

The Equilibrium Rate of Inflation with Discretion and Some Reputation

Introduction

This paper reviews a large literature concerned with the potential implications, for the equilibrium inflation rate, of allowing governments complete discretion with respect to the use of monetary policy. This literature is relatively new and is, in fact, an extension of the New Classical framework, which assigns a key role to expectations, which in turn are assumed to be rationally formed.

The question we pose is the following. Suppose governments had complete discretion on monetary policy and suppose the private sector can anticipate potential strategies by the government, what is likely to be the ultimate outcome in terms of inflation and unemployment?

We know that it is only under completely flexible exchange rates that governments have full discretion on money stock policy. We know, too, that the more managed the exchange rate, the greater is the constraint imposed on governments. At the other end of the continuum, when exchange rates are fixed, and asset substitution is perfect, governments lose all control over money stock policy, and discretion is lost.

Since we want to develop the implications flowing from *discretion*, we will assume, at least in our basic analysis, that exchange rates are flexible. The analysis draws on Kydland and Prescott (1977), Barro and Gordon (1983), Fischer (1988), Persson (1988) and Rogoff (1987). Our own presentation owes much to Fischer.

1. The Equilibrium Rates of Inflation under Flexible Rates

We explain here in words the key elements of the New Classical analysis. An Annex presents the arguments more rigorously.

The starting point of the analysis is a simple sequential game between two parties: the trade unions and the authorities, with the authorities in the position of being able to play their cards last. Assume that in period t_{-1} the authorities announce a money growth target for period t which is consistent with an inflation rate of zero; assume, too, that workers negotiate wages in t_{-1} for t and that they believe the authorities. So for t they will set wages in line with the (zero) inflation rate anticipated. Assume now further that the authorities have a welfare function which takes explicit account of deviations from a zero inflation rate and of deviations from an "optimal" unemployment rate (which last is taken to be below the natural rate), with weights attaching to each of those targets.

Period t starts with zero inflation and the natural rate of unemployment. If the authorities are very shortsighted (*i.e.* they will try to maximise the welfare function in period t only) they will have an incentive in the course of period t to renege on their announcement, adopt a more expansionary monetary policy, lower the real wage rate and drive the unemployment rate below the natural rate, albeit at a cost in terms of some inflation. Sooner or later, however, workers will anticipate the authorities' behaviour and adjust wages up accordingly. In time, the rate of inflation will settle above zero but the economy will revert to its natural rate of unemployment. Thus "activism" will have produced an outcome where the inflation rate is non-optimal and there is no change in the unemployment rate.

The steady state inflation rate (π) with activism can be shown to be (see Annex):

$$(1) \quad \pi = \frac{b}{a} (k - 1) y^* \quad k > 1$$

where a is the weight attaching to the inflation objective, b is the real effect of an unanticipated change in money, $k > 1$ reflects the assumption that the target unemployment rate is below the natural rate, and y^* is the level of output corresponding to the natural rate.

It is evident from the above that the less weight attaches to inflation (the lower a), the larger k (the greater the divergence between the efficient and the natural rate), the larger b , the larger will be the inflation rate (the excess over the optimal).

This base analysis could be modified or extended in several ways. We note here three potential criticisms and extensions.

First, the analysis assumed that in period t when the authorities sprang a monetary surprise on the public the wage rate was fixed, predetermined by the previous period's expectations. If, however, wages were automatically indexed *ex post* to the price level which eventuates in period t , the real wage rate could not fall, output could not increase and the monetary expansion would be completely absorbed in higher prices (Argy and Salop, 1979). This is so even though the monetary expansion was unanticipated. In this case the problem posed by discretion disappears completely. Paradoxically, in this context at any rate, wage indexation reduces the equilibrium rate of inflation to its "optimal" level of zero because the incentive to cheat now vanishes. In terms of equation (1) $b = 0$ and the expression becomes zero.

Second, a key assumption in the analysis is the notion that the "efficient" rate of unemployment is below the natural rate of unemployment. Several reasons are sometimes advanced for this, *e.g.* the presence of household taxes, generous unemployment benefits, an excessive real wage rate.

The importance of the assumption is readily demonstrated. Suppose the efficient rate was also equal to the natural rate and suppose again the economy starts in period t with a natural rate of unemployment and a zero rate of inflation. In these circumstances the authorities will have no incentive to push down the unemployment. Doing so would simply reduce welfare. In terms of equation (1) if $k = 1$ the expression would again be zero. Much, therefore, hinges on an underlying theory which, however, remains vague and controversial.

