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Are Long-run Price Stability and Short-run Output Stabilization All that Monetary Policy Can Aim For?*

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ABSTRACT

A central tenet of the so-called new consensus view in macroeconomics is that there is no long-run trade-off between inflation and unemployment. The main policy implication of this principle is that all monetary policy can aim for is (modest) short-run output stabilization and long-run price stability—i.e., monetary policy is neutral with respect to output and employment in the long run. However, research on the different sources of path dependency in the economy suggests that persistent but nevertheless transitory changes in aggregate demand may have a permanent effect on output and employment. If this is the case, then, the way monetary policy is run *does* have long-run effects on real variables. This paper provides an overview of this research and explores how monetary policy should be implemented once these long-run effects are acknowledged.

JEL Classification: E5, E52

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1. INTRODUCTION

A central tenet of the so-called new consensus view in macroeconomics is that there is no long-run trade-off between inflation and unemployment. The main policy implication of this principle is that inflation targeting strategies, namely aggregate demand fine-tuning through interest-rate management with a view to hitting inflation targets, do not affect unemployment, output or any other real variable in the long run. Note that by inflation targeting strategies this paper refers to any policy rule where there is either an explicit numerical inflation target like in the case of the UK and the Euro area, or an implicit inflation target like in the U.S., and where the central bank (hereafter CB) raises real interest rates when current or expected inflation is above target. In the following sections these inflation targeting strategies are reviewed under the label of conventional inflation targeting approach to monetary policy. According to this approach, thus, all monetary policy can achieve is (modest) short-run output stabilization and long-run price stability.

However, there are at least two potential problems with the conventional inflation targeting approach. First, monetary policy is understood to work through changes in the output gap, i.e., through deviations of current output from its potential or natural level. Since potential output is not observable, CBs may actually make some business cycle peaks endogenous to policy. In other words, some recessions could be policy-induced. Second, theoretical and empirical research on the different sources of path dependency in the economy suggests that transitory but nevertheless persistent changes in the level of aggregate demand may have permanent effects on output and employment. These two potential problems with the conventional inflation targeting approach play a key role in the paper as they open the door to long-run non-neutrality of monetary policy.

According to the conventional inflation targeting approach in order to achieve long-run price stability CBs need to respond to any change in the current or expected rate of inflation. For instance, in the face of a positive inflation shock (hereafter INS) CBs are supposed to engineer a disinflation process by raising the real interest rate, hence curbing aggregate demand and current output. But what if potential output is also affected by the level and time path of aggregate demand? An affirmative answer to this question would mean that the long-run time path of output and employment is determined, at least in part, by monetary policy. In this case, a fall in the level of aggregate demand leads to a significant and permanent output loss. This paper aims to provide evidence supporting this conclusion and to explore how monetary policy should be implemented once these long-run effects are acknowledged.

The paper is organized as follows. Section 2 briefly discusses the conventional inflation targeting approach. With the help of graphical analysis Section 3 examines some of its most problematic aspects. Section 4 discusses theoretical and empirical research on different sources of path dependency in the economy, namely demand-led growth models, hysteresis models, and multiple equilibria models. This research suggests that changes in the level of aggregate demand may have permanent effects on the level of output and employment. Section 5 proposes an alternative monetary policy framework that explicitly acknowledges the intimate relationship between potential output and aggregate demand. Finally, Section 6 concludes.

2. THE "NEW CONSENSUS VIEW" AND MONETARY POLICY: THE CONVENTIONAL INFLATION TARGETING APPROACH

Following Clarida *et al.* (1999), Meyer (2001), and Walsh (2002) the basic ideas underpinning the new consensus view in macroeconomics can be formally presented in the following set of three equations, namely an aggregate supply or expectations-augmented Phillips curve, an *IS* curve, and a monetary policy rule or CB's reaction function:

$$\dot{\pi}_t = g\left(y_t - \bar{y}_t, s_t\right) \tag{1}$$

$$y_t - \bar{y}_t = h\left(r, X, z_t\right) \tag{2}$$

$$r - r^* = f\left(\pi_t - \pi_t^*\right) \tag{3}$$

The first equation states that $\dot{\pi}_t$, namely the change in the current rate of inflation π_t, is a function of the output gap, that is deviations of current output, y_t, from its potential level, $\bar{y}_t$, and the error term, s_t, capturing any other factors affecting π_t. The second equation describes the behavior of the output gap as determined by the short-run real interest rate, r, a vector of variables, X, that may shift the *IS* curve, and the error term, z_t. The short-run real interest rate, r, is defined as the nominal interest rate, namely the inter-bank overnight lending rate, minus expected inflation. Finally, the third equation is a simple reactive rule. The stance of monetary policy, that is the difference between the actual real interest rate, r, and its long-run equilibrium level, r^*,[1] is a function of the gap between current and target inflation rates, i.e., $\pi_t - \pi^*$. Distributed lag relations among its variables as well as inflation expectations usually enrich this rather simple framework but in order to keep the analysis as simple as possible those complications are set aside.

According to one of the most illustrious exponents of the discipline there are two propositions that make the modern core of macroeconomics (Solow, 1997). First, the trend movement in real output is predominantly driven by the supply side of the economy, namely the rate of technical progress and the growth rate of the labor force. In turn, the latter are assumed to be exogenously determined. The trend movement in real output is captured by the concept of potential or natural output, $\bar{y}_t$, which indicates the capacity level of the economy. Potential output is the level of output that arises in the long run when, by definition, wages and prices have fully adjusted to their equilibrium values. It is the supply-determined output path of the economy.

Second, fluctuations around the trend of potential output are predominantly driven by changes in the components of the aggregate demand function. Current output, y_t, is the demand-determined level of output. It describes the fluctuations around the trend of potential output and is assumed to be inversely related to the real interest rate and, hence, under the influence of CBs via interest-rate management policies. In this way, the new consensus view promotes the view that macroeconomic fine-tuning policy decisions, i.e., monetary policy, are able to minimize fluctuations of current output around potential output.

Another feature of the above set of equations is that it shows in a very simple way the ultimate goals and operating targets of CBs. Long-run price stability and short-run output stabilization are the ultimate goals of monetary policy and the real interest rate r is the operating target variable used to achieve those goals. Of course, CBs only set the short-run nominal interest rate. However, it is usually assumed that CBs are actually able to target the *ex ante* short-run real interest rate r by appropriately adjusting the nominal interest rate to changes in expected inflation.[2] The conventional inflation targeting approach is thus consistent with empirical evidence showing that interest rate variations are in general accounted for by responses of CBs to the state of the economy rather than by random disturbances. Note in this respect the absence of an error term in the reactive rule (equation 3).

The above theoretical features of the new consensus view of monetary policy are best described by analyzing the nature of the adjustment process underlying the working of the conventional inflation targeting approach. In the new consensus view price inflation is an outcome “summary statistics” describing the state of economic unbalance. Since the natural or potential growth rate of output is assumed to be independent of the level and time path of aggregate demand, ideally current output should grow in line with potential output. Whenever current output y_t exceeds the potential level $\bar{y}_t$ the inflation rate accelerates, i.e., $\dot{\pi}_t > 0$ in equation 1. Changes in the inflation rate are thus signalling the unwarranted growth of aggregate demand in excess of the growth of aggregate supply. By appropriately adjusting the nominal interest rate to changes in the inflation rate CBs can then bring current output in line with potential output (equation 2).[3]

There are two essential features of this adjustment process. First, monetary policy affects real variables as long as temporary nominal rigidities give rise to frictions in the working of the price mechanism. In other words, price and wage rigidities are the necessary condition for CBs to have leverage over the short-run real interest rate and hence on output. Since in the long run prices and wages are assumed to be fully flexible monetary policy does not have any long-lasting effects either on the level or on the growth rate of output and employment (Meyer, 2001, p. 3). Second, there exists a trade-off between inflation and output variability. Note that the error term, s_t, in equation 1 stands for temporary INSs. Depending on the weight assigned to output variability relative to inflation variability, a CB may decide to offset the impact of a temporary INS (i.e., $s_t \neq 0$) by limiting fluctuations in output and letting inflation fluctuate more instead. For instance, in the face of a positive INS a CB may desist from changing the real interest rate and hence from affecting aggregate demand. As a result, the output gap will be relatively stable but at the cost of a higher level of inflation. Alternatively, a CB may opt for smaller fluctuations in the inflation rate and a higher variability in the output gap. In this alternative case, in the aftermath of a positive INS a CB will raise the real interest rate in order to reduce the current level of output and hence the inflation rate. The variance of the output gap rises while the variance of the inflation rate falls (Walsh, 2002, pp. 341-342; Arestis *et al.*, 2002).

