In third part of course, we reconsider some of the assumptions we have been making about consumption and investment behavior. We will draw on theories from microeconomics, which talk about how individuals behave. We will then use this microeconomic theory as a foundation for our macroeconomics theories.

1) **Keynesian consumption function**

The consumption function we have been using throughout this class was proposed by Keynes. Recall:

\[ C = a + bY \]  

abstracting here from taxes for simplicity

He chose this functional form because it had some specific properties he thought were realistic:

1) **MPC:** marginal propensity to consume \((\Delta C / \Delta Y = b)\) is between 0 and 1. This implies that when a person’s income goes up, he spends part and save part of the extra income.

2) **APC:** Average propensity to consume \((C / Y)\) falls as \(Y\) rises. In the consumption function above: \(APC = C/Y = (a+bY)/Y = a/Y + b\). This falls as \(Y\) rises.

3) function of \(Y\) not \(r\). Thought that people made their consumption and saving decisions base on their income, without much regard for what rate of interest they could earn on their saving.
b) **Empirical Tests:** Some support Keynesian function, some show a shortcoming

**Support Keynes:**
1) Compare rich people to poor people: rich people consume a smaller fraction of their total income. Consumption rise but not as fast as income. Says APC falls as Y rises.

2) Look how C changes during few years of Great Depression
   Years when Y was low, consumption fall but not as much as income—people needed to eat, so saved less - spent all of income. Says same as above.
   Also shows can explain why C changes in terms of changes in Y, not need r.

But lead to mistaken prediction: predicted that as economy grows and gets richer, consumption demand will not rise as much as income. So there will be a shortage of demand getting worse and worse and limiting rise in production, because no one will want to buy what is being produced. Stagnation, limited amount we can grow.

**Contradict Keynes**
3) Long-run study: Study look how C move over time, but longer period of time than above. Show that over long period of time APC is constant. As country grows richer, consumption stays a constant fraction of income.

So Keynesian function supported by short-run studies or done at a single point in time. Not supported by long-run studies.

Consumption Puzzle: APC seems to fall as Y rises in the short run, but is constant in long run
where APC = C / Y: share of income in a period used for consumption

Resolved by two approaches: Life cycle, Permanent income. Both build on Fisher model of consumption:
2) Fisher model

Want to find a way to explain the consumption puzzle (APC seems to fall as Y rises in short run, but APC is constant in long run).

Theory of how rational forward-looking people would choose how much to consume and how much to save.

a) Intertemporal budget constraint

Consider story of two years: earn Y1 and Y2, consume C1 and C2

first year budget constraint: S = Y1 - C1
this saving earns interest r, and can be used for extra consumption next year

second year budget constraint: C2 = (1+r)S + Y2 : consume everything (is no third year)

Example: if interest rate is 10%, then for every dollar I not consume today, I can consume $1.10 worth of goods next year.

Summarize by putting both year’s budget constraints together:
Intertemporal budget constraint: Plug in for S
C2 = (1+r)(Y1-C1) + Y2
rewrite:
(1+r)C1 + C2 = (1+r)Y1 + Y2
C1 + C2/(1+r) = Y1 + Y2/(1+r)

Interpret Budget constraint:

if r = 0, then says total C in both years equals total Y
If r >0, usual case, future C and Y are discounted by factor (1+r)

Discounting comes from interest earned on savings.

Showed if have 1$ today and put in bank, become $1.10 next year. Could say one of today’s $ equal 1+r of tomorrow’s $. Or say 1 of tomorrow’s $ is worth 1/(1+r) of today’s dollars. Two different types of dollars: today’s and next year’s.

Factor 1/(1+r) is price of second-year consumption measure in terms of first-year consumption: amount of C1 need give up to get 1 unit of C2.

BC says present value of total consumption (over both years) must equal present value of total income (over both years).
**Draw budget constraint.**

Shows points that are possible to consume, function of what income earned each period.
Slope is \(-(1+r)\).

Three points:  
A: consume each period what earn: certainly a possibility  
B: consume only next year, save everything now, then can consume \(C_1=0\), \(C_2 = (1+r)Y_1\) \(Y_2\) next year  
C: Consume all now (if can borrow it) \(C_1 = Y_1 + Y_2/(1+r)\), \(C_2 = 0\)

Budget line shifts out when total income increases. This can be due to increase in income either year. It is total income that matters.

