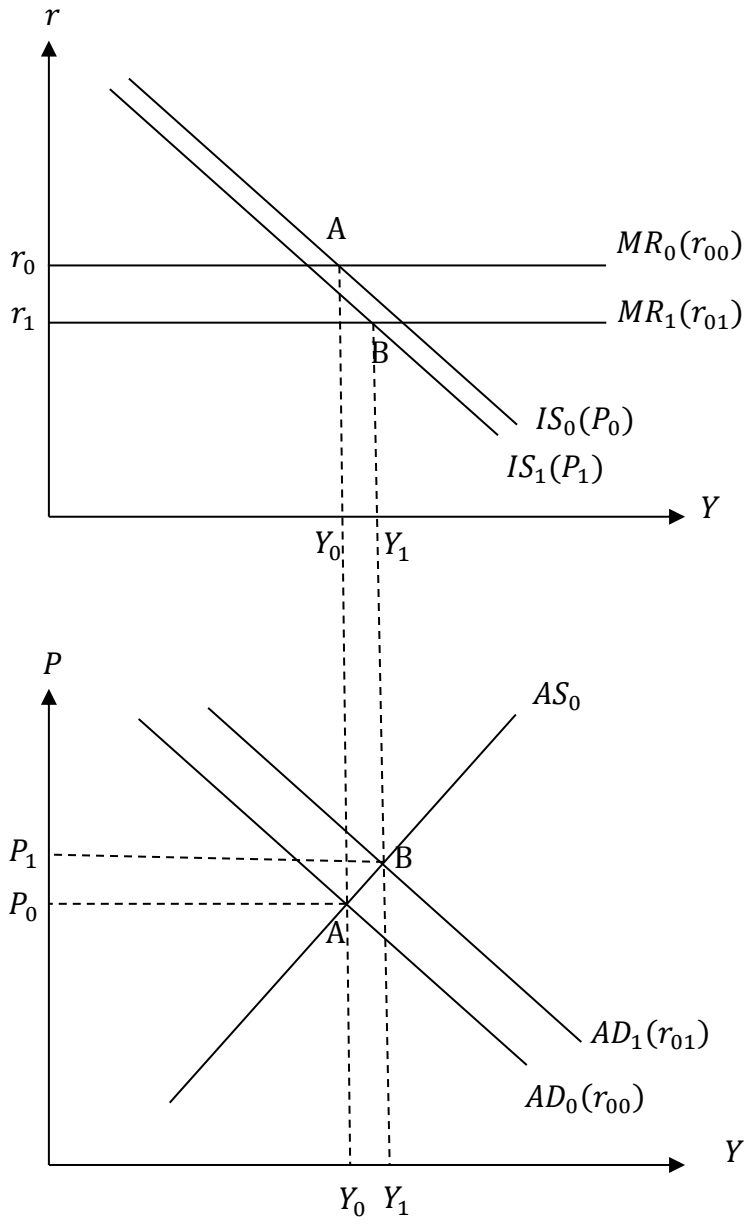
In the short term or period of impact, the lower interest rate pushes up investment, demand, and therefore production. When production increases, the output gap expands and the price level rises. The price rise reduces real wealth, causing consumption to fall and weakening, but not negating, the expansionary effect of the lower interest rate.

In sum, in the short term or period of impact, a lower interest rate pushes up production and prices.

In the lower part of Figure 13, starting from the initial equilibrium A, the aggregate demand curve shifts to the right due to the lower interest rate. At the new equilibrium, point B, both production and the price level are higher. In the upper part of the Figure, a downward shift in the MR and a leftward shift in the IS occur due to the higher price level. The short-term equilibrium occurs at point B, with a higher level of production.