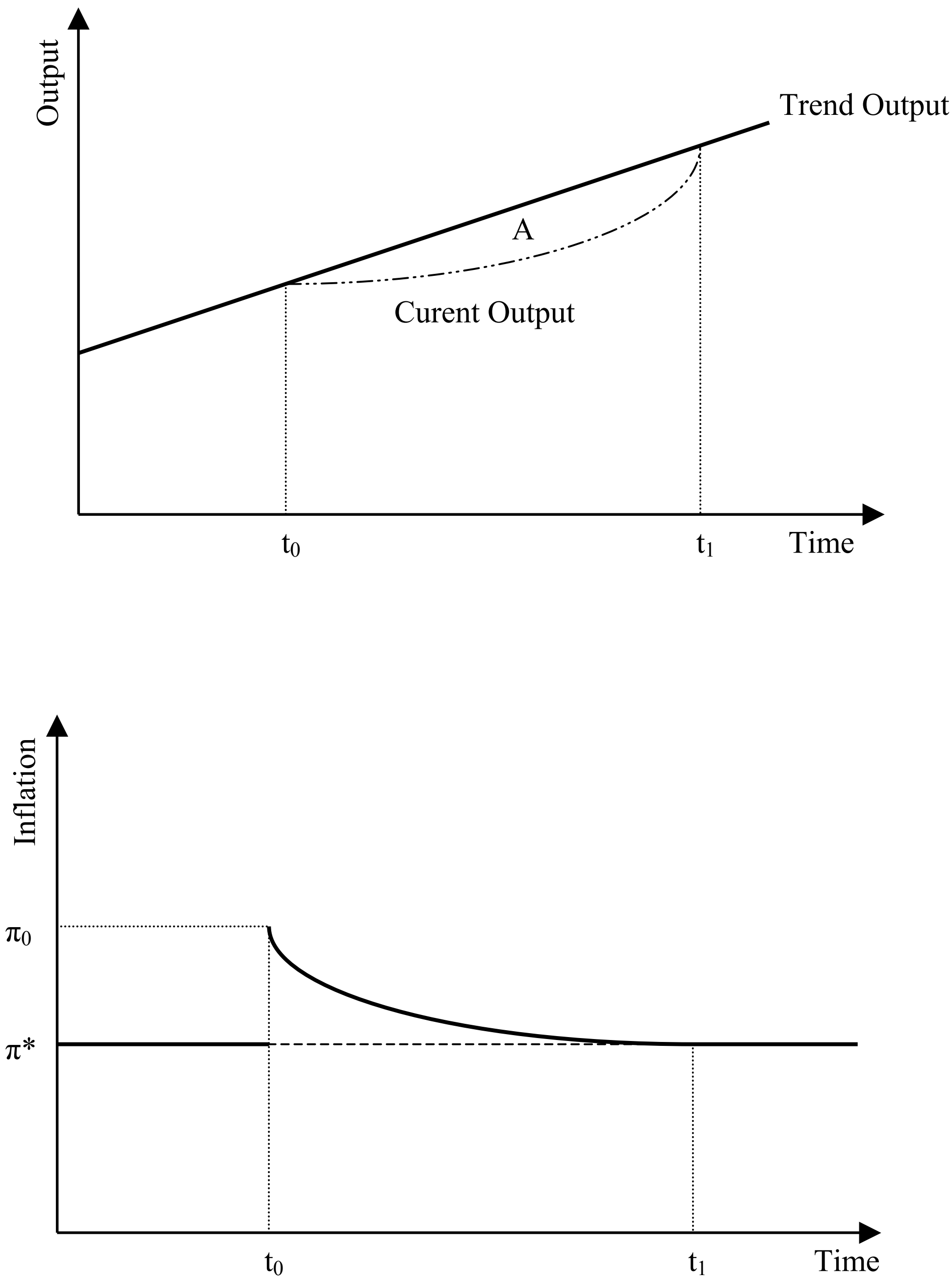
3. SOME PROBLEMATICAL ASPECTS OF THE CONVENTIONAL INFLATION TARGETING APPROACH

According to the new consensus view on macroeconomics a stable price level is assumed to eliminate or at least mitigate, among others, the following problems: (i) shoe-leather costs on the holding of money balances, (ii) distortions to the tax and social security systems due to the lack of full indexation of taxes and benefits, and (iii) noise information due to difficulty of distinguishing general from relative price changes (Cecchetti, 2000).[4]

However, a first problem posed by a monetary policy framework like the one described above is the possibility that some economic recessions become policy-induced. Evidence on the likelihood that recessions are policy-induced is provided by Romer and Romer (1989).[5] On the basis of records at the Federal Reserve System (Fed), they argue that as many as six of the eight post-war recessions in the U.S. appear to have been preceded by decisions of the Fed to cause an economic downturn in order to reduce inflation.[6] In each case, the Fed appears to have made a deliberate decision to exert a contractionary influence on the economy, thus sacrificing real output and employment for lower inflation (see also Fuhrer and Schuh, 1998, p. 3).[7] In addition, and crucially, Romer and Romer show that monetary policy shocks have highly persistent effects on output, although they acknowledge that the simple autoregressive procedures used cannot reliably distinguish between permanent effects and very long-lasting but nonetheless transitory ones. Bernanke and Mihov (1998) provide further evidence on this issue. Using the VAR methodology, they show that there is support for the argument that persistent but nonetheless transitory policy shocks have permanent effects on output. Bernanke and Mihov (1998) present the estimated impulse functions for real GDP in response to a transitory monetary shock and show that they do not die out toward zero as required by the principle of long-run neutrality of monetary policy. In addition, their point estimates imply a large impact of monetary policy on GDP even after ten years.

The possibility that restrictive monetary policies have real effects that are highly persistent raises the possibility that they become permanent. If this were the case there is no guarantee that, for instance, in the presence of severe positive INSs, the alleged benefits from price stability actually exceed the costs in terms of permanent output losses (Fontana and Palacio-Vera, 2002, p. 560). This is shown in Figure 1 below (Filardo, 1998, p. 35).

