Consumption, Saving and Investment

Topic 3
Goals for today’s class – start modeling Aggregate Demand (AD)

- What drives business *investment decisions*?

- Does investment theory accurately match the data?
- What is the role of inventory?

- What drives *household consumption*?

- Does consumption theory accurately match the data?
- What theories of consumption seem to match the data?
- What role can the government play in shaping spending?
- Should a distinction be made between *unexpected* and *expected* changes and *permanent* and *temporary* changes in income?
- What is the link between consumption and savings?
Part I: Investment
An introduction to investment

- Second major component of spending

- Includes purchase and construction of capital goods (fixed capital); inventories; residential structures.

- Two reasons why studying investment is important:

  1. It matters more for business cycle fluctuations. Much more volatile than consumption (accounts for 1/6 of GDP but more than ½ of decline in spending in a recession).

  2. Determines long-run productive capacity of an economy (output is higher if capital stock is higher).
Desired capital stock

- Firms optimize the amount of capital to have (just like they optimize the amount of labour to hire).

- Remember from Topic 2: For the optimal amount of labour, firms equate the MPN with the real wage (cost of an additional unit of labour).

- For the optimal amount of capital, firms equate the MPK (per period benefit of one more unit of capital) with the per period cost of an additional unit of capital.

- How does capital evolve: \( K_{t+1} = (1-\delta) K_t + I_t \)
  - i.e. Capital is increased tomorrow by investing today (less depreciation).
  - So the desired capital stock is determined by future MPK and expected user cost of capital

- What is the cost of an additional unit of capital (user cost of capital)?
User cost of capital

- User cost of capital = expected cost of using an extra unit of capital for a period
  - Capital is long lived - so user costs include not only current, but future costs

- Real interest rate (cost of funds). Usually have to borrow to buy equipment. If you do not borrow and instead use retained earnings, you give up the interest payments you would have received in you invested that money instead of buying new equipment. (Assume borrowing rates = lending rates = \( r \) = expected real interest rate).

- Depreciation rate on the capital (how long the capital lasts) (percent that depreciates, on average, per year) \( \langle\langle \text{Symbol}=\delta \rangle\rangle \)

- Maintenance rate - how much will it cost (per unit price) to maintain the equipment. \( \langle\langle \text{Symbol}=\text{mm}\rangle\rangle \)

- Real purchase price of capital (how much the equipment costs per unit) \( \langle\langle \text{Symbol} = p(K)\rangle\rangle \)

- User cost (per period) = \( UC = r* p(K) + \delta* p(K) + \text{mm}* p(K) \)
First order condition from profit maximization:

\[ P \ast MPK^f = p(k)[r + \delta + mm] \]

Benefits of investing are more output tomorrow – so, it is the future MPK that is important. \( P \) is the price of output, \( p(K) \) is the price of capital. If \( P = p(K) \), then:

\[ MPK^f = [r + \delta + mm] = \text{user cost} \]

If user cost of capital > MPK\(^f\), then MPK\(^f\) must rise (capital must fall - ie, investment must be lower today).

If user cost of capital < MPK\(^f\), then MPK\(^f\) must fall (capital must rise - ie, investment must increase).
The desired capital stock

- Graphical representation of the definition of the desired capital stock.
- The desired capital stock is affected by changes in future MPK or UC.

\[
UC_f(r, \delta) \quad MPK^f (A^f, N^f) \quad K^* \quad K^f
\]
Changes in the desired capital stock: $A^f$ increases

- As $(A^f)$ increases, $MPK^f$ shifts up, desired future capital stock, $K^f$, increases!
Changes in the desired capital stock: \( r \) increases

- As \( (r) \) increases (to \( r' > r \)), user cost shifts up, desired future capital stock, \( K^f \), falls!
Suppose now I start taxing revenues at rate $\tau$. At optimum: $MPK^f (1-\tau) = r + \delta + mm$

- Need to tax-adjust the user cost, equivalent to user cost shifting up, desired future capital stock, $K^f$, falls!
Reaching the desired capital stock: Investment

- **Rationale:** *Investment decisions today have effects on the capital stock tomorrow.* It takes time to build, install, train workers, etc. This is especially true with large expenditures (buildings, structures, assembly lines, etc).