**Figure 13**

**Expansionary monetary policy (short term)**




The mathematical responses for the short term are given by,

$$dY = -\frac{kb}{1+kc_2\lambda}dr_0 > 0$$

$$dP = -\frac{\lambda kb}{1+kc_2\lambda}dr_0 > 0$$

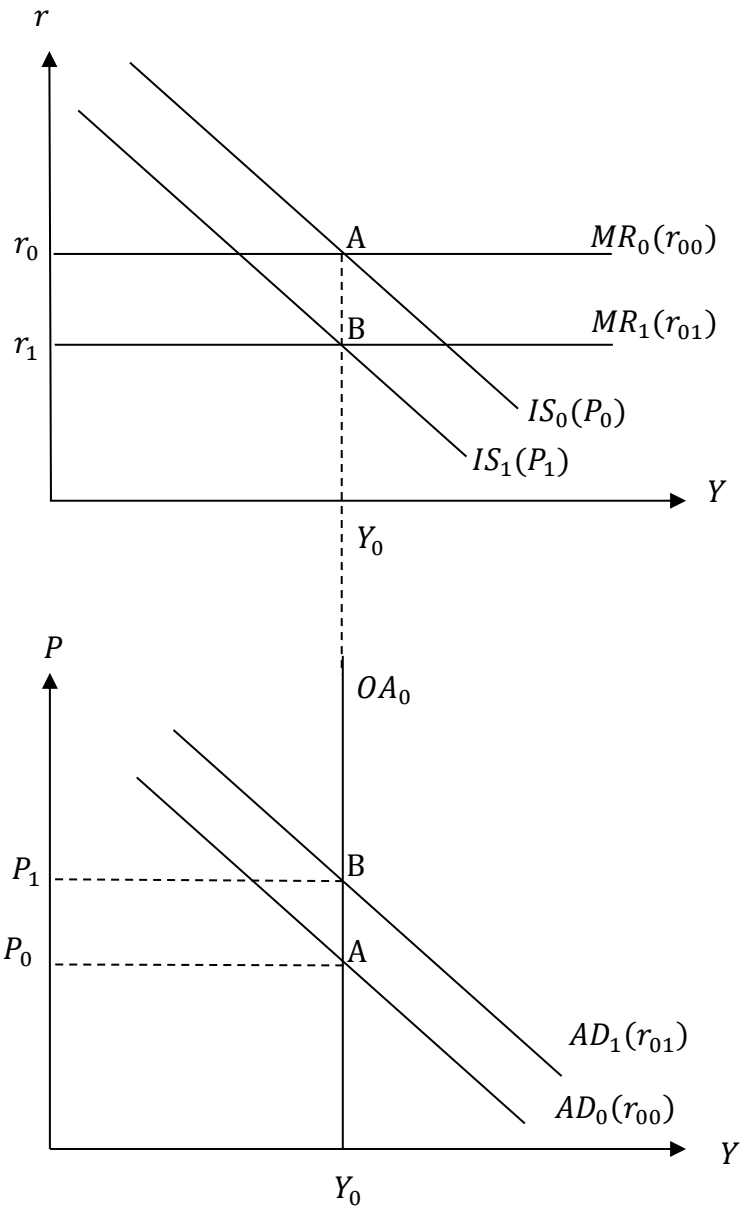
*The stationary equilibrium*

At the stationary equilibrium, the lower interest rate pushes up private investment. The excess of demand in the goods market increases the price level. The higher price level reduces real wealth and consumption. Since output is given, the greater investment displaces private consumption. Complete crowding out occurs.

The effects at the stationary equilibrium are shown in Figure 14. In the lower part, from the initial equilibrium at point A, a shift to the right of the aggregate demand curve is recorded as a result of the lower interest rate. The shift in demand, given a completely inelastic aggregate supply, has the sole effect of increasing the price level. This is what is recorded at point B of the lower part of Figure 14. In the upper part, the rise in prices shifts the IS to the left, such that production stays at its initial level.

**Figure 14**

**Expansionary monetary policy (stationary equilibrium)**




The mathematical results in the stationary equilibrium are,

$$dY = 0$$

$$dP = -\frac{b}{c_2} dr_0 > 0$$

*The stationary equilibrium transition dynamics*

What happens after the period of impact, before the economy reaches its new level of stationary equilibrium?

