Inflation, Deflation, and the Phillips Curve

Deflation

Potential output = AF(K,L)

Inflation

Macroeconomics pre-Halloween

IS-MP

\[ Y = Y_{pot} \]

\[ Y \]

\[ u \]

\[ i \]

\[ r \]

\[ n^e \]
Now add inflation as the spook of central bankers

\[ Y_{t} = Y^{*} - \alpha (r_{t} - r^{*}) + \mu G + \epsilon_{t} \]

\[ r_{t} = i_{t} - \pi^{e}_{t} + \text{risk and term premia} \]

\[ \pi_{t} = \pi^{e}_{t} + \varphi(Y_{t} - Y^{*}) + \xi_{t} \]

\[ \pi^{e}_{t} = \pi^{e}_{t-1} \]

\[ i_{t} = \pi_{t} + \theta_{e} (\pi_{t} - \pi^{*}) + \theta_{Y} (Y_{t} - Y^{*}) \]

Final steps toward full short-run model

We will develop full AS-AD model as presented in Mankiw Chapter 14. We will develop model on Friday and show its properties.

Equations of model:

1. IS
2. Cost of capital:
3. Phillips curve:
4. Inflation expectations:
5. Monetary policy (Taylor)

We did (1) in IS-MP section.
We did cost of capital (2) in investment section.
We do (3) Phillips curve today (but substitute Y for u).
We discuss (4) expectations briefly.
We discuss Taylor rule (5) on Friday and in pset.
Inflation's history in the US

Core inflation: Fed inflation target rate

"Comfort zone = 2% or a little less"
How do we measure price indexes?

**Consumer price index:**
- Traditionally a **Laspeyres price index** (fixed weight index using early prices)
- BLS has introduced an experimental index – the “chain CPI” – which is a **superlative Törnqvist index**.
- As with output inde:
  \[ g(\text{Paasche}) < g(\text{Tornqvist}) < g(\text{Laspeyres}) \]

**GDP price index**
- GDP indexes are Fisher (superlative) index
- Important one is personal consumption expenditures (PCE) price index, a parallel measure to the CPI, but a Fisher index.

“Core Inflation”
- removes volatile food and energy and is central target for monetary policy (personal consumption core price index)
Major topics

1. Why do we care about inflation?
2. The pathology of hyperinflation
3. Modern inflation theory

What are costs of inflation?

- Redistribution: inflation redistributes wealth from creditors to debtors (mortgages, pensions).
- Inefficiencies of inflation: shoe leather, menu costs, taxes,...
- Distinguish anticipated from unanticipated inflation (ex ante v. ex post real interest rates)
- Overall, costs appear relatively small at low inflation rates.
- Hyperinflation can destroy price mechanism
- Deflation can produce low-level equilibrium
- Fed’s “comfort zone” is 1 to 2 percent per year
Hyperinflation

- An important phenomenon because illustrates the most profound malfunction of a monetary system.
- Classic definitions:
  - hyperinflation: 50 percent per month for > 1 year (>12,900 % per year)
  - very high inflation: > 100 % per year for > 1 year
- Frequency:
  - hyperinflation:
    - none before French revolution
    - many after WW I
    - none 1947-84
    - 15 since 1984, of which 8 were countries emerging from central planning
  - very high inflation in last 4 decades:
    - 75 in 25(?) countries

[Source: Fischer and Vegh]

What Causes Hyperinflation?

- “Inflation is everywhere a monetary phenomenon.” (Friedman)
  - trivial in sense that value of money declining
  - deep in sense that it is accompanied by rapid money growth
  - but uninformative because money supply usually endogenous in hyperinflations, caused by monetization of deficits, and the web of causality is very complex

- More complex (non mono-causal) view is that hyperinflation is complex web of inconsistent social demands.
  - Fundamentally, rising inflation reflects inability to ration output among competing demands
  - Eichengreen’s chapter on German hyperinflation excellent description of the forces and dynamics at work.
Your pocket money: 1,000,000,000,000 marks

The Great German Hyperinflation 1922-23

![Graph showing the hyperinflation during 1922-1923]
Tales of wonder from Germany

"At 11:00 in the morning a siren sounded, and everybody gathered in the factory forecourt, where a five-ton lorry was drawn up loaded brimful with paper money. The chief cashier and his assistants climbed up on top. They read out names and just threw out bundles of notes. As soon as you had caught one you made a dash for the nearest shop and bought just anything that was going."