Draw shifting budget constraint:

<table>
<thead>
<tr>
<th>Increase in (Y_1) alone.</th>
<th>Increase both (Y_1) and (Y_2).</th>
</tr>
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<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
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b) Preferences

BC shows possible choices can make. Want to understand which choices want to make. Summarize consumer preferences over current and future consumption by indifference curves.

Indifference curves: here show combination of first-period and second-period consumption that makes the consumer equally happy.

![Diagram of indifference curves with points W, X, Y, and Z, and indifference curves I1 and I2.]

All points on I1 consumer likes equally well. W to X: less C1 but more C2. X and Y equally. Less C1 but more C2.

The slope of the IC tells you in what proportions you are willing to trade off extra C2 for lost C1. This is called the marginal rate of substitution between C1 and C2.

Marginal rate of substitution: \( MRS \) here is the rate at which a consumer is willing to give up C1 in exchange for more of C2; is the (negative of ) slope of the indifference curve.

MRS rises for lower levels of C1: IC gets steeper as move to left. Idea: If have less C1 to start with, if give up one unit matters more than if starting with lots of C1.

Graphically: W to X: less C1 and more C2. Then X to Y: less C1 and more C2, but require more additional C2 than from W to X.

All point on IC equivalent, but are other ICs: I2 preferred to I1. Easy to see prefer Z to W, more of both C1 and C2. But also know Z preferred to X and Y, even though Z less C2, the extra C1 more than compensates.

Note: this depends on individual preferences.
c) **Optimization:**

Know what choices are possible, and what choices consumer finds preferable. Combine to determine the choice made.

Goal is to get on highest indifference curve possible.

See is at point 0, where IC just barley touches budget constraint.

Note that slopes IC is tangent to budget constraint line at this point. **Slopes are equal.**

Suggests a condition for the optimal choice is that the slopes must be equal. **Optimality condition:** $\text{MRS} = 1 + r$. 
d) Effect of increase income

1) Case 1: Suppose first period income rises.
   This shifts budget constraint out, as showed before.
   Will choose to raise consumption in both periods. Because consumption in
   either period is a normal good:

   (Normal good: a good that consumer demands more of when income rises.)

   Not consume all of current increase in income - save part of it for next period
   So share of income used for consumption falls:
   \[ \frac{C_1'}{Y_1'} < \frac{C_1}{Y_1} \]: and APC falls here as \( Y \) rises.

2) Case 2: Suppose \( Y_1 \) and \( Y_2 \) increase together:

Now \( C_1 \) rises in proportion to rise in \( Y_1 \), because \( C_1 \) responds to change in
total income, and here both \( Y_1 \) and \( Y_2 \) rise together.

Consumption stays a constant fraction of income:
\[ \frac{C_1'}{Y_1'} = \frac{C_1}{Y_1} \]: APC is constant as \( Y \) rises.
3) **Permanent Income Hypothesis**: (Milton Friedman)

Extend model to large number of periods (infinite)

Then total income would be sum of income over all future years

Define related concept:
Permanent income: $Y^p$ part of income people expect to persist into the future.
(average level of income per year)

Friedman says People decide to consume a certain fraction of this permanent income

$C = aY^p$

If get extra income in one year, will add it to total income, and consume only fraction of it. Divide extra income over number of years. If infinite number of years, this extra income has no effect on current consumption.

Call this transitory income: $Y^T$: part of income not expect persist into future periods

Consumption is affected by permanent income, and not by transitory income.

Implication:

$APC = \frac{C}{Y} = \frac{aY^p}{Y}$

This is not constant for changes in current $Y$ (temporary changes). But is constant for changes in permanent $Y^p$ (permanent changes)

If get extra income in one year and income is above average level, will not affect consumption much. $APC$ will be low when $Y$ unusually high.

If get pay raise, and income go up every year in future, will affect permanent income, so consumption will rise.

Explain empirical findings:

When people become temporarily rich one year, they not change $C$ habits much.

When the country in recession and all people are temporarily poor, people not change $C$ as much. Know is temporary.

But when country grows richer because of long-run economic growth, know is permanent, so consumption rises.
4) Life-Cycle Hypothesis: (Modigliani)

Similar idea, but says not reasonable to say people live forever. Work for period of years, then retire. Save up for retirement. And focuses not on transitory changes from permanent income, but fluctuations in consumption over retirement versus working years.