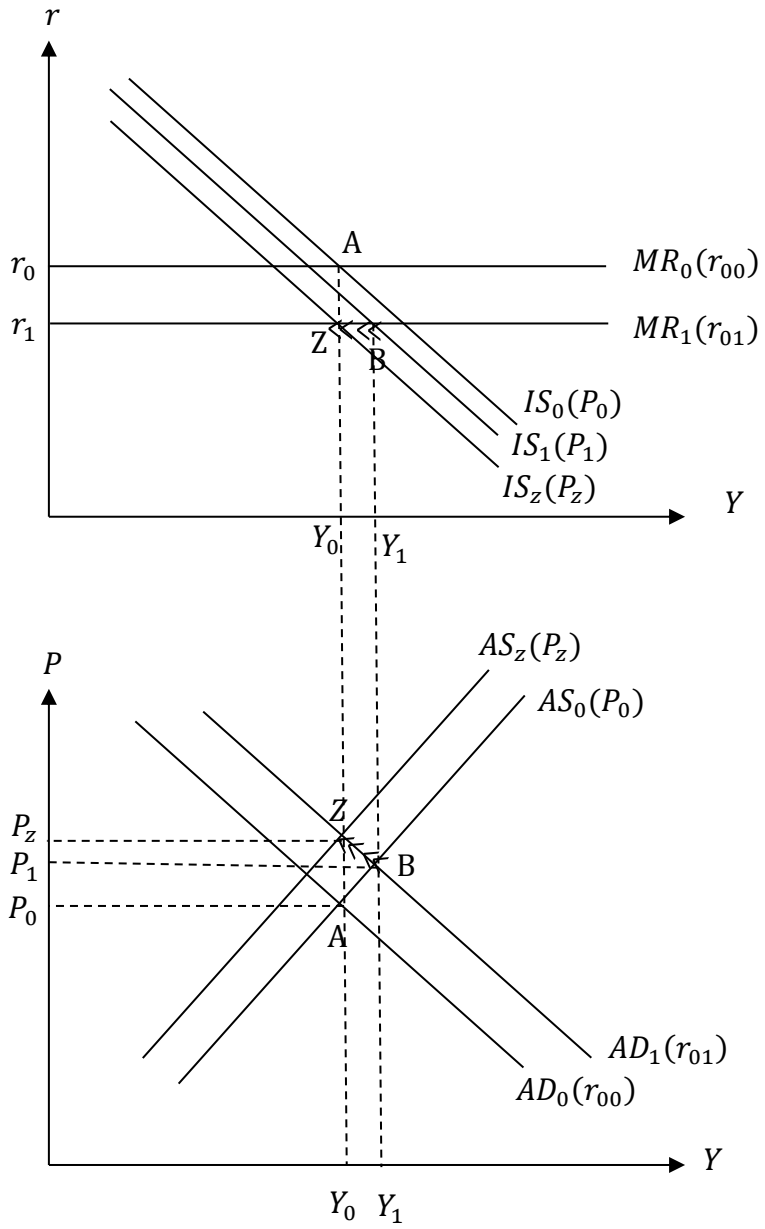
In the second period, because the price level rose in the previous period, the price expected by the public goes up. The higher expected price pushes up the price level, and reduces real wealth, consumption, and production.

In the following periods, these dynamics of rising prices and declining production continue until the economy reaches a new level of stationary equilibrium where output recovers its original level and the price level reaches a new, higher level.

Figure 15 shows the stationary equilibrium transition dynamics. The lower part shows the aggregate supply and demand between points B and Z, where the direction of the arrows signals the trajectory towards stationary equilibrium. A new short-term supply curve passes through each of the points in this section, which does not stop shifting upwards as the price level expectations increase period after period. In the upper part of the same Figure, between points B and Z, the arrows show the stationary equilibrium transition dynamics as a consequence of the shifts in the IS caused by the rises in the price level.

**Figure 15**

**Expansionary monetary policy (stationary equilibrium transition dynamics)**




The mathematical results for the second period are as follows.

$$dY = \frac{k^2\lambda c_2 b}{(1+kc_2\lambda)^2}\, dr_0 < 0$$

$$dP = -\frac{\lambda k b}{(1+kc_2\lambda)^2}\, dr_0 > 0$$

*With rational expectations*

We will now analyze the effects of an anticipated interest rate reduction.

