Economic Theory II
Lecture 9 [1]

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[1] Content of current lecture slides derives on slides prepared by Dr Valentin Jouvanceau previously.

Money [2]

- Money is defined by the functions it plays:
  - Medium of exchange.
  - Store of value.
  - Unit of measure.
- What types of money meet these criteria?
- What criteria does bartering violate?
- What criteria does commodity money violate?
- What if intrinsic value $>$ face value of commodity money?
- What about 'double coincidence of wants'?
- Does fiat money meet all criteria?

[2] Chapter 14 of GLS.

Money

- In our models so far: can money be a medium of exchange? No. Only one good.
- Can it be a unit of measure? Unnecessary. Can measure everything in terms of the single good.
- So, we introduce money as a store of value, an asset which you can save.
- But why will you use money to save when you can use bonds which will pay interest?
- To bypass this issue, we assume households derive utility from having money.

Households

- Period t flow budget constraint:

$$P_t C_t + P_t S_t + M_t \leq P_t w_t N_t - P_t T_t + P_t D_t \tag{1}$$

- Period $t+1$ flow budget constraint:

$$\begin{aligned} P_{t+1} C_{t+1} \leq P_{t+1} w_{t+1} N_{t+1} + (1 + i_t) P_t S_t + P_{t+1} D_{t+1} \\ - P_{t+1} T_{t+1} + P_{t+1} D^I_{t+1} + M_t \end{aligned} \tag{2}$$

Households

- Period t flow budget constraint in real terms:

$$C_t + S_t + \frac{M_t}{P_t} \leq w_t N_t - T_t + D_t \tag{3}$$

- Period $t+1$ flow budget constraint in real terms:

$$\begin{aligned} C_{t+1} \leq w_{t+1} N_{t+1} + (1 + i_t) \frac{P_t}{P_{t+1}} S_t + D_{t+1} \\ - T_{t+1} + D'_{t+1} + \frac{M_t}{P_{t+1}} \end{aligned} \tag{4}$$

- $(1 + r_t) := (1 + i_t) \frac{P_t}{P_{t+1}} S_t$: gross real return on saving through bonds
  $\Rightarrow$ Fisher relationship!

Households

- Define inflation as $1 + \pi^e_{t+1} := \frac{P_{t+1}}{P_t}$.
- Fisher relationship can be re-written as:

$$(1 + r_t) = \frac{1 + i_t}{1 + \pi^e_{t+1}} \tag{5}$$

- taking logs and using algebra for growth rates;

$$r_t = i_t - \pi^e_{t+1} \tag{6}$$

- Using the above, we can write the second period constraint as:

$$\begin{aligned} C_{t+1} \leq w_{t+1} N_{t+1} + (1 + r_t) S_t + D_{t+1} \\ - T_{t+1} + D^I_{t+1} + \frac{1 + r_t}{1 + i_t} \frac{M_t}{P_{t+1}} \end{aligned} \tag{7}$$

Household

- Lifetime budget constraint is:

$$C_t + \frac{C_{t+1}}{1+r_t} = w_t N_t - T_t + D_t - \frac{i_t}{1+i_t}\frac{M_t}{P_t} - \frac{w_{t+1}N_{t+1} + D_{t+1} + D^I_{t+1} - T_{t+1}}{1+r_t} \tag{8}$$

- Utility function:

$$U = u(C_t, 1-N_t) + \upsilon\left(\frac{M_t}{P_t}\right) + \beta u(C_{t+1}, 1-N_{t+1}) \tag{9}$$

where $\upsilon(.)$ is a concave function.