Def. Lifetime income: total income over person’s lifespan.

Say someone expects to live a total of T years, working and earning Y each year for N of those years.

Wants to smooth consumption over lifetime: Compute total income: (assume interest rate is zero)

\[
\text{total income} = YN
\]

spread total income over T years of consumption

\[
C = NY / T
\]

Draw picture of income, consumption, saving dissaving, wealth

Keep consumption at constant level
  Save for a period, use up saving in retirement.
  Mean build up wealth until retirement, then draw it down.

Numeric example:

Suppose start working at 20 plan to work until 65 and live 15 more years.
Suppose expect earn $40,000 a year. Then

lifetime income = $40,000 \times 45 \text{ years} = $1.8 \text{ million}

spread over 60 years, so

\[
C = 1.8\text{mil} / 60 \text{ years} = $30,000 \text{ per year}
\]
Story: saving and fear of nuclear War: Estimates of life-span falls, would consume more now and save less.

During years when nuclear war a greater threat (minutes to midnight clock). Saving moves closely with it: fall during 80s. Low beginning of 70s.

Survey: countries say is little danger (Japan) have higher saving rate than countries saying is big danger (US).

Implications:

Again, if income goes up temporarily, will only consume a small fraction of it, because spread it out over whole lifetime:

Transitory income affects consumption less, the more years you expect to live.

If you win lottery rises 1000\$ today, will spread it out over all T years, so C rises this year by $1000/T = $16.7. Has only small effect.

But if win lottery giving you 1000\$ every year, C go up by 1000\$.

So **MPC small for transitory changes in income, MPC large for permanent changes.**

Can extend to consider consumer who has initial wealth, W (Text does in detail. I not emphasize it as much here).

Then lifetime resources are sum of lifetime income an initial wealth:

\[ C = \frac{(W + NY)}{T} \]

\[ C = \frac{1}{T} W + \frac{N}{T}Y \]

use numbers of previous example:

\[ C = 0.0167W + .75Y \]

Looks like a Keynesian consumption function, but remember, Y here is annual income you are counting on for every year in working years, not just current income.
5) **Borrowing Constraint:**

Conclusion here: Can justify Keynesian consumption function, but should not use current income, but some measure of lifetime income (Modigliani) or permanent income (Freideman)

But could argue still should consider current income:

Consider borrowing constraints: Clearest if use Fisher model again:  
Assumed before could borrow against future income to finance extra current consumption if wanted to. 
Suppose now can’t borrow for current consumption. \( C_1 \leq Y_1 \).

Affects intertemporal budget constraint

Then consumption may be limited by \( Y_1 \). And if \( Y_1 \) rise, \( C_1 \) rise also. So \( C_1 \) determined directly by current income \( Y_1 \), not by total income \( (Y_1 + (1+r)Y_2) \).

**Conclusion:** Consumption is function of current income as well as lifetime or permanent income.

Perhaps one reason Japanese save more: harder to borrow for consumption or buy house. Down payments of 40% rather than 10%.
6) Effect of interest rate:

another feature of Keynesian consumption function is that not include interest rate:
assume interest rate not much affect consumption decision.
Start: point A: C1 < Y1, so are saving

If interest rate rises, means budget constraint rotates, through point of the two
incomes (know this point is always one of the possibilities, so is always on
the budget constraint.)
What point choose: here show case where lower C1 and higher C2.

Two effects:
1) Income effect: describes movement to a different indifference curve. Since is a
saver, higher r means are better off, higher indifference curve.
This effect tends to make both C1 and C2 to rise.

2) Substitution effect: describes movement along an indifference curve - change in
relative price of consumption in the two periods.
Here consumption in period two has become less expensive relative to period
1. Higher R means can give up less C1 now for same amount of extra C2
later.
This effect tends to make C2 rise (cheaper) and C1 fall (more expensive)

Consider both effects together: C2 rising because of both effects. But C1
could go either way because income and substitution effect work in
opposite directions.
Consistent with Keynesian theory that C not affected strongly by R.

Conclusions about Keynesian consumption function (C = a + bY)
1) Should include permanent or lifetime income or wealth, so as to distinguish
between temporary changes in income (which not affect consumption
much) and permanent changes in income (which do affect consumption
much)
2) But is good that includes current income, because of constraints.
3) Is debatable whether should include interest rate. May not affect con-
sumption because income and substitution effects work against each other.