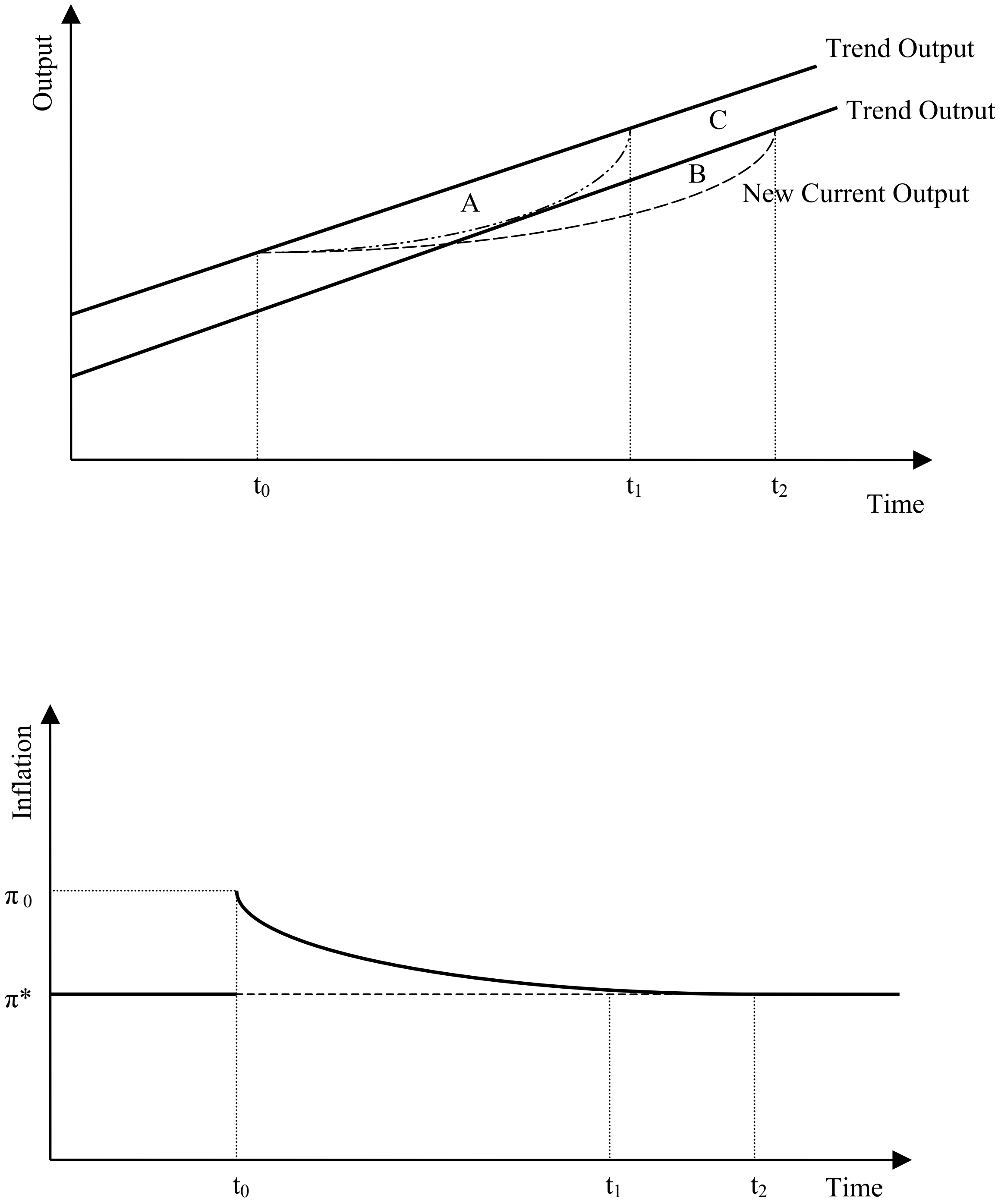
Figure 1: Output Loss Associated with Disinflation in a Conventional Inflation Targeting Strategy



Time is measured on the horizontal axis whereas the log of (current and potential) output is measured on the vertical axis. The positively sloped thick line describes the initial time path of (the log of) potential output whereas the positively sloped dashed line describes the time path of (the log of) current output. Current inflation (π) is assumed to be initially equal to target inflation (π^*) hence both lines follow the same trajectory. But at t_0 the economy is hit by a positive INS such that the new level of current inflation (π_0) is now above the target level. As a result of it, the CB raises (real) interest rates to bring about a fall in current output so that current inflation can eventually return to target. If potential output is independent of the level and time path of aggregate demand (as assumed in Figure 1) then, as current output falls below its potential level, the inflation rate gradually converges to its target. Eventually, the CB lowers interest rates thus letting current output return to the unchanged potential output path. The "flow" loss of output due to the restrictive monetary policy is measured by the so-called sacrifice ratio, i.e., the percentage reduction in real output needed to lower inflation by one percentage point. It is worth noting that the "flow" loss of output is equal to the confined area (A). In other words, though the CB engenders a recession in order to counteract the positive INS, the recession does not produce any long-run effect on the capital stock per worker or, more generally, on the level of potential output (Palley, 2002, p. 25). In terms of Figure 1, the recession does not change either the position or the slope of the positively sloped thick line.

The conclusions are dramatically different if, for instance, the deflationary policy causes a fall in current output that leads in turn, for reasons to be discussed in the next section, to a downward shift of the positively sloped thick line representing (the log of) potential output.[8] This is shown in Figure 2.

Figure 2: Output Loss Associated with Disinflation in a Path-Dependent Economy



In this case, if the CB aims at hitting the inflation target, and the sacrifice ratio remains constant, it will now have to keep current output below potential till say (t_2), with ($t_2 > t_1$). In addition, the CB will not be able to return current output to its original trajectory. The "flow" loss of output caused by the disinflation process is given by the sum of areas A, B, and C. Importantly, the "flow" loss of output grows as time goes by since the area C is unbounded.

4. SOURCES OF PATH DEPENDENCY IN THE ECONOMY

The closing paragraph of the previous section has presented the case of a downward shift of (the log of) potential output line due to a fall in the current level of aggregate demand and output which was, in turn, caused by a deflationary policy. But how likely it is that a fall (rise) in the level of aggregate demand leads to a significant and permanent downward (upward) shift in the trajectory of (the log of) potential output? A positive answer means that the long-run time path of real output and employment, and not only their volatility, is determined, at least in part, by monetary policy. This possibility is usually rejected *a priori* by proponents of the new consensus view of macroeconomics.[9] However, a variety of theoretical and empirical studies suggest that this is a real possibility. In this section, three types of models suggesting different sources of path dependency in the economy are discussed, namely demand-led growth models, hysteresis models, here formalized as "unit root" processes and "hysteretic" models, and multiple equilibria models. Path dependency is used here as a general organizing concept to indicate that economic outcomes are the product of a specific sequence of changes and adjustments. Path dependency models thus explicitly acknowledge that each sequence of changes and adjustments imbues the economic system with memories that affect current and future economic outcomes (Kriesler, 1999).

4.1. Demand-led Growth Models

A first source of path dependency in the economy is related to demand-led growth models that show the possibility that economic growth is, at least in part, determined by aggregate demand (Setterfield, 1999, 2002; León-Ledesma and Thirlwall, 2002; McCombie *et al.*, 2002). The strand of literature where this argument has been developed stretches back to the seminal work of Young (1928), and includes key contributions by Kaldor (1970, 1972) and Cornwall (1970, 1972). Demand-led growth models challenge two basic propositions of neoclassical growth theory, namely that (a) aggregate demand has (if any) only a transitory impact on the degree of utilization of existing productive resources, and (b) the rate of expansion of these resources over time is not influenced significantly by aggregate demand. In other words, demand-led growth models aim to show that aggregate demand affects the path of current and potential output. For example, the supply of labor may be affected, via labor force participation rates and patterns of immigration, by the actual level of income. Similarly, the demand for investment, and hence the availability of capital can be positively affected via retained profits and access to external finance by the realized level of output. Finally, advances in technology can be stimulated via learning-by-doing and innovations by expansions in the level of aggregate demand (Schmookler, 1966; Geroski and Walters, 1995; Brouwer and Kleinknecht, 1999). Thus, the quantity, quality and sectorial distribution of existing productive resources are the effects as much as the cause of the process of economic growth.

There are two main strands of demand-led growth models. A first strand is based on the Veblen-Myrdal hypothesis of "circular and cumulative causation" (Myrdal, 1957; also Veblen, 1919). According to this hypothesis, the workings of the market mechanism are conceived as a continuous process in which economic forces interact upon one another. An initial change to the system supports thus additional changes that by reinforcing and amplifying the initial change take the system further away from its initial position.