- **Recall how capital evolves:** $K_{t+1} = (1-\delta)K_t + I_t$
  
  - i.e. capital is increased tomorrow by investing today (less depreciation).
  - *Gross investment is $I_t$; depreciation is $\delta K_t$; net investment is $K_{t+1}-K_t$*
  - Net investment = Gross investment - Depreciation

- If $K^*$ is the desired capital stock then $K^* = (1-\delta)K_t + I_t$

- **A change in $K^*$ produces a change in $I_t$**. The relationship is 1-to-1. Investment is the means to achieve the optimal capital stock.
Investment (I) and real interest rates (r)

Key: As (r) decreases, desired capital stock increases, investment increases.

A must read: textbook 4.2 on investment.
Investment: some caveats on the process

- Investment takes time to plan.

- Investment tends to be ‘irreversible’ (costly to change if you over/under invest).

- Investment returns are uncertain (returns are in the future - which is unknown).
  - As economic uncertainty increases, investment decisions can become delayed.

- Firms - like individuals - are forward looking. If interest rates fall today, I may not invest today because I believe interest rates can be even lower tomorrow.

- Firms - like individuals - may be liquidity constrained. (The role of banks in the economy may be important). Liquidity constrained means that the firm is unable to have access to financial markets – or they have access, but the cost of funds is prohibitive!

- Tax policy can affect investment decisions (investment tax credit…)

- Correlation between $A$ and $A^f$ (if $A$ changes today and it is only temporary and it was unexpected, then no effect on investment)
Other components of investment

We have focused on business fixed investment so far.

But aggregate investment also includes:

- **Inventories** (unsold goods, unfinished goods, raw materials)
- **Residential structures** (new houses, condos, apartment complexes).

Same principles apply for the decision of how much inventories to keep or condos to build (i.e. equalize marginal benefit and marginal cost).
Investment: the role of inventories

- Investment is highly procyclical! (remember procyclical means – when Y increases I increases (and vice versa)).

- Inventories are the most volatile (and procyclical) component of GDP.

- Can inventories be a signal of future economic activity?
  
  - Yes, can predict recessions (a rapid rise in inventories - unplanned inventories)
  
  - Yes, can predict expansions (a smooth rise in inventories - planned inventories).
Investment: the cyclicality of inventories
Part II: Consumption
An introduction to consumption

- Major component of spending (70% of GDP).
- Includes purchase of goods and services by individuals.
- Two reasons why studying consumption is important:
  1. It is the largest component of demand for goods and services;
  2. Deciding how much to consume is linked to how much to save.
- $C^d = \text{desired consumption}; \ S^d = \text{desired saving}.$
- Assume income is all disposable ($Y_d = Y$), $Y - C^d - G = S^d$
Old school consumption?

- **Keynesian consumers** (named after a theory of John Maynard Keynes)

  \[ C = a + b^* Y_d \] (ignoring taxes and transfers: \( Y_d = Y \))

  \[ a = \text{‘subsistence’ level of Consumption} \]
  \[ b = \text{marginal propensity to consume} = \text{MPC} \]

  **Key: Consumption is based solely on current income.**

  Based on cross-country and long-run time series data: \( a \sim 0 \) and \( \text{MPC} = \frac{\Delta C}{\Delta Y} \sim 0.90 \)

  Problem: In Micro Data (household data) over short term, \( \text{MPC} << 0.90 \)

  People run a regression: \( \Delta C = \beta_0 + \beta_1 \Delta Y + \text{error} \) (using household data) \( \beta_1 \) around 0.40!

- **The Keynesian consumption function does not seem to match short-run (household) data. It does match long-run (country level) data.**
Old school consumption?