Third, our analysis also focussed on a one-period horizon, assuming the authorities did not look beyond maximising a welfare function in one year. This is almost certainly unrealistic and we need at least to make a tentative stab at what might happen if governments had a longer horizon and were also concerned about their reputation.

At this point, the analysis can be very complicated, with numerous potential outcomes depending on how we represent private sector expectations and the behaviour of the government.

Here, we follow Fischer (1988) in pursuing one particular possible outcome, noting again that it is just one of many conceivable results.

Suppose that once a government has cheated, the private sector will come to expect the rate of inflation in (1). The government can get away with cheating *just one period*; that government (party) then faces an expected rate of inflation and hence a rate of growth of wages equal to (1) for *all* future periods. At this point, the government can follow one of two strategies. First, the authorities can revert to a zero inflation money growth. In this case, real wages and unemployment would both rise. Second, the authorities can accommodate the new expected rate of inflation; in this case, inflation is stabilised at the higher rate while unemployment reverts to its natural rate. It is not difficult to see that in the circumstances assumed, the authorities will opt for the second strategy; in other words, go for (1) on an indefinite basis.

If the authorities had a longer horizon they would need to set off all future losses discounted to the present against the one-period short run gain. It is now no longer evident that they will pursue a short run strategy. If the discount rate is not too high the authorities might well opt for a long term strategy. Reputational considerations thus may serve to produce a more modest rate of inflation, closer to the optimal.

The framework we have used to analyse longer time horizons is admittedly far too simple. Party leaders, party commitments do change over time. The public is unlikely to hold it indefinitely against a party whose constituent has changed. In any event, "punishment" is not likely to take the drastic form suggested in the example. If a government announces a new inflation strategy and for a while, at least, implements it, the public may well be prepared to give it the benefit of the doubt.

There are other questions one might ask about the above framework. Are workers, assumed to be rational and forward-looking, able to predict the equilibrium rate of inflation, especially given the ideological shifts to which governments are subject? is it true that governments, in targeting the unemployment rate, end up with more inflation? Experience, after the second oil price shock, suggests most governments gave a very high priority to inflation even at the cost of rising unemployment.

2. Inflation Performance and the Conduct of Monetary Policy

One general prediction thrown up by the theory is that governments with a strong medium run orientation, who attach considerable importance to keeping inflation low, *are likely to end up with lower inflation rates, without any higher unemployment rates*. How can we test this? One direct way is simply to see if countries with low inflation on average have performed any worse on unemployment. Countries with low inflation would, by definition, be those whose governments have given inflation a high priority in their macro-economic management.

A different way to test this is the following. We take as a starting point the notion that governments who have greater control over monetary policy will be more likely to exploit these powers for short run ends and are thus more likely to end up in the worst of all possible worlds. By contrast, countries which have relatively independent central banks, whose horizon would be more oriented towards the medium run, are more likely to perform better on inflation and no worse on unemployment.

Alesina and Summers (1990), in a recent study, attempt to test these hypotheses. Their finding is that in the years 1951-1988, for 17 industrial countries, on average those countries whose central banks were relatively more independent did tend to have lower inflation; at the same time, there is no evidence that their real economic performance is in any way inferior (real economic performance is here measured by the variance of economic growth). A parallel investigation would also confirm that those same countries with low inflation do not necessarily on average have more unemployment (indeed, if anything, the opposite is suggested).

One question that might be asked about the Alesina and Summers study is that it covers a span of some 37 years, over which period many of the countries switched exchange rate regimes. In the case of countries with relatively fixed exchange rates, the question of central bank independence is only one element in the equation. The exchange rate constraint is another. In other words, however much discretion governments may have, they will be limited in the exercise of such discretion by the exchange rate constraint (see below).

Swinburne and Castello-Branco (1991) review all empirical work in this area and find that, in general, it confirms these findings. However, the authors express legitimate doubts themselves over tests

of this kind on at least two grounds. First, they, rightly, contend that there is a serious measurement problem in arriving at an indicator of independence. Second, they also note that there may be a *causality* problem: central bank independence and low inflation may both be due to a third factor.

"It might be argued that the German public's often quoted deep-seated fear of inflation has exerted a strong direct influence on the decisions of policy makers in that country, as well as being behind the creation of an independent Bundesbank."