The literature identifies several economic forces that lead to cumulative processes, including increasing returns to scale, learning and technical progress, and aggregate demand. According to Young (1928) the expansion of markets leads via a growing use of roundabout methods of production and a progressive specialization of industries to rising efficiency of production which manifests itself in increasing volumes of production and further expansion of markets. The existence of dynamic increasing returns to scale corroborates thus the view that a change in the economic system may become progressive and propagate itself in a cumulative way. This cumulative process is reinforced by learning-by-doing and induced-technical progress. The development of new technologies of production as well as the introduction and differentiation of goods results in efficiency gains and economic growth that in turn induce, via a higher rate of innovative efforts, further changes to the economic system.[10] In this cumulative process aggregate demand plays a key role. First, to a large extent technical progress is induced by the expectation of increases in the demand for goods and services. Second, and importantly, the development of technological advances depends on the validation of the growth of markets.

A second strand of demand-led growth models is closely related to John Cornwall's view of growth as a process of joint interaction between aggregate demand and aggregate supply (Cornwall, 1972, Ch. 4). The main thrust of the argument is that at any point in time in an economic system there are different goods with different income elasticities of demand (e.g. luxury goods and necessities with an income elasticity of demand greater than or less than one, respectively). Assuming a supply-driven increase in output and income, due to e.g. an increase in productivity, then the level of aggregate demand would change owing to a change in the composition of consumption demand. Importantly, aggregate demand would have feedback influence on aggregate supply via effects on the behavior of productivity. According to Cornwall, this is due to the fact that the possibility of achieving economies of scale and increases in productivity through mass production is positively related to the capital intensity of the technique actually chosen by individual firms. In turn, the degree of capital intensity chosen by any individual firm is positively related to the expected growth rate of the demand for its own goods and services. Viewed in macroeconomic terms, this means that firms are more likely to switch to highly capital-intensive techniques, and hence to achieve productivity increases for the economy overall, when demand is growing and is expected to grow relatively strongly. A similar argument can also be argued for the rate of transfer of resources. The higher the current and expected rate of growth of demand, the higher would be the mobility of labor and the transfer rate of capital from one sector to another.

The obvious policy implication to be derived from the two strands of demand-led growth models is that fiscal and monetary policy can make an active contribution to economic growth in the long run by generating a high level of aggregate demand.

4.2. "Hysteresis" Models

A second source of path dependency in the economy is related to the so-called "hysteresis" effects. The concept of "hysteresis" originated in the 19th century in the physical sciences to denote the persistent effects of temporary exposure of ferric metals to magnetic fields. Economists have recently used the concept especially in the field of unemployment theory since its properties seem to fit well the employment dynamics of the last two decades (Cross, 1995). The low growth environment of the 1970s could account for the high level of unemployment. However, the economic recovery of the 1980s and the 1990s could not be easily related to the persistence of high unemployment, especially in Western Europe.[11] For this reason, in recent years some economists have started to replace the familiar reversible dynamical tools of unemployment theory, i.e., the notion of reversible exogenous shocks to the system (and adjustment lags), with the concept of hysteresis (Katzner 1993).

When discussing the use of hysteresis in economics it is important to distinguish the theoretical interpretations from the empirical modelling of hysteresis. From a theoretical point of view hysteresis has usually been articulated in terms of two hypotheses, namely the “labor market phenomena” hypothesis and the “capital shortage” hypothesis. The labor market phenomena hypothesis postulates hysteresis effects in the labor market due to the negative impact of low aggregate demand on the effective supply of labor via, for example, the depreciation of skills and loss of work motivation in unemployed individuals (e.g. Blanchard *et al*., 1986; Franz, 1987; Ball, 1999) or the existence of insider-outsider relations (e.g. Blanchard and Summers, 1987; Lindbeck and Snower, 1989). The capital shortage hypothesis refers to hysteresis effects in the capital market due to the influence of aggregate demand on investment and thereby on the capital stock in the economy (e.g. Sarantis, 1993; Rowthorn, 1999; Arestis and Biefang-Frisancho Mariscal, 2000; Arestis and Sawyer, 2002; Sawyer, 2002). In other words, negative demand shocks affect employment and investment but when shocks reverse unemployment does not return to previous levels due to an insufficient level of capital stock in the economy.

From an empirical point of view, the relatively recent use of the concept of hysteresis in economics has generated a number of different, and not always consistent, formal characterizations (Amable *et al*., 1995). For this reason, two different types of hysteresis models are discussed in this section, namely “unit root” processes and “hysteretic” models.

4.2.1. *“Unit Root” Processes*

In economics hysteresis is usually associated with dynamic linear models characterized by zero root systems (i.e., zero eigenvalue) for continuous time or by unit root systems for discrete processes (Giavazzi and Wyplosz, 1985; Amable *et al*., 1995). In these systems there is a continuum of equilibria and the equilibrium reached, selected from within the continuum, depends on the particular features of the system. In a deterministic framework, the final equilibrium point depends on the initial conditions of the state variables as well as on the parameters describing the speed of adjustment. In a stochastic framework, this means that the position of the system is determined by the chronicle of exogenous shocks. In particular, shocks cumulate forever without progressively vanishing. In the simple case of a stochastic first-order difference equation, the general solution takes the form (see Katzner, 1993):

$$x_t = \alpha^t x_0 + \sum_{n=1}^{t} \alpha^{t-n} \varepsilon_n \quad (4)$$

so that if x_t possesses a unit root then $\alpha = 1$ and

$$x_t = x_0 + \sum_{n=1}^{t} \varepsilon_n \quad (5)$$

As a result, in a system like (5), the steady-state values of variable x_t depend not only on the history of the exogenous variable ε but also on the initial conditions of the state variable described by x_0 (Franz, 1990).[12] In terms of Figure 2 this means that a transitory positive INS to the economy (i.e., ε_0) triggering some contractionary monetary policy decision imbues the system with a memory such that the time path of (the log of) potential output is permanently affected, hence leaving a permanent "scar" on the economy (Mankiw, 2001, p. 48). Therefore, under a conventional inflation-targeting regime, and provided current inflation is initially equal to target, positive INSs lead to permanent output losses, whereas negative INSs lead to permanent output gains (Fontana and Palacio-Vera, 2002; Arestis and Sawyer, 2005).

An interesting property of a system like (5) is that an initial shock followed by a second one of the same intensity but opposite sign takes the system back to its initial position whatever the intensity of shocks. In other words, if the output dynamics in Figure 2 were described by a unit root process (or a zero root process in continuous time), then a negative INS at t_2 of the same intensity than the positive one occurred at t_0 would take current output back to the initial time path of potential output. This "reversibility" property has an undesirable implication for those searching for permanent effects of transitory shocks and, hence, for hysteresis effects explaining the employment dynamics of the last two decades (e.g. Clarida *et al*., 1999). If exogenous shocks are generated by a symmetric probability distribution, then, on average, negative and positive shocks, cancel each other out in the long run. Therefore, with unit root systems, any long-run permanent effect on output and employment can only be caused by any of the following two circumstances. First, shocks to the economic system are generated by an asymmetric probability distribution. Second, and independently from the nature of the source of the economic shocks, the response to shocks by policy makers is asymmetric.

The relevance of these two circumstances for understanding how real world events could produce path-dependency effects should not be ignored. For instance, although it is extremely difficult to determine empirically the nature of the probability distribution of shocks hitting an economy, it is reasonable to argue that for OECD countries there have not been negative INSs of the size of the positive 1970s oil-price INSs. Furthermore, Section 5 below shows that with a conventional inflation targeting strategy average output will be lower than potential output, even if INSs are symmetrically distributed. More importantly, as a result of the academic debate on policy credibility the consensus in policy circles is that it is always, or almost always, appropriate for monetary policy to "err on the side of caution" (Forder, 2001, p. 23; also Hargreaves Heap, 1980, p. 611), i.e., to adopt a conservative monetary stance biased toward economic contraction and loss of output.

