Aggregate Supply and Imperfect Information

There is strong evidence for the non-neutrality of money.

But, in the classical (RBC) model:

- prices are flexible
- the (vertical) LRAS is the only relevant supply curve
- movements in aggregate demand have no effect on output
- money is neutral

How can we simultaneously have market-clearing/flexible prices and a demand-driven story of fluctuations?

Informational Assymmetries can explain a non-vertical SRAS and monetary nonneutrality.

1. Friedman’s Worker Misperceptions Model
2. Lucas’ Island Model
The Worker Misperceptions Model of Friedman

Workers have *imperfect* information about the general price level.

Worker’s labor supply decisions are based on expected prices, but firm’s labor demand is based on actual prices.

Justification:

- Firms’ labor demand depends on real wage in terms of the own-product price, which they know.
- Workers consume a basket of goods whose current prices they may not all know.
The Worker Misperceptions Model of Friedman

\[ Y = AK^\alpha N^{1-\alpha} \Rightarrow \frac{dY}{Y} = \frac{dA}{A} + \alpha \frac{dK}{K} + (1 - \alpha) \frac{dN}{N} \] (Production)

\[ N = \left( \frac{W}{P^e} \right)^\xi \Rightarrow \frac{dN}{N} = \xi \frac{dW}{W} - \xi \frac{dP^e}{P^e} \] (Labor Supply)

where \( P^e \) is the expected price level

\[ \frac{W}{P} = A \left( \frac{K}{N} \right)^\alpha \Rightarrow \frac{dW}{W} - \frac{dP}{P} = \frac{dA}{A} + \alpha \frac{dK}{K} - \alpha \frac{dN}{N} \] (Labor Demand)

where \( P \) is the actual price level
The Worker Misperceptions Model of Friedman

\[
\frac{dY}{Y} = \frac{1 + \xi}{1 + \alpha \xi} \frac{dA}{A} + \frac{1 + \xi}{1 + \alpha \xi} \frac{dK}{K} + \frac{(1 - \alpha) \xi}{1 + \alpha \xi} \left( \frac{dP}{P} - \frac{dP^e}{P^e} \right)
\]

\[
= \frac{d\bar{Y}^{LRAS}}{\bar{Y}^{LRAS}} + \frac{(1 - \alpha) \xi}{1 + \alpha \xi} \left( \frac{dP}{P} - \frac{dP^e}{P^e} \right)
\]

The aggregate quantity of output supplied rises above the natural level \(Y^{LRAS}\) when the aggregate price level \(P\) is higher than expected \(P^e\).

This makes the AS curve slope upward!

\[
Y^{SRAS} = \bar{Y} + b(P - P^e)
\]

where \(b > 0\)
The Worker Misperceptions Model of Friedman

\[
\frac{dY}{Y} = \frac{d\bar{Y}^{LRAS}}{\bar{Y}^{LRAS}} + \frac{(1 - \alpha)\xi}{1 + \alpha\xi} \left( \frac{dP}{P} - \frac{dP^e}{P^e} \right)
\]

Note that this model also suffers from Critique 1 (Elasticity of labor supply)

- \(\xi\) high: large response of \(Y\) to price level misperception
- \(\xi\) low: small response of \(Y\) to price level misperception

The slope of the SRAS curve is smaller the larger is \(\xi\).

Explaining large fluctuations in \(Y\) requires large \(\xi\).
Monetary Policy and the Misperceptions Theory

\[ Y^{SRAS} = \bar{Y} + b(P - P^e) \]

*Unanticipated* monetary policy has real effects, \((P - P^e) \neq 0\);

*Anticipated* monetary policy has no real effects, \((P - P^e) = 0\)

Unanticipated increase in money supply shifts AD curve.

As people get information about the true price level, their expectations change, and the SRAS curve shifts left.

Unanticipated money is not neutral in the short run, but it is neutral in the long run.

Anticipated money is neutral in the short and long run.
An Unanticipated Increase in the Money Supply

1. Money supply increases
2. Expected price level rises
An Anticipated Increase in the Money Supply

1. Money supply increases

2. Expected price level rises
Lucas’ Islands Model

Workers in Misperceptions model are rather myopic.