Assume governments do abuse their power. How can we correct for this? The country can impose on itself a constitutional rule regarding monetary policy and inflation. Giving the central bank a much greater degree of independence from governments may achieve a similar result. As an alternative, a smaller country may be able to peg its currency to a large trading partner whose own inflation record is a good one.

How have the smaller countries coped with this question?

Of the OECD member countries outside the G3, only four – Australia, Canada, New Zealand and Switzerland – currently float their currencies.

In 1989 New Zealand passed new legislation which provided that:

"The primary function of the Bank is to formulate and implement monetary policy directed to the economic objective of achieving and maintaining stability in the general level of prices".

Section 9 of the legislation states that:

"The Minister shall before appointing or reappointing any person as Governor fix in agreement with that person policy targets for the carrying out by the Bank of its primary function during that person's term of office".

In accordance with this last section, the then Minister of Finance and the Governor agreed on an inflation target in the range 0-2 per cent to be achieved by end 1991. The new conservative government has extended the deadline to the end of 1992.

The Canadian case is also of interest. The Bank of Canada Act directs the Bank to:

"regulate credit and currency in the best interests of the economic life of the nation ... and to mitigate by its influence fluctuations in the general level of production, trade, prices and employment".

This is a vague and wide mandate, allowing considerable scope for interpretation. The Act also provides that in the event of a disagreement between the Minister and the Bank, the Minister may issue a formal directive, thus taking ultimate responsibility for the conduct of monetary policy. However, no directive has ever been issued; without such a directive, the bank is free to place its own interpretation on its responsibilities (Duguay and Poloz, 1991).

Its Governor, John Crow, has chosen in recent years to take a fairly hard line on inflation. In his Hanson Memorial lecture, he articulated his conviction that "monetary policy should be conducted so as to achieve a pace of monetary expansion that promotes stability in the value of money. This means pursuing a policy aimed at achieving and maintaining stable prices" (see Lucas, 1989).

An interesting further development in Canada has been that in February 1991, the Governor, John Crow, announced an explicit downward target path for inflation: 3 per cent by the end of 1992, 2.5 per cent by the middle of 1994 and 2 per cent by the end of 1995.

The case of Switzerland is straightforward. Switzerland's central bank is very independent. The Swiss constitution is very vague about the objectives the Swiss National Bank should pursue. It is directed to act "in the interests of the country as a whole" and to "combat unemployment and inflation". In reality, the bank has interpreted its mandate even more narrowly, giving overriding priority to the achievement of price stability (Rick, 1991).

The Reserve Bank Act of Australia gives the government ultimate responsibility for monetary policy. Some of its provisions for resolving differences are in fact very similar to the Canadian case. The Governing Board is required by the 1959 Reserve Bank Act to conduct its monetary policy in a way which "will best contribute to the stability of the currency ... the maintenance of full employment ... and the economic prosperity and welfare of ... Australia". The current government's position is that the Reserve Bank should "have a broad

range of objectives ... It is not there to pursue one objective (inflation) singlemindedly" (Dawkins, the Treasurer, reported in *The Australian* March 27, page 3). The Opposition, however, is now committed to changing the Charter of the Bank to one that focuses on fighting inflation only, with formal targets in the range of zero to 2%. At the moment, then, Australia is the odd one out in this group of four, being the "least committed" formally at any rate, to inflation targets.

The U.K. is a particularly interesting case because it in fact switched over the last dozen years or so from inflation discipline "at home" to external discipline (Miller and Sutherland, 1990). Between 1980 and 1986 it followed a hard line monetarist strategy. The exchange rate was to find its own level; at the same time, monetary policy was to be directed at achieving medium run inflation objectives. By 1986, the inflation objectives were largely attained but the monetarist strategy (primary emphasis on money growth policy) was downgraded. For a while after that the authorities began to give greater attention to the value of sterling in the setting of monetary policy. The policy of setting exchange rate targets was itself in turn also largely cast aside in the course of 1989 with some reversion to the earlier strategy. However, in October 1990, the U.K. accepted the ERM provisions of the EMS. From then on it shifted to a policy of achieving inflation objectives by pegging its currency to a low inflation trading partner.

Of the other countries virtually all are now either members of the EMS or likely to join soon; by pegging their currencies, these countries have opted for the external inflation discipline. France and Ireland provide a good illustration of countries, with a past record of relatively high inflation, now "toeing the line".

