1. **Dynamic New Keynesian (DNK) Model.** (60 pts) Consider the following variation of the DNK model:

\[\pi_t = \lambda y_t + E_t \pi_{t+1} + \epsilon_{\pi,t}\]  

(Phillips Curve)

\[y_t = y_{t-1} - \pi_t + g_t\]  

(Aggregate Demand)

where \(g_t\) is the growth rate of the money stock \(m_t\), \(\pi_t\) is inflation, \(\epsilon_{\pi,t}\) is a cost-push shock, and \(g_t\) follows an exogenous, mean-zero process: \(g_t = \rho g_{t-1} + \epsilon_{m,t}\). All variables are measured in logs.

(a) (10 pts) Why is \(\lambda > 0\) in the short run?

**Solution.** There are several theories to explain an upward-sloping short-run aggregate supply curve. One of the most popular is the sticky-price model and Calvo’s price adjustment process. Under Calvo’s model, each firm has a fixed probability of changing their price in each period. The fact that some firms update their price while others leave price fixed generates an upward-sloping Phillips curve.

(b) (10 pts) Solve for the rational expectations equilibrium (REE) for \(y_t\). [Hint: If you use undetermined coefficients, guess an AR(1) process for \(y_t\) with coefficient \(\phi\).]

**Solution.** Start by substituting aggregate demand into the Phillips curve:

\[y_{t-1} - y_t + g_t = \lambda y_t + E_t[y_t - y_{t+1} + g_{t+1}] + \epsilon_{\pi,t}\]

Then substitute for \(E_t y_{t+1}\) and \(E_t g_{t+1}\). Re-arranging, we get:

\[y_t = \left[\frac{1}{2 + \lambda - \phi}\right] y_{t-1} + \left[\frac{1}{2 + \lambda - \phi}\right] [(1 - \rho) g_t - \epsilon_{\pi,t}]\]

Equating coefficients, we get

\[\phi^2 - (2 + \lambda)\phi + 1 = 0\]

The two roots are

\[\phi_{1,2} = \frac{(2 + \lambda) \pm \sqrt{(2 + \lambda)^2 - 4}}{2}\]

The REE for \(y_t\) is therefore an AR(1) process with two possible coefficients: \(\phi_1\) and \(\phi_2\).

(c) (10 pts) Contrast the REE for \(y_t\) to the solution under naive expectations.

**Solution.** The solution under naive expectations is

\[y_t = -\frac{1}{\lambda} \epsilon_{\pi,t}\]

so that output depends solely on the supply-side shocks.
(d) (10 pts) What are the short-run and long-run effects of a permanent increase in the level of $m_t$ under rational expectations? Use a graph to assist your explanation.

**Solution.** In the short-run, the increase in the level of $m_t$ causes a temporary increase in $y_t$ and $\pi_t$. However, as time passes and all firms get the opportunity to change price, inflation and output will return to their previous steady-state levels. There are no long-run effects on output and inflation, but the price level is permanently higher.

(e) (10 pts) What are the short-run and long-run effects of a permanent increase in the growth rate of $m_t$ under rational expectations?

**Solution.** In the sticky-price DNK model, the inflation rate is not sticky and all firms have the ability to incorporate overall inflation into their pricing. Therefore, there are no short-run or long-run impacts on output, but inflation is permanently higher.

(f) (10 pts) Assume Chairman Bernanke announces today that the central bank will increase the growth rate of the money supply starting in January 2013. Contrast the transition path for the sticky-price DNK model above with the transition path for the sticky-information model of Mankiw and Reis (2002).

**Solution.** The sticky-price DNK model predicts an immediate recession. This is because Calvo firms know that they may not be able to adjust price when the Fed starts printing more money. Therefore, they will raise price in anticipation of the expansionary policy, creating an immediate recession. In Mankiw and Reis’ sticky-information model, there is no immediate recession because firms have flexible prices. Firms that gradually become informed about the policy will wait until January 2013 and then increase their price level. The result is a small boom with a higher inflation rate.

2. **Great Depression and Modern Macro Theory.** (40 pts) Use the three business-cycle paradigms presented in class (Classical, New Keynesian, and Farmerian) to explain the deep and prolonged downturn in macroeconomic activity from 1929 to 1939. Your explanation should include the abandonment of the gold standard, NIRA and the New Deal. (I am not looking for a regurgitation of the Great Depression articles we read in class, but rather a thoughtful discussion of how these models might propagate shocks through the macroeconomy given the political and institutional constraints of the time.)