Inflation: Jones Chapter 8

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Inflation: a sustained increase in the average price level. Measured as the annualized rate of change of the price level. Deflation: negative inflation. Monetary theory is the part of macroeconomics that studies the determination of the price level and the rate of inflation.
When we look at growth and business cycles, we look at real GDP: we care about actual quantities of goods and services. Nominal GDP is the actual dollar value of the goods and services.

One measure of the price level is the GDP implicit price deflator: GDP/RGDP. This is essentially the same as the GDP price index.

Other measures: CPI, PCE price index, PPI, the price index for Gross Domestic Purchases. (Gross Domestic Purchases includes imports but excludes exports.)
Example: Real Cost of a Gallon of Gasoline

1950: $0.27/gallon
2010: $3.00/gallon

Has gasoline gotten more expensive? It costs more dollars, but each dollar buys less. (i.e., there has been inflation.)

One approach: deflate by CPI.


1950: 24.08
2009: 215
1950: $0.27 / .2408 = $1.12 (in 1983 dollars)
2009: $3.00 / 2.15 = $1.39 (in 1983 dollars)

So yes, gasoline has gotten a bit more expensive relative to other goods.
Why did inflation rise in the 1960s and 1970s and then fall in the 1980s?

**FIGURE 8.1** The Inflation Rate in the United States, 1960–2009
US Inflation ($\% \Delta \text{ CPI}$)

Deflation = negative inflation.

Source: FRED
Quantity Theory

Treat the following terms synonymously:

- Quantity theory
- Classical theory of the price level
- Classical theory of aggregate demand.

Key message: $M$ is the crucial determinant of the price level $P$; high inflation involves high money supply growth.

We do not see large sustained increases in the price level without large sustained increases in the money supply.
Classical Quantity Theory

Important early contributors

- David Hume (1711-1776) (esp. the famous 1752 treatise *Of Money*).
- Irving Fisher (1867–1947)

Remarkable: an economic theory whose roots trace a quarter of a millennium retains relevance for modern experiences. Marshall is particularly relevant to us, since he suggested that a demand and supply analysis was appropriate for money.
“Inflation is always and everywhere a monetary phenomenon.”
– Milton Friedman

Perhaps the name most associated with monetarism in the popular mind is Milton Friedman, who is credited with leading a revival of monetarist ideas in the 1950s–1970s.
Quantity theory is best viewed as a theory of the long run. The best short-run application of quantity theory is to high inflation economies, where $M$ is changing much more than real variables such as $Y$.

We also expect this theory to be useful in low inflation economies if we are looking at them over long periods of time, because nowadays we see large changes in the money supply over a period of years.
Velocity and the Quantity Equation

We define the income velocity of money as

$$V \equiv \frac{PY}{M}$$

You can think of this as how many times the money stock “turns over” to pay for the flow of transactions.

Quantity equation:

$$MV = PY$$
Velocity

Source: http://research.stlouisfed.org/publications/mt/
Quantity Equation: Cambridge Version

\[ M = kPY \] (3)

You can see that the relationship between velocity and the Cambridge \( k \) is very simple:

\[ V = \frac{1}{k} \] (4)
Simple Quantity Theory

To turn the quantity equation into a theory of the price level, make V, M, and Y exog. (Jones puts a bar over exogenous variables.)

\[ P = \frac{MV}{Y} \]

Given Y and given V, doubling M doubles P. There is a corresponding theory of inflation:

\[ g_P = g_M + g_V - g_Y \]  \hspace{1cm} (5)
\[ \pi = g_M + 0 - g_Y \]  \hspace{1cm} (6)

Dichotomy: real values are determined independently of monetary values.
Neutrality of money: change in M does not change any real values.
New Budget Constraint (with Money)

Microfoundations: households will demand money up to the point where its marginal benefit equals its marginal cost. Benefit of holding money: \textit{exchange services} I.e., the added convenience in buying and selling goods and services. Cost of holding money (first pass): when you hold money, you forgo consumption.
What is Money?