- Drawbacks to Keynesian consumption functions (aside from not matching data):
  - Does not result from optimising household behaviour
  - Does not allow for the role of interest Rates
  - Does not distinguish between different types of income (one-time increase vs. permanent increase)
  - Does not include expectations

- Is there another theory which allows us to look at household consumption behaviour?

- Yes - Fisher/Lifecycle (Modigliani)/Permanent Income Hypothesis (Friedman)!
A model of consumption: Fisher’s model

- Fisher’s model of consumption allows us to look at individual/household consumption behaviour.

- Based on the intuition that in your consumption-saving decision you face a trade off.

- **Consuming more today means less saving today. Less saving today means that your resources for future consumption tomorrow are going to be lower.**

- Call $r$ the real interest rate (given).

- **The intertemporal price of 1 extra unit of consumption today is $-(1+r)$ less units of consumption tomorrow.**

- **If we understand this simple point we are already half way through!**
Set up of the Fisher’s model of consumption

- Study the decision of an individual that lives 2 periods. (may think of them as working age and retirement).

- \( r \) given.

- Current and future income given, wealth given (exogenous).

- Define:
  - \( y \) = current income  i.e. current wage
  - \( y_f \) = future income  i.e. future wage
  - \( a \) = initial assets  i.e. wealth
  - \( c \) = current consumption
  - \( c_f \) = future consumption

- Objective: determining the choice of \((c, c_f)\)
We call the relationship between current and future resources the (intertemporal) budget constraint.

Key: The amount of \( c \) chosen will determine the amount available for \( c^f \)

\( y + a - c \) are the leftover resources that you carry to period 2 (the future).

Particularly if you put those resources in a bank you will get \( (y + a - c)(1 + r) \)

Assume that at period 2 you consume everything. It’s the last period.

We have \( c^f = (y + a - c)(1 + r) + y^f \)

This is the budget constraint. Let’s look at it in the \((c, c^f)\) space
Intertemporal budget constraint

Slopes downward. There is a trade off between current and future consumption.

\[ c_f = (y + a - c)(1+r) + y_f \]
An additional concept: how much are all your resources (current and future) worth today?

We just need to add the resources up, appropriately discounted.

We call it the present value of lifetime resources = \( PVLR = y + a + \frac{y^f}{(1 + r)} \)

You can check that this is also equal to present value of lifetime consumption (PVLC). (nobody is getting away with consuming more that he can and nobody wastes resources that go unconsumed).

PVLR is also the maximum level of consumption that you can get in the current period.
Intertemporal budget constraint

Note the PVLR

\[ c^f = (y + a - c)(1+r) + y^f \]

\[ PVLR = y + a + y^f/(1+r) \]
Last piece: individual preferences

- Our individual consumer, George, has utility $U(c, c^f)$,

- Ignore their dependence on leisure for this example - makes it simpler.

- (Realistically) George likes consumption (both in the present and future)

- Assume $c$, $c^f$ are normal goods (if your income increases you want to consume more).

- (Realistically) George likes if the level of consumption $(c, c^f)$ remains smooth over time (consumption smoothing, more on this later). No large drops or jumps.

- So has regular indifference curves (curves representing the $(c, c^f)$ pairs that yield the same utility).
An indifference curve for standard preferences

Indifference Curve (same utility on each curve)

Utility increases moving outwards
Optimal choice of consumption (current and future)

\[ c^f = (y + a - c)(1+r) + y^f \]

\[ PVLR = y + a + y^f/(1+r) \]
Utility (current and future consumption)

\[ U(c, c^f) \]
Optimal choice of consumption (current and future)

$c^f = (y + a - c)(1+r) + y^f$

$U(c,c^f)$
Optimal choice of consumption (current and future)

\[ c_f = (y + a - c)(1+r) + y_f \]

Look at the contour!
c=[0.01:.1:5];
c_f=c;
y=.5;
y_f=.6;
a=1;
r=.05;
beta=.8;

[xx,yy] = meshgrid(c,c_f);
U_c_c_f = log(xx)+beta*log(yy);
mm=max(max(U_c_c_f));
mi=min(min(U_c_c_f));

surf(c,c_f,U_c_c_f);
xlabel('c')
ylabel('c_f')
zlabel('U(c,c_f)')
colormap(winter)
hold on

[xx, zz] = meshgrid(-6:.1:6);
Yv = @(xx) (y+a-xx)*(1+r)+y_f;
surf(xx,Yv(xx),zz);
hold off
Fisher’s model of consumption

- **Objective:** determining the choice of \((c, c')\)

- We just did it graphically!

