Monetary Policy & Inflation

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Milton Friedman, winner of the 1976 Nobel Prize in economics, once said: "Inflation is always and everywhere a monetary phenomenon. To control inflation, you need to control the money supply." Friedman believed what he said, but he also enjoyed thumbing his nose at the popular Keynesian theory of the 1960s, in which inflation was the result of excess demand for goods.

Was Friedman right? We consider his claim in the context of hyperinflations: episodes of very high inflation, 100% per year or more. Although extreme, hypinflations are a recurring phenomenon and a wonderful laboratory for studying inflation more generally. In these situations (but not necessarily in others), money growth is present, but it's invariably connected to government deficits. The key to stopping inflation, then, is to balance the government's budget.

The quantity theory

Friedman's claim about inflation is based on a theory that is several centuries old: the *quantity theory of money*. Like a lot of good theory, it's based on an analogy. Think for a moment about the effect of a two-for-one stock split on the price of a stock. If it's now selling for 100, then you'd probably expect it to sell for 50 after the split. (This wouldn't be true if the split were a signal of some new information about the firm, but let's assume it's not.) The point is that the value of a firm's total stock of equity shouldn't depend on anything as arbitrary as the number of shares.

Now suppose we do the same thing with money. This is unrealistically simple, but makes the point effectively. Suppose the government replaced every dollar with two "new dollars," marked so we can tell the difference between old and new notes. Then you'd expect, I think, that new dollars would be worth half as much as old dollars. That is, you'd expect prices of goods and services quoted in new dollars to be twice as high as prices quoted in old dollars. In short, changes in the quantity of money in circulation (the "money supply") executed in this way will be associated with proportionate changes in prices, with no effect on output. Why the latter? Because output is determined by productivity and inputs, and we wouldn't expect either one to be influenced by the number of pieces of paper used to make transactions.

Of course the world is more complicated than this, and monetary policy consists of more than just currency exchanges, but some of the same reasoning applies more

generally (we'll look at some data shortly). The quantity theory is the result of two ideas: that money is not fundamental (pieces of paper don't change the productivity of the US or Chinese economies), and that its usefulness is in executing transactions. Let's start with the latter. In all developed economies, transactions consists of exchanges of goods and services for money. This means that, by definition, the amount of money M in circulation must equal the dollar volume of transactions. If we approximate the volume of transactions in an economy by nominal GDP, then we have $M = PY$, where Y is real GDP and P is a measure of the price level such as the GDP deflator. This isn't quite right yet. A dollar can be used to execute several different transactions in a given year. To take this into account, we use

$$MV \equiv PY, \tag{1}$$

where V is the *velocity* of money: the number of times a dollar is used to execute transactions in a given year.

At this level of generality, equation (1) is a tautology: for any data we collect on M, P, and Y, we simply choose V to make the equation hold. What gives the equation content is the assumption that velocity V is (at least approximately) constant. This implies that increases in M are associated with proportionate increases in PY. We add one further assumption to get Friedman's connection between money and prices: that real GDP is determined by the productivity and inputs of the economy, and is not affected by the amount of money in circulation. We can change that later, but it seems like a good place to start.

The same theory explains inflation if we express it in growth rates. As with growth accounting, we define growth rates as differences in (natural) logs. Thus the growth rate of a variable X is $\gamma_X = \log X_t - \log X_{t-1}$. In logs, equation (1) and its first difference are

$$\begin{aligned} \log M_t + \log V_t &= \log P_t + \log Y_t \\ (\log M_t - \log M_{t-1}) + (\log V_t - \log V_{t-1}) &= (\log P_t - \log P_{t-1}) + (\log Y_t - \log Y_{t-1}) \\ \gamma_M + \gamma_V &= \pi + \gamma_Y, \end{aligned}$$

where $\pi = \gamma_P$ is the inflation rate (rate of growth of the price level). If velocity is constant,

$$\gamma_M = \pi + \gamma_Y, \tag{2}$$

and changes in the growth rate of money are associated with changes in the growth rate of inflation and output. The second assumption is that the growth rate of money does not influence output, so changes in money growth translate one-for-one into changes in inflation. That's Friedman's argument.