Notwithstanding the reversibility property, unit root systems exhibit another important property, originally presented as the "deceleration" hypothesis of employment and growth by Hargreaves Heap (1980). The model discussed has the following two final equations:[13]

$$\Delta\pi_t = b(u_t^* - u_t) \tag{6}$$

$$\Delta u_t^* = -c(u_t^* - u_t) \tag{7}$$

where u^* is the natural rate of unemployment, u is the current rate of unemployment and Δ denotes a positive variation in discrete time. Substitution of (7) into (6) yields:

$$\Delta\pi_t = b/c \cdot \Delta u_t^* \tag{8}$$

The implication that arises out of equation (8) strikes right at the heart of the conventional inflation targeting approach. Hargreaves Heap puts the argument as follows:

> Consider a government that chooses and holds a particular level of unemployment below the current "natural" rate. This will cause the rate of inflation to increase, but it will also reduce the "natural" rate of unemployment in the following time period so that the increase in the rate of inflation in the next time period will be smaller than the first time period's increase. Hence, if the government holds the rate of unemployment at its chosen level, then the gap between this level and the "natural" rate gets smaller and smaller, until the chosen level of unemployment becomes the "natural" rate and the rate of inflation stabilizes (Hargreaves Heap, 1980, p. 617).

In other words, the relationship given by equation (8) indicates that there is a trade-off between the change in the "natural" rate of unemployment and the terminal rate of inflation. Thus, this conclusion opens the way for a macroeconomic policy strategy aimed at striking a balance between inflation and unemployment. In particular, the higher is c and the lower is b in equation (8), then the more favorable the trade-off is and *vice-versa*.

4.2.2. *"Hysteretic" Models*

The weak hysteresis features of unit root models due to the reversibility property have recently led some economists to investigate the general properties of systems showing hysteresis effects. Drawing on the work of the Russian mathematician Mark Krasnosel'skii (Krasnosel'skii and Pokrowskii, 1989), it has been argued that hysteresis is a property of non-linear models with heterogeneous micro elements and that, for the most elementary representations, hysteresis effects are best modelled in terms of an input-output framework (Amable *et al.*, 1995). A system is then said to be hysteretic when it exhibits some "remanence," i.e., when the value of the output is permanently affected by an appropriate temporary change in the value of the input.

The key point is that in hysteretic systems a relevant exogenous force modifying the value of a given parameter λ entails a structural change in the dynamic of the system. For instance, the structural modification may move the system out of the initial equilibrium point toward a new equilibrium point. By altering the exogenous force such as to bring the parameter λ back to the initial value, a structural deformation of equal magnitude but opposite sign is produced. However, and this is a crucial difference with the case of unit root models, the system does not return to the original equilibrium point. In other words, the temporary change in the value of the parameter λ has produced a "remanent" effect on the final state of the system (Amable *et al.*, 1995, p. 172; see also Lavoie, 2002, p. 18). From this perspective, the essential difference between unit root models and "hysteretic" models lays in the formal characteristics of the dynamic process. In the former the application of an exogenous force only changes the state variables of the system and, hence, when the initial application is reversed the state variables also move back to their original value. The system is thus ultimately unaffected by the temporary applications of an exogenous force.

By contrast, in hysteretic models, a change in the value of the parameter λ, due to the application of a relevant exogenous force, produces a structural change in the formal characteristics of the dynamics of the system. Therefore, when the change in λ is reversed the system does not return to its initial position. The application of a relevant exogenous force to the system has influenced, via a temporary change of λ, the number, and stability properties, of the set of equilibria of the system. In terms of Figure 2, an exogenous force modifying the value of a parameter of the economy would thus affect the position of the line representing (the log of) potential output.[14]

An important property of hysteretic models is that not all applications of exogenous forces modify the value of a given parameter λ of the system. In other words hysteretic models display a selective memory of the non-dominated extremum values of past changes to the input of the system (Cross, 1995, pp. 190-196). A non-dominated extremum value is defined as a local maximum (minimum) that is bigger (smaller) than any subsequent change that follows it. This means that only the global maximum value (minimum value) of the past changes to the input of the system, and any relevant decreasing (increasing) sequence of local maxima values, produces a structural change in the formal characteristics of the dynamics of the system.

In terms of formal characterizations of a possible source of path dependency the attractiveness of hysteretic models is twofold. First, hysteretic models draw attention to the possibility that the application of exogenous forces to the economic system takes the form of deliberate policy decisions. Second, hysteretic models suggest that these permanent effects are a property of non-linear models with heterogeneous microelements. This means that a non-trivial consideration when analysing the final outcome of a change in monetary policy is the complex issue of how to aggregate the response of heterogeneous groups of economic agents to changes in interest rates (Chick and Dow, 2002; Dow 2004).

4.3. Multiple Equilibria Models

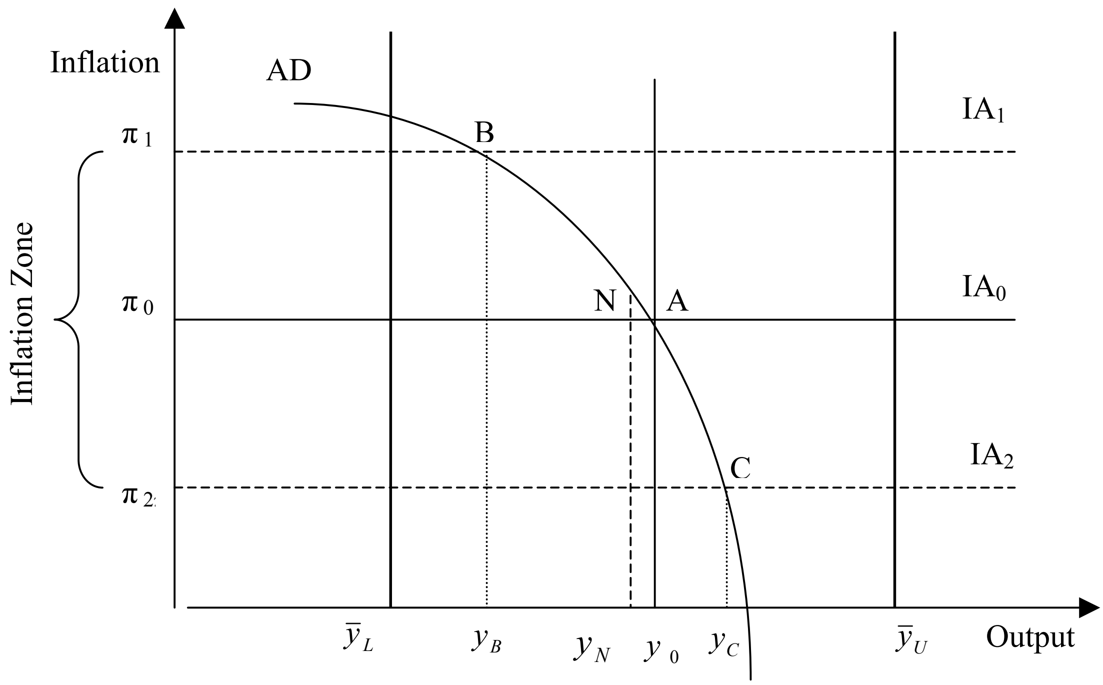
A final potential source of path-dependency is the existence of a discrete and finite multiplicity of equilibria in non-linear models.[15] For instance, in their study of the U.S. business cycle De Long and Summers (1988) address the alleged difference stationary nature of real GDP time series and show that fluctuations in production appear to persist indefinitely. They acknowledge that this result can be explained by permanent changes in production technology (De Long and Summers, 1988, p. 435). Nevertheless, they suggest that the notion of economies oscillating around a unique supply-side determined equilibrium is not appropriate. They maintain that fluctuations in aggregate demand are most likely to make the economy move between different equilibria. As a result, macroeconomic outcomes are path-dependent. The existence of a multiplicity of equilibria is justified on the grounds of: (i) the presence of "externalities" based on search considerations (Diamond, 1982), or increasing returns to scale (Weitzman, 1982); (ii) the existence of credit failures (Stiglitz, 1988); and (iii) hysteresis effects. Along similar lines, Dixon (1988) shows that an imperfectly competitive economy displays a natural range of employment levels, and hence macroeconomic policies can be used to select particular levels of employment (see also Manning, 1990). In particular, by causing the economy to move between different equilibria, aggregate demand shocks may produce permanent effects on output and employment.[16] In turn, this opens the way to welfare-improving macroeconomic policies aimed at moving the economy to an equilibrium position with low inflation and high employment.

