A Two Period Economy

— Week 5 —

Vivaldo Mendes

Dep. of Economics — Instituto Universitário de Lisboa

12 March 2015

Summary

I – Intertemporal economic decision making

Very similar to static optimization decision making

1. Agents try to do as well as possible, with the available information
2. Agents are subjected to constraints (financial or technological)
3. Agents **are rational** (even if some form of limited rationality)
4. They face two types of variables: **state** (stocks) and **control** (flows)

The differences

The differences are that in intertemporal decision making:

1. The decisions are made over time, and not only at one particular point in time
2. Be aware of a common mistake that may arise: mix up long term equilibria with short term transitional dynamics
3. Allows us to analyze the sustainability of economic processes
4. Allows us to analyze the **intertemporal consistency** of the decisions that are made over time
5. Uses specific mathematical techniques: difference equations, differential equations or partial deferential equations

The typical household problem: preferences

1. Agents have preferences

$$U(c_t, c_{t+1}) = u(c_t) + \frac{1}{1+R} \cdot u(c_{t+1})$$

2. Or in a more simple formulation

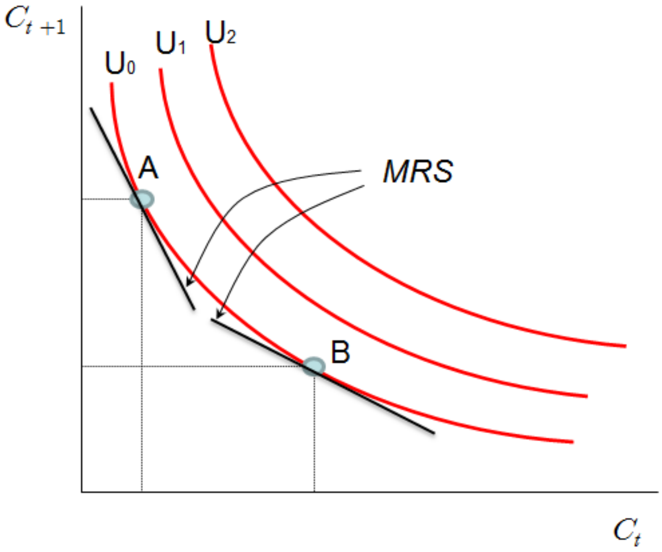
$$U(c_t, c_{t+1}) = u(c_t) + \beta \cdot u(c_{t+1})$$

$u-$ utility index, $c-$ consumption levels
$R-$ subjective rate ate of discounting utility
$\beta \in (0,1)-$ factor or gross rate of intertemporal discounting of utility

3. Important concept: marginal rate of substitution between c_t and c_{t+1}

$$MRS_{t,t+1} = -\frac{\partial U / \partial c_t}{\partial U / \partial c_{t+1}} = -\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})}$$

The typical household problem: preferences



The typical household problem: constraints

1. The constraints for the two periods of time are

$$\begin{aligned} c_t + a_{t+1} &\leq w_t \\ c_{t+1} &\leq (1 + r_{t+1})a_{t+1} + w_{t+1} \end{aligned}$$

   $a_{t+1}-$ savings at t and transformed into a financial asset at $t+1$
   w_t- wages or income at t , $r_{t+1}-$ interest rate (return on financial assets)

