

## The Nature of the ADAS Model Based on the ISLM Model\*

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### Abstract

The aggregate demand and supply model (*ADAS*) is interpreted as a synthesis of the Keynesian and neo classical models. It uses the *ISLM* model, without explaining its nature, to derive aggregate demand (*AD*). It is combined with an aggregate supply (*AS*) curve to explain price-inflation and output dynamics. This paper argues that neither the *AD* nor *AS* curve is conceptually the same as its microeconomic counterpart and *ADAS* is not a synthesis. In fact *ADAS* implies that discretionary policy is necessary and that price changes do not perform their traditional negative feedback function.

**JEL:** E0, E41, E52.

**KEYWORDS:** Keynesian and neo classical models, aggregate demand and supply, monetary policy rule, price adjustments, stabilization policy.

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## 1. INTRODUCTION

Current macroeconomic textbooks use different approaches to develop an aggregate demand and supply (*ADAS*) model in which there is a downward sloping aggregate demand curve (*AD*) and an upward sloping aggregate supply curve (*AS*) in price and output space ( $P, Y$ ) or inflation and output space ( $\Delta P, Y$ ). It is believed that such familiar looking *AD* and *AS* curves help students easily to grasp the working of the macroeconomic system because *ADAS* resembles the familiar demand and supply model of a single goods market in microeconomics. However, these textbook *ADAS* models fail to achieve their ultimate objective. Students are left more confused about the working of the economic system with *ADAS* and an early opportunity to teach the students to look at the economy from a systems perspective is also lost. Consequently, there is perpetual confusion on whether *ADAS* is a single goods market model or a system of inter-related aggregate markets of goods, labour, money and bonds.<sup>1</sup> Furthermore, since different approaches are used to derive the *ADAS* model, a student using a first year book, based on a particular approach, later finds that *ADAS* in the second and third years is different.<sup>2</sup>

This paper takes the view that the current textbook emphasis on the similarities between price-output determination in a single

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<sup>1</sup> In the past a similar confusion caused Rowan (1975) to develop a kinked aggregate demand function. Rao (1986) argued that the Rowan demand curve does not exist.

<sup>2</sup> For example, a first year student may use McTaggart, Findly and Parkin (2003) or Taylor and Moosa (2002) and later in the second year, for example, Dornbusch, Fischer and Startz (1999). In McTaggart, Findly and Parkin and in Dornbusch, Fischer and Startz although *AD* is derived from *ISLM*, derivation of *AS* is different. For the difference between *ADAS* in these two books see Rao (1998) and Grieve (1998).

In Taylor and Moosa there is a downward sloping *AD* curve, in the  $(\Delta P, Y)$  space, resembling the micro demand curve. It is based on the assumption that central banks target the (nominal) rate of interest. The original formulation of this type of model is due to Romer (2000). However, a point not emphasized in this sort of approach is that if the central bank fails adequately to adjust nominal rate of interest, *AD* will have a positive slope. A number of other textbooks use one or another variant of these three approaches with similar drawbacks. However, Blanchard (2000) and Blanchard and Sheen (2004) emphasize the underlying multi-market nature of *ADAS* and that *ADAS* is not a single goods market model.

goods market of microeconomics and the aggregate goods market in macroeconomics is inappropriate. The sooner this practice is given up the better would be our insights into the working of the real world economic systems. Our paper is organized as follows. In section 2 the nature of the *ISLM* model is explained. In section 3 a recent text textbook variant of the *ADAS* model, based on Romer (2000) and Taylor and Moosa (2000), is examined from a systems perspective. Section 4 examines the derivation of aggregate demand based on earlier textbook versions of *ADAS*. Section 5 examines the problem of inflation policy and finally conclusions are given in section 6.

## 2. NATURE OF THE ISLM MODEL

Virtually in all varieties of Keynesian models (henceforth Keynesian), goods prices are set by firms and not determined, as in microeconomics models, by the market forces of demand and supply. Furthermore, output is determined by demand and not even by the *Min.* condition of the disequilibrium models.<sup>3</sup> Since these Keynesian assumptions have been already incorporated into the Hicksian *ISLM* model, *ADAS* models in which *ISLM* is used to derive *AD* are already Keynesian in nature.