Money Supply Measures, April 2008

Source: http://www.newyorkfed.org/aboutthefed/fedpoint/fed49.html
What is Money?

http://research.stlouisfed.org/fred2/categories/24

M1

C (currency held by public)
D (demand deposits & OCDs)
traveler’s checks

M2 = M1 plus time deposits

M3 discontinued 2006-03

Source: http://www.federalreserve.gov/releases/H6/Current/

Time deposits include savings deposits (including money market deposit accounts); small-denomination (< $100k) time deposits (less retirement accounts); retail money market mutual funds (less retirement accounts)
**Demand for Money**

\[ M^D = kPY^D \]  \hspace{1cm} (7)

where \( k \) is your propensity to hold money as a fraction of the nominal value of your transactions. (I.e., it is the “Cambridge \( k \”).)

Note that we have a relation between the nominal money stock and the flow of nominal income. So \( k \) must have units of time. (In the U.S., \( k \) has been around \( (1/5) \) years (i.e., 10 weeks) but falling.)
Monetary Equilibrium I

\[ M^S = M^D \]  \hspace{1cm} (8)

Classical theory: price level adjusts endogenously to exogenous changes in the money supply.

\[ M = kPY^D \]  \hspace{1cm} (9)

Given \( k, M, \) and \( Y^D \) we can determine the price level as

\[ P = \frac{M}{kY^D} \]  \hspace{1cm} (10)

Price level is determined as the ratio of the *nominal* money supply to *real* money demand.

\[ PY^D = \frac{M}{k} \]  \hspace{1cm} (11)

Nominal income is entirely determined by \( M \) and \( k \): the
The growth rate of the price level is the growth rate of the nominal money supply less the growth rate of real money demand.

\[ g_P = g_M - g_k - g_Y \]  \hspace{1cm} (12)

Implication: given \( k \) (so that \( g_k = 0 \)), the rate of inflation is the difference between the growth rate of \( M \) and the growth rate of \( Y \).

\[ g_P = g_M - g_Y \]  \hspace{1cm} (13)

That is, the inflation rate is determined as the difference between the growth rate of the money supply and the growth rate of real income.
Neutrality of Money

Real vs. nominal variables. In the Classical model, money is *neutral*: changes in the money supply lead to no real changes! When the money supply changes, the price level changes proportionately. A change in the level of the money supply simply causes a proportional change in $P$ and other nominal variables (such as $W$). Changes in the money supply have no real effects.
Algebraic Example

Production function and implied labor demand:

\[ Y^S = L - \frac{L^2}{2} \quad \implies \quad L = 1 - \frac{w}{P} \quad (14) \]

Simple labor supply curve:

\[ L = \frac{W}{P} \quad (15) \]

Labor market equilibrium

\[ 1 - \frac{w}{P} = \frac{W}{P} \quad \implies \quad \frac{W}{P} = \frac{1}{2} \quad \implies \quad L = \frac{1}{2} \quad (16) \]

\[ \implies \quad Y = \frac{1}{2} - \left(\frac{1}{2}\right)^2/2 = \frac{3}{8} \quad (17) \]

Based on: Box 5.2 in Farmer 2nd edition.
To this we will add our new material: $M = kPY$. Let $k = 2$, $M=100$. As we have seen, this implies

$$P = \frac{M}{kY}$$

$$= \frac{100}{(2 \cdot \frac{3}{8})} \quad (18)$$

$$= 133\frac{1}{3}$$

$$W = \frac{W}{P}P$$

$$= \frac{1}{2}(133\frac{1}{3}) \quad (19)$$

$$= 66\frac{2}{3}$$
Superneutrality

In the simple Classical model, money is also superneutral. That is, changes in the growth rate of the money supply have no real effects.

\[ P = \frac{M}{kY} \]  

(20)

This explanation of the price level in the classical model becomes the explanation of inflation as well: we just put the model in rates of change.

\[ g_P = g_M - (g_k + g_Y) \]  

(21)

Or, holding \( k \) constant (so that \( g_k = 0 \)):

\[ g_P = g_M - g_Y \]  

(22)
FIGURE 8.2 Money Growth and Inflation in the United States, 1870–2008

Source: Jones (2011, Fig 8.2)
When we look at high inflation economies it is quite obvious that we do not see high inflation unless we also see high money growth.