- It is the point of tangency we just found. (where the intertemporal rate of substitution equals \(1+r\)). <<From Micro, some more details in an Example coming up>>

- This simple set up is good enough for start thinking at consumption and saving.

- Saving \(= y - c\)
Permanent Income Hypothesis (PIH)

- Milton Friedman/Franco Modigliani:
  - Consumers like smooth consumption
  - Optimize ‘lifetime’ utility (over consumption). Pretty much the Fisher model.
    - Today, you plan your consumption based upon what you observe today and what you expect to happen tomorrow!
  - Constraint: $PVLC = PVLR$ ($PVLC =$ present value of lifetime consumption).
  - They like to smooth ‘marginal utility’ across seasons, business cycles and life cycles.
  - Think about it: retirement, job loss, summer vacations, etc.
  - Does much better at matching data – (although not perfect)
From Micro: an example of solving the model

- Again assume households (George) maximize \( U(c, c_f) \) in a two period model (current = period 1, future = period 2)

\[
U(.) = \ln(c) + \beta \ln(c_f) \quad \text{(log utility - for simplification, } \beta = \text{Discount Factor - i.e., how much you like eating today versus tomorrow)}
\]

\[
c_f = (y + a - c)(1 + r) + y_f \quad \text{(Budget Constraint; } a = \text{Initial Wealth)}
\]

or

\[
c + c_f/(1+r) = a + y + y_f/(1+r) \quad \text{(I just re-wrote the above constraint PVLC=PVLR)}
\]

- Do some simple constrained optimization:

Maximize \( U(c, c_f) \) with respect to \((c, c_f)\) subject to intertemporal budget constraint.
Maximise utility: we get by FOC……

\[ \frac{\partial U(c)}{\partial c} = \frac{1}{c} - \beta (1+r) (1/c_f) = 0 \]

<<Process: a) Use budget constraint and substitute out \(c_f\) from utility function (utility function is only a function of \(c\) now (not \(c\) and \(c_f\)).
b) Take derivative of utility function with respect to \(c\).
c) Set derivative equal to zero (this is how we maximize).
d) Substitute \(c_f\) back into the second term using the budget constraint. >>

For our example, assume that \(\beta = 1\) and \(r = 0\) (for simplicity, not realism).

Solution: \(c = c_f\) (households want equal levels of consumption each period).

Suppose: \(y = 1, y_f = 9, a = 0\): What are the optimal \((c, c_f)\)?

We know that \(c\) is smoothed over time (optimizing behaviour).

We also know that \(c_f = (a + y - c) (1 + r) + y_f\) (budget constraint).

Solving we get \(c = (a + y + y_f)/2 = \text{PVLR/LL} = 5\); where \(\text{LL} = \text{length of life} \).
An example (cont.)

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Consumption</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Savings</td>
<td>-4</td>
<td>4</td>
</tr>
</tbody>
</table>

- Note: *expected* income increases are already included in today’s consumption plan:

  - **Only news today (about today or the future) affect our consumption plan!!**
  - The fact that income rises from 1 to 9 between periods 1 and 2 is already included in my consumption plan!!

- *Unexpected* news about income, life spans, etc. **WILL** effect consumption decisions.
Unexpected transitory increase in current income

- Example: Suppose today I find out that my current income increases by $\Delta = $2. What is the new consumption plan associated with this transitory (temporary) increase in $y$?