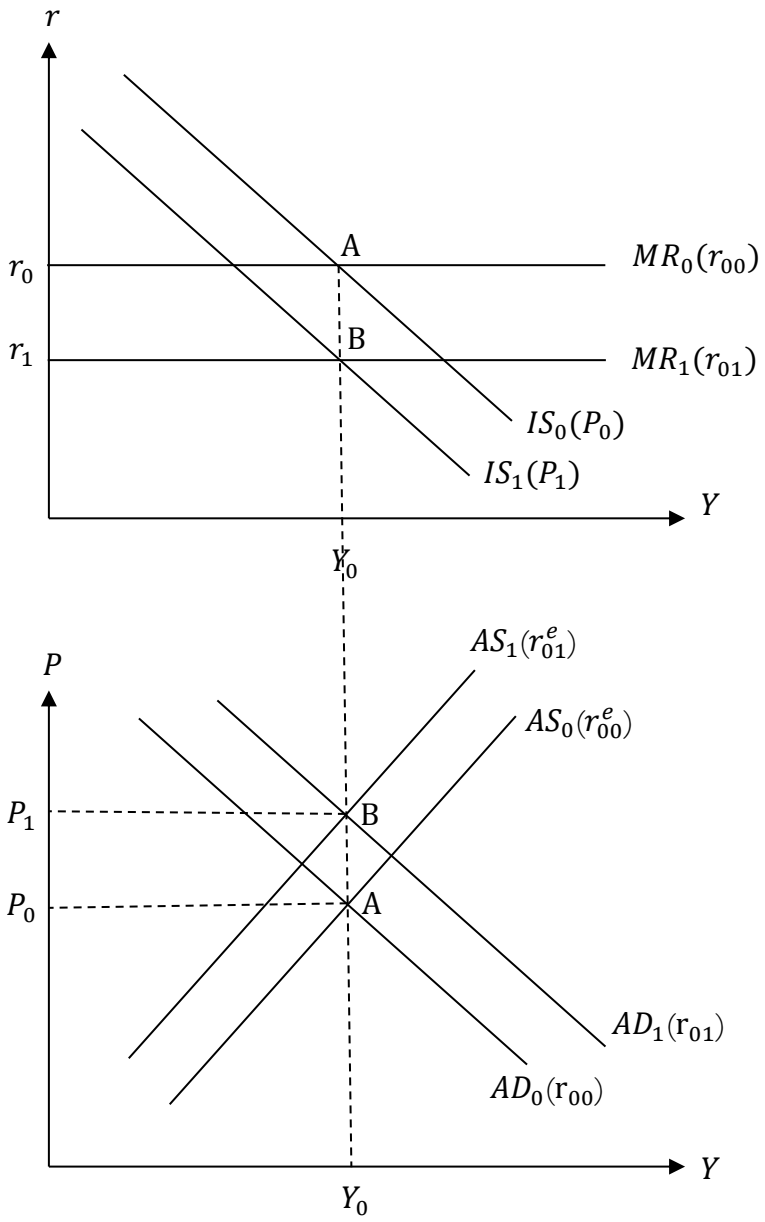
The lower interest rate causes, on the one hand, an increase in investment. But, on the other hand, the lower interest rate, by prompting an increase in the price expected by the public, causes the price level to rise. This price rise pushes down real wealth, due to which consumption falls by the same magnitude as the increase in investment. Since the goods market demand does not change, production remains constant.

In sum, an anticipated reduction in the interest rate does not affect production. The only thing that changes is the price level and the composition of demand.

Figure 16 shows the effects of the anticipated expansionary monetary policy. Starting from the initial equilibrium given by point A, the lower interest rate shifts, on the one hand, the aggregate demand curve to the right. On the other hand, as the expected price goes up, there is a leftward shift in the aggregate supply curve. The new equilibrium is reached at point B with the initial production level and a higher price level. In the upper part of the Figure, the MR curve shifts downward and the IS shifts leftward due to the higher price level.

**Figure 16**

**Expansionary fiscal policy (rational expectations)**




The mathematical results are obtained from equations (26) and (27). If the monetary policy is anticipated, $dr = dr^e < 0$ will be fulfilled. In consequence,

$$dY = 0$$

$$dP = -\frac{b}{c_2} dr_0 > 0$$

This result - that monetary policy does not affect production - underpinned the belief, widespread in the 1980s but with increasingly few adherents at present, in the possibility that macroeconomic policy is ineffective.