It is important to understand Hicks' later clarifications of the nature of his *ISLM* model in Hicks (1983), a much neglected contribution compared to the famous Hicks (1937). Hicks (1983) clarifies the differences between the all flex-price Walrasian general equilibrium system (*GE*) and his *ISLM*. *ISLM* is a product of the Walrasian nature of Hicks' approach and it is his way of representing the Keynesian three way exchange in the goods, money and bond markets on a two dimensional diagram. Therefore, according to Hicks, *ISLM* model should be seen as a simple Walrasian *GE* model with only three markets and two relative prices viz., the price of goods and the price of bonds which is the reciprocal of the rate of interest. Because of Walras law, if two markets are in equilibrium

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<sup>3</sup> There is considerable evidence, based on the non-nested hypothesis tests as well as the standard likelihood ratio tests, to support the validity of these Keynesian assumptions; see Pesaran (1982, 1988) and Rao (1992, 1993a) for evidence based on the non-nested hypothesis tests and Rao and Srivastava (1991) and Rao (1993b, 1994) for evidence with likelihood methods for the U.S. and U.K. economies. In Rao (1993b) it is found that more than 85% of the U.S. *GNP* transactions take place in the Keynesian markets.

the third market must be also in equilibrium. Therefore the three-way exchange can be understood by analyzing any two markets. Hicks ignored the bond market. His *ISLM*, therefore, analyzes the conditions under which the goods and the money markets can be in equilibrium.

There is, however, an important difference between *ISLM* and Walrasian *GE*. It is that while in the Walrasian model all markets are flexprice, or *P* markets in Hicks' terminology, in *ISLM* the bond and money markets are *P* markets and the goods market is a fixprice, or a *Q* market in Hicks' terminology. It is in this sense *ISLM* is novel and departs from the Walrasian tradition.<sup>4</sup>

Once the fixprice assumption is introduced into the Walrasian system, its nature and conclusions change. In contrast to the Walrasian system where all the demand and supply functions depend on the relative prices and initial endowments, in the fix-price systems these relationships depend on the relative prices and initial endowments in the *P* markets, and instead of the relative prices, on the quantities actually transacted in the *Q* markets. It is for this reason the Keynesian consumption function depends on current income, instead of the inter-temporal relative price of consumption viz., the real rate of interest.

Furthermore, while in *GE* adjustment to equilibrium is through price changes, in *ISLM* such adjustment is through quantity adjustments. Unlike in *GE*, equilibrium in *ISLM* is affected by monetary and fiscal policies. The system may remain in underemployment equilibrium for a long period. Therefore stabilization policy is necessary to achieve full employment equilibrium. It is for this reasons that *ISLM* can be said to have successfully formalized Keynes' underemployment equilibrium. Finally, what is the nature of the labour market that has been ignored in *ISLM*? It can be either a *P* or a *Q* market, but Hicks says that it is a *Q* market although admitting that Keynes might have thought that it is a *P* market; see Hicks (1983, p.54).

Therefore, to use an *AD* function derived from *ISLM* with an

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<sup>4</sup> Critiques of *ISLM* who point out that it lacks micro foundations may note these clarifications by Hicks. Those critical of the fix-price assumptions may also note that there is no micro foundation for the market clearing assumption in the Walrasian model; see Arrow (1981, pp.141-2) and Benassy (1986, p.3). Furthermore, it is not hard to incorporate partial price adjustment into the fix-price disequilibrium models. In fact most empirical works do so.

*AS* function to illustrate, among other things, the differences between the Keynesian and the more market oriented new and neo classical (henceforth neo classical) models is methodologically unsound and gives misleading conclusions. It may also be noted that when firms are demand constrained in the goods market, there cannot be a supply curve. Thus neither *AD* nor *AS* is conceptually the same as its counterpart in the competitive microeconomic model. Furthermore, given the underlying Keynesian assumptions in the *ISLM* model, it is even more amazing that some Keynesians uncritically accept that *ADAS* model's implication that the economy is capable of attaining full employment equilibrium, sooner or later, through price adjustments. Therefore, any discretionary policy can be seen somewhat as a catalyst to speed up this process of adjustment through the market forces.

In spite of these limitations, if *AD* and *AS* are given the correct interpretation, with some simplifying assumptions for expository convenience, they can be used to analyze aggregate output and price level or the rate of inflation within the Keynesian framework. In particular, such an interpretation emphasizes the need for discretionary stabilization policy and therefore it is not an appropriate framework to analyze the market oriented neo classical models. Which one of these rival models is better in explaining observed stylized facts is an age old question. But existing empirical evidence, based on various alternative methods, favour the Keynesian model; see footnote 3.