This leaves the G3. Germany's central bank, the Bundesbank, has a high degree of independence and is committed to a policy of achieving price stability. Since 1985, the Bundesbank, in determining its money growth targets, has "set an unchanged normative-price increase of at most 2%" (Schmid and Hermann, 1991).

In Japan, policy decisions are made by the Policy Board, made up of the Governor (appointed for a term of five years), four other members drawn from the banking and industrial sector (appointed for four years) and two government appointees. The last two, however, have no voting rights, but provide an important means of liaising with government policy (Nakao and Horii, 1991).

The Bank of Japan has seen its task as one primarily of achieving price stability. Bryant (1991) undertook an econometric study of Japan's monetary policy reaction function. He found that easily the largest weight attaches to the inflation target with much smaller weights attaching to output, the exchange rate and the balance of payments ratio. Bryant summarises:

"The status of inflation as a goal variable for Japanese monetary policy is unambiguous. A great variety of statements from the Bank of Japan and other parts of the government forthrightly assert that control of inflation is a central if not paramount objective".

Despite these points, the Governor of the Bank of Japan has a capacity for imposing his own predilections on the course of monetary policy. The present Governor Yasushi Mieno took over in 1989 and has since earned the reputation for being a very hardliner on inflation, more so than his predecessor Satoshi Sumita. At a time (early 1992), when the economy is stalling, this hardline has met with strong opposition from within government and business circles. A prominent LDP member, Shin Kanemaru, recently urged the Prime Minister to fire the bank chief (*Business Week*, March 20, 1992, pp. 16-17).

In the U.S. monetary policy decisions are made by the Federal Reserve Board, composed of seven members appointed by the President for terms of 14 years each. The Chairman is selected by the President from the Board members. Given the longevity of the terms the President has in general only limited capacity to appoint members of similar persuasion. However, the independence of the Board is circumscribed by the multiplicity of economic goals it is expected to pursue, including "maximum employment, production and purchasing power" with no priorities prescribed. Moreover, despite the appearance of independence, the activities of the Federal Reserve are closely monitored by the government and Congress, making it in practice "difficult, if not impossible, for the Federal Reserve to *sustain* a generally unpopular monetary policy course in the absence of substantial support from the President and the Congress" (Akhtar and Howe, 1991).

In the U.S. too, there have been proposals put forward by Congress at various times to reform the conduct of monetary policy so as to give a much higher priority to inflation. The most recent was the proposal in 1989 by the House Joint Resolutions 382 and 409 to

establish a zero or near zero inflation objective to be achieved over a period of five years.

Proposals to fix exchange rates for the three major currencies also provide for price stability. McKinnon's prescriptions (McKinnon, 1988) fall in this category. Exchange rates are to be fixed for the three key currencies. Central banks in each of these three countries should allow their money supplies to move in line with balance of payments developments. At the same time, monetary policy in the three participating countries should be directed at stabilising the average world price of traded goods.

In the EMS too, the new Central Bank to be set up in the years to come is to be independent and to have responsibility for inflation in the region.

Suppose a smaller country wanted to commit its monetary policy to inflation, is it better to peg to another key currency with a good inflation record or to give its central bank a new charter with priority assigned to price stability? (On the Irish experience in the EMS, see Kremers, 1990.)

Not all have this option. The U.S. is not a strong performer on inflation, so pegging to the U.S. dollar is not going to provide a solid external discipline. Thus, Canada, whose trade is dominated by the U.S., is better off going its own independent way. For those that do have that option, the issues come down to this: on the one hand, pegging may offer a stronger political commitment than committing the central bank to price stability. On the other hand, pegging commits the country to an externally determined rate of inflation, which may not be the one most appropriate or suitable to the country (Argy, 1992).

What are we to conclude on the question of central bank independence and inflation targeting?

Many subtle forces are at work in trying to resolve questions of central bank autonomy. First, governments have some limited capacity to bias central bank decisions in their favour by appointments they make to the governing boards. As a last resort, they can even sack Governors but this is an extremely rare event. Also, government nominees can make strong representations on behalf of the government.

Second, there are subtle and non-subtle ways, which governments exercise, of drawing attention to differences of opinion and putting pressure on boards.

Third, government flexibility and discretion are very limited where the charter not only directs the central bank to achieve price stability, but also prescribes a low and narrow target range. This, however, is rare. There is more flexibility where the target range is to be negotiated with the government (*e.g.* as in New Zealand).