“The flight from currency that had begun with the buying of diamonds, gold, country houses, and antiques now extended to minor and almost useless items -- bric-a-brac, soap, hairpins….People bought things they didn't need and used them to barter -- a pair of shoes for a shirt, some crockery for coffee.”

- Adam Smith (nom de plume, not the real one), The Money Game, Supermoney, and Paper Money

Tales of wonder from Germany

Businesses couldn’t change prices sufficiently rapidly. “So they left the price marks as they were and posted hourly a new multiplication factor. The actual price marked on the goods had to be multiplied by this factor to determine the price which had to be paid for the goods…. Banks had whole batteries of telephone boys who answered each call as follows: ‘100 milliarden, bitte sehr, guten Tag.’ Which meant: ‘The present quotation on the dollar is 100 billion marks, thank you, good day.’ “

- Karl R. Bopp, 'Hjalmar Schacht: Central Banker'
**Hyperinflation, Stabilization, and Real Wages**

Notes:
1. Surprising how small impact of hyperinflation on real wages.
2. Stabilization had major positive impact on real wages.

---

**The tangled web of causality**

- Deficits are high because of political struggles and need to pay reparations at unrealistically high level (Keynes, *Econ Cons Peace*)
- Interest rates rise as investors lose confidence.
- Deficits are monetized because of high interest burden required to service debt.
- As inflation rises, incur Tanzi effect (lag in tax collection implies low real taxes with high inflation), increasing deficit.
- With increasingly high inflation, prices are often indexed to gold or foreign currencies, leading to lower real demand for M.
- This leads to unstable debt dynamics as government debt and money grow ever faster as inflation passes unstable tipping point.
  - Next slides show math and graph on unstable dynamics.
- Hyperinflation ends when fiscal and monetary reform change to stable inflation-price-deficit-money-debt-exchange rate dynamics
Now to modern inflation theory for large open market economy (US, Europe, Japan)

The Expectations-Augmented Phillips Curve

Fundamentals of theory:
1. Unemployment rate (u) determined by interaction of potential Y and AD – Okun’s Law
2. Inflation determined by labor/product market tightness (u relative to “natural rate of unemployment”*) and expected inflation (πe) – Phillips curve
3. Expected inflation (πe) determined by inflation history and forecasts of future inflation

*natural rate of unemployment (Mankiw); sometimes called the NAIRU = “non-accelerating inflation rate of unemployment” = Goldilocks unemployment rate
The short-run P.C.

Graph from Economic Report of the President 1969

This was relationship that led Keynesian to believe that P.C. was a good explanation for inflation (1960s)

---

Early Phillips Curve

---
Collapse of short-run P.C.

This was relationship that led many new classical economists to conclude that Keynesian theories were "fatally flawed" (Lucas and Sargent. 1970s)

Mainstream 3-equation inflation model

(1) \( \pi(t) = [w(t)-a(t)] + \varepsilon\pi(t) \) [from \( P(t) = k \frac{W(t)}{A(t)} \)]

(2) \( w(t) = \alpha + \pi\varepsilon(t) - \beta[u(t) - u^*] + \varepsilon w(t) \)

(3) \( \pi\varepsilon(t) = \pi(t-1) \)

Endogenous variables
- \( \pi \) = rate of price inflation
- \( w \) = rate of wage inflation
- \( w-A \) = growth rate of unit labor costs
- \( \pi\varepsilon \) = expected rate of inflation (or similar concept)
- \( u^* \) = natural rate of unemployment

Exogenous variables
- \( a \) = growth rate of average labor productivity (Q/L)
- \( u \) = actual unemployment rate (determined by policy and shocks)
- \( \varepsilon\pi(t) \) and \( \varepsilon w(t) \) = wage and price shocks (oil prices, exchange rates, globalization, decline of unions, immigration, etc...)
- \( t \) = time

[Note: (3) is backward looking rather than rational expectations.]
Simplest 1-equation inflation model

Simplify price equation by assuming no shocks:

(1') \( \pi(t) = w(t) \)

Substituting, we get:

(4) \( \pi(t) = \pi(t-1) - \beta [u(t) - u^*] \)

(5) \( \Delta \pi(t) = -\beta [u(t) - u^*] \)

which is the linear expectations-augmented P.C. model.