5. MONETARY POLICY IN A PATH-DEPENDENT ECONOMY: THE "FLEXIBLE OPPORTUNISTIC" APPROACH

In the previous sections two problems for the adoption of a conventional inflation targeting regime were identified, namely that (1) recessions may be policy-induced, and (2) persistent but nevertheless transitory changes in the level of aggregate demand may have permanent effects on output and employment. In this section an inflation targeting regime that attempts to deal with these two problems is proposed (Fontana and Palacio-Vera, 2003).

In order to keep the discussion as simple as possible, following Palacio-Vera (2005) an amended version of Romer's *IS-MP-IA* textbook model is used (Romer 2000). In Figure 3 below, output and inflation are measured on the horizontal and vertical axes, respectively. The current level of output and rate of inflation are determined by the intersection of the aggregate demand curve (hereafter *AD*) and a short-run aggregate supply curve, the so-called inflation adjustment line (hereafter *IA*). The horizontal IA_0 line reflects the fact that in the short-run the rate of inflation presents some degree of persistence such that changes in the *AD* are fully converted into output changes. Movements in the output gap will thus shift the line upwards or downwards in the forthcoming periods, if current output is above or below otential output respectively. In addition, negative (positive) INSs shift the *IA* line downwards (upwards) contemporaneously.

Figure 3: Monetary Policy in a Path-dependent Economy: The Standard Opportunistic Approach



Another feature of the model represented in Figure 3 is that the current level of output can wander freely between the upper limit $\bar{y}_U$ and the lower limit $\bar{y}_L$ without having any significant effect on the current rate of inflation.[17] In other words, for the range of values of potential output between the two vertical solid lines $\bar{y}_U$ and $\bar{y}_L$ the rate of inflation is constant in the absence of INSs. The horizontal *IA* line will thus shift upwards when the current level of output is above the upper limit $\bar{y}_U$, and it will shift downwards when the current level of output is below the lower limit $\bar{y}_L$. This means that the output gap that keeps inflation constant is a plateau measured by the distance $\bar{y}_U - \bar{y}_L$ rather than a single point as in the conventional inflation targeting approach.

The final remark on Figure 3 is that the *AD* function is represented by a concave downward sloping curve. The negatively sloped *AD* function is derived from the set of three equations discussed in Section 2. As current inflation rises above the long-run inflation target, the CB raises the real interest rate which leads via a decrease in aggregate demand to a reduction in output and employment (see, for the graphical analysis, Palacio-Vera 2005, Figure 1). Similarly, the concavity of the *AD* function derives from the nature of the reaction function of the CB (see Equation 3 in Section 2). At higher levels of inflation, other things being equal, it is easier for the CB to reduce real interest rates and hence spur aggregate demand whereas, due to the existence of a lower bound on nominal interest rate, it is increasingly difficult for the CB to produce similar effects at lower levels of inflation. Also, at higher levels of inflation the CB is willing to sacrifice an increasingly larger amount of output to prevent inflation from rising further above the long-run inflation target.[18]

A crucial policy implication of the concavity of the *AD* function in Figure 3 is that, if the probability distribution of INSs hitting the economy is symmetric, then the conventional reaction function of the CB leads to inefficient results. For example, let us assume in Figure 3 that the economy is in an equilibrium position (point *A*), with current inflation and the long-run inflation target equal to π_0 and an equilibrium level of output equal to y_0. If now the economy is hit by a positive, and then by a negative INS of equal size, under the conventional inflation targeting approach the CB should respond by first raising and then reducing nominal and real interest rates. The new equilibrium points, at the intersection of the *AD* with the new IA_1 and IA_2 lines, would thus be point *B* and point *C*, respectively. In the long run INSs should not affect average output as they balance each other out. However, this is not the case in Figure 3 where the new average level of output y_N, an average of y_C and y_B to be sure, will be below the initial equilibrium level of output y_0. Importantly, under our assumptions, as long as the new average level of output is above the lower limit of potential output of $\bar{y}_L$, it will not bring inflation down. At the same time, if any of the path-dependent effects presented in the previous section are at work, then the new lower average level of output may crucially have negative effects on the potential level of output. In terms of Figure 3, the new average level of output should set between y_0 and $\bar{y}_L$, and it could shift leftwards the vertical solid lines $\bar{y}_L$ and $\bar{y}_U$. Without anticipating too much of a point discussed later in the section, this means that by following the conventional inflation targeting approach the response of the CB to INSs may inadvertently increase the sacrifice ratio in the economy (see Figure 2). What is worse is that this strategy has deleterious long run effects. A vicious circle is set off, where for any given targeted reduction in the level of inflation, the more the CB deflates the economy now, the more it needs to do in the future.

The alternative inflation targeting regime proposed in this section deals with this problem, and with the limitations of the conventional inflation targeting approach, more generally. It is an amended version of the so-called "opportunistic" approach to disinflation which has been discussed at meetings of the Federal Open Market Committee (e.g. Federal Reserve Board 1995, 1996), formally presented by Orphanides and Wilcox (1996) and explored quantitatively in Orphanides *et al*. (1997). In terms of the path-dependent effects presented in the previous section, the opportunistic approach marks significant progress from the conventional inflation targeting approach. For any given set of underlying economic conditions, it calls in fact for a more cautious deflationary strategy, and hence it minimizes the possibility that economic recessions are policy induced. Table 1, Columns 1 and 2 below summarize the crucial differences between the two approaches.

Both approaches start from the premise that price stability is the appropriate long-run goal of monetary policy. As a result, in a high-inflation environment both approaches suggest to raise nominal and real interest rates. However, according to the conventional inflation targeting approach, the CB should aim to achieve price stability steadily, no matter whether current inflation is high or low. In other words, as long as inflation remains above its long-run target the CB should keep putting downward pressure on inflation by keeping some slack in the labor and goods markets. By contrast, proponents of the opportunistic approach maintain that, when current and expected inflation is moderate, though above the long-run target, the CB should keep the economy producing at its potential level.

