Inflation: Understanding Overshooting

Economics 105
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1. We want to distinguish between a continuous rate of change of prices, inflation, and a "once and for all" increase in the price level.

Assume initially that we are at full equilibrium with price level P_0, and no inflation. At full employment, or at least for an unchanging rate of unemployment, an increase in the quantity of money from M_0 to $2M_0$ will increase the price level from P_0 to $2P_0$. This is a once and for all increase in the price level.

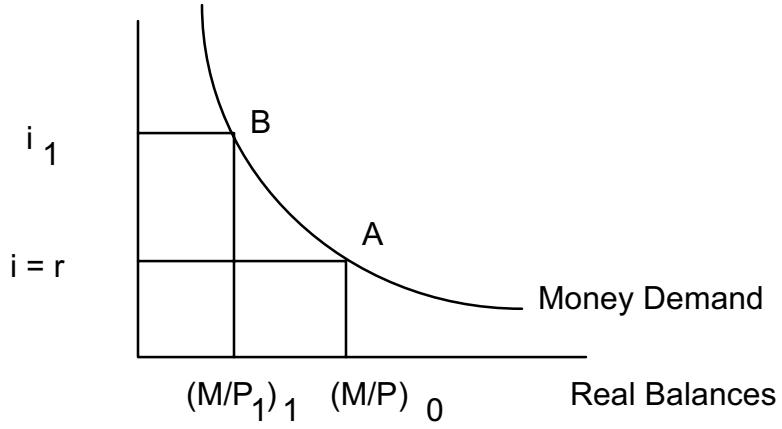
From a point of some initial money stock of M_0, an increase in the quantity of money at a **rate** of 10% **per year** will mean, in the long-run, an increase in the **rate of inflation** to 10% **per year**.

2. Consider now the **thought experiment** of moving from an expected zero rate of inflation to a long-run rate of inflation of 10%.[1] Look first at the level of real balances, $(M/P)_0$, where there is no inflation -- as at point **A** in Figure 1. In general, the nominal interest rate, i, is equal to the real rate of interest, r, plus the *expected* rate of inflation, π^e: so that $i = r + \pi^e$. In long-run equlibrium, the expected rate of inflation is equal to the actual rate of inflation. Therefore, at **A**, i = r. That is,. since the expected rate of inflation is zero, the real interest rate is equal to the nominal interest rate.

Now consider the interest rate associated with a long-run expected inflation rate of 10% per year. In this case the nominal interest rate rises to $i_1 = r + .10$, which is point **B** in Figure 1. This interest rate is associated with the level of real balances $(M/P_1)_1$ where the new desired level of real balances is reduced to $(M/P)_1$ from the zero inflation level, $(M/P)_0$. This is an equilibrium because at this level of real balance holdings there is no desire to adjust real balances. Since the nominal quantity of money, M, has not been changed in this thought experiment, the price level must rise to decrease the quantity of real balances.

[1]This is a thought experiment insofar as we do not explain why the expected rate of inflation is expected to increase. Usually we would think that expectations were an endogenous variable -- were determined within the model. For the purposes of the thought experiment, however, we are treating them as if they were exogenous. Later on we will explain how they may be adjusted endogenously.

Figure 1: The Price Level and the Expected Rate of Inflation



Why does the price level rise? and why does it stop rising once it is going up? The price level rises because at the new higher expected rate of inflation, this is just like a tax on your real balances. If real balances are being taxed, then holders of real balances will reduce the amount that they keep on hand. The only way to do this is to try to spend some of them. Even though every individual may attempt to spend more money, the community as a whole must hold the stock of money, M, since what I spend, you receive. That is, we don't throw money away or burn it! But in attempting to spend more, the price level is driven up -- recall we have fixed real output (incomes) and the real interest rate. How far is the price level driven up? Until the level of prices, P_1. Why P_1? Because this is the level of prices that is consistent with the level of real balances associated with the (new) expected inflation rate of 10% (per year.) Put it another way. The expected inflation has driven the opportunity cost of holding money to i_1. At this opportunity cost, desired real balances are now $(M/P)_1$. If we are initially at $(M/P_0)_0$, we will attempt to increase spending until our real balance level is reduced to $(M/P)_1$. This will take place when the price level has been bid-up to P_1.

In sum, the price level rises once and for all from P_0 to P_1 simply on the basis of expectations about the future rate of increase in prices.