**FIGURE 8.3** Money Growth and Inflation around the World, 1990–2003
Causation

It is pretty clear that high inflation cannot happen without high money growth. However suppose that the money supply is *accommodating* the inflation. Some economists treat money growth as endogenously accommodating inflation, especially in developing countries. Nevertheless, a change in monetary regime can eliminate the inflation. Think of Bolivia, which rapidly eliminated hyperinflation by simply refusing to print money to finance government expenditures.
First example

Suppose you are told that \( Y = 3, \ M_s = 600, \) and \( k = 0.2. \) Recall that the quantity theory implies that the price level is

\[
P = \frac{M^s}{kY}
\]  

(23)

so you can now calculate \( P. \)

\[
P = \frac{600}{0.2 \times 3} = 1000
\]  

(24)
Second example (more detail) I

We will skip the utility maximization problem of households and simply say labor supply is

\[ L^s = \frac{W}{P} \]  \hspace{1cm} (25)

We will go into a bit more detail on the firm level decision. Take the production function of the typical firm to be

\[ Y = L - \frac{L^2}{2} \]  \hspace{1cm} (26)

so that the marginal product of labor is

\[ MPL = 1 - L \]  \hspace{1cm} (27)
Second example (more detail) II

Equating $MPL = W/P$ for profit maximization we get

$$MPL = W/P$$
$$1 - L = W/P$$

$$L^d = 1 - \frac{W}{P} \tag{28}$$

Labor market equilibrium is when $L^d = L^s$:

$$1 - \frac{W}{P} = \frac{W}{P} \tag{29}$$

so we find that in equilibrium

$$\frac{W}{P} = \frac{1}{2}, \quad L = \frac{1}{2}, \quad Y = \frac{3}{8} \tag{30}$$
This gives us real income. To find the price level we need in addition to know two details about money supply and demand: the values of $M$ and $k$. Suppose $M = 100$ and $k = 0.2$. Then we can use the quantity theory of the price level

$$P = \frac{M}{kY} \quad (31)$$

to solve for the price level as

$$P = \frac{100}{0.2 \times (3/8)} = \frac{4000}{3} \quad (32)$$
Note that we can also go back and figure out the nominal wage from the real wage and the price level. Since

\[ W = P \frac{W}{P} \]

\[ = \frac{4000}{3} \frac{1}{2} \]

\[ = \frac{2000}{3} \]  

(33)
Fisher Effect

Define real interest rate:

\[ r = i - \pi \]  \hspace{1cm} (34)

Fisher equation:

\[ i = r + \pi \]  \hspace{1cm} (35)

Fisher effect: \( r \) exogenous, so \( \pi \rightarrow i \)
Source: Jones (2011, Fig 8.4)
Costs of Inflation

- Anticipated
  - costs of conserving money balances (shoe leather costs)
  - costs of changing prices (menu costs)
  - distortions via tax system (bracket creep; taxation of nominal interest and profits)

- Unanticipated
  - the volatility of relative prices in high inflation economies reduces the signaling value of market prices.
  - redistribution from debtors to creditors
“Inflation is always and everywhere a fiscal phenomenon.”
– Thomas Sargent
Seigniorage

Is there any benefit that accrues to government from the printing of money? Imagine that you had a perfect two-sided color copier: clearly this could provide you with additional control over goods and services. It is the same for government: it can acquire goods and services for the cost of printing the money.

\[ G = (T_x - T_r) + \Delta B + \Delta M \]  \hspace{1cm} (36)

We refer to these revenues as seigniorage:

\[ R_t = \frac{M_t - M_{t-1}}{P_t} \]
Inflation tax

Your money loses value due to inflation. Initial balances of $M_t/P_t$ are worth only $M_t/P_{t+1}$. Money loses value at the rate:

$$\frac{M_t}{P_{t+1}} - \frac{M_t}{P_t} = \frac{P_t}{P_{t+1}} - 1$$

which is determined by the rate of inflation. Currency holders pay an inflation tax.
High Inflation and Hyperinflation

How do you know when it is hyperinflation? (Class anecdotes.) Jones (2011) suggests: 500%+ per year is hyperinflation.
Germany 1921–23: in 1923 prices increased about 230%/month (That comes to 4%/day: 
\[ (1 + 2.3)^{1/30} - 1 = 0.04 \]
Israel 1985: 400%
Bolivia 1984: 12,500%
Argentina 1989: 700%
Russia 1993: 875%
High Inflation