Table 1: Monetary Policy Matrix in a Low Inflation Environment (i.e., $\pi_2 < \pi < \pi_1$) for (1) a Conventional Inflation Targeting Approach, (2) an Opportunistic Approach, and (3) a "Flexible" Opportunistic Approach

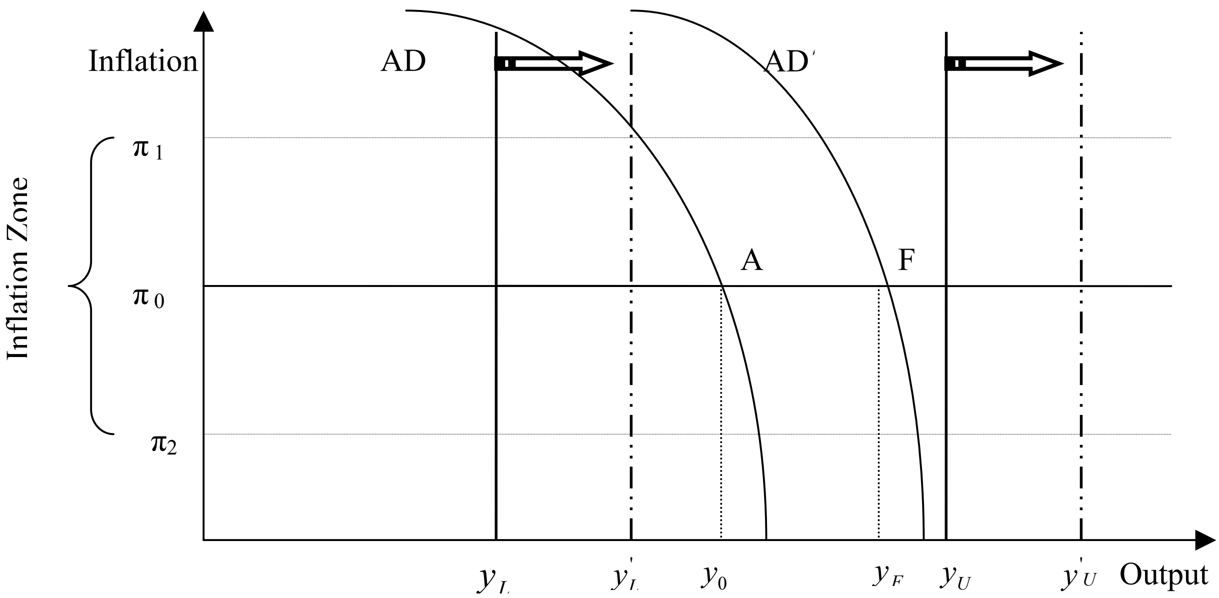
	1. A Conventional Central Bank	**2. An Opportunistic Central Bank**	**3. A "Flexible" Opportunistic Central Bank**
Policy response to:			
(a) Current and expected inflation above the long-run inflation target but within the upper limit of the inflation zone (i.e., $\pi_0 < \pi < \pi_1$)	(a) raise real interest rate	(a) raise real interest rate in the case of any inflation pressure otherwise no response, i.e. keep real interest rate constant	(a) no response, i.e., keep real interest rate constant
(b) Current and expected inflation at the long-run inflation target (i.e., $\pi = \pi_0 = \pi^*$)	(b) raise real interest rate	(b) no response, i.e. keep real interest rate constant	(b) lower real interest rate
(c) Current and expected inflation below the long-run inflation target but above the lower limit of the inflation zone (i.e., $\pi_2 < \pi < \pi_0$)	(c) no response, i.e., keep real interest rate constant	(c) lower real interest rate in the case of favorable permanent shocks or no response, i.e. keep real interest rate constant in the case of temporary shocks	(c) lower real interest rate

The standard opportunistic disinflation model (e.g. Orphanides and Wilcox 2002) is represented in Figure 3. As before the long-run inflation target is equal to π_0, but now a relatively wide inflation zone equal to $\pi_1 - \pi_2$ is set around it. Let us now assume that current inflation is above the long-run inflation target but below the upper bound of the inflation zone π_1. In this case, as long as there are no inflation pressures the CB keeps the real interest rate *r*, and hence the current output level *y*, constant. In Figure 3 this is shown by the long solid line at y_0. In other words, rather than starting a deliberate deflationary strategy the CB waits for exogenous circumstances such as an unforeseen shortfall in the level of *AD* or negative INSs to deliver the long-run inflation target (see, for an earlier statement of this "opportunistic" view, the then president of the Federal Reserve Bank of Philadelphia, Boehne, in Federal Reserve Board 1989, p. 19). This policy strategy marks a significant progress with respect to the conventional inflation targeting approach. It means that in a low-inflation environment an opportunistic CB is less deflationary than a conventional CB, and hence the likelihood that recessions are policy induced is reduced.

Building on Fontana and Palacio-Vera (2002, 2003) and Palacio-Vera (2005), the case is here made for an amended version of the opportunistic approach, let us call it, the "flexible" opportunistic approach. The flexible opportunistic approach starts from the same principle of the conventional and opportunistic approaches, namely that price stability is the long-run goal of monetary policy. This means that, like in the previous two cases, in a high-inflation environment, namely when current or expected inflation is above the upper limit of the inflation zone (i.e., $\pi > \pi_1$) the flexible opportunistic approach will induce and tolerate some output loss in order to reduce inflation.[19] Again, in accordance with the opportunistic approach, and in contrast to the conventional inflation targeting regime, the "flexible" opportunistic approach concurs that in a low-inflation environment, namely when current and expected inflation are above the long-run inflation target but within the boundaries of the inflation zone set by the CB, the chance that recessions are policy induced is reduced if the CB keeps the real interest rate constant. However, differently from the standard opportunistic approach, the flexible opportunistic approach maintains that when current inflation is at the long-run inflation target or below it, the CB should actually lower the real interest rate. There are two reasons for this strategy. First, since it has been assumed that the output gap that keeps inflation constant is a plateau measured by the distance $\bar{y}_U - \bar{y}_L$ rather than a single point, then as long as there are no pressures on current or expected inflation the

CB has some margin of flexibility in stimulating the economy through interest-rate management. Second, by lowering real interest rates the CB may be able to trigger some of the positive long-run path-dependent effects discussed in the previous section. Table 1, Columns 2 and 3 summarize the different policy responses of the standard and flexible opportunistic approaches, respectively.

Figure 4: Monetary Policy in a Path-dependent Economy: The "Flexible" Opportunistic Approach



The challenge for monetary policy of path-dependent effects and the policy response of the flexible opportunistic approach are represented in Figure 4. Like in the case of the opportunistic approach represented in Figure 3, the long-run inflation target is π_0 and an inflation zone equal to $\pi_1 - \pi_2$ is set around it. Again, like before the economy is in equilibrium at point *A*, with current and long-run inflation target equal to π_0 and the equilibrium level of output equal to y_0. Finally, and very importantly, for the range of values of potential output between the two vertical solid lines y_U and y_L the rate of inflation is constant in the absence of INSs.

Let us now assume that the CB decides to boost aggregate demand by reducing the real interest rate. In terms of Figure 4, this more accommodative monetary policy actually means that the CB is temporally accepting an inflation target higher than π_0, say π_1, such that for any given rate of inflation and output the CB now sets a lower nominal and real interest rate than before. The *AD* curve would then shift to the left to *AD*′. According to the conventional inflation targeting approach and the standard opportunistic approach, whatever the short-run impact of this accommodative policy is, the new (higher) level of aggregate demand would soon put serious pressure on the resource available in the economy. The new current level of output y_F is in fact dangerously close to the upper limit of potential output, y_U. Next period, current or expected level inflation could be higher, possibly beyond the upper bound of the inflation zone, and hence the CB would have to intervene again and cut aggregate demand by raising the short-term interest rate. In the conventional wisdom, the CB cannot create out of thin air the resources needed for growth. By lowering the real interest rate the CB can only start a boom-burst type of business cycle.