Fourth, many charters define a whole range of objectives, leaving Governors considerable discretion in interpretation. Indeed, within the given constraints, governors do often leave their personal imprint on the course of policy. For example, Paul Volker in the U.S. and Mieno in Japan both have had reputations as "hardliners".

Fifth, as we saw earlier, attitudes to inflation differ markedly across countries depending on a country's own cultural and economic history. This sometimes is more important than technical-legal questions bearing on relative discretionary power (see on some of these issues Swinburne and Castello-Branco, 1991).

3. Questions Associated with a Rigid Inflation Target

A first question is the price index to be targeted. Should it be the consumer price index, the GDP deflator, wholesale prices, the price of traded goods? For example, if the consumer price index is stabilised, this may require that the price of traded goods *fall* secularly. In both New Zealand and Canada, targets are defined in terms of the consumer price index.

A second question is, should it exclude transitory shocks to the price level? In both New Zealand and Canada, the effects of one-off changes in food and energy prices or in indirect taxes are discounted.

In this context, the p^* approach to measuring underlying inflationary pressures has recently received a good deal of attention (Hoeller and Poret, 1991). The price level predicted is calculated from the money stock per unit of *potential* output ($m_0 - y^*$) adjusted for trend velocity (v^*) as in:

$$p^* = (m_0 - y^*) + v^*.$$

A third question is: given the price index used, what should be its target rate of change? The notion of an "optimal" rate of inflation

is a complex and elusive concept (Argy, 1992, reviews the issues here in some detail). There are two points worth making here. To begin, the literature does not support the idea that the target rate ought to be zero. The optimal rate is a function of several structural-institutional considerations, *e.g.* the extent to which interest is paid on transactions balances, the degree to which the tax system is indexed and the relative distortions associated with the tax on inflation as against debt or tax finance.

A related point is that whatever the optimal rate of inflation, it is bound to be different across different countries, a point, as noted above, which argues *against* imposing a *common* rate of inflation on a regional group (*e.g.* as in the EMS).

A fourth question has to do with how democratic an arrangement is which delegates responsibility in some circumstances for a vital element in macroeconomic policy to an independent institution. Governments can wash their hands of responsibility for outcomes which turn out to be unpleasant. Currently, (early 1992) in both Germany and Japan the hard line on inflation adopted is not being well received by business, trade unions and some government circles.

A fifth question has to do with the potential cost flowing from loss of monetary policy discretion associated with such policies. It is not difficult to demonstrate analytically that if we allow some discretion to respond within each period to observed real shocks (before wages have had time to adjust) there is some loss from the higher inflation but some potential gain from being able to respond flexibly (see Annex).

The basic point here, in words, is that, in the presence of, say, a supply shock, discretion allows the authorities to choose a combination of inflation and unemployment more consistent with society's preferences. For example, an adverse supply shock with a fixed money stock will normally generate some inflation and some unemployment. Monetary discretion, on the other hand, gives the authorities the capability of fine tuning the inflation unemployment outcomes (see also on this Flood and Isard, 1989).

Accommodating stochastic shocks introduces yet another possibility, first raised by Canzoneri (1985). Suppose there were a money demand shock (say a fall in money demand); there could then be a surprise "inflation" for which the authorities were not responsible. A similar result could come from a lack of money stock control. The

possibility may then arise that there may be loss of credibility *which is undeserved*.

Finally, we need to address the question of short and long run trade-offs between inflation and unemployment. It is now widely agreed that in the short run at any rate there is a trade-off between inflation and unemployment (for empirical evidence on this, see Kawasaki *et al.* 1990). One important implication of the short run trade-off is that if the rate of inflation exceeded the target rate, monetary policy will have to be tightened and this will almost certainly create some short run unemployment. In recent years (1989-92), there was an upsurge in unemployment in both Canada and New Zealand in the wake of tight monetary policies used to achieve target rates of inflation. The precise cost (the sacrifice ratio) will, of course, differ across different countries but few would be likely to escape such costs entirely (for country comparisons of sacrifice ratios, see Balls, 1992).

Moreover, if the natural (equilibrium) rate of unemployment is itself a function of the actual unemployment rate, as implied by theories of hysteresis in labour markets, the unemployment costs of an anti-inflation policy may prove to be long-lasting. Thus, what is required here, is a careful cost-benefit analysis which compares the short and longer run economic (and social) costs with the long run benefits flowing from a permanently lower inflation rate. Such calculations are very difficult to make. Indeed, should it turn out that the costs in those circumstances *exceed* the benefits, the concept of an optimal rate of inflation becomes particularly fuzzy, being, in fact, a function of the ongoing rate of inflation (Argy, 1992).

