Intermediate Macroeconomics: Midterm Review Questions

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October 26, 2012

1. Write down the definition of a competitive equilibrium.

2. Write down the three functions that define money, and discuss which one is the most important.

3. Discuss two different empirical studies that have looked at empirical predictions of the life cycle / permanent income hypothesis. Discuss, using both words and indifference curve-budget line graphs, how borrowing constraints can potentially help reconcile theory with evidence.

4. Suppose that a household expects to live for $T = 50$ periods, and to work for the first $R = 40$ of these periods. Assume that there is a fixed, constant real interest rate across time, $r$.

   (a) Write down the Euler equations that must hold between any two adjacent periods of time.

   (b) If $\beta(1 + r) > 1$, what will be true about the time path of consumption?

   (c) If $\beta(1 + r) < 1$, what will be true about the time path of consumption?

   (d) If $\beta(1 + r) = 1$, what will be true about the time path of consumption?

   (e) Regardless of what $\beta(1 + r)$ is, how much savings will the household end life with? In what period will the stock of savings reach its peak?

   (f) Suppose that $r = 0$ and $\beta = 1$. Suppose that income is 1 in each of the first $R = 40$ periods of life, and 0 during each period of retirement. Provide solutions for (i) the value of consumption in each period of life, (ii) the value of saving in each period of life, and (iii) the stock of savings at the date of retirement.

   (g) Suppose that the household (at the beginning of time) becomes aware that it will win the lottery in period 20, with income in that period equal to 10 (and income in every other non-retirement period still equal to 1). How will this affect your answers for the time paths of consumption and saving?

5. What is the difference between the nominal interest rate and the real interest rate? Write down the Fisher relationship relating the real interest rate to the nominal interest rate and the current and future price levels. Provide some intuition for it. Write down the approximate Fisher relationship as well, relating the real rate, the nominal rate, and the rate of expected inflation.
6. Suppose that a firm wants to maximize its value, equal to the present value of dividends. Dividends today and tomorrow are given by:

\[ \Pi_t = A_t K_t^\alpha N_t^{1-\alpha} - w_t N_t - I_t \]
\[ \Pi_{t+1} = A_{t+1} K_{t+1}^\alpha N_{t+1}^{1-\alpha} - w_{t+1} N_{t+1} - I_{t+1} \]

The value of the firm is:

\[ V = \Pi_t + \frac{\Pi_{t+1}}{1 + r_t} \]

The capital accumulation equation is:

\[ K_{t+1} = I_t + (1 - \delta) K_t \]

(a) What will the firm set \( I_{t+1} \) equal to? Provide some intuition for this.
(b) What are choice variables of the firm?
(c) The firm’s objective is to maximize \( V \) subject to the accumulation equation. Use calculus to derive the first order conditions characterizing optimal behavior by the firm.
(d) Provide some intuition for each of these first order conditions.
(e) Argue that desired employment, \( N_t \), is a decreasing function of \( w_t \), an increasing function of \( A_t \), and an increasing function of \( K_t \).
(f) Argue that desired investment, \( I_t \), is a decreasing function of \( r_t \), an increasing function of \( A_{t+1} \), and a decreasing function of \( K_t \).

7. Suppose that a household wants to maximize its lifetime utility, given by:

\[ U = \ln C_t + \ln(1 - N_t) + \beta \ln C_{t+1} + \beta \ln(1 - N_t) \]

The household faces two period budget constraints:

\[ C_t + S_t = w_t N_t - T_t + \Pi_t \]
\[ C_{t+1} + S_{t+1} = w_{t+1} N_{t+1} - T_{t+1} + \Pi_{t+1} + (1 + r_t) S_t \]

\( \Pi_t \) is distributed dividends from firms, and \( T_t \) is taxes paid to the government.

(a) Explain why \( S_{t+1} = 0 \).
(b) Use that fact to combine the two period budget constraints into one intertemporal budget constraint.
(c) Use calculus to derive the first order conditions characterizing optimal behavior by the household.

8. Write down the definition of Ricardian equivalence and explain its implications.

9. Suppose that we have an endowment economy with a government. Optimal behavior by the household implies that:

\[ C_t = C(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t) \]

The household takes income, government spending, and the real interest rate as given. Total expenditure demand in the economy is given by:

\[ Y_t^d = C_t + G_t \]
(a) Write down the definition of the $Y^d$ curve.

(b) Graphically derive the $Y^d$ curve as we did in class and in the notes.

(c) Since this is an endowment economy, the $Y^s$ curve is vertical. Graphically depict the equilibrium of the economy.

(d) Suppose that there is an increase in the current endowment, $Y_t$. Show how this will affect the equilibrium graphically. Provide some intuition for the effect on the equilibrium real interest rate.

(e) Suppose that there is an increase in the future endowment, $Y_{t+1}$. Show how this will affect the equilibrium graphically. Provide some intuition for the effect on the equilibrium real interest rate.

(f) Suppose that there is an increase in current government spending, $G_t$. Show how this will affect the equilibrium graphically. Provide some intuition for the effect on the equilibrium real interest rate.

(g) Suppose that there is an anticipated increase in future government spending, $G_{t+1}$. Show how this will affect the equilibrium graphically. Provide some intuition for the effect on the equilibrium real interest rate.

