

ECON 3510 - INTERMEDIATE MACROECONOMIC THEORY

Fall 2013

Mankiw, *Macroeconomics*, 8th ed., Chapter 14

Chapter 14: The Tradeoff Between Inflation and Unemployment

Key points:

- Derivation of the AS curve
- Derivation of the Phillips curve
- How expectations affect the inflation/unemp tradeoff

Theory of AS:

- We spent a lot of time deriving AD
- Now we'll derive the theory of AS
- Note: This is a bit messy
- Move from extreme case of horizontal SRAS to and SRAS with some slope to it
- Goal: and SRAS of the form: $Y = \bar{Y} + \alpha(P - EP)$, $\alpha > 0$
 - i.e., we want an SRAS where output increases with prices
- Two models to get there:
 1. Sticky price model
 - Some firms can change prices, some can't each period
 2. Imperfect information model
 - All firms can adjust price
 - But firms lack info about how to adjust prices
 - Can't tell if increase in the price of their own output from increased demand or increases in price level

Sticky price model:

- Some firms can change prices flexibly
- Some firms have stocky prices
 - Can set prices in advance
 - But can't change prices in short run
- If can change price, set price according to: $p = P + a(Y - \bar{Y})$
 - p is firm's price
 - P is overall price level
 - That is, increase price if:

- * Overall price level increases
- * Output higher than natural (Long-run) level, \bar{Y}
- If can't change prices every period, set price according to: $p = EP + a(EY - E\bar{Y})$
 - EP denotes expected price level
 - EY denotes expected output
 - $E\bar{Y}$ denotes the expected natural rate of output
 - Assume that $EY = E\bar{Y}$
 - $\Rightarrow p = EP$ for those who can't change price
- In overall economy, assume fraction s of firms have sticky prices
- Price level of overall economy is average of all firms:

$$- \Rightarrow P = \underbrace{sEP}_{\text{Those w/ sticky prices}} + \underbrace{(1-s)[P + a(Y - \bar{Y})]}_{\text{For those w/o sticky prices}}$$
- Solve overall price level for P :
 - $P = sEP + (1-s)[P + a(Y - \bar{Y})]$
 - $P - (1-s)P = sEP + (1-s)[a(Y - \bar{Y})]$
 - $\frac{sP}{s} = \frac{sEP + (1-s)[a(Y - \bar{Y})]}{s}$
 - $P = EP + [(1-s)\frac{a}{s}](Y - \bar{Y})$
- What this means:
 - When expect high prices, set prices higher and this causes others to set prices higher so $P \uparrow$
 - When output high, demand is high, so flexible price firms increase prices and $P \uparrow$
- Can rearrange and get AS curve of form $Y = \bar{Y} + \alpha(P - EP)$
 - $P = EP + [(1-s)\frac{a}{s}](Y - \bar{Y})$
 - $\Rightarrow P - EP = [(1-s)\frac{a}{s}](Y - \bar{Y})$
 - $\Rightarrow \frac{P-EP}{[(1-s)\frac{a}{s}]} = Y - \bar{Y}$
 - $\Rightarrow Y = \bar{Y} + \underbrace{\frac{s}{(1-s)a}}_{\alpha} [P - EP]$

Imperfect info model:

- All firms can adjust price
- But firms lack info on how to adjust prices
- In particular, they observe changes in the prices of others, but are not sure if this is due to increased demand for their product (a change in relative prices) or increases in the price level
- So if $P \uparrow$ more than expect, increase Y
- \Rightarrow AS of form $Y = \bar{Y} + \alpha(P - EP)$

SRAS

- Both theories of price setting behavior imply an SRAS curve of the form $Y = \bar{Y} + \alpha(P - EP)$
- NOTE: When we draw SRAS, it's usually with P on vertical and Y on horizontal axis - so slope of SRAS = $\frac{1}{\alpha}$
- So while they rely on different "micro-foundations", they give the same result
- There is empirical support for both models
 - Sticky price: countries with high inflation have more flexible prices
 - * \Rightarrow AS curve steeper (b/c s smaller, α bigger)
 - * These countries show more response to AD shocks
 - Imperfect info: countries with large AD shocks have firms who response less to change in P
 - * B/c lots of fluctuations in P , firms don't read much into changes in price level when setting own prices
 - * In terms of the model, this means that α is small and the AS is steep
 - * These countries show less response to AD shocks
- DRAW SRAS and LRAS. Note slope of SRAS = $\frac{1}{\alpha}$, Note that LRAS and SRAS intersect at \bar{Y} and $P = EP$

SRAS and AD together again

- DRAW SRAS, LRAS, AD. Show shift out in AD due to increase in M.
 - Notes that $Y_1 = \bar{Y} + \alpha[P_1 - EP_1] = \bar{Y} + \alpha[0] = \bar{Y}$
 - $Y_2 = \bar{Y} + \alpha \underbrace{[P_2 - EP_2]}_{>0} > \bar{Y}$
 - Then expectations change:
 - * $EP_3 > EP_2$
 - * Change in EP is a shift in AS
 - * DRAW $SRAS_2$, noting changes in prices and changes in expected prices
 - * $Y_3 = \bar{Y} + \alpha \underbrace{[P_3 - EP_3]}_{=0} = \bar{Y} + \alpha[0] = \bar{Y}$
- Implication:
 - Money neutral in longer run
 - Money not neutral in short run
 - Get both results in same model - meaning they are consistent with each other.