- $c = c_f = 6$ <<still smooth consumption across periods>>

- $s = -3$, $s_f = 3$

- **Consumption increases by a little today (and in the future), saving increases today!**

  - Saving increases today so consumption tomorrow will be higher (transfer some of the transitory income shock towards the future)

- $\text{MPC} = \frac{\Delta c \ (\text{today})}{\Delta y \ (\text{today})} = \frac{1}{LL} = (\text{in this example}) = \frac{1}{2} = 0.5$
**Unexpected transitory increase in current income**

**Increase in current income** ($y + \Delta = y' > y$). Pure income effect. Increasing income increases both current and future consumption (both normal goods). George is a lender here.

\[
PVL R = y + a + y_f / (1+r)
\]

\[
PVL R' = y + a + y_f / (1+r) + \Delta
\]

*Note that current saving (y’-c’) also goes up when y’ increases. The level of c f increases for this reason.*
Transitory increase in future income

**Increase in future income** \((y^f + \Delta(1+r) > y^f)\). Pure income effect. I know now that in period 2 I have \(\Delta(1+r)\) more. Increasing future income increases both current and future consumption (both normal goods).

\[
PVLR = y + a + \frac{y^f}{(1+r)}
\]

\[
PVLR' = y + a + \frac{y^f}{(1+r)} + \Delta
\]

*Note that current saving \((y-c')\) goes down when future income increases!*
Example: Suppose today I find out that my income will permanently increase by $2 (in both period 1 and period 2). What is the new consumption plan associated with this permanent increase in $y$ and $y_f$?

$c = c_f = 7$

$s = -4, s_f = 4$

Consumption increases more today (and in future) than compared with the case of a transitory income shock, and saving remains constant!

MPC = $\Delta C$ (today) / $\Delta Y$ (today) = 1 = (in all examples) = 2/2 = 1

• With permanent changes in income, consumption and income move 1 for 1.
Unexpected increase in wealth

- Example: Suppose today I find out that my wealth increased by $2 prior to period 1 (a one-time unexpected stock market gain). What is the new consumption plan associated with this unexpected increase in \( a \)?

- \( c = (a + y + y_f)/2 = c_f = 6 \)

- \( s = -5 \) (= \( y - c \)), \( s_f = 3 \) (increase in PVLR due to wealth = 2)

- **Consumption increases today (and in future), and saving falls.**

- One time increases in wealth are identical to one time (transitory) changes in current income. Different effect on saving though.
Unexpected increase in wealth

Increase in initial wealth \((a + \Delta = a' > a)\). Pure income effect. Increasing wealth increases both current and future consumption (both normal goods).

\[ PVLR = y + a + \frac{y^f}{1+r} \]
\[ PVLR' = y + a + \frac{y^f}{1+r} + \Delta \]

Note however that current saving \((y-c')\) goes down when \(a\) increases!
Some evidence consistent with PIH behaviour

- Business Cycles are likely to be associated with temporary shocks to income.
  - We find consumption to be more stable than income over the business cycle.
  - And the saving rate is generally procyclical.
  - So, $C$ does not move 1-for-1 with $Y$.

- Micro studies find the MPC out of income changes to be much less than 0.9 ($c$ does not track $y$ one for one).

- Micro studies find a MPC out of changes in wealth of about 0.05. (Unexpected capital gains in housing/securities are like one time increases in income).

- Household consumption responds more to permanent shocks to income than to temporary shocks.
However…

In contrast to the predictions of the PIH, consumption does vary too much with temporary income changes.

- Suppose a household earns $60,000 (on average) over 40 working years.
- Total earnings over working years = $2.4 million (do not worry about discounting)
- Suppose in a recession, that household loses their job for 1 year and because of transfers (unemployment insurance, severance?) only earns $20,000 that year.
- That household’s lifetime income only declined by 0.166% (less than one fifth of one percent) …. ($40,000/$2.4 million) because of recession.
- *Being unemployed --- even for one full year out of a lifetime --- does not effect lifetime income all that much!*
- According to the PIH, consumption should not respond that much…. (household should spread that $40,000 over 40 years. Consumption should, at most, decline only $1,000/year).
- If you prepared for the possibility of job loss, consumption really shouldn’t change at all (just draw down savings).

