LECTURE 9:
SEIGNIORAGE & HYPERINFLATION

Key Question:
Government attempts to stimulate the economy may explain moderate levels of money growth & inflation....

but why do high rates of inflation -- even hyperinflation -- sometimes occur?
The world’s most recent hyperinflation: Zimbabwe, 2007-08

Inflation reached 50% per month in March 2007, meeting definition of hyperinflation.

It reached 2,600% per mo. in mid-2008.

Sources: International Monetary Fund’s International Financial Statistics database; Reserve Bank of Zimbabwe’s Monthly Economic Reviews.

The driving force? Increase in money supply:

The central bank monetized government debt.

Chart 7
Zimbabwe Central Bank Government Debt Holdings Jump After 2003

Millions of Z$, log scale

NOTE: Central bank’s holdings of government debt were zero or near zero between 1980 and 1989.

SOURCE: International Monetary Fund’s International Financial Statistics database.
The exchange rate increased along with the price level. Both increased far more than the money supply. Why?

When the ongoing inflation rate is high, the demand for money is low, in response. For $M/P$ to fall, $P$ must go up more than $M$. 
How do governments finance spending?

• Taxes

• Borrowing
  - Domestic †
  - Abroad

• Seigniorage ≡ creating money to finance deficits

Inflation tax ≡ Money creation in excess of money demand justified by real growth.

† Regarding government borrowing, you may encounter
-- “Ricardian” debt neutrality (Barro):
  People know taxes eventually will rise; so Saving ↑.

-- “Fiscal dominance” (Sargent & Wallace; Woodford): people know that the debt eventually will be monetized. So P ↑.
The inflation tax can be a major source of government finance, (which is lost if the country gives up its independent currency).

Pre-euro revenues from the inflation tax, Greece, 1845-2000

Estimates of the inflation tax as percent of GDP as percent of GDP $\pi/(1+\pi) \times \text{Money/GDP}$

Based on:
- M2 or M3
- M0 or M1

Years in external default are shaded

Percent of GDP

[Data not available during WWII hyperinflation]

But a government that relies too much on seigniorage to raise real resources risks “killing the goose that lays the golden egg.”

• High money growth eventually gets built into expected inflation; and so the public reduces money demand
  — whether because $\pi^e$ is built into $i$ (Fisher effect)
  — or because $\pi^e$ enters the money demand function directly.
    • Bond markets often break down in hyperinflations.
      — So $M/P = L(\pi^e, Y)$

• When demand for real money balances falls, there is less of a “tax base” that the government can exploit.
Real money supply = real money demand:
\[
\frac{M}{P} = L(\pi^e, Y)
\]

If $\pi^e$ rises, real money demand falls, as households protect themselves against the loss in purchasing power. In "steady state," the actual & expected rates of inflation = the rate of money growth. The fall in real $M$ takes the form of a transitional rise in $P >$ rise in nominal $M$.

The government gets to spend at rate $dM/dt$ in nominal terms. Divide by $P$ to see what that buys in terms of real resources.

A higher "tax rate" (inflation) lowers the "tax base" (real money holdings). "Inflation tax revenue" = "tax rate" "tax base"
Where $\pi$ went the highest, $P$ went up the most, even relative to the increase in $M$: $M/P \downarrow$. 

Real money holdings fall in hyperinflations, because the demand for money depends on expected rates of return. The larger the increase in the inflation rate, the bigger the fall in real money.
Inflation tax revenue is “tax rate” times “tax base.”
Seignorage revenue as a function $\pi L(\pi)$ of money growth rate

If money growth $= 0$, seignorage $= 0$.

If inflation is very high, seignorage is very low.
You have killed the goose that laid the golden eggs.

The seignorage-maximizing rate of money growth

**FIGURE 11.7 The inflation-tax Laffer curve**
Seignorage = \( \pi L(\pi, Y) \)

For govt. to maximize seignorage,

\[
\frac{d\text{Seigniorage}}{d\pi} = L(\ , \ ) + \pi \frac{dL}{d\pi}
\]

E.g., following Cagan (1956), we choose exponential functional form:

Let \( L(\ , \ ) \equiv e^{a-\lambda \pi Y} \).

\[
\Rightarrow \frac{dL(\ , \ )}{d\pi} = -\lambda e^{a-\lambda \pi Y} = -\lambda L(\ , \ ).
\]

\[
\frac{d\text{Seigniorage}}{d\pi} = L(\ , \ ) - \pi \lambda L(\ , \ )
\]

\[
= L(\ , \ ) [1 - \pi \lambda]
\]

Set derivative = 0.

We thereby find that revenue-maximizing \( \pi \) is inversely related to \( \lambda \), i.e., the sensitivity of money demand to \( \pi \).

E.g., if \( \lambda = 1/2 \), revenue-maximizing \( \pi = 200\% \). Or higher, if in SR \( \lambda \) is lower.
The seigniorage-maximization approach doesn’t get to true levels of hyperinflation, if the revenue curve peaks at lower levels of inflation.

One needs a dynamic process, where

• money-holders respond more adversely to inflation over time than they do in the short run, and

• the central bank chases a receding seigniorage target.

Cagan (1956) modeled adjustment in continuous time.

(Or Romer, 4th ed., pp. 572-576)
Consider a stylized example of the dynamic process, which could end up at hyperinflation

- Assume
  - Elasticity rises over time from short run to long, and
  - Government tells CB to finance budget target by seigniorage (say, 92% GDP).

- In VSR, elasticity is low. Seigniorage target can be reached with moderate rates of money creation & inflation $\pi_1$.

- Then, in SR, elasticity rises.
  \[ \implies \text{demand for money falls} \implies \pi_1 \text{ no longer raises enough real revenue.} \]
  \[ \implies \text{CB raises money growth & inflation to } \pi_2 \text{ to attain required revenue.} \]

- In MR, elasticity rises more \( \implies \pi_2 \) no longer raises enough revenue.
  \[ \implies \text{CB raises money growth & inflation to } \pi_3. \]

- In LR, elasticity rises more \( \implies \pi_3 \) no longer raises enough revenue.
  \[ \implies \text{CB raises money growth & inflation to } \pi_4, \]
  which is now past the revenue-maximizing hump.
  A foolish government might chase its target indefinitely.
Seignorage $= \pi L(\pi)$ with functional form $L(\pi) = e^{a - \lambda \pi} Y$.

Assume govt. requires seignorage 92% of GDP.
Appendix: Exchange rates in hyperinflations

Mugabe vs Milosevic

Increases in the exchange rate

Sources:
(Marks/USD) - Thomas J. Sargent, Rational Expectations and Inflation, 2nd ed. (New York: Harper Collins, 1993); (Dinar/USD) - Steve Hanke; (ZWD/USD) - Imara Asset Management Zimbabwe
The exchange rate in Zimbabwe’s hyperinflation

"Parallel rate" (black market)

Official rate