The rest of this paper develops a simple systems framework within which the aforesaid Keynesian implications of the current textbook *ADAS* model are explained.

### 3. A SIMPLE SYSTEMS FRAMEWORK

It is useful to look at the economy from a systems perspective in which various markets are inter-related. This will also avoid the confusion about whether *ADAS* is a single goods market, which it is not, or a model of interrelated aggregate markets, which in fact it is. Needless to say this is not a new insight, because the Walrasian *GE* is familiar to many teachers of economics if not to the first year students. Therefore, at the outset a descriptive account of how the competitive flex-price *GE* system works would be valuable.<sup>5</sup>

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<sup>5</sup> Although some dismiss the frictionless Walrasian *GE* model as based on

Macroeconomics textbooks of an earlier generation, e.g., Ackley (1978) and Felderer and Homburg (1987), have utilized such an approach to illustrate, diagrammatically, how the flex-price classical macro system works. Similarly, early diagrammatic versions of the *ISLM* model have utilized a similar approach. But in neither approach was the systems perspective highlighted. A downside of this deficiency is that it is hard to grasp the differences between the Walrasian *GE* and the Keynesian model, using a common systems perspective. However, as noted earlier, Hicks (1983) clarified the differences between these two types of models. According to Hicks, his *ISLM* is very similar in structure to the Walrasian *GE*, except that *ISLM* is a system where some markets are flex-price and others are fix-price. The Keynesian model neatly fits into the *ISLM* system where the goods market is fix-price and money and bond markets are flex-price. Thus, in the *ISLM* part of *ADAS*, *IS* is the equilibrium path of output in the goods market with Keynesian assumptions; *LM* is the equilibrium path of output in the money market, for given rates of interest, ignoring the differences between nominal and real rates of interest. Therefore the reduced form output equation of *ISLM* satisfies equilibrium in the goods, money and bond markets.

The labour market, ignored in *ISLM*, can be either fix-price or flex-price. But, as noted earlier, Hicks makes clear that it is a fix-price market. The *AS* relationship derived through the Phillips curve in some textbooks, e.g., in Dornbusch, Fischer and Startz (1999), may be seen as a reduced form mark-up price-setting equation of a disequilibrium labour market and adding this to the reduced form output equation of *ISLM* gives the *ADAS* model for analysis of the behaviour of output, the rate of interest, and the price level or the rate of inflation. Unfortunately many textbook *ADAS* models neglect these systems features of *ADAS* and leave the impression that *AD* and *AS* are the demand and supply relationships of a single aggregate goods market. Among other things, the main weakness of this is that movements towards equilibrium are explained only in terms of price adjustments and the role of spillover effects from the other markets are neglected.

The specification of the *ISLM* model is too familiar and does not

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unrealistic assumptions, it is a useful framework for developing and generalizing theoretical propositions. Therefore, it would be useful to teach *GE* in some detail because generalizations with non-competitive models are hard.

need elaboration.<sup>6</sup> To keep the solutions simple, the specification of the relationships of a closed economy *ISLM* are:

$$Y = C + I + G \quad (1)$$

$$C = c_0 + c_1(Y - T) \quad (2)$$

$$I = i_0 - i_1(rn - \Delta P) \quad (3)$$

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

$$\left(\frac{M}{P}\right) = l_0 + l_1Y - l_2rn \quad (5)$$

where:  $Y$  = output,  $C$  = real consumption,  $I$  = real investment,  $rn$  = nominal rate of interest,  $\Delta P$  = rate of inflation,  $T$  = taxes,  $G$  = autonomous government expenditure,  $P$  = price level and  $M$  = nominal money supply.

Some departures from the standard practice of solving for  $Y$  and  $rn$  are made for the following reasons. First, we ignore price expectations for expositional convenience and adding expectations does not change the nature of the model. Therefore, instead of the expected rate of inflation in the definition of the real rate of interest in the investment equation, the actual rate of inflation is used. This simplification also helps to analyze output and inflation instead of output and the price level; see Romer (2000) for the advantages of this approach compared to earlier textbook versions.