Suppose that $u(C_t) = \ln C_t$, so that the consumption function is:

$$C_t = \frac{Y_t - G_t}{1 + \beta} + \frac{Y_{t+1} - G_{t+1}}{(1 + \beta)(1 + r_t)}$$

(h) Use this specification of the consumption function to algebraically derive an expression for the $Y^d$ curve.

(i) Use this algebraic expression to verify your qualitative answers to parts (d)-(g).

(j) Use your algebraic expression to verify that the horizontal shift in the $Y^d$ curve for a one unit change in $G_t$ is 1.

10. Suppose that we have an endowment economy, and that there is an increase in uncertainty over the future endowment. Graphically show how this ought to affect the equilibrium of the economy.

11. For our full production economy, the qualitative functions characterizing equilibrium are as follows:

   Labor market: $N_t^d = N^d(w_t, A_t, K_t)$  
   \hspace{1cm} $N^s_t = N^s(w_t, C_t)$

   Goods market: $C_t = C(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t)$
   \hspace{1cm} $I_t = I(r_t, A_{t+1}, K_t)$

The production function is $Y_t = A_t F(K_t, N_t)$ and total desired expenditure is $Y^d_t = C_t + I_t + G_t$.

(a) Explain why investment is a function of $r_t$ and why the sign of the effect of $r_t$ on $I_t$ is what it is.
(b) Explain why investment is a function of $A_{t+1}$ and not $A_t$.
(c) Write down the definition of the $Y^s$ curve.
(d) Graphically derive the $Y^s$ curve.
(e) Write down the definition of the $Y^d$ curve.
(f) Graphically derive the $Y^d$ curve.
(g) What are the exogenous variables in this model?
(h) What are the endogenous variables in this model?
(i) Graphically show how an increase in each exogenous variable (changing one at a time) will shift the $Y^s$ curve (it’s possible that there is no shift in the $Y^s$ curve). Recall that a shift of the curve is a change in the quantity supplied for a given interest rate.
(j) Graphically show how an increase in each exogenous variable (changing one at a time) will shift the $Y^d$ curve (it’s possible that there is no shift in the $Y^d$ curve). Recall that a shift of the curve is a change in the quantity demanded for a given interest rate.
(k) Graphically show how increases in each exogenous variable (one at a time) will affect the equilibrium of the economy. If there is any ambiguity, state that. In some instances, you may be able to use some math to resolve ambiguity.

12. In our basic production economy, the first order conditions characterizing optimal household and firm behavior in the labor market are:

$$v'(1 - N_t) = u'(C_t)w_t$$
$$w_t = A_tF_N(K_t, N_t)$$

Combine these first order conditions to argue that, in the absence of a change in $A_t$ or $K_t$, that $C_t$ and $N_t$ cannot move in the same direction.

13. What is the definition of the “classical dichotomy”? What does it mean for money to be “neutral”? Provide some intuition for monetary neutrality.

14. Suppose that we have an endowment economy, but one in which there is money. Households get utility from holding “real money balances.” Lifetime utility is:

$$U = \ln C_t + \ln \left( \frac{M_t}{P_t} \right) + \beta \ln C_{t+1}$$

Households have a real endowment each period of $Y_t$ and $Y_{t+1}$. In nominal terms income is $P_t Y_t$ and $P_{t+1} Y_{t+1}$. The household can save in nominal bonds that pay interest $(1 + i_t)$ in period $t + 1$. Let $S_t$ denote real saving and $P_t S_t$ denote nominal saving (the dollar value of real saving). The household faces two period budget constraints:

$$P_t C_t + P_t S_t + M_t = P_t Y_t - P_t T_t$$
$$P_{t+1} C_{t+1} = P_{t+1} Y_{t+1} - P_{t+1} T_{t+1} + (1 + i_t) P_t S_t + M_t$$

(a) Divide each period budget constraint through by that period’s price level to write the period budget constraints in real terms.

(b) What is the Fisher relationship between the real interest rate, the nominal interest rate, and the current and future price levels? Use this to eliminate $i_t$ where you can (which will not be everywhere).
(c) Combine the two period budget constraints into one intertemporal budget constraint by eliminating $S_t$.

(d) Use calculus to find the first order conditions characterizing optimal household behavior.

(e) Manipulate the first order condition for the choice of $M_t$ to express money demand as a function of $P_t$, $i_t$, and $C_t$.

(f) The money supply is set exogenously. Graphically show equilibrium in the money market.

(g) In the long run, assume that the nominal interest rate is constant and that consumption and prices both grow at constant rates, call these $g^c$ and $\pi$, respectively. Also assume that the money supply grows at a constant rate, $g^M$. $g^c$ is exogenous (determined by growth in population and productivity from the Solow model), and $g^M$ is exogenously set by the central bank. Solve for $\pi$. What effect does an increase in $g^M$ have on $\pi$?

(h) In the long run, the real interest rate is determined by $\beta$ and consumption growth. How will an increase in $g^M$ affect the nominal interest rate, $i_t$?

(i) Graphically show how $r_t$ and $P_t$ will react to an unexpected increase in the current endowment, $Y_t$.

(j) Graphically show how $r_t$ and $P_t$ will react to an anticipated increase in the future endowment, $Y_{t+1}$.