7. Deficits, seignorage and the end of hyperinflations

We have already analyzed the link - the government intertemporal budget constraint - between large debts and deficits, on the one hand, and seignorage and inflation, on the other.

Though we have implicitly assumed throughout that agents are not only forward-looking, but even endowed with perfect foresight (they know the future without errors), our conclusions on the eventual inflationary consequences of large deficits did not hinge on this. What mattered was that if the government is to stay solvent without raising taxes or cutting expenditure it has to resort to seignorage at some point in time. If you want, this may be summarized by saying that "the present affects the future".

We now further exploit (and explore) the link between deficits and inflation to discuss:

1. how *future policies* may affect current equilibrium if **expectations** are **endogenous**;
2. the role played by *announcements* of future policy changes;
3. the importance of the credibility of announcements of policy changes.

Clearly, the future can affect the present only in so far as economic decisions are intertemporal and, at least some, agents in the economy form their expectations in a forward-looking way.

Credibility is an issue if policymakers may make false announcements (e.g. moral hazard, adverse selection or sheer lunacy and/or myopia). The credibility of an announcement can only be evaluated against a model (implicit or explicit) that agents use to understand the real world.

To make the case as stark as possible and as a useful benchmark it is common to assume that agents have rational, or, more appropriately, **model-consistent** expectations. This means that agents form their expectations about the future using the same model of the economy that policymakers use (e.g. they have taken a course in Macro Policy!) and that this model is an accurate description of the way the economy works.

In our simple set up model-consistent expectations are equivalent to perfect foresight. In the absence of unexpected changes (surprises) agents' expectations about the variables in the economy coincide with the true values of these variables.

1 Announcements of future policy changes

Suppose an economy in which the Classical dichotomy holds. Output and the real interest rate are determined on the labour and goods markets. We can then take them as predetermined and look at the money market in isolation to determine the price level and the rate of inflation. We assume, for simplicity, that output and the real interest rate are constant over time and that money demand follows a simple quantity theory equation. The money market equilibrium condition is then

$$\frac{M_t}{P_t} = \frac{Y}{V(i_t)}. \tag{1}$$

We will work in discrete time and all variables indexed by t are to be intended as measured at the beginning of time t. So the relevant form for Fischer equation is

$$(1 + i_t) = (1 + r)(1 + \pi_t^e),$$

where π_t^e is the expectation at the beginning of time t of the rate of inflation between time t and $t + 1$, that is $\pi_t^e = \left(P_{t+1}^e - P_t\right) / P_t$. Fischer equation can then be rewritten as

$$1 + i_t = (1 + r)P_{t+1}^e / P_t. \tag{2}$$

If we assume (without loss of generality) a simple, linear functional form for velocity

$$V(i_t) = (1 + i_t).$$

If we further assume that the real interest rate is zero velocity is a function of expected inflation alone - $V(i_t) = P^e_{t+1}/P_t$ - and equation (1) can be rewritten as

$$\frac{M_t}{P_t} = \frac{Y}{(P^e_{t+1}/P_t)}. \tag{3}$$

The crucial insight from equation (3) is that velocity is an **endogenous, forward-looking** variable since it depends on expectations about the future through P^e_{t+1}. So, anything that affects expectations about the *future* may affect money market equilibrium, hence prices, in the *present*.

Since expectations are endogenous, equation (3) contains two endogenous variables: the current price level P_t, and the expected future price level P^e_{t+1}. We obviously need one more equation to solve for equilibrium. The second equation comes from the perfect foresight assumption. Agent's expectations have to be correct *ex post* **in the absence of further surprises**; i.e.

$$P^e_{t+1} = P_{t+1}.$$

Let us take logarithms of both sides of equation (3) and denote by lower case letters logarithms of variables. This gives us

$$m_t - p_t = y - (p_{t+1} - p_t), \tag{4}$$

where we have replaced for P^e_{t+1} using our perfect-foresight assumption. Assume for convenience that $Y = 1$ (i.e. $y = 0$) and define $\Delta p_t = (p_{t+1} - p_t)$ the expected change in prices. Equation (4) then simplifies to

$$m_t - p_t = -\Delta p_t. \tag{5}$$

Confronting (5) with (3) it should be clear that the term Δp_t is just the logarithm of velocity.