Second, given the developments in the financial markets, following their liberalization, and the proliferation of near moneys, the *LM* curve is found to be unstable. Therefore many central banks have switched to targeting the nominal rate of interest instead of the money supply. It is well known that if *LM* is unstable, targeting the nominal rate of interest results in less fluctuations in economic activity and if *IS* is unstable targeting the money supply is preferable; see Poole (1970). Therefore,  $rn$  is treated as an ex-

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<sup>6</sup> It is important to note that in the Keynesian model income is the determinant of consumption and saving decisions, unlike the real rate of interest in the standard Walrasian model. Nevertheless, many neo classical versions of the *ADAS* model, using a Walrasian labour market to derive the *AS* curve, uncritically assume that consumption depends on income. A similar confusion was also present in the earlier Keynes versus the Monetarists debate. Perhaps Friedman uncritically admitted that “We are all Keynesians now” when he accepted *ISLM* as a suitable common framework for the monetarist and Keynesian approaches.

ogenous policy variable and denoted as  $rn^*$  and real money supply as an endogenous variable, since the central bank cannot control both. Furthermore, in *ISLM*  $P$  or  $\Delta P$  are exogenous variables and therefore, solving for  $Y$  and  $(M/P)$ , with these assumptions gives:

$$Y = \frac{(c_0 + i_0) - c_1 T - i_1 rn^* + i_1 \Delta P + G}{(1 - c_1)} \quad (6)$$

$$\frac{M}{P} = l_0 + \left[ \frac{1}{(1 - c_1)} \right] \left\{ (c_0 + i_0) l_1 - c_1 l_1 T \right. \\ \left. \left[ (1 - c_1) l_2 - i_1 l_1 \right] rn^* + i_1 l_1 \Delta P + l_1 G \right\} \quad (7)$$

Note that the *LM* relationship, as pointed out by Romer (2000), is redundant in this model, because the rate of interest is now exogenous. Equation (7) determines only the real money balances.

It is obvious from (6) that there is no downward sloping relationship between output and inflation rate. In fact this relationship is positive implying that when the economy experiences a shock, a change in the inflation rate works as a positive feedback mechanism, and not as the negative feedback mechanism implied by the textbook *ADAS* models. This is intuitively obvious since, following a deflationary shock, if the rate of inflation falls, the real rate of interest increases (for a given nominal rate of interest) and investment expenditure declines.

A somewhat questionable way to get a negative relationship between  $Y$  and  $\Delta P$ , and thus make the price mechanism pretend to function like a negative feedback mechanism (as in microeconomic markets) is to impose a monetary policy rule such that the central bank adjusts the targeted nominal rate of interest by a larger proportion than the change in the inflation rate. For example, Romer (2000) uses this approach and Taylor and Moosa (2002) adopt it to derive their *AD* curve. This can be explained by adding an additional relationship:  $rn^* = (1 + \alpha)\Delta P$  where  $\alpha$  is a positive fraction. Substitution of this for  $rn^*$  in (7), makes the coefficient of  $\Delta P$  as  $-i_1 \alpha / (1 - c_1)$ .

There are several problems with this approach. First, in the absence of a discretionary policy e.g. a monetary policy rule (*MPR*), though it is called a (policy) rule, price adjustment cannot restore full employment equilibrium by itself. Second, it is not only this *MPR* but any other discretionary demand management policy can

also be used to restore full employment and change the inflation rate. And there is no need for a downward sloping  $AD$  for the discretionary policy to work. The point is that if an appropriate discretionary policy is not implemented, equilibrium cannot be restored by price adjustments. However, with a  $MPR$  or with a similar policy, price adjustments can speed up the adjustment process. Third, there is no guarantee that central banks will continue targeting interest rates forever, once the effects of financial innovations are stabilized and  $LM$  becomes more stable. Therefore, the downward sloping  $AD$  in this  $ADAS$  model is an *ad hoc* and transient relationship. Fourth, it is the change in the real rate of interest, induced by  $MPR$  or some other discretionary policy, not price adjustments through demand and supply interactions, that take the economy towards the full employment equilibrium. Fifth, given the current international instability due to terrorism, it is difficult to rule out future instability in  $IS$  and therefore a return to money supply targeting. Finally, to achieve an increase in the real rate of interest, if a substantial increase in the nominal rate is necessary, it could be politically costly because of substantial increases in the mortgage payments by the householders.