Deriving the Phillips Curve

- Want to relate inflation to:
 - Expected inflation
 - Cyclical unemployment (deviation in unemp from its natural rate)
 - Supply shocks
- So, looking for equation like: $\pi = \underbrace{E\pi}_{\text{Expect inflation}} - \beta \left(\underbrace{u - u^n}_{\text{unemp - natural rate}} \right) + \underbrace{v}_{\text{supply shock}}$

- Note the negative sign in front of β (β is a constant)
 - \Rightarrow inflation higher if unemployment is lower (i.e., they move in opposite directions)
- How do we get an equation like this?
 - $SRAS = Y = \bar{Y} + \alpha(P - EP)$
 - rearranging $\Rightarrow P = EP + (\frac{1}{\alpha})(Y - \bar{Y})$
 - Add supply shocks:
 - * Exogenous events that shift the price level
 - * $\Rightarrow P = EP + (\frac{1}{\alpha})(Y - \bar{Y}) + v$
 - Put in term of inflation by subtracting P_{-1} from each side ($P_{-1} \equiv$ the price level on period ago)
 - * $\underbrace{P - P_{-1}}_{\pi} = \underbrace{(EP - P_{-1})}_{E\pi} + (\frac{1}{\alpha})(Y - \bar{Y}) + v$
 - * NOTE: $P - P_{-1}$ is not exactly inflation (which is the percentage change), but if we interpret P as the natural log of the price level, then differences do represent percentage changes
 - * $\Rightarrow \pi = E\pi + (\frac{1}{\alpha})(Y - \bar{Y}) + v$
 - Lastly, get unemp in this equation by using Okun's Law
 - * Okun's Law: unemp and output move in opposite directions
 - * $\Rightarrow (\frac{1}{\alpha})(Y - \bar{Y}) - \beta(u - u^n)$
 - * Substitute this in:
 - * $\Rightarrow \pi = E\pi - \beta(u - u^n) + v$
- This is the Phillips equation!
- Directly related to SRAS
 - SRAS relates changes in output to changes in prices
 - Phillips curve related changes in unemployment and changes in prices
 - The two are directly related though Okun's Law

Causes of Inflation

1. Demand-pull inflation

- Low unemployment $\Rightarrow u < u^n \Rightarrow -\beta(u - u^n) > 0$
 - $\Rightarrow \pi \uparrow$
 - High aggregate demand b/c more people working pushes up price level

2. Cost-push inflation

- Higher input costs from adverse supply shock
- $v \uparrow \Rightarrow \pi \uparrow$

The Short-run tradeoff between inflation and unemployment

- Policy makers options lie along the Phillips curve:
 - DRAW downward sloping Phillips curve with π on vertical and u on horizontal axes. Mark point where u^n correspond to $E\pi + v$

- If want lower inflation, must settle for higher unemployment.
- If want lower unemp, must settle for higher inflation.
- Central bank limitations
 - The Fed’s objective (according to the Federal Reserve Act (1913)): “maximum employment, stable prices, and moderate long-term interest rates”
 - Is this impossible?
 - Many other central banks have controlling inflation as their sole objective (e.g., UK, NZ, AUS, CAN)
- Note what shifts Phillips curve
 - A change in $v \Rightarrow$ cost push inflation
 - * $\uparrow v \Rightarrow$ shift out Phillips curve
 - * DRAW Phillips curve and one shifted to right
 - A change in expected inflation, $E\pi$
 - * $\uparrow E\pi \Rightarrow$ shift out Phillips curve
 - * DRAW Phillips curve and one shifted to right
 - When the Phillips curve shifts out, the policy maker’s situation become worse - must accept more inflation for given level of unemp (and vice-versa)

The importance of expectations

- Expectations of inflation move the Phillips Curve - they are important for the policy maker!
- This is why you see such attention paid to the Fed FOMC meeting minutes - every phrase of Chairman’s statement, etc are dissected - and he/she knows this so is very careful with language so that proper expectations are set.
- Two main ways to model expectations:
 1. Adaptive expectations
 - $E\pi = \pi_{-1}$ - you use the past to form expectations about future
 - $\Rightarrow \pi = \pi_{-1} - \beta(u - u^n) + v$
 - So if there is a positive shock to v , inflation is going to be permanently increased (for a given level of unemp)
 - To see this:
 - Assume $\pi_0 = 0$ and set π such that $u = u^n$
 - $\pi_1 = \pi_0 + v_1$
 - Assume $v_1 > 0$ and $v_t = 0$, for all $t > 1$
 - $\Rightarrow \pi_1 = v_1$
 - $\Rightarrow \pi_2 = \pi_1 = v_1$
 - $\Rightarrow \pi_3 = \pi_2 = \pi_1 = v_1$
 - And on and on...
 - DRAW shift out in Phillips curve.
 - This idea is called inflation inertia - that inflation tends to stay at where it’s been in the past
 2. Rational Expectations
 - Don’t use past to guess future - make forward looking projections
 - Not as much inertia in inflation as with adaptive expectations

- Makes Fed talk very important
- Result of these expectations: Less/no tradeoff between inflation and unemployment even in short run
- This is because Fed can lower $E\pi$ by changing expectations
- Thus they get lower inflation with no change in unemp even if adverse supply shock
- DRAW Phillips curve shift out as v increases then back as Fed sets expectations lower
- Mainstream macroeconomists mostly use these types of expectations in models