Evidence

It's not that easy to check the second assumption, but we can check the first (constant velocity) by looking at the components of equation (1). They imply that velocity is constant and that movements in the price level P mirror those in M/Y. You can see both in Figure 1 for the US. (Money here is M2, a detail we recommend you ignore — forever.) The figure suggests that the theory is a reasonable approximation of the data, at least over the last fifty years or so. The two increasing lines (P and M/Y) show some short-run differences, but their movements are similar. Velocity itself wiggles around a little, but is not much different now than it was in 1960.

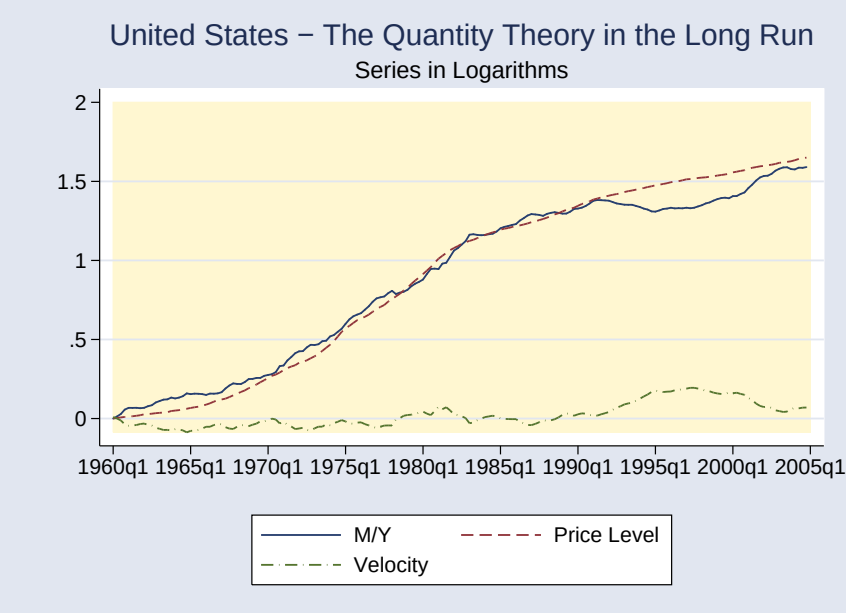

Figure 1: The quantity theory in the long run.

The evidence for short-run changes is much different. When we look at deviations from trend (Figure 2), movements in prices are only loosely related to movements in money, and velocity has as much short-run volatility as the stock of money.

Changing the money supply

Currency is a liability of the government, which can (and does) change the quantity in circulation. To see how this works, it's helpful to take a step back and consider the broader issue of government debt. We can divide the government's debt management into two related pieces. The first piece is the size of the debt. Measured in units of

