1. Consider the Carlstrom-Fuerst model of agency costs. Assume there are two types of agents, entrepreneurs and lenders, both risk neutral. Entrepreneurs enter the period with net worth of \( n \) and have access to a stochastic technology that contemporaneously transforms \( i \) units of consumption goods into \( \omega i \) units of capital, with \( i \) distributed \( i.i.d., \ i > 0, \ E(i) = 1 \), with distribution \( \Phi \) and density \( \phi \). The shock, \( \omega \), is privately observed by entrepreneurs but can only be observed by lenders by incurring a monitoring cost of \( \mu i \) capital units. The lending contract stipulates an interest rate \( r^k \). Thus, an entrepreneur borrows \( (i - n) \) and repays \( (1 + r^k) (i - n) \). The entrepreneur defaults if the projects returns are insufficient to pay back the loan; in this case, the lender incurs the monitoring costs and confiscates all the returns on the project. Given this environment, answer the following

(a) Define the lower bound of the technology shock \( \omega \) that determines solvency; i.e., for values \( \omega < \bar{\omega} \) entrepreneurs default on the loan.

(b) Show that the optimal debt contract can be defined in terms of \( (i, \omega) \).

(c) Calculate expected lender’s and entrepreneurial’s income as a function of \( (i, \omega) \).

(d) Design the optimal contract as the pair \( (i, \omega) \) that maximizes entrepreneur’s expected returns subject to the lender being indifferent between lending or retaining the funds. Derive and interpret the necessary conditions associated with this contract.

(e) Describe the roles that net worth and monitoring costs play in the equilibrium characteristics of this model.

2. An economy is populated by a representative household that makes labor, consumption and asset choices in order to maximize:

\[
E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[ \ln c_t + \ln \left( \frac{M_t}{P_t} \right) + A (1 - h_t) \right] \right\}
\]

where \( c_t \) denotes consumption, \( M_t \) is money chosen in period \( t \), and \( h_t \) denotes labor. In addition to labor income, the household is supplied with one unit of
of capital which it rents to firms at the nominal price of \( R_t \). (There is no investment in the economy, \( k_t = 1 \) for all \( t \).) The income from labor and capital is combined with the income from one period nominal bonds purchased in the previous period and beginning of period money holdings in order to finance consumption, new bond purchases and the acquisition of new money. (Note that the household does not acquire new capital - hence the aggregate capital stock is fixed at one.) Also, the household receives a lump sum monetary transfer from the government, denoted \( T_t \).

Firms in the economy hire capital and labor in order to maximize profits. These inputs are used to produce output, \( y_t \), using a constant returns to scale technology:

\[
y_t = z_t h_{t-1}^{1-\alpha} h_t^\alpha
\]

where \( z_t \) denotes a stochastic technology shock. The law of motion for \( z_t \) is given by

\[
z_t = z_{t-1} \varepsilon_t
\]

where \( \varepsilon_t \) is an i.i.d. shock with \( E(\varepsilon_t) > 1 \). Note that this implies that the economy is, on average, growing over time. The government controls the money supply and adjusts the monetary growth rate according to the current innovation to the technology shock. That is, the money supply is given by:

\[
M_t = (\gamma \varepsilon_t) M_{t-1}
\]

If \( \gamma > 1 \), then the central bank “accomodates” a technology shock; if \( \gamma < 1 \), this can be interpreted as the central bank “leaning against the wind”.

Given this environment, do the following:

(a) Write down the household’s maximization problem as a dynamic programming problem and derive the associated necessary conditions.

(b) Derive the necessary conditions associated with the firm’s maximization problem.

(c) Define a recursive monetary equilibrium. (Again, note that output in this economy is growing over time.)

(d) Characterize the equilibrium behavior of consumption, labor, inflation, and nominal interest rates in this economy.

(e) How does the value of \( \gamma \) affect the equilibrium behavior of nominal interest rates? Explain.

3. Imagine you are an advisor to a new Federal Reserve Bank President. His background is investment banking; he has no formal training as an economist. Write a memorandum outlining:
(a) The main features of dynamic new Keynesian models.
(b) Their most important normative lessons for monetary policy.

4. Discuss the following:

(a) Explain intuitively why optimal monetary policy under commitment is history dependent.
(b) Explain the difference between $t_0$-optimal commitment and commitment from the timeless perspective. In your opinion, which is a more plausible concept of commitment? Why?