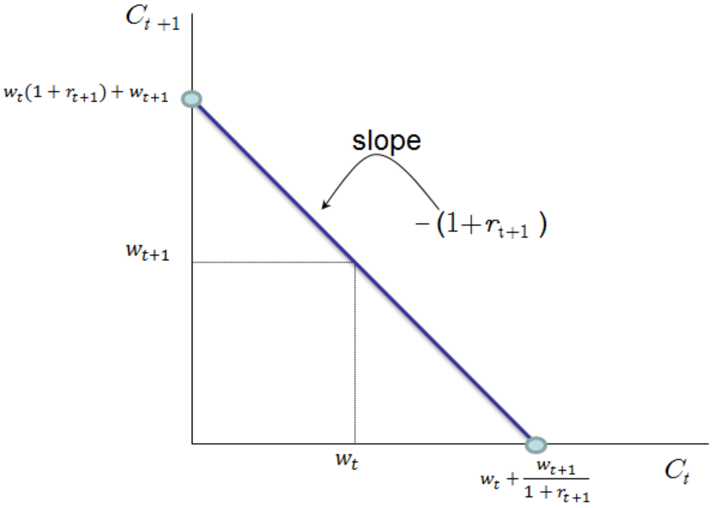
2. The consolidated intertemporal constraint: eliminate a_{t+1}. **Expressed in current values**

$$\underbrace{c_t + \frac{c_{t+1}}{1 + r_{t+1}}}_{\textit{value of intertemporal consumption}} \leq \underbrace{w_t + \frac{w_{t+1}}{1 + r_{t+1}}}_{\textit{value of intertemporal income}}$$

3. The consolidated intertemporal constraint: eliminate a_{t+1}. **Expressed in future values**

$$(1 + r_{t+1})c_t + c_{t+1} \leq (1 + r_{t+1})w_t + w_{t+1}$$

The typical household problem: constraints



The maximization of utility

1. It implies the finding of the optimal levels of consumption (c_t^*, c_{t+1}^*) and of savings (a_{t+1}^*) over time
2. This can be done in two ways: graphically, algebraically
3. The slope of the intertemporal budget constraint is given by

$$-(1 + r_{t+1})$$

4. The Marginal Rate of Substitution is given by

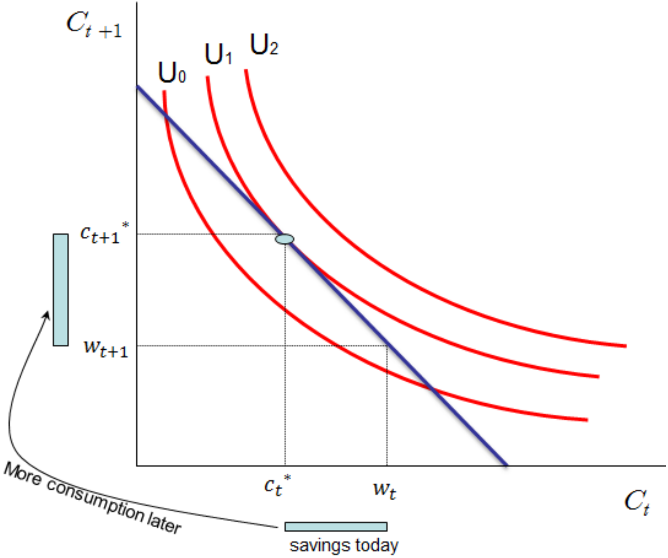
$$MRS_{t,t+1} = -\frac{\partial U / \partial c_t}{\partial U / \partial c_{t+1}} = -\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})}$$

5. Equalizing both, we get

$$-\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})} = -(1 + r_{t+1})$$

$$u'(c_t) = (1 + r_{t+1}) \cdot \beta \cdot u'(c_{t+1})$$

The typical household problem: constraints



II – The Lagrange Method

What is it?

1. In everything similar to the Lagrangean function that you learned in every intermediate course in Microeconomics
2. Very useful if time is discrete
3. Very intuitive
4. Highly used in modern macroeconomics everywhere
5. We have:
    1. An objective function
    2. A constraint (or various constraints)
    3. Viability conditions (to assure the optimal values)

