Readings

- GLS Ch. 24
Dynamics

- The New Keynesian model is a special case of the neoclassical model – we simply swap labor demand with an AS curve, most general form of which is:

\[ P_t = \bar{P}_t + \gamma(Y_t - Y_t^f) \]

- Call \( Y_t^f \) the “flexible price” level of output – the level of output which would emerge in the neoclassical model.
- If firm could freely adjust price, it would do so such that it is on its labor demand curve, which would entail \( Y_t = Y_t^f \).
- Refer to \( Y_t - Y_t^f \) as the output gap – the gap between actual output and what it would be in the absence of price stickiness.
- To see this graphically, draw in a hypothetical AS curve for the neoclassical model – call this \( AS^f \).
A Negative Output Gap

Sticky price model
Hypothetical flexible price model

0 subscript: equilibrium value
f superscript: hypothetical flexible price equilibrium

\[ r_t = \gamma_{0,t}, \theta_{0,t}, N_{0,t}, f \]

\[ P_{0,t}, P_{0,f} \]

\[ w_{0,t}, w_{0,f} \]

\[ N^d(w_t, A_t, K_t) \]

\[ N^s(w_t, \theta_t) \]

\[ LM(M_t, P_{0,t}) \]

\[ LM(M_t, P_{0,f}) \]

\[ Y_t = Y_t \]

\[ Y_t \]

\[ r_t \]

\[ IS \]

\[ AD \]

\[ AS \]

\[ AS^f \]
Transition from Short Run to Medium Run

- With a negative output gap, the firm is producing less than it would like.
- The reason the gap exists is because a friction (e.g. menu cost) prevents it from lowering price all the way necessary to close the gap.
- Given equilibrium real wage, firm would like to hire more labor. But only way to put more labor to use is to have more demand for output, which would require a drop in \( P_t \).
- Once it is given the opportunity to do so, the firm will change \( \bar{P}_t \) in such a way that the AS curve intersects the AD curve at \( Y_t^f \).
- Hence, as we transition from short run (price sticky) to medium run (price flexible), the exogenous component of the price level, \( \bar{P}_t \), will adjust so as to shift the AS curve and “close the gap”.
- We will not use different time subscripts or anything to think about this transition, so this is admittedly a bit loosey-goosey.
Closing a Negative Output Gap

\[ Y_t = Y_t \]

\[ N^d(w_t, A_t, K_t) \]

\[ N^s(w_t, \theta_t) \]

0 subscript: equilibrium value
f superscript: hypothetical flexible price equilibrium
1 subscript: equilibrium value after price adjustment

\[ w_{0,t} = w'_{0,t} \]

\[ r_{1,t} = r_{0,t} \]

\[ P_{0,t}, P_{1,t} \]

\[ \bar{P}_{0,t}, \bar{P}_{1,t} \]

\[ L(M_t, P_{0,t}) \]

\[ L(M_t, P_{1,t}) \]

\[ IS \]

\[ AS \]

\[ AD \]

\[ LM(M_t, P_{0,t}) \]

\[ LM(M_t, P_{1,t}) \]
Dynamic Response to Shocks

- We shall assume that the economy initially sits in the neoclassical, no output gap equilibrium.
- Then something exogenous changes and causes either the $AD$ or $AS$ to shift.
- This will in general result in a non-zero output gap in the short run.
- This will put pressure on $\bar{P}_t$ to adjust to shift the $AS$ curve to close the gap.
Monetary Shock, $↑ M_t$
Monetary Neutrality, Short Run vs. Medium Run

- Money is non-neutral in the short run – $AD$ shifts when $M_t$ changes which causes $Y_t$ (and $r_t$ and other real variables) to change

- But this puts pressure on $\bar{P}_t$

- As economy transitions to medium run, $\bar{P}_t$ adjusts in such a way as to close the output gap, and the neoclassical equilibrium emerges – money is neutral and the classical dichotomy holds
Supply Shock, $\uparrow A_t$