However, these are not the conclusions that are derived from the "flexible" opportunistic approach. Let us assume again that the decision of the CB to boost aggregate demand stimulates the current level of output and employment. According to the "flexible" opportunistic approach, this also means that some of the path-dependent effects discussed in the previous section may now come into play, and hence produce positive effects on the potential level of output. In Figure 4 this is shown by the rightward shift of the two vertical solid lines y_U and y_L (see, for a similar argument in terms of the Phillips curve, Freedman *et al.* 2004). In other words, in the presence of sources of path dependency, the decision of the CB to stimulate aggregate demand not only increases the current level of output and employment but, importantly, it also changes the underlying economic relationships such as to allow the economy to produce permanently at higher levels of output and employment without engendering inflationary pressures. In other words, the CB has lowered the NAIRU. In conclusion, the adoption of the "flexible" opportunistic approach should solve two of the major problems of the widely held inflation targeting approach, namely that (i) recessions are policy-induced and (ii) persistent but nevertheless transitory changes in aggregate demand lead to permanent output losses.[20]

6. CONCLUSION

This paper has discussed the conventional inflation targeting approach to monetary policy, namely aggregate demand fine-tuning through interest-rate management with a view to hitting inflation targets. Using a basic three-equation model and some simple graphical analysis the paper has uncovered the underlying theoretical core of the conventional inflation targeting approach, the so-called new consensus view, and then reviewed some of its most problematic features. The main outcome of this analysis is clear: the conventional inflation targeting approach rests on the principle of neutrality of monetary policy in the long run. Monetary policy does not have any long-run effects on output and employment. In the language of the conventional targeting approach, long-run price stability and short-run output stabilization are all that monetary policy can aim for.

However, these policy implications of the new consensus view rely on the assumption that the trend movement in real output, the so-called potential or natural level of output, is independent from the level and time path of aggregate demand. This assumption seats very uncomfortably with the Keynesian label usually attached to the new consensus view. Furthermore, there is a long and increasingly popular literature on different sources of path dependency in the economy showing that transitory but nevertheless persistent changes in the level of aggregate demand do have permanent effects on output and employment. The existence of unit root processes, hysteretic systems or multiple equilibria models together with the long-standing claims of demand-led growth models provide plenty of warnings against the adoption of the principle of long-run neutrality of monetary policy. The paper has reviewed theoretical and empirical research on different sources of path dependency and has concluded that monetary policy does have long-run effects on output and employment. Putting it boldly, the demand side of the market does matter in both the short and the long run. As a result of these conclusions, the paper has made the case for a "flexible" opportunistic approach which not only seeks to stabilize output in the short-run and achieve price stability in the long-run but that also makes an active contribution to the growth rate of output and employment.

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NOTES

[1] See Alonso-González and Palacio-Vera (2002) for a discussion of the effects of uncertainty over the values of the long-run equilibrium real interest rate and potential output on the implementation of this type of monetary policy rule.

[2] In the inflation targeting literature the ability of the CB to target the short-run real interest rate is discussed under the issue of inflation persistence. See Fuhrer and Moore (1995) for a presentation of the debated issue and Mankiw (2001, pp. C58-C59) for a critical review of it.

[3] See Fontana and Palacio-Vera (2004) for a discussion of the theoretical background of this view.

[4] With price stability as the goal for monetary policy, the desirable target for the (measured) inflation rate is around 1-2 %. This positive rate of inflation is considered to be consistent with price stability in the presence of improvements in or introduction of new goods and services as well as other biases in the measurement of the actual rate of inflation.

[5] See also Galbraith (1997, pp. 96-99), Dalziel (2002), and Citu and Twaddle (2003).

[6] The controversial dates are: October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979.

[7] Similarly, in a model examined in Leduc and Sill (2004), an interest rate rule is calibrated to match the policy of the Fed in the post-1979 era. They find that nearly 40 percent of the decline in output following a positive oil shock can be attributed to the way monetary policy responds to the shock. A similar rule calibrated to the pre-1979 era results in up to 75 percent of the drop in output being attributed to the monetary policy response.

[8] A further possibility is a rotation rather than simply a downward shift of the line representing the path of (the log of) potential output. In this case, a fall in real aggregate demand causes a fall in the rate of growth of potential output. In Section 4.2.1 this possibility is reviewed under the discussion of demand-led growth models.

[9] See, for instance, Blanchard and Quah (1989), Galí (1992), Solow (1997), and Taylor (1994).

[10] The existence of increasing returns to scale in this very broad sense is well captured by Verdoorn's Law, i.e., the existence of a strong positive association between the rate of growth of labor productivity and the rate of growth in industrial output (Kaldor 1970, p.340).

[11] For instance, Ball suggests that passive macroeconomic policies are largely to blame for the observed rise in unemployment in several OECD countries since 1985. In countries where policy shifted toward expansion after tight policy had disinflated the economy, unemployment rose only temporarily. By contrast, in countries where policy remained relatively tight unemployment rose permanently (Ball, 1999, p.190; also 1997). Similarly, Bibow (2001) argues that an excessively tight monetary policy was the main cause of the rise of unemployment in Germany in the 1990s.

[12] Further examples of zero-eigenvalue systems include those in Hargreaves Heap (1980), Sachs (1987), Van de Klundert and Van Schaik (1990), Bruno (1999) and Lavoie (2002).

[13] See Hargreaves Heap (1980, pp. 612-615) for a rationale for equations (6)-(7). Importantly, the model and its conclusions are dependent on the assumption of adaptive expectations.

[14] An important property of hysteretic models is that not all applications of exogenous forces modify the value of a given parameter λ of the system. In other words hysteretic models display a selective memory of the non-dominated extremum values of past changes to the input of the system (Cross,

1995, pp. 190-196). A non-dominated extremum value is defined as a local maximum (minimum) that is bigger (smaller) than any subsequent change that follows it. This means that only the global maximum value (minimum value) of the past changes to the input of the system, and any relevant decreasing (increasing) sequence of local maxima values, produces a structural change in the formal characteristics of the dynamics of the system.

[15] In Kaldor's taxonomy, this corresponds to an "indefinite determinate" equilibrium case (Kaldor, 1934). The presence of multiple equilibria leads to the possibility that equilibrium points can be Pareto-ranked. Cooper (1999) shows that the existence of coordination failures may make the economy "stuck" at a Pareto-inferior equilibrium.

[16] As Arthur (1994, p. 7) shows, the existence of a single equilibrium point for the economy is closely associated with the assumption of diminishing returns to scale so that a combination of increasing and diminishing returns is enough to yield more than one equilibrium point. Notwithstanding, as Romer (1993, p. 16) points out, the question whether shocks have permanent effects does not hinge on whether there is a single equilibrium level of output. This is because, if shocks are symmetrically distributed, the economy will move randomly among the different equilibria. As in the case of unit root processes, the existence of multiple equilibria does not *per se* guarantee that transitory shocks will have permanent effects in the long run.

[17] Dixon (1988) shows that an imperfectly competitive economy displays a natural range of employment levels concluding that fiscal and monetary policy can be used to obtain a range of equilibrium levels of employment.

[18] Since the ability of the CB to stimulate aggregate demand through interest rate cuts is confined to the downward sloping section of the *AD* curve then, as the rate of inflation approaches zero, the non-interest-elastic components of the *AD* function becomes crucial for the determination of the level of income.

[19] Similarly, when current or expected inflation are below the lower limit of the inflation zone (i.e., $\pi < \pi_2$), the flexible opportunistic approach would just look like the conventional and opportunistic approaches. In this case all three approaches would recommend lowering the real interest rate.

[20] A possible objection to the "flexible" opportunistic approach is that, since its implementation is likely to lead to both higher average inflation and inflation volatility (albeit lower output volatility), the potential benefits in terms of higher long-run output that its adoption brings about may be offset by (i) the welfare costs associated with a higher and more volatile rate of inflation, (ii) a lower rate of economic growth associated to a less efficient resource allocation, and (iii) a rise in the sacrifice ratio owing to a loss of CB anti-inflationary credibility (see, for example, Feldstein, 1997). Unfortunately, due to space constraints, these critical arguments cannot be properly discussed here. However, readers should note that (i) conventional empirical estimates of welfare costs associated with a higher and more volatile rate of inflation do not allow for permanent long-run effects of disinflation policies, (2) the empirical support for the presence of correlation (either negative or positive) and/or co-integration between the rate of inflation and the rate of growth of real GDP is still poor (e.g. Bruno and Easterly, 1996), and (3) the analysis of the potential for the benefits of supposed solutions to the credibility problem is very controversial (see, for example, Forder, 2001, p.19).