Households as Suppliers

- So far we have treated households as if they were consumers only
- But they also supply labor and capital to the market
- Initially, we want to see how to handle labor supply
- We will address capital later

Labor Supply Assumptions

- People have $H$ hours of time (per day/week/year as appropriate)
- Time may be spent either on Labor ($L$) or Leisure ($R$)
- Labor is supplied at a wage schedule $w(L)$ – We usually assume a constant wage $w$
- People have non-wage income $m$, which may be zero
- Wage and non-wage income go into aggregate consumption $c$, which we treat as our numeraire
- People have preferences over consumption and leisure
- Consumption and leisure are normal goods

Budget Constraints

- In this case we have two budget constraints
- One for Time
  $H = L + R$
- And one for money or consumption
  $c \leq m + wL$
- We usually write the latter in terms of Leisure:
  $c = m + w(H - R)$ or $c + wR \leq m + wH = M$
Present and Future Values Primer

• Take two periods -- 1 and 2
  – This month and next, this year and next
  – Lifetime: earning years and retirement years

• Let $r$ denote the interest rate per period

• If $r = 0.1$ then $\$100$ saved at the start of period 1 becomes $\$110$ at the start of period 2

• Future Value: Value next period of $\$1$ saved today

Future Value: Formulas

• Given $r$, FV of $\$1$ one period from now is
  – $FV_1 = 1 + r$

• Given $r$, FV one period from now of $\$m$ is
  – $FV_1 = m(1 + r)$

• FV two periods from now is the
  – $FV_2 = (1 + r) FV_1 = m(1 + r)^2$

• FV $n$ periods from now is the
  – $FV_n = (1 + r) FV_{n-1} = m(1 + r)^n$

Present Value: Introduction

• How much do you save now to get $\$1$ next period?

• $v$ saved now becomes, in next period: $v(1 + r)$

• So, want $v$ such that $v(1 + r) = 1$

• Thus, $v = 1 / (1 + r)$ is present-value (PV) of $\$1$ obtained at start of next period

• Then, the present value of $\$m$ obtained at start of the next period is:
  $$PV = \frac{m}{1 + r}$$
**Present Value: Formulas**

- Given \( r \), PV of $m$ one period from now is
  \[
  PV_1 = \frac{m}{1 + r}
  \]

- Given \( r \), PV of $m \ n$ periods from now is
  \[
  PV_n = \frac{m}{(1 + r)^n}
  \]

**Inflation**

- If the inflation rate is \( \pi \)
- Then the *real* present value of $m$ in the next period is:
  \[
  PV_1 = \frac{m(1 + \pi)}{1 + r}
  \]
- That implies that the real interest rate \( \rho \) is:
  \[
  \frac{1 + \rho}{1 + \pi} = \frac{1 + r}{1 + \pi}
  \]
- This is often approximated as: \( \rho = r - \pi \)

**Present Value: Stream of Income**

- Suppose we have a bond that pays $m$ each period for \( n \) periods

- The simplest way to calculate this is to calculate present value of the stream:
  \[
  PV = m \left[ \frac{1}{1 + r} + \frac{m}{(1 + r)^2} + \cdots + \frac{m}{(1 + r)^n} \right]
  \]
- This can be shortened to:
  \[
  PV = m \frac{(1 + r)^n - 1}{r(1 + r)^n}
  \]

**Summary: Formulas**

- Given \( r \), PV of $m \ n$ periods from now is: \( PV = \frac{m}{(1 + r)^n} \)

- Given \( r \), FV \( n \) periods from now of $m$ is \( FV = m(1 + r)^n \)

- Given \( r \), PV of $m$ each period for \( n \) periods is
  \[
  PV = m \frac{(1 + r)^{n+1} - 1}{r(1 + r)^n}
  \]
- Given \( r \), PV of $m$ each period forever is
  \[
  PV = \frac{m}{r}
  \]
End Primer

Intertemporal Choice – Capital Supply

- Households savings serve as the supply of capital to the market
- We model the savings decision as a decision between consumption today and consumption in the future

Intertemporal Choice Assumptions

- People live for two periods: Now and Later
  - Interpretations of these include “working years” and “retirement”
  - Consumption in the two periods is $c_1$ and $c_2$
- They have a (usually fixed) income endowment of $(m_1, m_2)$
- The “price” at which consumption today can be traded for consumption later is the market interest rate
- People have preferences over consumption now and later

Budget Constraint

- If the only limitation people have on borrowing is that they must be able to repay it
- And the interest rate is $r$
- The the maximum consumption people can have in the present is
  \[ m_1 + m_2 / (1 + r) \]
- The budget constraint then becomes:
  \[ c_1 + \frac{c_2}{1 + r} \leq m_1 + \frac{m_2}{1 + r} \]
Graphically

Including Preferences

Savers
- Savers move consumption from the present to the future
- That is,
  - \( c_1 < m_1 \); and
  - \( c_2 > m_2 \)

Borrowers
- Borrowers move consumption from the future to the present
- That is,
  - \( c_1 > m_1 \); and
  - \( c_2 < m_2 \)
Preferences

- General preferences take the form $U(c_1, c_2)$
- Usually, though, economists use time-separable preferences:
  - That is $U(c_1, c_2) = u(c_1) + \rho u(c_2)$
- Monotonicity and Convexity of preferences imply
  - $u'(c) > 0$ and $u''(c) \leq 0$
- Where $\rho$ is the pure rate of time preference

Applications

- Labor Supply Model
  - Overtime Pay
  - AFDC
  - Religious Participation
- Intertemporal Choice
  - Different Interest rates for borrowing and lending
  - Social Security
  - Social Security with different interest rates