## 5.3 Adverse supply shock

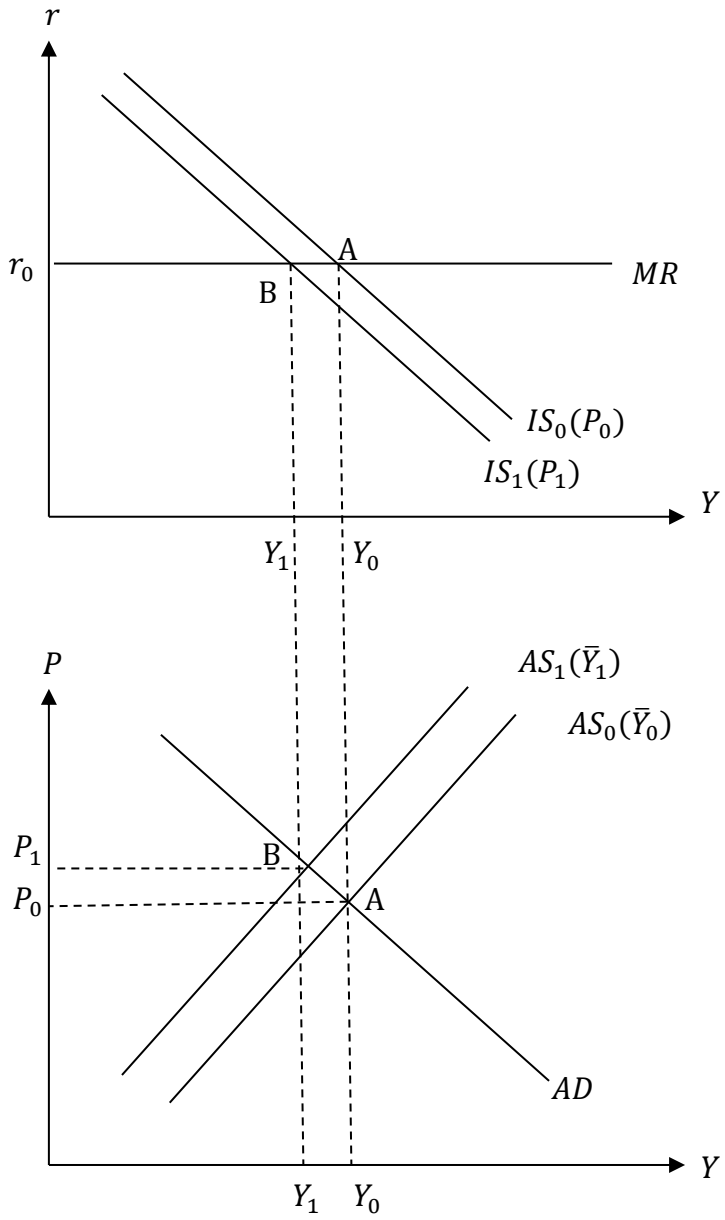
Finally, we will look at the effect of an adverse supply shock, the decline in potential GDP.

*Short term*

In the short term, a decline in potential GDP increases the price level. The higher price level pushes down real wealth and thus consumption, demand, and production.
In Figure 17, the lower potential output shifts the aggregate supply curve to the left, which increases the price level and causes production to fall. In the upper part of the figure, the IS shifts to the left as a result of the rise in the price level.

**Figure 17**

**Fall in potential output (short term)**




The mathematical response is as follows.