Short-run Phillips curve

\( \pi_1 = \pi_1^e \)

\( u^* = \text{natural rate} \)
$u^* = \text{natural rate}$

**Moving up short-run Phillips curve**

- $\pi_1 = \pi_1^e$
- $\pi_2$

$\text{SRPC}_{1,2}$

**Short-run Phillips curve shifts upward with higher inflation expectations**

- $\pi_1 = \pi_1^e$
- $\pi_2^e = \pi_2$

$\text{SRPC}_{3}$

$\text{SRPC}_{1,2}$

$u^* = \text{natural rate}$
Now unemployment rate back to the natural rate

\[ \pi_3 = \pi_3^e \]

\[ \pi_1 = \pi_1^e \]

\[ u^* = \text{natural rate} \]

\[ \text{SRPC}_3 \]

\[ \text{SRPC}_{1,2} \]

u equals the natural rate in both periods 1 and 3, but the expected and actual inflation rates are higher in period 3.

This diagram shows the way that the SRPC shifts as expected inflation adjusts to higher rate.
The Phillips Curve back from the dead ....

Note clockwise hysteresis loops as are predicted by the expectations-augmented P.C.

New synthesis of accelerationist PC

Δ π(t) = β[u(t) - u*]

u* is u where Δ π(t) = 0.

This was the new synthesis developed by Phelps and Friedman (1967-68). It now forms the basis of mainstream macro for large open economies.
Summary on
The Expectations-Augmented Phillips Curve

- u and π are negatively related in short run
- no relation between u and π in the long run
- short-run PC adjusts up and down as economic agents adjust their inflation expectations to reality (combination of backward and forward looking expectations).
- Natural rate is u at which inflation tends neither to rise nor fall

Deflation

Deflation = falling price level
This seldom occurs in modern economy, but sometimes have near-zero inflation (Japan for two decades, US today).
Problems:
- If full-employment interest rate < 0, have liquidity trap
- Unstable dynamics: since \( r = i - \pi \), as \( \pi \) falls have higher real interest rate, lower I, lower Y, and “low-level trap”
Some of the issues involved are discussed in Bullard, Seven Faces. Very interesting discussion!
But this is uncharted territory in modern macro!
The Issue of Wage-Price Flexibility

The single most important issue in inflation theory, policy, and history revolves around the question of the flexibility of wages and prices. This in turn mainly concerns the flexibility of wages.

Major historical developments:
1. Nominal wage change became much less volatile.
2. Nominal wages became downwardly rigid.
**Distribution of wage increases**
(nominal, percent year over year)

<table>
<thead>
<tr>
<th>Distribution</th>
<th>1866-1928</th>
<th>1946-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 to -5</td>
<td>13%</td>
<td>0%</td>
</tr>
<tr>
<td>-5 to 0</td>
<td>24%</td>
<td>0%</td>
</tr>
<tr>
<td>0 to 5</td>
<td>48%</td>
<td>63%</td>
</tr>
<tr>
<td>5 to 10</td>
<td>6%</td>
<td>35%</td>
</tr>
<tr>
<td>10+</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Why are wages rigid?*

1. Rise of unionization and worker representation
2. Rise of multi-year nominal contracts
3. Social norms against nominal wage reductions
4. Money illusion on nominal wage reductions

From an microeconomic point of view, wages are sticky because it is costly for employers to adjust them rapidly (“menu costs” in “New Keynesian macroeconomics”)

The result is a fundamentally different macroeconomic dynamics from a flexible-wage-price economy!

* Warning: This is very controversial area in macro.