Still without knowing the right hand side of (5) we cannot determine p_t. By shifting (5) forward one period we can write

$$m_{t+1} - p_{t+1} = -\Delta p_{t+1}. \tag{6}$$

Taking differences of (5) and (6) we can write

$$p_{t+1} - p_t = m_{t+1} - m_t + \Delta p_{t+1} - \Delta p_t. \tag{7}$$

This can be rearranged as

$$\Delta p_t = \frac{1}{2}\left(\Delta m_t + \Delta p_{t+1}\right), \tag{8}$$

where $\Delta m_t = m_{t+1} - m_t$. Equation (8) implies that the expected change in the price level between today and tomorrow is a weighted average of the expected change in the money supply and the expected change in the price level between tomorrow and the day after. We can shift (8) forward one period to replace for Δp_{t+1}. This gives

$$\Delta p_t = \frac{1}{2}\left(\Delta m_t + \frac{1}{2}\left(\Delta m_{t+1} + \Delta p_{t+2}\right)\right). \tag{9}$$

Doing it recursively we obtain

$$\Delta p_t = \frac{1}{2}\left(\sum\nolimits_{i=t}^{T}\left(\frac{1}{2}\right)^{i-t}\Delta m_i + \left(\frac{1}{2}\right)^{T-t}\Delta p_T\right) \tag{10}$$

which for Δp_T finite and $T \to \infty$ reduces to

$$\Delta p_t = \frac{1}{2}\sum\nolimits_{i=t}^{\infty}\left(\frac{1}{2}\right)^{i-t}\Delta m_i. \tag{11}$$

So the expected change in prices between today and tomorrow (which fully determines today's velocity) equals a weighted average, with declining weights, of the expected changes in the money supply. So, velocity will respond to any actual or expected change in monetary policy between today and the infinite future. It will respond more to changes closer in time.

Notice that since the present and future (logarithms of) levels of the money supply m_i are all exogenous, the system formed by (5) and (11) fully determines the two endogenous variables p_t and Δp_t.

Let us use these two equations to get some insight. Consider the simplest possible case. A one-off future policy change announced in advance. Since, policy is unchanged today, any change in endogenous variables can only be due to the forward-looking nature of expectations.

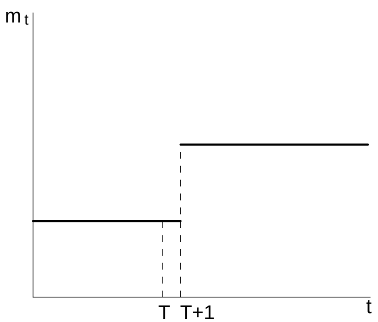
Suppose the money supply has been kept constant at 100£ for a long time up to and including time T. The question we want to answer is: **what is the effect on the endogenous variables of a fully believed, government announcement at beginning of time time T that it will double the level of the money supply from the beginning of $T+1$ onwards and keep it constant forever after.**

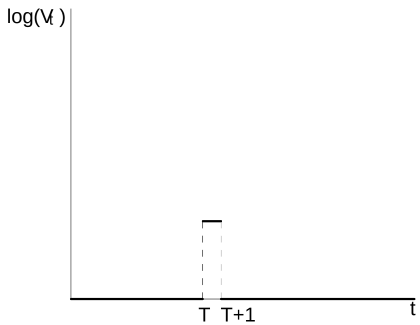
1. Up to the end of time $T-1$ the money supply has been constant at 100£. Since up to the announcement agents were expecting the money supply to stay unchanged, $\Delta m_i = 0$ for any i up to the time of the announcement. Equation (11) implies that velocity and the expected change in the price level $\Delta p_t = 0$ for $t = 0...T-1$. Equation (5) implies that the equilibrium price level up to time $T-1$ is $p_t = m_t = \log 100$ (i.e.$P_t = 100$).