However, within the current interest rate targeting framework, there is hardly any need for an upward sloping  $AS$  curve. Furthermore, as pointed out earlier, if firms are constrained by demand or even if they face downward sloping product demand curves, a supply curve does not exist. Nevertheless several textbooks derive an upward sloping  $AS$  curve in the price-output space or inflation-output space. Taylor and Moosa (2000) avoid calling such a relationship as the  $AS$  curve. It is, as Taylor and Moosa (2000) and Romer (2000) emphasize, a price or inflation adjustment function ( $IA$ ). It may be based on the mark-up principle in which the unit cost of production may be mildly pro-cyclical. Therefore, a demand pressure variable in this type of inflation adjustment relationship is not necessary and the inflation adjustment function is a horizontal line. Even if a demand pressure variable is added, it makes no difference because one can use a positively sloping relationship, also known as the goods market Phillips curve, such as:

$$\Delta P = \lambda_0 + \lambda_1(Y - YPOT) \quad (8)$$

where  $YPOT$  = potential output. Equation (8) also implies that price adjustments do not perform their negative feedback role, as in the micro markets. We shall examine this shortly. For now we

shall accept the Romer formulation that  $IA$  is horizontal in  $(\Delta P, Y)$  space.

Romer (2000) and Taylor and Moosa (2000) also explain clearly why firms do not adjust their pricing policies quickly. It is partly due to well known explanations based on implicit contracts, staggered wage and price setting policies and menu costs etc. In fact delays in price adjustments may give the policy makers adequate time to consider implementing appropriate counter cyclical stabilization policies. Otherwise, a rapid change in the pricing policies of firms will only worsen the effects of a shock.

For illustration we assume, in Figure 1 below, that initially output ( $Y_0$ ) equals full employment output ( $YPOT$ ) and the rate of inflation is  $\Delta P_0$ . A deflationary shock, say due to a deterioration of the investor expectations, decreases the autonomous component of investment,  $i_0$ . The reduced form *ISLM* equation (7), *ISLM*  $Y_0$ , shifts to the left to *ISLM*  $Y_1$ . In the short run there is no immediate change in the pricing policies and equilibrium output  $Y_0$  falls to  $Y_1$ . If pricing policies are adjusted downwards from  $IA_0$  to  $IA_1$ , in the absence of a reduction in the nominal rate of interest, the real rate of interest increases, causing a further reduction in demand and output to  $Y_2$ . Even if an upward sloping “an *AS* look-alike” *IA* is added to this model, price changes accentuate the problem. Therefore, discretionary policies, e.g., a more than proportionate reduction in the nominal rate of interest and/or an increase in the government expenditure (or even an increase in money supply in the traditional model, to be examined in the next section), are necessary to stimulate demand and output. There is nothing in the Keynesian system, based on the *ISLM* model to bring back the economy to the full employment level through market mechanisms of price adjustment.

#### 4. ALTERNATIVE DERIVATION OF AD

We have ignored so far a widely used traditional textbook approach to the derivation of *AD*. In this approach no distinction is made between the real and nominal rates of interest. Therefore interest rate in the investment and demand for money functions is just  $r$ . The reduced form income equation from the *ISLM* model shows that  $Y$  depends on real balances. Therefore by assuming higher values for the absolute price level, and ignoring what may happen to the real rate of interest in this process, the *LM* curve is shifted upwards. The result would be a decline in  $Y$  and an increase in  $r$ .

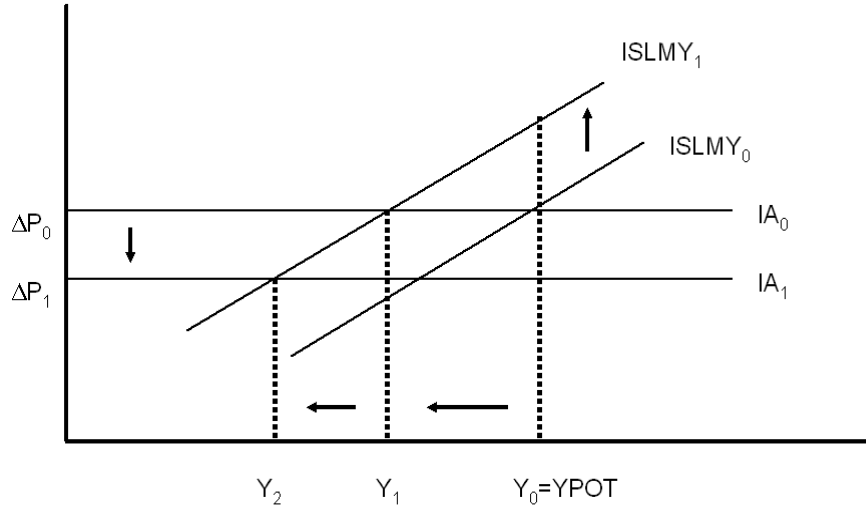


FIGURE-1

Thus this negative relationship between  $P$  and  $Y$  is said to be the illusive  $AD$  curve. However, if a distinction is made between the real and nominal rates of interest, it is hard to establish, *a priori*, that  $AD$  is downward sloping in the inflation-output space.