If there is some trade-off in the short run, it is not obvious what the longer run trade-off is. There are, in fact, three analytical possibilities, each supported by some theory:

- 1) there is no long run trade-off, the economy returning to its natural rate of unemployment;
- 2) there is a negative trade-off (this comes from hysteresis considerations);
- 3) there is a positive trade-off. This is the view, first advanced by Friedman (1977), that the higher steady-state rate of inflation is actually likely to *increase* the natural rate of unemployment.

Unfortunately, there is no conclusive empirical work that allows us to discriminate between these three theories.

Sydney

VICTOR ARGY

ANNEX

One-Period Analysis

As in Barro and Gordon (1983), we begin with an analysis of the single-period case and then extend it to the multi-period case. We begin by writing a conventional loss function,

$$(1) \quad L = a\pi^2 + (y - ky^*)^2 \quad k > 1.$$

Assuming the optimal rate of inflation is zero, the loss in utility (L) is assumed to be positively related to the square of the inflation rate (π) and the square of the excess of output over the target level. The target level of output is, importantly, represented by ky^* where y^* is the level of output corresponding to the natural rate of unemployment; $k > 1$ reflects the assumption that the "target" unemployment rate is below the natural rate. In equation (1) a represents the weight the authorities attach to inflation in their loss function.

Next assume that the deviation of actual output (y) from its full employment (y^*) is a function of the divergence between the actual and expected rate of inflation (π^*).

$$(2) \quad y = y^* + b(\pi - \pi^*)$$

where b is the share of wages to profits $\left(\frac{\pi_1}{1 - \pi_1}\right)$.

Equation (2) is derived as follows. We start with a standard Cobb-Douglas production function in log form:

$$(3) \quad y = \pi_1 l + (1 - \pi_1) k$$

where l is labour and k is the fixed capital stock.

π_1 and $1 - \pi_1$ are respectively the shares of wages and profits in production.

Assuming labour is employed to the point where the real wage rate is equal to the marginal product, we have with a fixed capital stock:

$$(4) \quad y = b(pd - w)$$

where pd is the price of home produced goods and w is the nominal wage rate.

Assuming there is no formal indexation provision and workers set wages during negotiations to secure full employment at the natural rate, we have, from equation (4), the wage contract

$$(5) \quad w = -\frac{1}{b} y^* + t_{-1} Epdt$$

where $t_{-1} Epdt$ is the home price level in t expected during negotiations in t_{-1} .

Inserting equation (5) into (4), we have

$$(6) \quad y = y^* + b(pd - t_{-1} Epdt).$$

Remembering $\pi = pd - pd_{-1}$ and $\pi^* = t_{-1} Epdt - pd_{-1}$ allows us to arrive at equation (2).

Money supply policy is used to minimise (1). Underlying the unexpected inflation rate is an assumption about unanticipated monetary policy. Output can increase only if an increase in money is unanticipated.

The starting point is assumed to be one where there is a steady state inflation rate of zero and output is at its full employment level.

Substituting equation (2) into (1), we have

$$(7) \quad L = a\pi^2 + [b(\pi - \pi^*) - (k - 1)y^*]^2.$$

The authorities proceed to use money supply policy to minimise (7), assuming expected inflation is given. Differentiating (7) with respect to π and setting the expression equal to zero gives the "optimising" discretionary rate of inflation for the one-period.

$$(8) \quad \pi = \frac{b[(k - 1)y^* + b\pi^*]}{a + b^2}.$$

In due course, in steady state, $\pi = \pi^*$. From (2), the economy returns to its full employment level of output. The equilibrium rate of inflation under discretion (πd) will then be

$$(9) \quad \pi d = \frac{b}{a} (k - 1) y^*.$$

We want now to compare the loss implied by (8) (L_s) and (9) (L_d) with the loss for the case where the authorities followed a simple rule which aimed at a zero rate of inflation (L_r).