Formally speaking

1. Objective: to maximize utility (now, intertemporal)

$$\max_{c_t,\ c_{t+1},\ a_{t+1}} u(c_t) + \beta \cdot u(c_{t+1})$$

2. There are two constraints:

$$c_t + a_{t+1} \leq w_t$$
$$c_{t+1} \leq (1 + r_{t+1})a_{t+1} + w_{t+1}$$

3. Viability conditions are: $c_t,\ c_{t+1} \geq 0$
4. Formal setting of the problem

$$\max_{c_t,\ c_{t+1},\ a_{t+1}} u(c_t) + \beta \cdot u(c_{t+1})$$

$$\text{s.t.} \quad c_t + a_{t+1} \leq w_t$$
$$c_{t+1} \leq (1 + r_{t+1})a_{t+1} + w_{t+1}$$
$$c_t,\ c_{t+1} \geq 0$$

The Lagrangean

1. The Lagrangean function is written as

$$\begin{aligned} \mathcal{L} &= u(c_t) + \beta \cdot u(c_{t+1}) + \\ &\quad \lambda_t(w_t - c_t - a_{t+1}) + \lambda_{t+1}[w_{t+1} + (1 + r_{t+1})a_{t+1} - c_{t+1}] \\ c_t,\ c_{t+1} &\geq 0, \\ \lambda_t,\ \lambda_{t+1} &\geq 0 \end{aligned}$$

2. How many unknowns?
3. Five unknowns: $c_t,\ c_{t+1}, a_{t+1}, \lambda_t,\ \lambda_{t+1}$
4. Five First Order Conditions **(FOC)**

First Order Conditions

1. The 5 FOCs are

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial c_t} &= 0 \Rightarrow u'(c_t) - \lambda_t = 0 && (1) \\
\frac{\partial \mathcal{L}}{\partial c_{t+1}} &= 0 \Rightarrow \beta \cdot u'(c_{t+1}) - \lambda_{t+1} = 0 && (2) \\
\frac{\partial \mathcal{L}}{\partial a_{t+1}} &= 0 \Rightarrow -\lambda_t + \lambda_{t+1}(1 + r_{t+1}) = 0 && (3) \\
\frac{\partial \mathcal{L}}{\partial \lambda_t} &= 0 \Rightarrow w_t - c_t - a_{t+1} = 0 && (4) \\
\frac{\partial \mathcal{L}}{\partial \lambda_{t+1}} &= 0 \Rightarrow w_{t+1} + (1 + r_{t+1})a_{t+1} - c_{t+1} = 0 && (5)
\end{aligned}$$

2. Now there is always a very useful trick: **you can eliminate the** $\lambda' s$.
3. Then simplify
4. Let's do it.

Simplification

1. From the first two FOCs (FOC1, FOC2)

$$\begin{aligned} \partial\mathcal{L}/\partial c_t &= 0 \Rightarrow u'(c_t) - \lambda_t = 0 \\ \partial\mathcal{L}/\partial c_{t+1} &= 0 \Rightarrow \beta \cdot u'(c_{t+1}) - \lambda_{t+1} = 0 \end{aligned}$$

2. we get

$$\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})} = \frac{\lambda_t}{\lambda_{t+1}} \qquad (6)$$

3. From FOC3 $-\lambda_t + \lambda_{t+1}(1 + r_{t+1}) = 0$ we get

$$\lambda_t / \lambda_{t+1} = 1 + r_{t+1} \qquad (7)$$

4. Equalizing the two previous eq., we get our already known result

$$\underbrace{\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})}}_{MRS_{t,t+1}} = \underbrace{(1 + r_{t+1})}_{relative\ price}$$

5. So, either graphically, or by the Lagrange method we arrived at the

The Euler Equation

1. We have just got this result

$$\underbrace{\frac{u'(c_t)}{\beta \cdot u'(c_{t+1})}}_{MRS_{t,t+1}} = \underbrace{(1 + r_{t+1})}_{relative\ price}$$