The relationship between inflation and output can be derived by making a minor change to the investment and demand for money functions as follows:

$$I = i_0 - i_1(rr) \quad (3.a)$$

$$\left(\frac{M}{P}\right) = l_0 + l_1Y - l_2(rr + \Delta P) \quad (5.a)$$

where  $rr$  = real rate of interest. The reduced form income equation, after defining  $P = (1 + \Delta P) \times P_{-1}$ , is:

$$Y = - \left[ \frac{1}{(1 - c_1) + i_1 l_1} \right] \left[ (c_0 + i_0 - l_0 i_1) \right]$$

$$+ l_2(-c_1T + G + i_1\Delta P) + \frac{i_1MP_{-1}}{(1 + \Delta P)}] \quad (9)$$

Differentiating (9) with respect to  $\Delta P$  gives:

$$\frac{\partial Y}{\partial \Delta P} = -i_1 \left( l_2 - \frac{MP_{-1}}{(1 + \Delta P)^2} \right) \div \left( (1 - c_1) + i_1 l_1 \right) \quad (10)$$

Thus a negative relationship between  $Y$  and  $\Delta P$  exists only if  $l_2 > (MP_1)/(1 + \Delta P)^2$ . Needless to say this is somewhat implausible given that estimates of  $l_2$ , the coefficient of the rate of interest in the money demand function, are generally small. Therefore a positive relationship between  $Y$  and  $\Delta P$  is most likely, implying that generally the real rate of interest declines in inflationary periods. And this is not far from the truth because targeting the nominal rate of interest is a more recent phenomena.

## 5. THE PROBLEM OF INFLATION

So far there is nothing in this model to explain inflation and inflation policy. This does not justify the development of an *ADAS* model from the *ISLM*. As is well known, the Phillips curve and its expectations augmented versions have been successfully used to explain inflation and inflation policy without the need for an *ADAS* type of model. But by inappropriately transforming the Phillips curve, a price adjustment equation, into an *AS* curve, which should be conceptually a quantity adjustment equation, the *ADAS* model shows how expansionary policies take the economy from a low inflation equilibrium to a high inflation equilibrium through price adjustments and the implied adjustments in inflationary expectations.

However, the *ISLM* model implies that if the inflation adjustment line *IA* shifts up, following an expansionary shock, there is no equilibrium through price adjustments. In fact the inflation rate becomes higher and higher. This process comes to a halt only if the *ISLM Y* line in Figure 1 somehow shifts up adequately. For example, increased demand pressures and limited increases of output beyond the capacity limits may lead to increased imports and substantial falls in exports. This would shift *ISLM Y* to the left. More importantly, since high inflation rates are costly, the government may implement a deflationary policy or as in the Romer model the central bank may substantially increase the real rate of interest. Such deflationary policies will eventually stop further upward shifts

in the  $IA$  line, thus bringing back the economy to its potential output level. But this state of rest occurs at a much higher level of the  $IA$  line and therefore acceleration of inflation comes to an end after inflation rate has considerably increased from its inertial low but stable rate. What is noteworthy here is that this dynamic adjustment from a low to a high but steady inflation rate is reached because of policy measures, not through shifts in the  $AS$  function because of changes in the expected rates of inflation.

## 6. CONCLUSIONS

These results imply that modeling of the economic system where market mechanisms ensure full employment output should be based on other than the  $ISLM$  model. Such classical and neo classical systems have been adequately explained in the textbooks of the early sixties. The adequacy of this type of model in comparison to the rival Keynesian model may be tested using the non-nested hypothesis tests, such as those developed by Pesaran (1983). Although the existing evidence favours the Keynesian model, further empirical work is desirable. Until then it may be said that the current belief that  $ADAS$  is a synthesis of the Keynesian and neo classical systems, like the earlier belief that  $ISLM$  is a synthesis of the Keynesian and monetarist models, seems to be untenable. The sooner the textbooks correct these untenable expositions the better would be our insights into the working of the real world economic systems.

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