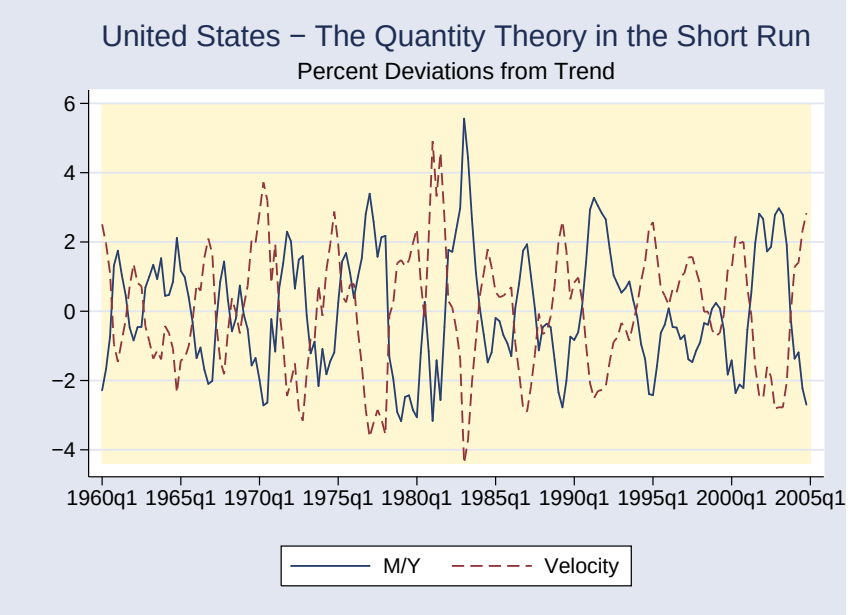

Figure 2: The quantity theory in the short run.

currency (dollars, say, or pesos), the debt changes over time as the government runs surpluses or deficits. Mathematically, we might write:

$$\text{Debt}_t \quad = \quad \text{Debt}_{t-1} + \text{Deficit}_t.$$

This is an example of a government budget constraint, something we'll see more of later on. The second piece is the composition of the debt. In practice, governments have lots of different liabilities, but for the purposes of this discussion let us say it has two: government bonds and money (currency). In both theory and practice, these two pieces are typically separate, with the treasury issuing bonds to cover the entire debt and the monetary authority (central bank) buying back some of these bonds and issuing money in return.

Day-to-day monetary policy is most countries consists of what we term *open market purchases* or *sales* of government debt (bonds). At any point in time, the treasury's balance sheet looks something like

Assets	Liabilities	
	Bonds	200

and the central bank's looks like

Assets		Liabilities	
Bonds	100	Money	100

If it seems strange to treat money as a liability of the central bank (isn't money an asset?), think of it as a bond with the unusual feature that its nominal interest rate is zero. That's what it is, which makes it a good deal for the borrower.

An open market purchase of bonds results in an increase in bonds held by the central bank and an equal increase in its monetary liability. For example, a purchase of 20 worth of bonds would change its balance sheet to

Assets		Liabilities	
Bonds	120	Money	120

The result is an increase in the amount of money in private hands, since the private sector (the other side of this transaction) has reduced its holdings of government bonds and increased its holdings of money. Similarly, an open market sale of bonds would reduce the amount of money in private hands.

The question we're leading up to is why money growth is so high in countries with hyperinflations. Why does the central bank keep issuing money?

Hyperinflations

If inflation is as easily cured as Friedman suggests ("control the money supply"), why do big inflations happen? People who live through such episodes describe them as traumatic; they spend an hour or more every day converting cash into anything with stable value: real estate, cars, foreign assets. The economy is usually a mess, but whether's that cause or effect is hard to say. But if hyperinflations are so painful, why do governments let them happen? The problem, typically, starts with a government deficit. A political impasse makes it nearly impossible to reduce the deficit. Given the government's budget constraint, it must then issue debt. There is apparently no shortage of ready buyers of US debt (ditto other developed countries), but the same can't be said for every country. If no one will buy its debt, the remaining option is to finance the deficit with money (read: oblige the central bank to purchase bonds from the treasury). In short, when the government can't pay its bills in any other way, it pays them with money, which is easy enough to print. The effect of this, of course, is inflation.

The conventional solution to hyperinflation has two parts. The first is fiscal discipline: balance the government budget. The second is monetary discipline: separate the central bank from the treasury and tell the bank that its job is to maintain price stability. There are lots of fine points — how quickly must the deficit be eliminated? should the IMF supply short-term financing? — but the outlines of the problem and its solution are clear. Going back to Friedman's quote: inflation may be a

monetary phenomenon, but the trouble often starts with fiscal policy — and the political situation that led to it.