If this the PIH theory is true, consumption of the economy should not respond that much during recessions ((i) recessions have little effect on our lifetime incomes and (ii) we should prepare for recessions and as a result, have savings to buffer our low income).
But consumption falls during recessions
  • Not a prediction of the standard permanent income hypothesis (PIH).

If households were smoothing consumption, they should realize that their lifetime income has not changed that much because of job loss.

Furthermore, they should have saved to prepare for a recession (we all know that recessions sometimes happen!)

During recessions, aggregate consumption behaviour looks more Keynesian than PIH.....

Why do I say this? Well, Keynesian behaviour says C is a function of only current Y.
  i.e. \( C = a + b \ Y_d \)

As current Y falls (as in a recession), current C falls. However, data shows that C falls only by about 40% of the Y fall. That implies b is 0.40. But, this doesn’t match long term response of consumption to income changes (too high).
Refinements to consumption theory

- These are refinements to consumption theory that we will not spend much time on (there is a whole consumption literature modeling consumption behaviour more thoroughly to match the data).

- Liquidity constraints <<Let’s talk about this - borrowing constraints - maybe consumers cannot smooth income!!>>
- Uncertainty (precautionary savings)

- Little is known about preferences (time preference rates - \( \beta \) and risk aversion).
- Bequests explain a large portion of wealth accumulation
- Portfolio choice makes a difference
- Large variation in wealth accumulations across individuals (we will discuss this more).
- Life cycle shocks

- Home production (including shopping for bargains)
Liquidity constraints refer to the fact that sometimes a household (or a firm) optimally wants to borrow to smooth consumption (or for investment), but lenders are unwilling to lend to that household against future streams of income.

Why will lenders refuse to lend?

(a) Lender may not believe that the household will pay them back.
(b) Lender cannot distinguish between households who want to borrow to smooth consumption from borrowers who want to borrow and then default.

In recessions, in order to smooth consumption, households who receive a negative income shock either have to draw down saving or borrow. If they are prevented from borrowing, household will have no choice but to cut their consumption. As a result, C will fall during recessions.

Liquidity constraints make households look Keynesian when income falls (C falls when Y falls – for those with no saving and who cannot borrow).

However, when Y is high, households look like PIH households – nothing prevents them from saving. If Y is temporarily high, households would want to save some of that income. Liquidity constraints prevent borrowing NOT saving......
Liquidity constraints

Desired consumption is $c^d$. Note: current and future consumption are constrained.

\[
\begin{align*}
    c^f &= (y + a - c)(1+r) + y^f \quad \text{if } c^d < y+a \\
    c &= y+a \quad \text{and } c^f = y^f \quad \text{if } c^d \geq y+a
\end{align*}
\]
Refinement of PIH Theory (part 2): Grasshoppers and Ants

- Perhaps the economy is made up of both Keynesian and PIH consumers:

  *It was wintertime, the ants’ store of grain had got wet and they were laying it out to dry. A hungry grasshopper asked them to give it something to eat. ‘Why did you not gather food in the summer like us?’ the ants asked. ‘I hadn’t time’, it replied. ‘I was too busy making sweet music.’ The ants laughed at the grasshopper. ‘Very well’, they said. ‘Since you piped in the summer, now dance in the winter’. – An Aesop Fable*

- Fable is a story about consumption (eating), saving (storing food) and retirement (winter)…..
- Suppose the population is made up of both economic grasshoppers (Keynesian consumers) and ants (PIH consumers).
- The ants in the parable were forward looking (like PIH theory suggests – they know retirement is coming and prepare for it).
- The grasshoppers eat their current income and do little saving. They behave as if retirement does not exist. When retirement comes, they do not have enough recourse to sustain their consumption. "we can also think of winter as a recession…the grasshoppers do not prepare for recessions"
- As a result, the consumption of grasshoppers will respond to predictable changes in income (recessions, retirement, etc.)
Grasshoppers and Ants: evidence

- About 20% of households behave according to Keynesian theories (increasing consumption with income without regard for future states of the world).