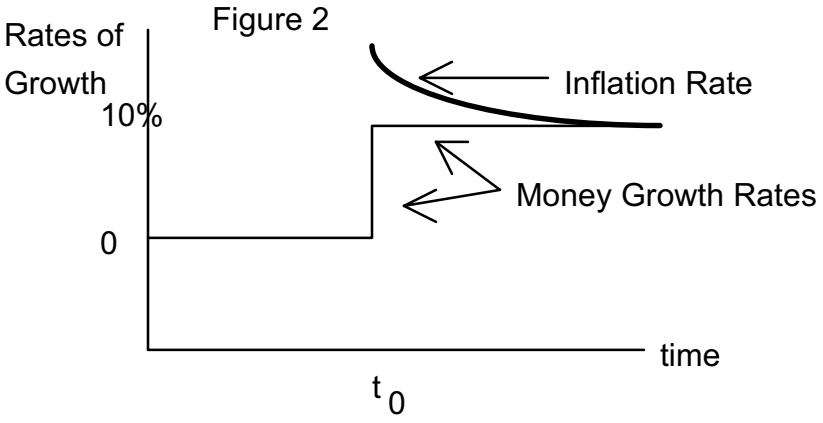
3. Now let us consider the consequences of moving from a zero rate of monetary growth, point **A** in Figure 1, to a rate of monetary growth of (say) 10% per year. Again we will hold real interest rates and real income constant.

The Long Run: In this case, we will have a situation where in the long-run, the actual rate of inflation will be the same as the rate of growth of the money supply. That is, if you pump 10% per year more money into the economy, all else equal, it should come as no surprise that the inflation rate will be 10% per year -- *in the long-run.* If the actual rate of inflation is equal to the expected rate of inflation, a reasonable thing in the long-run, then notice that we are at point **B** in Figure 1. Further, it is important to notice that at point **B**, the level of real money balances will be constant. That is, the *ratio* of M to P will not be changing. This in turn means that the rate of growth of the money supply is <u>exactly</u> equal to the rate of growth of prices -- the rate of inflation. That is because the numerator and denominator of real balances, (M/P), must be growing at the same rates if we are in equilibrium at $(M/P)_1$, the new desired level of real balance holdings.[2]

The Short-run: But what will happen to the rate of inflation during the process of transition from a zero rate of increase, the initial equilibrium at point **A**, to the long-run 10% per year rate at point **B**? From Figure 1, we know that the rate of inflation must <u>overshoot</u> the long-run rate. Why? Notice that the level of real balances *must be reduced* in moving from point **A** to point **B**. Why? Because the opportunity cost of holding real balances has increased and people will want to hold fewer real balances at this higher cost (since the expected inflation is higher.) But since the rate of growth of the nominal money stock is now 10% per year -- the numerator of the ratio (M/P) -- the **only** way in which the ratio of money to prices, the level of real balances, *can be decreased is that the denominator increase more rapidly than the rate of increase in the numerator*. This means that during the transition from point **A** to point **B**, the rate of inflation must be greater than 10% per year! This phenomenon is called "overshooting". One such pattern

[2]We are cheating at little in Figure 1 to economize on notation. In the ratio (M/P), both the numerator and the denominator are growing at 10% per year, so there is no single "P_1" in the denominator as there was during our "thought experiment." In this case the price level is increasing by the rate of inflation so that each year the price level is 10% higher: $P(t)=P(1)\exp(\pi t)$.

is found in Figure 2 which reflects the kind of experiment in which after a change in the money growth rate from 0 to 10% per year at time t_0, the inflation rate lies above the long-run rate all the way the long-run. In terms of Figure 1, we move smoothly from **A** to **B**.[3]



This kind of argument may help to explain why inflations are so difficult to understand. If the government increases the money stock at 10% per year – for whatever reason – it is shocked when the actual rate of inflation is more than 10%. This may lead to a sharp reduction in the money growth rate which in turn leads to a fall in the inflation rate that is greater than the reduction in the money growth rate. This "Stop-Go" policy as it is sometimes called, is very confusing to politicians who have not had Economics 105!

[3]This is only one path that inflation might follow. There are many other possibilities. The only thing we know with certainty is that in the long run the level of real balances is reduced and that to get there, the inflation rate *must* be faster than the rate of nominal money growth for some of the period of adjustment.