$$dY = \frac{kc_2\lambda}{1+kc_2\lambda} d\bar{Y} < 0$$

$$dP = \frac{-\lambda}{1+kc_2\lambda} d\bar{Y} > 0$$

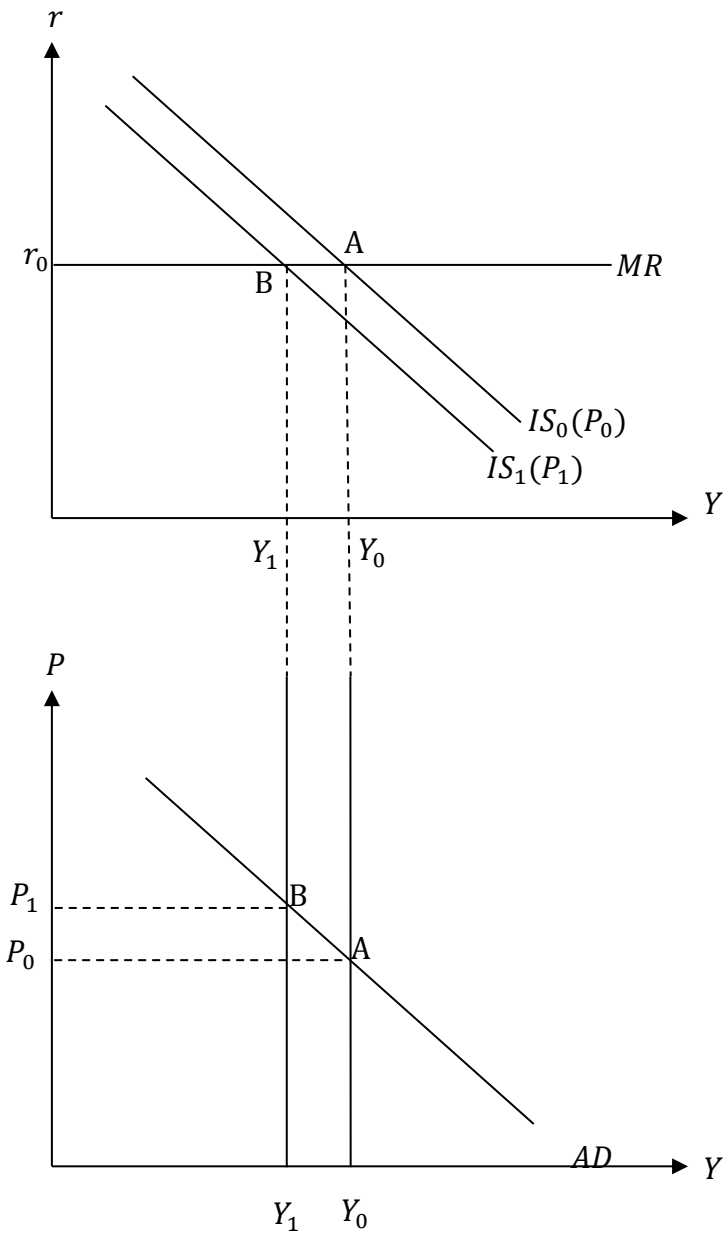
*Stationary equilibrium*

In the stationary equilibrium, a lower potential output causes real output to fall. In the goods market, the lower output causes an excess of demand that translates into a rise in the price level, causing consumption and demand to fall due to the decrease in real wealth.

In Figure 18, the stationary equilibrium supply curve shifts to the left, increasing prices and causing production to fall. In the upper part, the IS shifts to the left due to the higher price level.

**Figure 18**

**Fall in potential output (stationary equilibrium)**




The mathematical responses are,

$$dY = 0$$

$$dP = -\frac{1}{kc_2} d\bar{Y} > 0$$

*The stationary equilibrium transition dynamics*

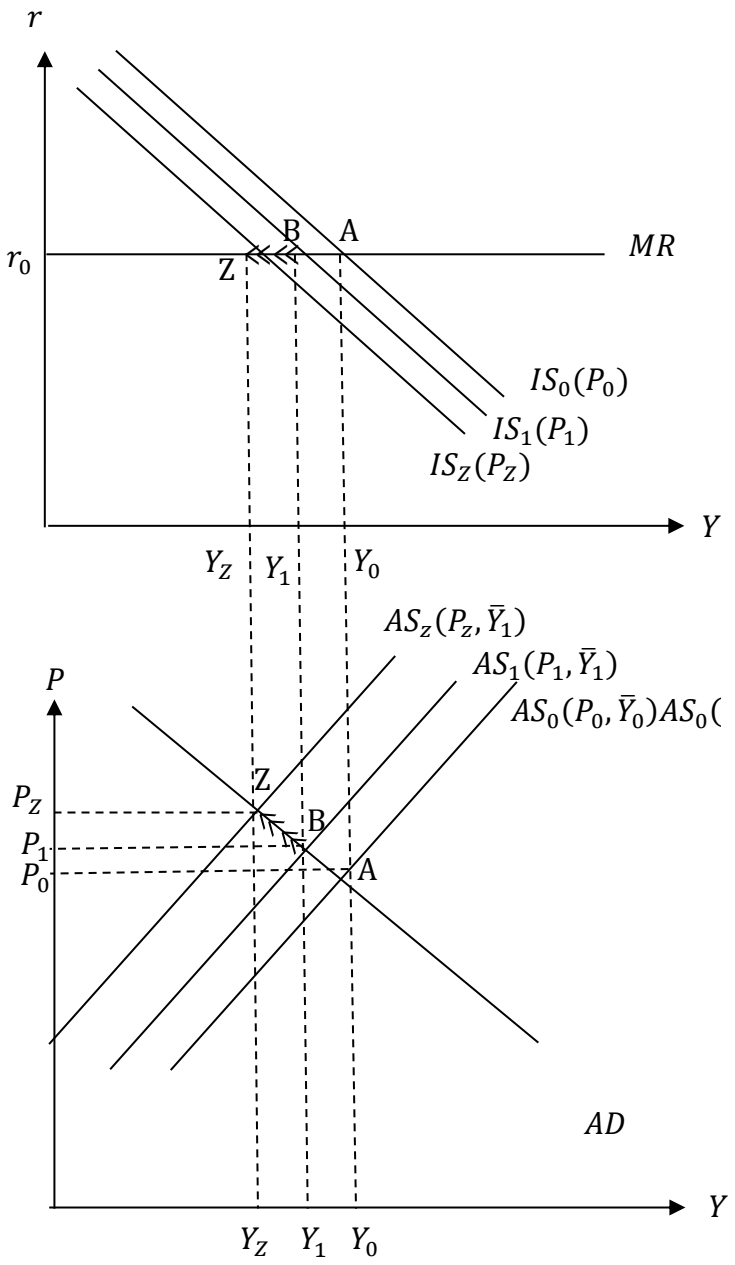
In the second period, the price level continues to rise because the expected price level has increased due to the static expectations. The increase in the price level pushes down real wealth and thus consumption, demand, and production.