Lucas’ island assumes agents are better informed about local conditions.

Assume $N$ ‘islands’ indexed by $i$ of firm/workers.

Each island produces $y_i$ sold at own product price $P_i$ with supply function

$$y_i = \bar{y}_i + \alpha(p_i - P_i^e), \quad \alpha > 0$$

$P_i^e$: Expected general price level in island $i$.

$P = \sum_{i=1}^{N} p_i$: Actual general price level

$Y = \sum_{i=1}^{N} y_i$: Aggregate Supply of Goods.
Lucas’ Islands Model

Suppose

\[ p_i = P + u_i \]
\[ P = P_0 + \nu \]

\( u_i \): island-specific shock only observed at island \( i \)
\( \nu \): economy-side shock not directly observed by producers

\( P_0 \): Previous general price level (observed).

\( u_i \) and \( \nu \) are normal random variables with mean zero and variances \( \sigma^2_u \) and \( \sigma^2_\nu \).
Lucas’ Islands Model

How does each island form expectations $P_i^e$ about the general price level after observing $p_i$?

$$p_i = P_0 + u_i + v$$

If change in $p_i$ is due to idiosyncratic shock $u_i$: adjust production.

If change in $p_i$ is due to economy wide shock $v$: do not adjust production.

**Signal Extraction Problem:** given $P_0$, $p_i$ and $\sigma_u^2$ and $\sigma_v^2$ are known, the mathematical (rational) expectation is

$$P_i^e = (1 - \theta)p_i + \theta P_0 \text{ where } 0 \leq \theta = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} \leq 1$$
Lucas’ Islands Model

The expected price level is a weighted average of the island own price $p_i$ and the last observation of the general price level.

The weights depend on the relative variance of the idiosyncratic and economy wide shocks.

The AS curve is

$$ Y = \sum_{i=1}^{N} y_i = \sum_{i=1}^{N} \bar{y}_i + \alpha \left( \sum_{i=1}^{N} p_i - \sum_{i=1}^{N} P_i^e \right) $$  \hspace{1cm} (1)

$$ = \bar{Y}^{LRAS} + \alpha \left( \sum_{i=1}^{N} p_i - (1 - \theta) \sum_{i=1}^{N} p_i - \theta P_0 \right) $$ \hspace{1cm} (2)

$$ = \bar{Y}^{LRAS} + \alpha (P - (1 - \theta)P - \theta P_0) $$ \hspace{1cm} (3)

$$ = \bar{Y}^{LRAS} + \alpha \theta (P - P_0) $$ \hspace{1cm} (4)

where $\bar{Y}^{LRAS} \equiv \sum_{i=1}^{N} \bar{y}_i$. 
Lucas’ Islands Model

The AS curve is

\[ Y = \bar{Y}^{LRAS} + \alpha \theta (P - P_0) \] (5)

The AS curve is upward sloping \( \alpha \theta > 0 \).

The slope depends on \( \theta \), which is not invariant.

Attempts to systematically exploit the upward slope of the AS curve through more interventionist policies will raise \( \sigma_v^2 \) and lower \( \theta \).

**Lucas critique:** Policies can not be evaluated based on historical reduced form relationships as these relationships will change with the policies.
Rational Expectations

Traditional (IS/LM) analyses took expectations as given or was based on backward looking models.

Examples:

- **Extrapolative Expectations**
  \[ X_t^e = X_{t-1} + \gamma (X_{t-1} - X_{t-2}) \]

- **Adaptive Expectations**:
  \[ X_t^e = X_{t-1} + \gamma (X_{t-1} - X_{t-1}^e) \]

- **Regressive Expectations**:
  \[ X_t^e = X_{t-1} + \gamma (\bar{X} - X_{t-1}) \]

  \( \bar{X} \) is long run equilibrium value, \( \gamma \) is a parameter

\( X_t^e \) denotes the expected value of \( X \) in period \( t \)
\( X_t \) denotes the actual value of \( X \) in period \( t \)
The Role of Rational Expectations

These models all imply that economic agents make systematic errors in forecasting.