For someone operating an international business, the thing to remember is that "big inflations" are relatively common. What do you do if you're hit with one? You'll probably find that the most important thing you can do is streamline your cash management. If you can reduce the payment terms from (say) 60 days to 30 days, you increase your "real" revenue substantially. You may also find that big inflations lead to policies, like price controls and capital controls, that make life more complicated. Finally, you may find that your financial statements are highly misleading, since they measure performance in terms of the local currency, whose value is changing rapidly. For a US subsidiary, high inflation triggers a change in the rules for translating financial entries into dollars for tax and reporting purposes.

Inflation and interest rates

The interest rates we typically use are nominal: they tell us how much money we get in the future for a given investment of money today. Since inflation measures the change in the value of money, it shows up in interest rates. More concretely, we would say that the nominal interest rate equals the real interest rate (the interest rate adjusted for inflation) and inflation:

$$i \;=\; r + \pi. \tag{3}$$

For a given real interest rate r, an increase in inflation raises the nominal interest rate one for one.

If you buy that, you can stop there. If you want a deeper explanation, here's how it works. Consider a one-year interest rate on a Treasury bill. The rate tells us how many dollars (say) we get in one year for a given payment of dollars today. For example, if a 12-month treasury bill has a price of $96.15, its annualized yield is the value of i that solves

$$96.15 \;=\; \frac{100}{1+i}. \tag{4}$$

In this case, $i = 4\%$. Thus each dollar invested today gives us 1.04 dollars in 12 months. We refer to i as the *nominal rate of interest* — nominal because its refers to payments of currency.

For many purposes, we'd like to know not only the dollar yield, but also how much 1.04 dollars will buy when we get it. If we expect the inflation rate to be 3% a year, then we'd guess that 3/4 of the interest will be eaten up by inflation. The investment only gains us about 1% in terms of purchasing power. We refer to the increase in

purchasing power as the *real rate of interest* — real because it refers to the quantity of real consumption it finances. That gives us equation (3).

We can show this more formally by translating the words into equations more carefully. We have just argued that investors are interested not in the money the bond is a claim to but in what that money will buy. If by "what that money will buy" we mean the basket of goods used to construct the CPI, we can define the real interest rate r by

$$(96.15/P_t) \;=\; \frac{100/P_{t+1}}{1+r_t},$$

where P_t is the CPI index in year t and P_{t+1} is the expected value of the same index in year $t+1$. What we are doing here is expressing the current bond price, measured in terms of what it will buy, as the discounted value of the principal, also measured in terms of what it will buy. Doing a little algebra, we find

$$(1+r)(P_{t+1}/P_t) = 100/96.15$$

Then equation (4) tells us that the real and nominal interest rates are related by

$$1+i_t \;=\; (1+r_t)(1+\pi_t),$$

where $(P_{t+1}-P_t)/P_t$ is the expected inflation rate between t (now) and $t+1$ (a year from now). Since the product $r_t\pi_t$ is a small number, it follows that

$$i_t \;\approx\; r_t + \pi_{t+1},$$

where $\approx$ means "equals approximately." If we're careful about timing, we see that all three variables are comparisons between now and one year from now. Inflation is therefore typically understood to be expected inflation, since we don't know what inflation will be when we buy the bond. In principle, we could also take into account the risk inherent in inflation — but we won't.

Now that we're done with definitions, we can ask how inflation affects nominal interest rates. In principle, either component (the real rate or expected inflation) can change the nominal interest rate. In practice, we typically find that in periods of high and variable inflation, the inflation component dominates. This is approximately true of the US, where high-inflation periods (the 1970s and early 1980s) are high-interest rate periods, too. It's even more evident in countries with very high inflation rates.