- A full 1/3 of the baby boom generation is ‘ill prepared’ to sustain consumption through retirement (Bill Gale, Brookings).

- Over 20% of households do not own a checking/saving account (over 50% of African American Households) - (40% have less than $5k in liquid assets).

- Observe ‘Grasshopper’ behaviour among households in the population (consumption responds to both predictable income increases and predictable income declines). These same households are ill prepared for retirement.

- Pseudo-Keynesian behaviour important for policy!
  - Keynesian’s will have large current response to temporary tax cuts.
  - PIH households (who are not liquidity constrained) will have very small response to temporary tax cuts.
Refinement of PIH theory (part 3): Home Production

- We measure consumption (as with most macro variables) in dollars. Expenditure may not be a good measure of consumption when the value of time changes.

- When the value of time is low (unemployment – like in recessions) or retirement, individuals can take action to reduce their expenditure (holding consumption constant).
  
  - Clip coupons
  - Search for bargains across stores
  - Make your lunch at home instead of buying it at a cafeteria.

- If home production/search is important, we would expect EXPENDITURE to fall during a recession. However, CONSUMPTION may remain unchanged!

- Strong evidence for the home production/search theory of consumption expenditures. The decline in expenditure during recessions does not mean people are consuming less.
Consumption and interest rates

- So far we have focused at changes in income and wealth.

- Now let’s analyze what are the consequences of changes in prices.

- The real interest rate is the price of today’s consumption relative to future consumption. You forgo \(1+r\) dollars of future consumption to consume 1 dollar today.

- An increase in the real interest rate produces an increase of the price of today’s consumption relative to future consumption.
Consumption and interest rates

Increase in real interest rate \((r' > r)\): Example of income effect dominating (Lender). New intertemporal budget constraint.

\[
PVLR = y + a + \frac{yf}{(1+r)}
\]
Substitution and income effects: intuition

- Assume current and future consumption are normal goods.

- 1 plus the real interest rate is the price of today’s consumption relative to future consumption: *You forgo 1+r dollars of future consumption to consume 1 dollar today.*

- Increase in the real interest rate => Increase of the price of today’s consumption relative to future consumption.

- The fact that you shift away from current consumption (i.e. you increase your saving) as a consequence of this change in price is the substitution effect. Cheaper future consumption produces an incentive to consume less today and save more.

- But an increase in r also affects income (hence an income effect):
  1. An increase in the real interest rate increases interest receipts for a lender. This produces an incentive to consume more today and save less.
  2. An increase in the real interest rate increases interest payments for a borrower. This produces an incentive to consume less today and save more.
Intertemporal substitution in consumption

Increase in real interest rate: Example of income effect dominating (Lender). Step 1: Trace substitution effect (allow original choice at new prices).

- **Diagram:**
  - Axes: $c$, $y$, $c_f$, $c_{f*}$, $y_f$
  - Points: $c_1^*$, $c^*$, $y+a$, $0$
  - Labels: No-borrowing, no lending

- **Equations:**
  - No borrowing, no lending
Increase in real interest rate: Example of income effect dominating (Lender). Step 2: Now increase income to new level. Both current and future $c$ increase.

Note: Current saving decreases. See text for an example where $S_{fx}$ dominates (saving increase).
Note: for a borrower $I_f x$ and $S_f x$ go in the same direction. When $r$ increases, saving increases.
Recap consumption and interest rates

Assume households are net lenders.