Original, hypothetical flexible price

Post-shock, indirect effect of $P_t$ on LM curve

Post-shock, post-price adjustment

0 subscript: original

1 subscript: post-shock

2 subscript: post-shock, post price adjustment

$P_{0,t} = P_{0,t}$

$N^d(w_t, A_{0,t}, K_t)$

$N^s(w_t, \theta_t)$

$A_{0,t}F(K_t, N_t)$

$A_{1,t}F(K_t, N_t)$

$LM(M_t, P_{2,t})$

$LM(M_t, P_{1,t})$

$LM(M_t, P_{0,t})$

$r_t$

$r_{0,t}$

$r_{2,t}$

$r_{3,t}$

IS

$AD$

$N_t$ $N_{0,t}$ $N_{2,t}$

$Y_t$

$Y_{0,t}$ $Y_{1,t}$ $Y_{2,t}$

$Y_t = Y_t$

$Y_{0,t} = Y_{0,t}$ $Y_{1,t} = Y_{1,t}$
Supply Shock Dynamics

- Output *under-reacts* to $A_t$ in the short run (the more so the flatter is the $AS$ curve, i.e. the smaller is $\gamma$)
- The price level falls, but not enough to implement the neoclassical equilibrium
- At new short run equilibrium, firm would like to produce more. Must lower price in order to do this. So downward pressure on $\bar{P}_t$
- $AS$ shifts as economy transitions through time to restore neoclassical equilibrium
IS Shock, e.g. $\uparrow A_{t+1}$
IS Shock Dynamics

- After a positive IS shock, $Y_t$ and $P_t$ both rise
- But at new equilibrium, firm is producing more output than it would find optimal (i.e. labor input exceeds quantity of labor firm would demand at equilibrium real wage)
- Firm wants to reduce labor, which requires increasing $P_t$ to reduce demand
- This results in $\bar{P}_t$ rising, AS shifting in, and neoclassical equilibrium being restored
Our discussion about dynamics above suggests there ought to exist some kind of relationship between the output gap and the change in prices (i.e. inflation).

Subtract previous period’s price level from both sides of AS relationship:

\[ P_t - P_{t-1} = \bar{P}_t - P_{t-1} + \gamma(Y_t - Y_f^t) \]

Normalize previous period’s price level to \( P_{t-1} = 1 \), which means we can re-interpret changes as percentage changes. Call \( \pi_t^e = \frac{\bar{P}_t - P_{t-1}}{P_{t-1}} \) the inflation rate expected to obtain between \( t - 1 \) and \( t \). Firm sets \( \bar{P}_t \) where if it guesses inflation correctly it will produce \( Y_t = Y_f^t \). Then:

\[ \pi_t = \pi_t^e + \gamma(Y_t - Y_f^t) \]

An equation like this is called a Phillips Curve after Phillips (1958).
Empirical Relationship Between Inflation and the Output Gap

- Pretty weak – more of a “blob” than a clear positive relationship
“Wrong” sign in early sample; looks much closer to theory in later sample
What Gives?

- Does the fact that the sign of the correlation looks “wrong” invalidate the theory?
- Not necessarily – correlation between gap and inflation should only be positive holding \( \pi^e_t \) (equivalently \( \bar{P}_t \)) fixed
- What do inflation expectations look like in data?
- Large and volatile in early sample; much more stable in later sample
Expected Inflation

![Graph showing Mean Expected Inflation over time. The graph has a timeline from 1960 to 2015 and the y-axis shows inflation rates from 0 to 10. There is a notable peak around 1980 and a general decline thereafter.]
Can Monetary Policy Permanently Engineer Higher Output?

- No
- Can temporarily raise output by increasing $M_t$, but in medium run this puts upward pressure on prices and the effect goes away
- Continually trying to raise output will only result in more inflation
- Further, it may cause the firm to anticipate the change in $M_t$, which could cause the AS curve to shift simultaneously with the AD shift, resulting in no effect of monetary expansion on output
- It is really only unanticipated monetary expansion that can stimulate output, and even then only for a while
Fully Anticipated Increase in $M_t$, so that $\bar{P}_t$ also rises

0 subscript: initial equilibrium
1 subscript: post-shock equilibrium where $M_t$ increases but this is anticipated and reflected in $\bar{P}_t$
Costless Disinflation

▶ Can central bank lower prices (disinflation) without incurring an output loss?

▶ Conventional wisdom for 1980-1982 recession was that it was caused by Fed trying to get inflation under control (negative monetary shock)

▶ Suppose that the Fed announces in advance that it is going to reduce $M_t$. If people believe this, prices may adjust down in anticipation, causing AS curve to shift down at same time the AD shifts in

▶ In principle, this allows for a reduction in $P_t$ with no change in $Y_t$ – i.e. costless disinflation

▶ Underscores importance of central bank *credibility* and *communication*: for this to work, people must believe the central bank, and the central bank must clearly communicate its objectives