2. In an equivalent way, known as the **EULER EQUATION**

$$u'(c_t) = (1 + r_{t+1}) \cdot \beta \cdot u'(c_{t+1})$$

3. The Euler equation is extremely important in modern macroeconomics:
   1. allows to incorporate microfountations into macroeconomics (preferences of the demand side)
   2. allows to measure the welfare of different macroeconomic policies
4. Three possible cases can be easily spotted.

$$\begin{aligned} (1 + r_{t+1}) \cdot \beta &= 1 \Rightarrow u'(c_t) = u'(c_{t+1}) \\ (1 + r_{t+1}) \cdot \beta &\lesseqgtr 1 \Rightarrow u'(c_t) \lesseqgtr u'(c_{t+1}) \end{aligned}$$

From the Euler Eq. to the Consumption Function

1. For simplicity consider that utility is logarithmic, like

$$u(c_t) = \ln c_t \ \ , \ \ u(c_{t+1}) = \ln c_{t+1}$$

2. Therefore the Euler Equation can be written as

$$c_{t+1} = [\beta (1 + r_{t+1})] c_t$$

3. Now using the consolidated intertemporal constraint

$$(1 + r_{t+1})c_t + c_{t+1} = (1 + r_{t+1})w_t + w_{t+1}$$

4. We can solve for the optimal levels of c_{t+1} and c_t :

$$c^*_{t+1} = \left(\frac{\beta}{1+\beta}\right) [(1 + r_{t+1})w_t + w_{t+1}]$$

$$c^*_t = \left(\frac{1}{1+\beta}\right) \left[w_t + \frac{w_{t+1}}{(1 + r_{t+1})}\right]$$

The Consumption Function

1. We obtained the optimal levels of c_{t+1} and c_t as:

$$\begin{aligned} c_{t+1}^* &= \left(\frac{\beta}{1+\beta}\right)\left[(1+r_{t+1})w_t + w_{t+1}\right] \\ c_t^* &= \left(\frac{1}{1+\beta}\right)\underbrace{\left[w_t + \frac{w_{t+1}}{(1+r_{t+1})}\right]}_{\Omega} \end{aligned}$$

2. For simplicity: $\Omega =$ *current value of intertemporal income*
3. Let us concentrate on current consumption c_t^*.
4. Current consumption will increase if :

$$\downarrow \beta \quad , \quad \downarrow r_{t+1} \quad , \quad \uparrow w_t \quad , \quad \uparrow w_{t+1}$$

5. Can you think about the economic intuition?

III – Some important points

"Permanent" vs. "Transitory" Income Changes

1. What happens to our consumption function if we have **permanent changes** in income?

$$w_t \text{ , } w_{t+1} \text{ both change}$$

2. Do they produce different impacts from **transitory changes** in income?

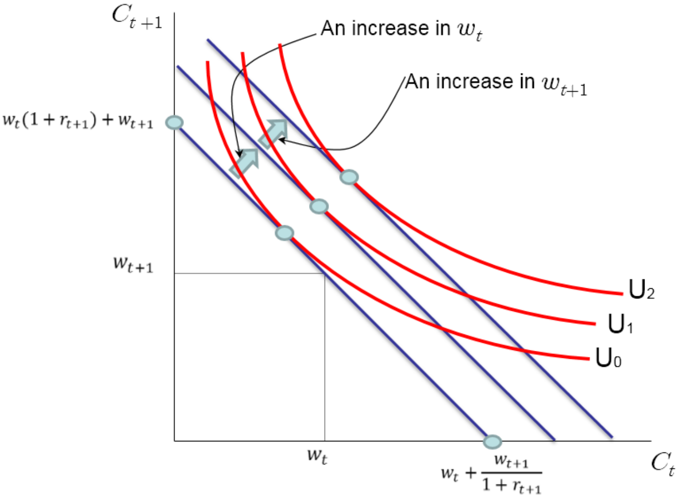
$$w_t \text{ changes}$$

3. These changes will affect directly the consolidated intertemporal constraint
4. The results can be observed from the consumprion function:

$$c_t^* = \left(\frac{1}{1+\beta}\right) \underbrace{\left[w_t + \frac{w_{t+1}}{(1+r_{t+1})}\right]}_{\Omega}$$

5. It is easy to see that permanent changes have higher impact on consumption than transitory changes

"Permanent" vs "Transitory" Changes (cont.)