- **Substitution effect:**
  
  Higher $r$ lowers $c$. Think of people saving more to reap the higher return, or people borrowing less b/c it is more expensive. Higher interest rate today, makes saving more beneficial (price of future consumption falls). Households will switch away from consumption today (i.e., $c$ today falls, $c_f$ tomorrow increases, and $s$ today increases)

- **Income effect:**
  
  Higher $r$ raises $c$ today. For every dollar saved, you get higher income (if you are a net saver). When richer, you buy more of the things you like. What do you like? Consumption today and consumption tomorrow. As a result, you can save less and get more of both. ($c$ today increases, $c_f$ tomorrow increases, and $s$ today falls)

- **Evidence:**
  
  Some studies find the substitution effect stronger, others find they are the same. My belief is that higher $r$ has little, if any, effect on current consumption ($Sfx = Ifx$)

**What if households are net borrowers?** - Income effect is opposite as lender. Higher interest rates make households poorer (they have to pay higher interest payments!) Income effect will say that $c$ today will fall, $c_f$ tomorrow will fall and $s$ today will increase.
Full recap of the Fisher/PIH model

- Assume current and future consumption are normal goods.

- An increase in current income increases current and future consumption and increases saving.

- An increase in future income or wealth increases current and future consumption but decreases saving.

- An increase in the real interest rate decreases current consumption but increases future consumption and saving for a lender, if the substitution effect dominates.

- An increase in the real interest rate increases current and future consumption but decreases saving for a lender, if the income effect dominates.

- An increase in the real interest rate decreases current consumption and increases saving for a borrower. May increase or decrease future consumption.
From Topic 2: go back to assuming households maximize $U(C, L)$. Where $U(.)$ is a utility function, $C$ is consumption and $L$ is the fraction of time spent on leisure (Leisure is Not Working). Households are made happier by consuming more and working less (all else equal...i.e., holding lifetime resources fixed).

From micro, we also know that:

\[ \frac{MU_C}{P_C} = \frac{MU_X}{P_X}, \text{ where } MU = \text{marginal utility and } P \text{ equals prices}. \]

This is the equilibrium condition that exists for all utility optimization over two goods.

We also know that the budget constraint also has to hold:

\[ P_C \times C = W \times (1-t) \times (1-L), \text{ where } (1-L) \text{ is the fraction of time worked, } t \text{ is the income tax rate and } W \text{ is the Wage}. \]
Suppose income taxes fall….. What has to happen to consumption and leisure????

**Income Effect (Equation 2 on previous slide)**
When income taxes fall – equation 2 says that, all else equal, households will be richer [i.e., \((W(1-t))\) will increase].
When households are richer, they will buy more of the things they like. What do households like?........ C and L.

**So, according to income effect, C and L will increase when income taxes fall.**

**Substitution Effect (Equation 1 on previous slide)**
When income taxes fall, equation 1 says that, all else equal, after tax wages will increase [i.e., \((W(1-t))\) will increase].
As the price of leisure increases, \(MU_x\) must increase AND/OR \(MU_C\) must fall.
As X falls, \(MU_X\) increases (law of diminishing marginal utility of X).
As C increases, \(MU_X\) must fall

**So, according to substitution effect, C will increase and L will fall when income taxes fall.**

Putting two effects together: **Effect on L is ambiguous. C will definitely increase!**
Summary: what affects consumption

- Current income (Both PIH and Keynesian theories)
- Expectations of future income (only PIH theory)

- Wealth
- Temporary vs. permanent Changes
- Tax Policy
- Interest rates (slightly)

- Preferences

- The magnitude of the results depend on whether consumers follow Keynesian or PIH consumption rules and whether or not liquidity constraints exist!!!!

- In our Government Policy Lecture, we will talk about Social Security Systems and Consumer’s Expectations of Tax Changes
Conclusion: getting closer to modelling demand

PVLR

- \( C(\text{today}) = C(y, y^f, \text{wealth, taxes, liquidity constraints, consumption rules, expectations}) \).

We will assume that \( r \) does affect \( C \) only through the Substitution effect! (You can extend the model to account for Substitution and Income effects)

- \( I(\text{today}) = I(r, A, \text{expectations, investment taxes}) \)

- We are moving towards a model of Aggregate Demand:
  - \( Y^d = C^d(.) + I^d(.) + G + NX \) (We will get to \( G \) & \( NX \) later in the course)