*You can fool all the people some of the time, and some of the people all the time, but you cannot fool all the people all the time*

A. Lincoln

Lucas advocated **rational expectations** (Muth, 1961):

Agent’s subjective expectations correspond to the objective expectations conditional on all available information.
The Role of Rational Expectations

The **rational expectations hypothesis** suggests that the public’s forecasts of economic variables are well-reasoned and use all the available data.

This has strong implications for policy analysis.

The only way the Fed can use monetary policy to affect output is to surprise people.

But people realize that the Fed would want to increase the money supply in recessions and decrease it in booms.

Rational Expectations leads to the **Policy Ineffectiveness Proposition** (T. Sargent and N. Wallace).
Systematic increases in the money supply during recessions are anticipated and therefore ineffective.
What Should Monetary Policy Do?

Given the Policy Ineffectiveness Proposition, monetary policy cannot stabilize output fluctuations.

So what should the Fed do?

In order to not be a source of output fluctuations, monetary policy should follow a simple predictable rule.

Any rule, including an arbitrarily complicated or a very simple one, will do.

Fed watchers and professional forecasters will figure it out.
Evidence on PIP

Do the data support the PIP?

Robert Barro found support for the misperceptions theory:

1. Estimate a monetary policy rule to deduce the “predictable” component
2. The deviations from the estimated rule are proxies for “monetary surprises”.
3. Estimate the impact on output of the predictable component and the monetary surprises separately.

His results suggested that output was affected only by the monetary surprises.
Evidence on PIP

But others challenged these results and found that both anticipated and unanticipated money growth seem to affect output.

One of the problems of Barro’s approach is observational equivalence.

Suppose the PIP does not hold and anticipated monetary policy is effective.

Suppose that the Fed was perfectly able to stabilize output.

You would find no relation between output and predictable monetary policy, just as Barro, but for different reasons.
Evidence on Rational Expectations

Are price forecasts rational?

- Economists can test whether price forecasts are rational by looking at surveys of people's expectations.
- The forecast error of a forecast is the difference between the actual value of the variable and the forecast value.
- If people have rational expectations, forecast errors should be unpredictable random numbers; otherwise, people would be making systematic errors and thus not have rational expectations.
Are Price Forecasts Rational?

Many statistical studies suggest that people do not always have rational inflation expectations about inflation.

- But people who answer surveys may not have a lot at stake in making forecasts, so couldn’t be expected to produce rational forecasts.
- Instead, professional forecasters are more likely to produce rational forecasts.
- Keane and Runkle, using a survey of professional forecasters, find evidence that these forecasters do have rational expectations.
- Croushore used inflation forecasts made by the general public, as well as economists, and found evidence broadly consistent with rational expectations, though expectations tend to lag reality when inflation changes sharply.
Are Price Forecasts Rational?

Forecasters made very bad forecasts of inflation around 1973 to 1974 and again around 1979 to 1980 (large rises in oil prices).

Looking at data on interest rates, if you take nominal interest rates and subtract the expected inflation rate (using the professional forecasts of inflation), the resulting real interest rates are nearly always positive.

But if you subtract actual inflation rates from nominal interest rates, you'll find negative realized real interest rates around the time of the oil price shocks.

In fact, the real interest rate was as low as negative 5% at one point.

So making bad inflation forecasts has expensive consequences in financial markets.
Measuring Expected Inflation

interest rate differential = TIPS spread
Conclusion

New Classical/RBC models assume flexible prices, (labor) market clearing and rational expectations.

**Standard classical/RBC model:**
- Business cycles must be due to AS shocks
- Monetary policy is neutral

**Neo-classical models with Informational Asymmetries**
- Business cycles can be due to AS shocks and AD shocks
- Only monetary *surprises* are not neutral
- Monetary policy cannot be used to stabilize the cycle (PIP)

Next: **New Keynesian models**: sticky prices/wages and involuntary unemployment, but keep rational expectations.