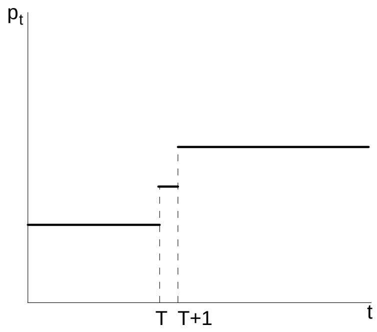
2. From $T+1$ onwards the money supply will be expected to be constant at its new level of 200£. The same kind of reasoning implies that from $T+1$ onwards velocity is constant at zero and $p_t = m_t = \log 200$.

3. Knowing what happens up to $T-1$ and from $T+1$ onwards we are now in a position to determine what happens at time T when the future policy change is announced. The money supply stays unchanged at 100£ at time T. It will double at time $T+1$ and then stay constant. This means $\Delta m_T = m_{T+1} - m_T = \log(200) - \log(100)$ and $\Delta m_t = 0$ for $t = T+1$...Agents expect inflation to be positive between T and $T+1$ and zero forever after. Equation (11) implies $\Delta p_t = \frac{1}{2}\Delta m_T$. Velocity at time T increases as the opportunity cost of hold-

ing money increases in the current period. Hence the real demand for money (in logs), the right hand side of (5), falls. Since the nominal money supply is unchanged at time T, the price level has to increase to keep real balances, the left hand side of (5), in line with the lower demand for money. So, the mere announcement of a future policy change affects the present equilibrium.







The main message is that since velocity is a forward-looking variable any change in expectations about future policies affect the equilibrium price level today. As we have already mentioned, equation (11) implies that the same is also true for policy changes more than one period away.

2 Credible and non-credible announcements

Suppose now that the government announces to cut the rate of money *growth* from some future time T onwards. What is the effect on the (log of the) current price level p_t? The current price level is affected only if the forward-looking variable velocity, the right hand side of (5), is affected. This is the case only if Δp_t is expected. to be affected.

We have to possible cases:

1. The announcement is non-credible. People believe that when T comes the government will renege on its promise and not alter its monetary policy. Hence future changes in m_i, Δm_i, for $i = T...$ are unchanged and, from equation (11) so are Δp_t and velocity. Real money demand at time t is unchanged and the price level is the same as in the case in which no announcement is made.

2. The announcement is credible. People expect changes in the money supply Δm_i to be lower from time T onwards, as the government will reduce the *rate of growth* at time T. Equation (11) implies that Δp_t, hence velocity, falls. From equation (5) then the price level p_t has to fall, with respect to the case in which the announcement is not credible, to maintain money market equilibrium.

The price level stabilizes ahead of time in response to credible announcements. Of course, if announcements are only partly believed the price level falls but by less that in case 2.

3 Ending hyperinflations

The above analysis can provide important insight about how to end hyperinflations. Hyperinflation is often defined as a situation in which prices rise at a rate in excess of 50% a month. By lagging equation (11) one period we can write

$$p_t - p_{t-1} = \frac{1}{2}\sum\nolimits_{i=t-1}^{\infty}\left(\frac{1}{2}\right)^{i-t-1}\Delta m_i. \qquad (12)$$

The left hand side is approximately inflation (the rate of change in prices) the terms in bracket on the right hand side are (approximately) the rates of money growth in periods $i = t...$ So, the rate of inflation is a weighted average, with declining weights, of present and future rates of money growth.

It is clear then that a necessary condition to stop a hyperinflation is to cut the rate of money growth. Yet, we have shown that expectations and the credibility of the policy change play a crucial role.

In the previous section we have not discussed what determines whether an announced policy change is credible or not. We have seen, though, that high rates of inflation are often the consequence of the government resorting to money printing to remain solvent in the face of a given time path for fiscal policy.