Velocity reconsidered (optional)

In very high inflation environments, people often find that that the inflation rate accelerates quickly, often far exceeding the rate of money growth. One factor here is velocity, which typically rises sharply with inflation. Why? Because inflation (and

nominal interest) is effectively a tax on holding money: the higher the tax, the less money you hold. During hyperinflations, people spend money as soon as they get it, because its value falls by the minute. It's common, for example, for people to buy groceries and gasoline as soon as they get their paychecks; if they wait even a day or two, their purchasing power falls.

If velocity V rises with inflation, then we can reconsider

$$\gamma_M + \gamma_V \quad = \quad \pi + \gamma_Y. \tag{5}$$

If γ_Y is approximately constant, then an increase in money growth not only produces inflation directly, its impact is magnified by the increase in the interest rate, which increases velocity ($\gamma_V > 0$). Similarly, when hyperinflations are reversed, we often see a larger drop in inflation than in money growth, as velocity falls.

Executive summary

1. Over long periods of time, inflation is closely related to money growth.
2. Extremely high rates of inflation are invariably associated with high rates of money growth.
3. High money growth is often the result of financing large fiscal deficits with money. The deficits, in turn, often reflect some kind of political gridlock.
4. High inflation is typically associated with high interest rates, since investors demand higher yields to compensate for the loss of purchasing power of the currency.

Review questions

1. Friedman suggested that the Fed might do better to adopt a rule in which it kept the growth rate of the money supply constant.

   (a) If the growth rate of real GDP is 3%, on average, what growth rate of the money supply would deliver average inflation of 2%?

   (b) What are the strengths and weaknesses of such a policy rule?

   Answer.

   (a) If velocity is constant, then equation (2) gives us a money growth rate of

   $$\gamma_M \quad = \quad \gamma_P + \gamma_Y \quad = \quad 2 + 3 \quad = \quad 5.$$

   In words: money growth accommodates inflation and economic growth.

(b) Strengths: predictable, good average inflation performance, avoid major policy mistakes. Weakness: no room for policy to respond to current conditions. Compare, for example, policy in the aggregate supply and demand model.

2. Why do many countries make central banks independent of the treasury?

   Answer. The idea is that monetary policy should focus on good long-term performance, and to accomplish this should be immune to short-term political pressure. With respect to hyperinflations, you might argue that if the government does not have access to money finance, it will be forced to confront its deficit issues earlier, which is a good thing.

3. If we evolve toward an economy in which transactions are made without money, what role will the central bank play?

   Answer. Good question, someone should start thinking about that!

4. Zimbabwe ended its hyperinflation by abandoning its currency. Even official transactions were switched to either US dollars or South African rand. Does this seem like a good solution? Does it make sense for a country to abandon its currency?

   Answer. There's a long tradition of each country having its own currency, but there's good reason to think at least some countries would be better off using someone else's. Zimbabwe has shown no ability to manage its own currency effectively, so using another sounds like a great idea. There are other examples — Panama uses the US dollar — and perhaps there should be more.

5. Describe the short- and long-run impact of increasing the money supply on inflation and output in the aggregate supply and demand model. How do your answers compare to the quantity theory: more money leads to higher prices, period.

   Answer. In the short run, an increase in the money supply increases both output and the price level. In the long run, only the price level increases. The latter is the quantity theory.

6. Go to FRED and find the 3-month treasury bill rate (TB3MS) and the consumer price index (CPIAUCSL). Manipulate them as needed and graph the nominal interest rate and inflation rate together. What do you see?

   Answer. Do it and see!

If you're looking for more

Similar material is covered in most macroeconomics textbooks. Wikipedia has a nice article on hyperinflation, including a list of the biggest ones. Two recommended (but

more specialized) pieces about specific episodes are

- Thomas Sargent, "The ends of four big inflation," linked here. It's about hyperinflations in Europe in the 1920s and documents the fiscal situations that produced them. Really interesting if you like history.
- Thomas Sargent and Joseph Zeira, "Israel 1983." The idea is that expected future government deficits (in this case triggered by a large bank bailout) can generate inflation immediately, even before the money supply has increased.