**FIGURE 8.6** High Inflation in Mexico and Nigeria, 1950–2009

Source: Jones (2011, Fig 8.6)
Hyperinflation

**FIGURE 8.5** Hyperinflations in Argentina, Brazil, and Russia, 1950–2009

Source: Jones (2011, Fig 8.5)
Zaire 1990–1996
Stop.
Inflation Targeting

The 1990s saw a resurgence of interest insulating central banks from political influence, and explicit inflation targeting was considered by a number of central banks as a guide to monetary policy. The most famous central bank restructuring is the “New Zealand experiment.”

In an inflation targeting regime, naturally the question arises: which price index should be used for inflation targeting? This question is often implicit in the discussion of the significance of inflation outcomes. Many economists prefer to ignore short-run price fluctuations in volatile sectors, especially food and energy, and to attend to some measure of “core inflation”. Some economists have suggested attending to rapidly responding commodity prices, others have suggested asset prices—including the price of gold—should serve as a guide. Advocates of fixed exchange rate regimes implicitly argue that monetary policy should target the price of foreign exchange.
The New Zealand Experiment

New Zealand’s Reserve Bank Act of 1989 is an attempt to insulate the central bank from direct electoral influences. It states that the primary function of the central bank is to maintain stable prices. It is also an attempt to establish a policy structure that ensures accountability. The Governor of the RBNZ is given public, fixed inflation targets, and s/he can be dismissed for failing to achieve these targets. As inflation fighting policy, it is also a success story: New Zealand lowered its inflation rate and continues to achieve low rates of inflation.
Some simple comparisons give the general flavor of this change.

- 1973-1985 New Zealand’s inflation rate averaged over 12 percent annually.
- 1986 to 1992: $g_P$ fell to 6 percent
- 1992 to 2000: $g_P$ fell further to 1.8 percent

While the US also experienced a fall in inflation (roughly from 7.2 percent to 3.7 percent to 2.5 percent), New Zealand started out with markedly higher inflation and ended up with markedly lower inflation.
Low and narrow target inflation ranges have been embodied in Policy Target Agreements (PTAs), which are negotiated by the RBNZ Governor and the Minister of Finance. The first PTA set a inflation range of 0–2 percent, while the 2002 PTA set a range of 1–3 percent. Exceptions that would allow the range to be exceeded include various supply side shocks, including tax increases and natural disasters. The measure of success and locus of responsibility is clear: the Governor is responsible for policy decisions, and success or failure is clearly linked to a target inflation range for the CPI, which is publicly available at high frequency.
Use of a politically insulated and publicly available price index is important. However, Walsh (1996) claims that as CPI inflation rose above the 0-2 percent range in late 1994, the RBNZ focused more and more on its own “underlying rate”, even going so far as to call the CPI inflation rate the “headline” inflation rate. Naturally, this raised concerns that the RBNZ would define its own rate in ways that would allow it to hit its target range, even when the CPI inflation fell outside that range. This threatened the whole notion of accountability. However, the Reserve Bank maintained its credibility even while emphasizing the “underlying rate.” Walsh (1996) points out that underlying inflation sometimes exceeds CPI inflation, so that the target is not necessarily easier to hit.
Clear goals defined transparently in terms of public data facilitates policy accountability. Inflation goals stated as target CPI inflation ranges are attractive for this reason. But is the CPI the most appropriate measure of inflation for monetary policy purposes? Perhaps most importantly, current inflation is a bad indicator of current monetary policy, the prices respond with long a varied lags to the money supply. So unfortunately the most transparent measures of the appropriateness of monetary policy may be misleading or even too late to be useful.
Problems with CPI Targets

New Zealand includes interest costs in the CPI, so that contractionary monetary policy, which raises interest rates in the short term, can increase inflation as measured by the CPI. This provides a misleading indicator of policy. Even aside from this, any central bank’s ability to control inflation is imperfect, and the central bank’s performance evaluation should not be based on the effects of unforeseen events. The New Zealand PTAs deal with this by allowing policy adjustments in the face of supply shocks.
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