Wealth effects

1. What happens if our representative consumer is endowed with a certain level of wealth in the initial period

$$a_t$$

2. Notice that the two constraints will look like

$$\begin{aligned} c_t + a_{t+1} &\leq w_t + a_t \\ c_{t+1} &\leq (1 + r_{t+1})a_{t+1} + w_{t+1} \end{aligned}$$

3. And the consolidated intertemporal constraint will be

$$(1 + r_{t+1})c_t + c_{t+1} = (1 + r_{t+1}) \left(w_t + a_t \right) + w_{t+1}$$

4. So this is like as the case of transitory income changes
5. The results can be observed from the consumption function:

$$c_t^* = \left(\frac{1}{1+\beta} \right) \underbrace{\left[(w_t + a_t) + \frac{w_{t+1}}{(1 + r_{t+1})} \right]}_{\Omega}$$

Three fundamental points

The basic theory laid out leads to three fundamental points:

1. Consumption ought to be forward-looking, depending not just on current income but future income as well
2. Consumption ought to react more to permanent changes in income than transitory changes in income
3. Predictable changes in income that were anticipated in the past will not change the patterns of consumption

Three fundamental points ... rejected by evidence

1. Empirical evidence rejects very clearly those three fundamental points. Why?
2. **Hypothesis 1**. People are not as **rational optimizer** as the theory sustains:
    1. Costs to optimization and information processing
    2. People are simply not optimizer
3. **Hypothesis 2**. People are not equal, and some may be **liquidity constrained**.
4. **Hypothesis 3.** It does not take into account **endogenous labor effort**.
5. We will explore this last two possibilities further.

IV – Endogenous labor supply

The two fundamental assumptions: up to now

1. The results obtained depended on two fundamental assumptions.
2. **Assumption1**. The level of income in both periods was taken as exogenous

$$w_t, w_{t+1} \text{ were given}$$

3. **Assumption 2**. The level of leisure (and the labor effort) was taken as exogenous

$$\begin{aligned} \ell &= \bar{\ell} \text{ , labor effort as given} \\ & 1-\ell, \text{ leisure time given} \end{aligned}$$

4. However, in reality we know that the two ingredients in the previous assumptions are linked

wages can increase, if the labor effort increases

5. So what happens to intertemporal utility?

The new intertemporal problem

1. How can this link be integrated into the model? Through the utility function.
2. Working more hours
   1. leads to higher income, which leads to higher consumption, which implies higher utility levels
   2. However, it also implies less leisure time, which implies lower utility
   3. There is a trade-off here
3. So now we will have two intertemporal decisions, not just one:
   1. Not only, should I consume more now, or more in the future?
   2. But also, should I work more hours, or should I enjoy more leisure?

$$\uparrow \quad \ell \Rightarrow \uparrow \textit{income} \Rightarrow \uparrow \textit{consumption} \Rightarrow \uparrow \textit{utility}$$

$$\uparrow \quad \ell \Rightarrow \downarrow \textit{leisure} \Rightarrow \downarrow \textit{utility}$$

Setting the new intertemporal problem

1. Symbols:
   ℓ : labor effort; $1-\ell$: leisure
   β : intertemporal discount factor
2. Agents preferences

$$U(c,\ell) = u(c_t, 1-\ell_t) + \beta \cdot u(c_{t+1}, 1-\ell_{t+1})$$

or in another way

$$U(c,\ell) = u(c_t, \ell_t) + \beta \cdot u(c_{t+1}, \ell_{t+1})$$

3. Let's impose some useful conditions on the utility function

$$\begin{pmatrix} u'_c > 0 & , & u''_c < 0 \\ u'_{1-\ell} > 0 & , & u''_{1-\ell} < 0 \\ u'_\ell < 0 & , & u''_\ell > 0 \end{pmatrix}$$

Setting the new intertemporal problem (cont.)