These dynamics of rising prices and falling production will continue until production drops to its new lower stationary equilibrium level, and until the price level reaches its new higher stationary equilibrium level.

The arrows between points B and Z in Figure 19 show that, after the short term, the aggregate supply curve shifts to the left period after period due to the sustained increases in the expected price. In the upper part of the Figure, the arrows between B and Z show the shifts in the IS associated with the systematic rise in the price level. The economy reaches its new level of stationary equilibrium at Z.

**Figure 19**

**Fall in potential output (stationary equilibrium transition dynamics)**



The mathematical responses for the short term are given by,

$$dY = \frac{kc_2\lambda}{(1+\lambda kc_2)^2} d\bar{Y} < 0$$

$$dP = -\frac{\lambda}{(1+\lambda kc_2)^2} d\bar{Y} > 0$$

It should be noted that production continues to fall in the second period, but at a slower pace than in the period of impact. The price level continues to rise, but also at a slower pace than in the first period.

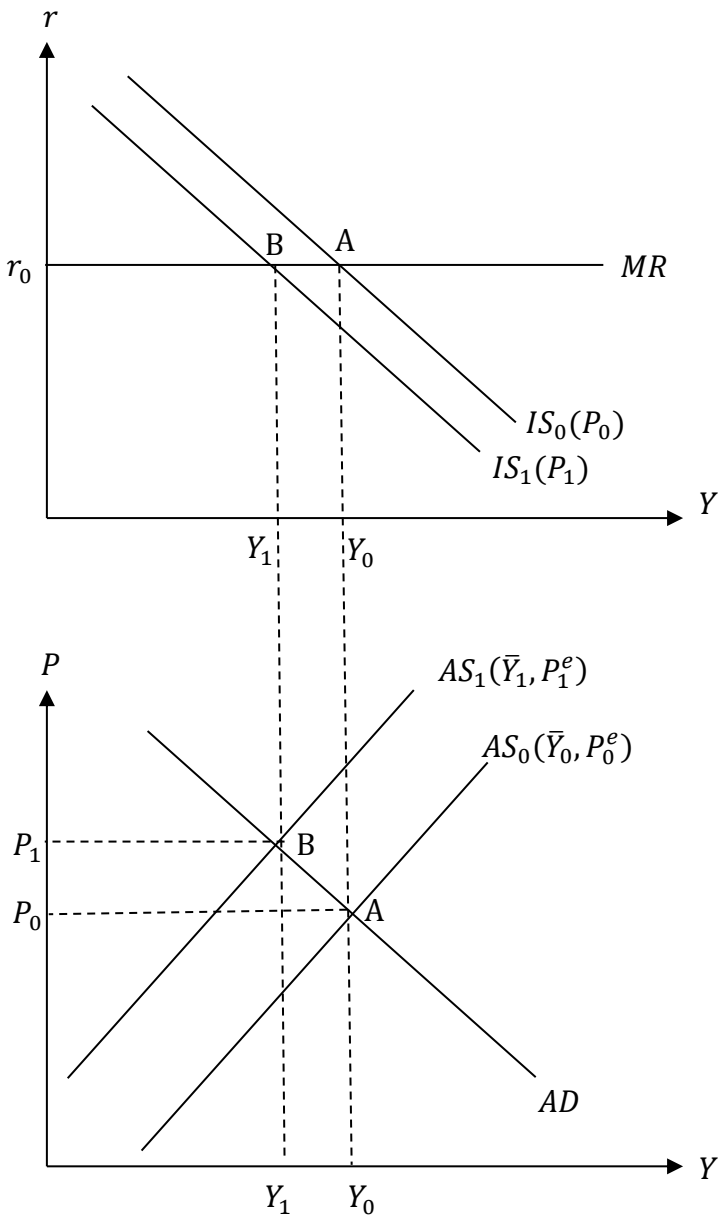
*With rational expectations*

With rational expectations, the decline in potential output has two effects. On the one hand, as in the short term, the lower potential output increases the output gap and thus pushes up the price level. But the lower potential output, by increasing the expected price level, is an additional adverse shock that also pushes up prices. The increase in the price level pushes down real wealth, due to which consumption, demand, and production fall.