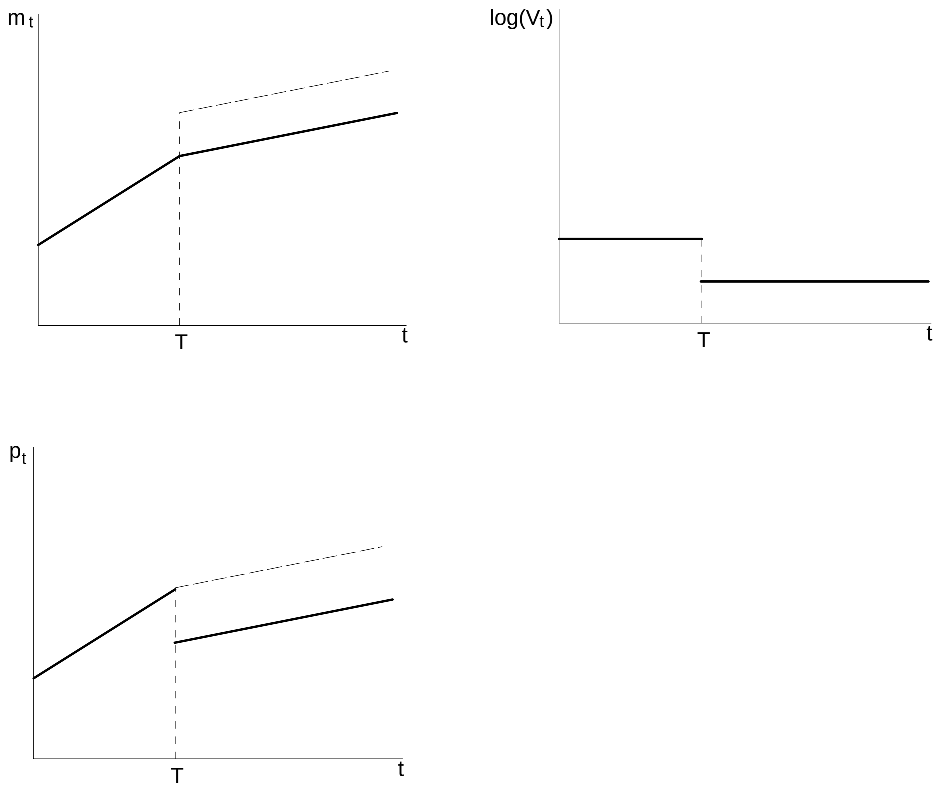
The government pledge to end a hyperinflation is unlikely to be credible if, given its fiscal plans, it is inconsistent with solvency. This is why it is sometimes claimed that the end of a hyperinflation is a "fiscal phenomenon".

For a given level of debt, unless the PDV of primary surpluses is increased, cutting seignorage requires increasing seignorage tomorrow to remain solvent. Since, expectations are forward-looking a monetary contraction not accompanied by fiscal tightening may even result in higher rather than lower inflation as velocity increases now and prices have to rise to maintain money market equilibrium.

Historically, attempts to stabilize the price level not accompanied by fiscal retrenchement often failed.

Consider instead the case in which the pledge to end a hyperinflation is accompanied by fiscal tightening and is credible.

Suppose the money supply has been increasing the money supply at a constant rate $\Delta m_i = \mu$ until T and people expected the same rate to persiste in the future. At the *current* time T the government reduces the rate of growth of the money supply to $\mu_1 < \mu$ and people believe that the reduction will be maintained in the future. Since the policy change is credible Δp_t and velocity fall from T onwards and the demand for real balances increases. Since the government is reducing the rate of growth, *not the level* m_T, of the supply of high powered money at time T, the increase in real balances can only be achieved through a downward jump in the price level p_T. This is illustrated in the diagrams below (continuous lines).



If prices are sticky, the fall in the price level will cause a recession. What could the government do?

It could reduce the rate of growth of money buy engineering a one-off increase in its *level* at time T (dotted lines). In this way the necessary increase in real balances would be achieved through an increase in nominal balances rather than through a fall in prices, avoiding the recession.

The problem, though, is that such a policy change is counterintuitive to the man in the street and could jeopardize the credibility of the price stabilization programme.