1. Intertemporal constraints

$$c_t + a_{t+1} \leq w_t \ell_t$$
$$c_{t+1} \leq (1 + r_{t+1}) a_{t+1} + w_{t+1} \ell_{t+1}$$

2. Consolidated constraint: eliminate a_{t+1}. **Expressed in current values**

$$\underbrace{c_t + \frac{c_{t+1}}{1 + r_{t+1}}}_{\text{value of intertemporal consumption}} \leq \underbrace{w_t \ell_t + \frac{w_{t+1} \cdot \ell_{t+1}}{1 + r_{t+1}}}_{\text{value of intertemporal income}}$$

3. Maximizing utility

$$\max_{c_t, c_{t+1}, \ell_t, \ell_{t+1}, a_{t+1}} u(c_t, 1 - \ell_t) + \beta \cdot u(c_{t+1}, 1 - \ell_{t+1})$$

$$\text{s.t.} \quad c_t + a_{t+1} \leq w_t \ell_t$$
$$c_{t+1} \leq (1 + r_{t+1}) a_{t+1} + w_{t+1} \ell_{t+1}$$
$$c_t,\ c_{t+1} \geq 0, \quad \ell_t,\ \ell_{t+1} \in (0, 1)$$

The Lagrangean function

1. The Lagrangean function is written as

$$\begin{aligned}\mathcal{L} &= u(c_t, 1-\ell_t) + \beta \cdot u(c_{t+1}, 1-\ell_{t+1}) + \lambda_t(w_t\ell_t - c_t - a_{t+1}) + \\ &\quad \lambda_{t+1}[w_{t+1}\ell_{t+1} + (1+r_{t+1})a_{t+1} - c_{t+1}]\end{aligned}$$

$$c_t,\ c_{t+1} \geq 0, \quad \ell_t,\ \ell_{t+1} \in (0,1), \quad \lambda_t,\ \lambda_{t+1} \geq 0$$

2. λ_t are the Lagrange multipliers
3. How many unknowns? Seven.

$$c_t, \quad c_{t+1}, \quad \ell_t, \quad \ell_{t+1}, \quad a_{t+1}, \quad \lambda_t, \quad \lambda_{t+1}$$

4. How many First Order Conditions? Seven

The First Order Conditions (FOCs)

$$
\begin{aligned}
\frac{\partial \mathcal{L}}{\partial c_t} &= 0 \Rightarrow u'_{c_t} - \lambda_t = 0 \\
\frac{\partial \mathcal{L}}{\partial c_{t+1}} &= 0 \Rightarrow \beta \cdot u'_{c_{t+1}} - \lambda_{t+1} = 0 \\
\frac{\partial \mathcal{L}}{\partial \ell_t} &= 0 \Rightarrow -u'_{1-\ell_t} - \lambda_t w_t = 0 \\
\frac{\partial \mathcal{L}}{\partial \ell_{t+1}} &= 0 \Rightarrow -\beta \cdot u'_{1-\ell_{t+1}} + \lambda_{t+1} w_{t+1} = 0 \\
\frac{\partial \mathcal{L}}{\partial a_{t+1}} &= 0 \Rightarrow -\lambda_t + \lambda_{t+1}(1 + r_{t+1}) = 0 \\
\frac{\partial \mathcal{L}}{\partial \lambda_t} &= 0 \Rightarrow w_t \ell_t - c_t - a_{t+1} = 0 \\
\frac{\partial \mathcal{L}}{\partial \lambda_{t+1}} &= 0 \Rightarrow w_{t+1} \ell_{t+1} + (1 + r_{t+1}) a_{t+1} - c_{t+1} = 0
\end{aligned}
$$