In Figure 20, the lower potential output shifts the aggregate supply curve due to both the fall in potential output and the rise in the expected price, due to which the prices go up and production goes down. In the upper part, the higher price level shifts the IS to the left.

**Figure 20**

**Fall in potential output (rational expectations)**



The mathematical responses are,

$$dY = \frac{k(1+\lambda k^e c_2)}{k^e(1+\lambda k c_2)} d\bar{Y} = d\bar{Y} < 0$$

$$dP = -\frac{(1+\lambda k^e c_2)}{(1+\lambda k c_2)c_2 k^e} d\bar{Y} = -\frac{1}{k^e c_2} d\bar{Y} > 0$$

## 6. CONCLUSIONS

This paper has presented a model, the IS-MR-AD-AS, which seeks to serve as a good substitute for the traditional IS-LM-AD-AS. The alternative model is as simple as the traditional one, but allows monetary policy to be tackled in keeping with current practice by central banks around the world.

Moreover, like the traditional model it is highly versatile, which allows consideration of more complex matters such as the short term, the stationary equilibrium transition dynamics, the stationary equilibrium, and rational expectations.

We believe that this model can become central to the teaching of the general equilibrium in undergraduate macroeconomics.

BIBLIOGRAPHY


Blanchard, Olivier
(2016) How to Teach Intermediate Macroeconomics after the Crisis? Peterson Institute for International Economics, *Real Time Economic Issues Watch*, https://piie.com/experts/senior-research-staff/olivier-blanchard

Blanchard, Olivier
(2017) *Macroeconomics*. Seventh edition. Pearson USA.

Carlin, Wendy and David Soskice
(2005) The 3-Equation New Keynesian Model-A Graphical Exposition. *Contributions to Macroeconomics*, 5(1), 1-36.

(2015) *Macroeconomics: Institutions, Instability, and the Financial System*. Oxford: Oxford University Press.

Clarida, Richard, Jordi Gali and Mark Gertler
(1999) The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature*, *XXXVII* (4), 1661-1707.

Colander, David
(2010) *The Economics Profession, the Financial Crisis, and Method*, Middlebury College Economics Discussion Paper 38, Middlebury.

De Araujo, Pedro, Roisin O'Sullivan and Nicole Simpson
(2013) What Should be Taught in Intermediate Macroeconomics? *The Journal of Economic Education*, *44*(1), 74-90.

Dornbusch, Rudiger and Stanley Fischer
(1994) *Macroeconomía*. Sixth edition, McGraw-Hill

Farmer, Roger
(2017) *Prosperity for All. How to Prevent Financial Crises*. Oxford University Press, U.S.A.

Hicks, John
(1937) Mr. Keynes and the "Classics": A Suggested Interpretation. *Econometrica*, 5, 147-159.

Mendoza, Waldo
(2015) *Macroeconomía Intermedia para América Latina*. Secando edition. Lima: Fondo Editorial de la PUCP.

(2017) Teaching Modern Macroeconomics in the Traditional Language: The IS-MR-AD-AS Model. Working Paper, Departamento de Economía de la PUCP.

Pigou, Arthur
(1943) The Classical Stationary State. *The Economic Journal*, 5(212), 343-351.Wiley on behalf of the Royal Economy Society.

Romer, David
(2000) Keynesian Macroeconomics without the LM Curve. *Journal of Economic Perspectives*, *14*(2), 149-169.

(2013) *Short-Run Fluctuations*. Working Paper, California University.

Sorensen, Peter and Hans Whitta-Jacobsen
(2009) *Introducción a la Macroeconomía*, vol. II. Madrid: McGraw-Hill.

Taylor, John
(1993) Discretion versus Policy Rules in Practice. *Carnegie-Rochester Conference Series on Public Policy*, 39, 195-214.

(2000) Teaching Modern Macroeconomics at the Principles Level. *American Economic Review. Papers and Proceedings*, 90(2), 90-94.

Walsh, Carl
(2002) Teaching Inflation Targeting: an Analysis for Intermediate Macro. *Journal of Economic Education*, 33(4), 333-346.