Maximisation Problem

$$\max_{C_t, C_{t+1}, N_t, N_{t+1}, M_t} U = u(C_t, 1 - N_t) + \upsilon\left(\frac{M_t}{P_t}\right) + \beta u(C_{t+1}, 1 - N_{t+1}) \quad (10)$$

subject to:

$$\begin{aligned} C_t + \frac{C_{t+1}}{1 + r_t} = {} & w_t N_t - T_t + D_t - \frac{i_t}{1 + i_t}\frac{M_t}{P_t} \\ & - \frac{w_{t+1} N_{t+1} + D_{t+1} + D^I_{t+1} - T_{t+1}}{1 + r_t} \end{aligned} \quad (11)$$

optimality Conditions

- Optimality conditions:

$$
\begin{aligned}
u_C(C_t, 1 - N_t) &= \beta(1 + r_t)u_C(C_{t+1}, 1 - N_{t+1}) \\
u_L(C_t, 1 - N_t) &= w_t u_C(C_t, 1 - N_t) \\
u_L(C_{t+1}, 1 - N_{t+1}) &= w_{t+1} u_C(C_{t+1}, 1 - N_{t+1}) \\
v'\left(\frac{M_t}{P_t}\right) &= \frac{i_t}{1 + i_t} u_C(C_t, 1 - N_t)
\end{aligned}
$$

- Last condition is marginal benefit $=$ marginal cost.

Functions

- Consumption function: $C_t = C^d(Y_t - T_t, Y_{t+1} - T_{t+1}, r_t)$.
- Labour supply function: $N_t = N^s(w_t, \theta_t)$.
- For money demand;
  - If price levels increase, people want to hold higher amount of money: M_t increases in P_t.
  - If interest rate rises, people will want to hold less money and more bonds: M_t is falling in i_t.
  - If consumption is increased, people will want to hold more money: M_t increasing in C_t.
- So, money demand function can be written as: $M_t = P_t M^d(\underset{-}{i_t}, \underset{+}{Y_t})$.
- Written as a function of Y_t and not C_t as C_t also depends on Y_t.
- Can use the Fisher equation to write in terms of real rate and inflation: $M_t = P_t M^d(\underset{-}{r_t + \pi^e_{t+1}}, \underset{+}{Y_t})$.

Government

- Government constraints:

$$P_t G_t \leq P_t T_t + P_t B_t + M_t$$
$$P_{t+1} T_{t+1} \leq P_{t+1} G_{t+1} + (1 + i_t) P_t B_t + M_t$$

- Divide by P_t and P_{t+1}, and combine using B_t to get:

$$G_t + G_{t+1} = T_t + \frac{T_{t+1}}{1 + r_t} + \frac{M_t}{P_t} - \frac{1}{1 + r_t} \frac{M_t}{P_{t+1}}$$

- Re-writing:

$$G_t + G_{t+1} = T_t + \frac{T_{t+1}}{+} \frac{i_t}{1 + i_t} \frac{M_t}{P_{t+1}}$$

Equilibrium

- Market clearing in period t requires:

$$C_t + S_t + \frac{M_t}{P_t} = w_t N_t - T_t + D_t$$

- Bond market clearing requires:

$$S_t - B_t = I_t$$

- Firm profit is:

$$D_t = Y_t - w_t N_t$$

- Combining gives:

$$C_t + I_t + B_t + \frac{M_t}{P_t} = Y_t - T_t$$

Equilibrium

- From government's constraint we have:

$$T_t = G_t - B_t - \frac{M_t}{P_t}$$

- Combining with previous result:

$$C_t + I_t + G_t = Y_t$$

Equilibrium

Equilibrium conditions:

$$
\begin{aligned}
C_t &= C^d(Y_t - T_t, Y_{t+1} - T_{t+1}, r_t) \\
N_t &= N^s(w_t, \theta_t) \\
N_t &= N^d(w_t, A_t, K_t) \\
I_t &= I^d(r_t, A_{t+1}, K_t) \\
Y_t &= A_t F(K_t, N_t) \\
Y_t &= C_t + I_t + G_t \\
M_T &= P_t M^d(i_t, Y_t) \\
r_t &= i_t - \pi^e_{t+1}
\end{aligned}
$$

End