The Euler Equation

1. From the first two FOCs

$$\frac{\partial \mathcal{L}}{\partial c_t} = 0 \Rightarrow u'_{c_t} - \lambda_t = 0$$
$$\frac{\partial \mathcal{L}}{\partial c_{t+1}} = 0 \Rightarrow \beta \cdot u'_{c_{t+1}} - \lambda_{t+1} = 0$$

2. we get

$$\frac{u'_{c_t}}{\beta \cdot u'_{c_{t+1}}} = \frac{\lambda_t}{\lambda_{t+1}}$$

3. From FOC5 $-\lambda_t + \lambda_{t+1}(1 + r_{t+1}) = 0$ we get

$$\frac{\lambda_t}{\lambda_{t+1}} = 1 + r_{t+1}$$

4. Equalizing the two previous eq., we get our already known **Euler Equation**

$$u'_{c_t} = (1 + r_{t+1}) \cdot \beta \cdot u'_{c_{t+1}} \quad (8)$$

Optimal intertemporal labor effort

1. Use FOC3, FOC4, and combine, respectively, with FOC1 and FOC2
2. We will get

$$\frac{u'_{1-\ell_t}}{u'_{c_t}} = w_t$$

$$\frac{u'_{1-\ell_{t+1}}}{u'_{c_{t+1}}} = w_{t+1}1$$

3. We get a static condition for each period that optimizes the labor effort

$$\underbrace{u'_{c_t}}_{marginal\ utility\ of\ c} = \underbrace{\frac{u'_{1-\ell_t}}{w_t}}_{marginal\ utility\ of\ leisure\ weighted\ by\ its\ price}$$

$$\underbrace{u'_{c_{t+1}}}_{marginal\ utility\ of\ c} = \underbrace{\frac{u'_{1-\ell_{t+1}}}{w_{t+1}}}_{marginal\ utility\ of\ leisure\ weighted\ by\ its\ price}$$

Summary: the three intertemporal optimal conditions

1. One dynamic condition: the Euler equation, should I consume more now, or should I consume more in the future?

$$u'_{c_t} = (1 + r_{t+1}) \cdot \beta \cdot u'_{c_{t+1}}$$

2. Two static conditions: should I work more, or should I work less?

$$u'_{c_t} = \frac{u'_{1-\ell_t}}{w_t}$$

$$u'_{c_{t+1}} = \frac{u'_{1-\ell_{t+1}}}{w_{t+1}}$$

Example 1

1. Assume that agents only work in the first period
2. Assume that the utility function is logarithmic

$$U(c,\ell) = \ln c_t + \ln(1-\ell_t) + \beta \ln c_{t+1}$$

3. Utility maximization

$$\max_{c_t, c_{t+1}, \ell_t, a_{t+1}} \ln c_t + \ln(1-\ell_t) + \beta \ln c_{t+1}$$

$$\text{s.t..} \quad c_t + a_{t+1} \leq w_t \ell_t$$

$$c_{t+1} \leq (1+r_{t+1})a_{t+1} + w_{t+1} \cdot \underbrace{\ell_{t+1}}_{0}$$

$$c_t,\ c_{t+1} \geq 0, \quad \ell_t \in (0,1)$$

Example 1 (cont.)

1. Applying directly the Euler equation

$$u'_{c_t} = (1 + r_{t+1}) \cdot \beta \cdot u'_{c_{t+1}}$$

2. We get

$$\frac{1}{c_t} = (1 + r_{t+1}) \cdot \beta \cdot \frac{1}{c_{t+1}} \tag{9}$$

3. That is

$$c_{t+1} = \beta \left(1 + r_{t+1}\right) c_t$$

4. Now applying the first static condition $u'_{c_t} \cdot w_t = u'_{1-\ell_t}$, we get

$$\begin{aligned} \frac{1}{c_t} \cdot w_t &= \frac{1}{1 - \ell_t} \\ c_t &= w_t \left(1 - \ell_t\right) \end{aligned} \tag{10}$$

Example 1 (cont.)

