ECOS2902 Study notes

Thien Can Pham

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Contents

1 Short-run macroeconomics

1.1 IS-LM models

1. IS: Y = Y(Y, T) + I(Y, i) + G
2. LM: i = $\bar{i}$

Remark: Here we assume closed economy, so omit trade for now.

The IS curve is from the goods market and the LM curve is from the financial market.

The slope of IS affects the impact of monetary policy on output. A steeper IS curve will imply smaller monetary policy effect on Y.

2 Labor markets and unemployment

2.1 Labor Market

Simple model of flows:

$$U_{t+1} + U_t = s(1 - U_t) + fU_t$$

where $s > 0$ is constant job separation rate and $f > 0$ is constant job finding rate.

At steady state,

$$U_{t+1} = U_t = \bar{U} \Rightarrow U = \frac{s}{s+f}$$

For unemployment dynamics at t,

$$\begin{aligned} U_t - \bar{U} &= \lambda^t (U_0 - \bar{U}) \\ &= (1 - (s+f))(U_0 - \bar{U}) \end{aligned}$$

Remark: $(s+f)$ is called the turnover rate. The return to $\bar{U}$ is faster if λ^t is small or equivalently if $(s+f)$ is high.

1. matching of jobs: M = F(U, V)
2. job finding rate: f = $\frac{M}{U} = f(\theta) = f(\frac{v}{u})$
3. vacancy filling rate: q = $\frac{M}{V} = q(\theta) = q(\frac{v}{u})$

Beveridge Curve: $u = \frac{s}{s+f(\frac{v}{u})}$

Job Creation Curve: $v = \theta^* u \Leftrightarrow v = (\frac{AJ}{C})^{\frac{1}{1-\alpha}} u$, where θ^* comes from the relation $q(\theta^*)J = C$

2.2 Duration

1. Expected Duration of current labor market status: 1 + p + p^2 + p^3 = $\frac{1}{1-p}$ months
2. Expected Duration of unemployment of currently unemployed: 1 1 + (1 - f) + $(1-f)^2$ = $\frac{1}{f}$ months
3. Expected Duration of employment of currently employed: 1 + (1 - s) + $(1-s)^2$ = $\frac{1}{s}$ months

3 Macroeconomic adjustment

3.1 Dynamic Aggregate Demand and Aggregate Supply

Building Blocks:

1. Accelarationist Philips Curve: $\pi_{t+1} = \mathbb{E}_t(\pi_{t+1}) + \phi(Y_t - \bar{Y}) + v_t$
2. Adaptive Expectation: $\pi_t = \mathbb{E}_t(\pi + 1)$
3. Output Equation: $Y_t = \bar{Y} - \alpha(r_t - \rho) + \epsilon_t$
4. Fisher Equation: $r_t = i_t - \mathbb{E}_t(\pi_{t+1})$
5. Monetary Policy Rule: $i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi^*) + \theta_Y(Y_t - \bar{Y})$

Dynamic Aggregate Supply curve (DAS): $\pi_{t+1} = \pi_t + \phi(Y_t - \bar{Y}) + v_t$

Dynamic Aggregate Demand curve (DAD): $Y_t = \bar{Y} - \frac{\alpha\theta_\pi}{1+\alpha\theta_Y}(\pi_t - \pi^*) + \frac{1}{1+\alpha\theta_Y}\epsilon_t$

Taylor Rule from Monetary Policy Rule says the following: $\frac{\partial i_t}{\partial \pi_t} = 1 + \theta_{pi} \Rightarrow \theta_\pi > 0$

Remark: It is important to distinguish the **endogenous variables** and the **exogenous variables** in order to tackle problems in AD-AS models.

Remark: DAS has a time lag feature in the model (looking at the inflation term π), so any deviation from the medium run equilibrium will require DAS to incrementally recover back to this state. DAD does not have such feature so once the shock vanishes, the DAD curve will immediately adjust back to the initial equilibrium.

4 Long run macroeconomics

4.1 Solow Growth Model

The Solow Growth Model is an exogenous growth model, which means it considers output growth as determine by productivity growth which is taken as exogenous.

Long run growth is determined by supply side factors, which can be summarized by a production function: Y = F(K, AN), where K is physical capital and N is labor, and A is technological progress.

The capital accumulation equation in **per worker** terms: $K_{t+1} - K_t = sy_t - \delta k_t$

The capital accumulation equation in **per effective worker** terms:

$$(1 + g_A + g_N)(k_{t+1} - k_t) = sy_t - (\delta + g_N + g_A)k_t$$

In steady state,

$$sy_t^* = (\delta + g_N + g_A)k_t^*$$

where $y^* = f(k^*)$.

4.2 AK growth Model

This is the basic model where output growth is endogenous as it is determined by endogenous technological growth. Note that in this model there is no steady state but a long run growth rate g^*.

The Cobb-Douglas function is now Y = AK.

The long run growth rate can be calculated as

$$g^* = sA - \delta = \frac{K_{t+1} - K_t}{K_t}$$

Remark: When compare growth across countries, notice countries with a discrepancy in g^* will perpetually diverge in terms of output level.

Given an initial capital stock K_0,

$$Y = AK_t \Rightarrow Y_t = (1 + g^*)^t AK_0$$

Remark: The initial capital stock K_0 will have permanent effect on the level of output.

4.3 Human Capital Accumulation

This is an endogenous growth model which accounts for the diminishing return of output to capital accumulation.

The Cobb-Douglas function is now $Y = AK^\alpha H^{1-\alpha}$.

Along a balanced growth path, the physical and human capital share a common growth rate g^*.