To arrive at L_r , we impose the condition that $\pi = 0$ on (1). Because, however, the "full employment" level of output is non optimal, there will be some loss. This is readily shown to be (setting $y = y^*$):

$$(10) \quad L_r = y^{*2} (k - 1)^2.$$

To arrive at L_s (the one-period loss), we substitute (2) into (1). This gives

$$(11) \quad L_s = \pi [(a + b^2)\pi - 2b y^* (k - 1)] + y^{*2} (k - 1)^2.$$

To arrive at the actual loss, we also need to substitute (8) (with $\pi^* = 0$) into (11) (which we do not do here).

To arrive at L_d , we have (with $y = y^*$)

$$(12) \quad L_d = a\pi^2 + y^{*2} (k - 1)^2.$$

We now need to compare (10), (11) and (12):

$$(13) \quad L_d - L_r = a\pi^2 > 0.$$

Since ultimately there can be no improvement in welfare from increasing output (y reverts back to y^*), the economy is left unambiguously worse off, having now a positive rate of inflation. Comparing steady states, a discretionary policy is clearly inferior to a zero inflation rule.

We can also compare (10) and (11):

$$(14) \quad L_r - L_s = \pi [2b y^* (k - 1) - (a + b^2) \pi] > 0.$$

Substituting (8) for π in the bracketed expression would verify that the expression is greater than zero. There is, in other words, some advantage in pursuing a short run discretionary policy.

The Longer Horizon

Our starting point for the analysis of a longer horizon is (14) which defines the one-period short run gain. This needs to be set off against all future losses defined by (13) discounted to the present. The present loss (L) from following the short period strategy is:

$$(15) \quad L = -(L_s - L_r) + \left(\frac{L_d - L_r}{\delta} \right)$$

where δ is the discount rate applying to all the given (infinite horizon) loss. This expression may be positive, in which case the zero inflation rule will be followed, or negative, in which case the short run strategy will be adopted. δ is crucial here. The higher the discount rate which the government applies to future losses, the more likely the expression will be negative. At one extreme, when $\rightarrow \infty$, we have the one-period result. As $\rightarrow 0$, $L \rightarrow \infty$. So, in the end, in addition to the factors entering into (9), we also have to accommodate a discount rate.

Discretion in the Face of Shocks

Following Fischer (1988) and Rogoff (1985), assume that we now add a stochastic term (u_2) to our aggregate supply equation.

$$(16) \quad y = y^* + b (\pi - \pi^*) + u_2$$

where u_2 is a disturbance term which has an expectation of zero, $E u_2 = 0$, and which is not serially correlated.

We can now again figure out losses under one-period discretion, long run discretion and a simple rule which sets the money stock at a level which on average will yield price stability.

Following a procedure used previously we arrive at a one-period inflation rate of:

$$(17) \quad \pi = b \left[\frac{y^* (k - 1) - u_2 + b\pi^*}{a + b^2} \right].$$

The loss can now readily be derived by inserting (17) and (16) into (1). However, our interest is primarily in the other two losses (both corresponding to steady states).

To get the steady state inflation under discretion, we set $\pi^* = \frac{b}{a} (k - 1) y^*$ which it should be noted is not equal to π because π is also affected by the shocks. We arrive at:

$$(18) \quad \pi = \frac{b}{a} y^* (k - 1) - \frac{b}{a + b^2} u_2^2.$$

To arrive at the expected loss (noting that $E u_2 = 0$ but the variance of $u_2 (= u_2^2)$ is not zero), we substitute (18) and (16) into (1):

$$(19) \quad L_d = (1 + \theta) (k - 1)^2 y^{*2} + \left| \frac{1}{1 + \theta} \right| u_2^2 \theta = \frac{b^2}{a}.$$

We turn now to the loss under the rule. $\pi^* = 0$ now and π is now the actual price level (p). Using the simple quantity theory equation:

$$(20) \quad m_0 = y^* = p + y$$

the real money stock (m_0) is set at a level which will exactly be absorbed by the trend level of output. We have then:

$$y^* - y = p$$

and from (16):

$$(21) \quad p = y^* - y = -bp - u^2 \quad \text{or:}$$

$$p = -\left(\frac{1}{1+b}\right) u^2.$$

Recalling again that $Eu_2 = 0$ but u_2^2 is not, we can readily arrive at the expected loss:

$$(22) \quad Lr = (k-1)^2 y^{*2} + \frac{(1+a)}{(1+b)^2} u_2^2.$$

Comparing (22) and (19), it can be shown that the first expression is *larger* under discretion, as previously, but the second expression is larger under a rule.

V.A.

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