1. Using the intertemporal consolidated constraint (notice that $\ell_{t+1} = 0$)

$$c_t + \frac{c_{t+1}}{1 + r_{t+1}} \leq w_t \ell_t$$

2. ...together with the Euler Equation (9), we get

$$c_t = \frac{1}{1+\beta} w_t \ell_t \tag{11}$$

3. Now we can determine the optimal intertemporal value of labor effort
4. Just combine eq(10) and eq(11) and we get

$$\ell_t^* = \frac{1+\beta}{2+\beta}$$

Example 1: final results

1. We have just got the optimal level of labor effort for period t

$$\ell_t^* = \frac{1+\beta}{2+\beta}$$

2. Applying back into eq(11), we get

$$c_t^* = \frac{1}{2+\beta} w_t$$

3. And once we know c_t^*, we can easily determine c_{t+1}^*

$$c_{t+1}^* = \left(\frac{w_t}{2+\beta} \right) \beta (1 + r_{t+1})$$

4. **Important conclusion: the supply of labor is inelastic with respect to wages.** (ℓ_t^* is independent from w_t)

Example 2

1. Assume now that agents have an initial level of wealth $a_t > 0$.
2. Moreover, they continue working only in period t
3. We will see that the conclusion in the previous slide is totally reversed.
4. The problem now looks like

$$\max_{c_t, c_{t+1}, \ell_t, a_{t+1}} \ln c_t + \ln (1 - \ell_t) + \beta \ln c_{t+1}$$

$$\text{s.t.} \quad c_t + a_{t+1} \leq w_t \ell_t + a_t (1 + r_t)$$
$$c_{t+1} \leq (1 + r_{t+1}) a_{t+1} + w_{t+1} \cdot \underbrace{\ell_{t+1}}_{0}$$

$$c_t, \; c_{t+1} \geq 0, \quad \ell_t \in (0, 1)$$

Example 2 (cont.)

1. From the two FOCs with respect to ℓ_t, ℓ_{t+1}, we will get

$$w_t\left(1-\ell_t\right)\left(1+\beta\right)=w_t\ell_t+a_t(1+r_t)$$

2. From where we can obtain the optimal level of labor effort

$$\ell_t^*=\frac{1}{2+\beta}\left[1+\beta-\frac{a_t(1+r_t)}{w_t}\right]$$

3. Therefore, in this case we have

$$\uparrow w_t \Rightarrow \uparrow \ell_t^* \quad , \quad \uparrow r_t \Rightarrow \downarrow \ell_t^* \quad , \quad \uparrow a_t \Rightarrow \downarrow \ell_t^*$$

V – Bibliography

Bibliography

- For the basic Two Period model read:

Eric Sims (2014). *"Intermediate Macroeconomics: Consumption"*, University of Notre Dame. Lecture Notes.

Notice that section 4 (Multi-Period Generalization and the Life Cycle) is not for reading. So please skip pages 20 to 28.

- If you are able to read Spanish, the next reading is also very good:

J.C. Conesa and C. Garriga (2011). *Teoria Económica del Capital y la Renta*, Universitat Autònoma de Barcelona.

Read chapter 4 (only sections 4.1 and 4.3) and Chapter 5 (only section 4.1) for point 4. Follow the slides, as some parts of each chapter are skipped without loss of any relevant information for the course.

Bibliography (cont.)

- If you have not dealt with any kind of this stuff before in your studies, and you feel a little bit uneasy, *for an introductory treatment of the issues discussed in this week, see Chapters 4 and 8 of the next textbook, at the expenses of having to read a much larger number of pages:*

Stephen Williamson (2011). *Macroeconomics*, Pearson, New York.