

*Partner assignments*

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**1. A Simple IS/LM Model**

Consider the following linear version of the *IS/LM* model:

$$Y = C + I + G \tag{1}$$

$$C = c_0 + c_1(Y - T) + \varepsilon_c \tag{2}$$

$$T = t_0 + t_1Y + \varepsilon_T \tag{3}$$

$$I = i_0 + i_1r + \varepsilon_I \tag{4}$$

$$m - p = m_0 + m_1Y + m_2(r + \pi^e) + \varepsilon_m \tag{5}$$

The variables  $m$  and  $p$  are in logs to preserve linearity of the model. The other variables are levels. Lower-case letters with subscripts are coefficients that are assumed to be constant. The  $\varepsilon$  terms are shocks to the various equations of the model.  $G$ ,  $m$ ,  $p$ , and  $\pi^e$  are exogenous.

- For each of the slope coefficients (coefficients that do not have a subscript of zero), tell whether it is positive or negative and explain why. (Some coefficients must be less than one, so indicate that as well.)
- Why is there no shock term in equation (1)?
- Find the equation for the *IS* curve. What is its slope? Can we determine the sign of the slope? How (if at all) does each of the exogenous variables and shocks affect the *IS* curve?
- Find the equation for the *LM* curve. What is its slope? Can we determine the sign of the slope? How (if at all) does each of the exogenous variables and shocks affect the *LM* curve?

- e. Solve the model for  $Y$ ,  $C$ ,  $I$ ,  $T$ , and  $r$  in terms of the exogenous variables and shocks. Find an expression for the effect of each exogenous variable and shock on the equilibrium values of  $Y$  and  $r$  and, if possible, determine its sign.
- f. Find the equation for the aggregate-demand curve in this model. How (if at all) is the AD curve affected by each of the exogenous variables and shocks?
- g. The “zero-lower bound” constraint on nominal interest rates means that the demand curve for money must flatten as  $i$  approaches zero. If money demand as a function of the interest rate were perfectly flat (with the interest rate on the vertical axis), what would be the limiting value of  $m_2$ ? What would happen to the slopes of the  $IS$ ,  $LM$ , and/or AD curves as a result? What would happen to the effects on  $Y$  of monetary policy (changes in  $m$ ) and fiscal policy (changes in  $G$  or  $\varepsilon_T$ )?

## 2. A Simple Sticky-Wage Model of Aggregate Supply

Suppose that production in this economy is given by the production function

$$y = \alpha k + (1 - \alpha)l + \varepsilon_y. \quad (6)$$

The lower-case letters are again logs, so this is a Cobb-Douglas function with  $\alpha$  being the usual constant parameter, but with a logarithmic shock  $\varepsilon_y$  attached. The capital stock is assumed to be fixed in the short run.

- a. What is the marginal product of labor? (Be careful here, because MPL is  $\frac{\partial Y}{\partial L}$ , not  $\frac{\partial y}{\partial l}$ .)
- b. Suppose that firms set the level of employment so that the marginal product of labor equals the real wage,  $\frac{W}{P}$ . Show the equilibrium condition (and solve it for  $L$  or  $l$  if you can).
- c. If we assume that nominal wages are perfectly sticky, so  $W$  is exogenous, derive the equilibrium relationship between  $y$  and  $P$ : the short-run aggregate-supply curve. Is the slope of the SRAS curve positive, negative, zero, or infinite?
- d. What variables and shocks affect the SRAS curve and in which direction? In particular, what effect would a productivity shock ( $\varepsilon_y$ ) and a change in the nominal wage ( $W$ ) have on the SRAS?
- e. Suppose that a shock to aggregate demand causes  $P$  to increase. What would be the effect on  $W/P$  and on  $Y$ ? Are real wages procyclical or countercyclical in this model?

**3. Monetary policy targeting in IS/LM model.** Suppose that the *IS* curve is given by

$$Y = \alpha_0 + \alpha_Y (Y - T) - \alpha_r r + G + \varepsilon, \quad (7)$$

$$\alpha_0 > 0, \quad 0 < \alpha_Y < 1, \quad \alpha_r > 0,$$

where  $\varepsilon$  is a random expenditure shock with a mean value of 0. Money demand is given by

$$m^d - p = \beta_0 + \beta_Y Y - \beta_r r + \eta, \quad (8)$$

$$\beta_0 > 0, \quad \beta_Y > 0, \quad \beta_r > 0.$$

The term  $\eta$  is a random shock to money demand with a mean value of 0 and  $m$  and  $p$  are the logs of money and prices. We assume that the expected rate of inflation is zero here.

We know that central banks can choose either money-supply targets or interest-rate targets. We often think of the central bank choosing these targets based on current values of important variables such as  $Y$  and  $\pi$ . However, central banks cannot usually observe  $Y$  and  $\pi$  immediately. In fact, it is sometimes as much as a year lag before reliable data on GDP and prices become available. In the interim, the central bank must choose its “operating rule” without any guidance from  $Y$  and  $\pi$ , either a fixed money-supply rule  $m^s = \bar{m}$  or a fixed interest-rate rule  $r = \bar{r}$ .

- a. Suppose that the central bank chooses a money-supply rule. Solve the model and find  $\partial Y / \partial \varepsilon$  (the effects of an expenditure shock on output) and  $\partial Y / \partial \eta$  (the effects of a money-demand shock on output).
- b. Now suppose that the central bank follows an interest-rate rule. Solve the model under the interest-rate rule and calculate the effects on output of each kind of shock.
- c. Which policy rule is more effective at stabilizing output when expenditure shocks occur? Which rule is better at stabilizing output in the face of money-demand shocks? Show the corresponding result using *IS* and *LM* curves.
- d. Money demand has been unstable in recent decades, due in part to rapid technological innovation in the financial-services sector. Most central banks now follow interest-rate rules. Based on your analysis above, would they be better off with a money-supply rule?