Along a balanced growth path,

$$g^* = \frac{K_{t+1} - K_t}{K_t} = \frac{H_{t+1} - H_t}{H_t}$$

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The intensity of balanced growth path is

$$\frac{H_t}{K_t} = \frac{s_H}{s_K} = \phi^*$$

The endogenous g^* for both capitals can be found using

$$g^* = s_K A(\frac{s_H}{s_K})^{1-\alpha} - \delta = s_K^\alpha s_H^{1-\alpha} A - \delta$$

The transitional dynamics of intensity in the Short Run:

$$\phi_0 < \phi^* \Rightarrow \frac{\text{low}H_t}{\text{high}K_t} \Rightarrow \phi_t < \phi_{t+1}$$
$$\phi_0 > \phi^* \Rightarrow \frac{\text{high}H_t}{\text{low}K_t} \Rightarrow \phi_t > \phi_{t+1}$$

Remark: The balanced growth intensity ϕ^* is the "point of steady state", so initial intensity will converge to this steady state intensity over time if $\phi_0 \neq \phi^*$.

4.4 Productivity Measure & Growth Accounting

Productivity cannot be directly observed in the economy, but we can try to derive it from given parameters.

$$Y = AK^\alpha N^{1-\alpha} \Leftrightarrow A = \frac{Y}{K^\alpha N^{1-\alpha}}$$

For $t \in (0, T), g_Y = \frac{ln(Y_T) - ln(Y_0)}{T}$.

To account for sources of growth rate across time,

$$\begin{aligned} g_Y = g_A + \alpha g_K + (1-\alpha) g_N \\ \Rightarrow g_A = g_{\frac{Y}{N}} - \alpha g_{\frac{K}{N}} \\ \Leftrightarrow g_Y - g_N = g_A + \alpha(g_k - g_N) \end{aligned}$$

To compare across countries i and j,

$$ln\frac{Y_i}{N_i} - ln\frac{Y_j}{N_j} = lnA_i - lnA_j + \alpha(ln\frac{K_i}{N_i} - ln\frac{K_j}{N_j})$$

4.5 Factor Income

We start off with the profit maximization problem of a firm.

$$F(K, N) - rK - wN$$

where r is return to capital and w is wage for labor.

1. Firm's capital demand: $K = (\frac{\alpha}{r})^{\frac{1}{1-\alpha}} AN$
2. Firm's labor demand: $N = (\frac{(1-\alpha)A^{1-\alpha}}{w})^{\frac{1}{\alpha}} K$

Under a Cobb-Douglas function, we have constant income shares.

$$\frac{rK}{Y} = \alpha$$
$$\frac{wN}{Y} = 1 - \alpha$$

The profit is zero: $Y - rK - wN \Leftrightarrow Y - \alpha Y - (1-\alpha)Y = 0$

We can calculate the factor incomes along the balanced growth path in Solow Model,

$$w = (1-\alpha)y^* A_t \Rightarrow g_w = g_A$$
$$r = \alpha \frac{y^*}{k^*} \Rightarrow g_r = 0$$

5 Open Economy Macroeconomics

5.1 Exchange rates

The relation between the real exchange rate and the nominal exchange rate:

$$\epsilon = \frac{EP}{P^*}$$

where P^* is the price of goods in foreign country.

The Uncovered Interest Parity: $(1+i_t) = (1+i_t^*)\frac{E_t}{E_{t+1}^e}$

We can derive an approximation for the domestic interest rate with $i \approx i^* - \frac{E_{t+1}^e - E_t}{E_t}$

The demand for domestic goods: Z = C + I + G + X - $\frac{IM}{\epsilon}$

The **Marshall Lerner condition** states that export is overall decreasing in real exchange rate ϵ in medium run.

$$NX_{(\epsilon)} \equiv X(Y^*, \epsilon) - \frac{IM(Y,\epsilon)}{\epsilon}$$

5.2 Mundell-Fleming model (open economy IS-LM)

$$\text{open economy IS} : Y = C(Y,T) + I(Y,i) + G + NX(Y, Y^*, E)$$
$$\text{open economy LM} : i = \bar{i}$$

Remark: We assume E = ϵ due to zero inflation in the model. Marshall Lerner condition holds.

The relation between saving and trade balance:

$$NX = (S - I) + (T - G)$$

Under the flexible exchange rate, we can rewrite the open economy IS equation taking into account the interest rate parity:

$$Y = C(Y,T) + I(Y,i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}E_{t+1}^e)$$

5.3 Pegged exchange rate

Peg $E^e = E$, so i = i^* from interest rate parity.

Open economy IS under fixed exchange rate:

1. short run: $Y = C(Y,T) + I(Y,i^*) + G + NX(Y, Y^*, \frac{E^e P}{P^*})$

2. long run: $\bar{Y} = C(\bar{Y},T) + I(\bar{Y},i^*) + G + NX(\bar{Y}, Y, \bar{\epsilon}))$

Remark: For fixed exchange rate, we use $E = E^e$ and $\epsilon = \frac{EP}{P^*}$

Remark: In the medium run, $Y = \bar{Y}$ and $\epsilon = \bar{\epsilon}$ independent of exchange rate regime in medium run. This adjustment happens through price adjustment.

Exchange rate crisis of incredible fixed exchange rate
Under credible exchange rate, we have $E^e_{t+1} = E$ and $i = i^*$

Under incredible exchange rate, we have $E^e_{t+1} < E \Rightarrow i \approx i^* - \frac{E^e_{t+1} - E}{E} \Rightarrow$ i will increase if the government decides to keep $E^e = E$. Increase of i will result in fall in output, possibly recession.