# ECO 3302 – Intermediate Macroeconomics

## Lecture 5: National Income—How It Is Spent

Luis Pérez
(luisperez@smu.edu)

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# Introduction

# Introduction

- Previous lectures:
  - **Output creation**: How inputs transformed into output via production functions
  - **Income shares**: How income distributed among workers, capitalists, firm owners
- Today:
  - Demand for goods and services
  - Equilibrium in market for goods and services

# Demand for goods and services

# GDP in a closed economy

- In previous lectures, we identified four GDP components:
  - Consumption, $C$
  - Investment, $I$
  - Government spending, $G$
  - Net exports, $NX$
- That is, $Y = C + I + G + NX$
- To simplify analysis, we now assume **closed economy**—that is, $NX = 0$

# Demand for goods and services

- In a closed economy, there are three uses for goods and services:

$$Y = C + I + G$$

- Equation above is a **(national accounting) identity**
  - It doesn't admit causal interpretations (eg, $\uparrow C \not\Rightarrow \uparrow Y$)
  - Only accounting interpretations:
    - Output spent on private consumption $C$, government $G$ and investment $I$ purposes
    - Sum of $C$, $G$, and $I$ equals $Y$

- *Big (and common) mistake to see people give accounting identities a causal interpretation...* Watch out! You don't want to belong to that group!

# Private consumption, $\mathbf{C}$

- **Private consumption is largest GDP component, accounting for $\approx 2/3$ of GDP**
  - 13% durables: cars, TVs, fridges, ...
  - 22% Non-durables: food, clothing, gas, ...
  - 65% Services: haircut, meals out, movie tickets, ...
- **Simplest consumption model**:
  - Household earns income $Y$ $(= WL + RK + \Pi)$ from work and ownership
  - Government takes $T$ dollars in taxes
  - Household ends up with **disposable income** $Y - T$
  - Household allocates disposable income between consumption and savings

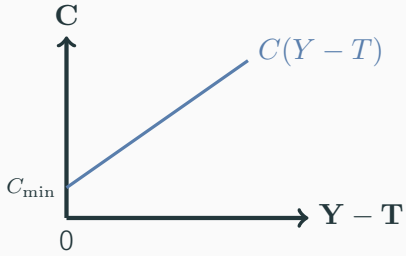
# The consumption function

- All consumption models assume consumption is a function of income
- Simple **consumption function**

$$C = C(Y - T)$$

Ie, consumption is *only* a function of disposable income

- Example of linear consumption function:



# The marginal propensity to consume (MPC)

**Marginal propensity to consume (MPC)**

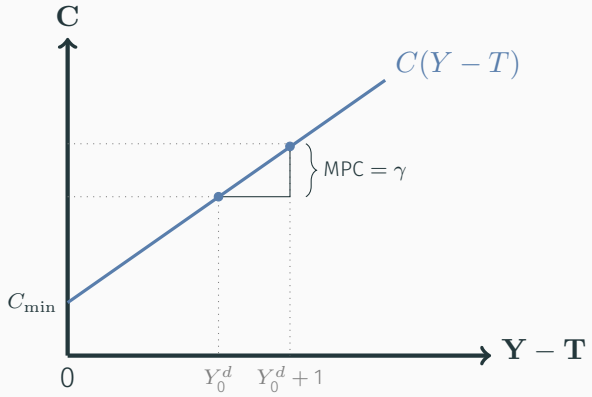
The **marginal propensity to consume**, a number between 0 and 1, is the amount by which consumption changes when disposable income increases by one dollar. Formally, if the consumption function is $C = C(Y - T)$, the MPC is $\mathrm{d}C/\mathrm{d}(Y - T)$

Eg, If I give you $1 extra dollar of disposable income and you spend $0.7 dollars, your MPC is 0.7

- **The MPC is a very important object for policymakers.** Can you guess why?
  - Important to determine the effects of fiscal stimulus!

# Example: MPC of linear consumption function

- Let $C(Y-T) = C_{\min} + \gamma(Y-T)$, where $C_{\min} > 0$ and $\gamma \in [0,1]$
- By definition, MPC $:= \frac{\mathrm{d}C}{\mathrm{d}(Y-T)} = \gamma$



# Investment, $\mathbf{I}$

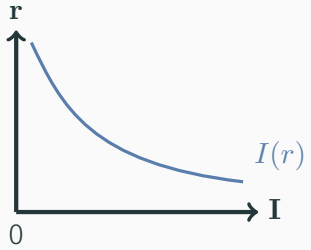
- **Total investment in the US accounts for about 15% of GDP**
  - Households do residential investments (ie, housing)
  - Firms do nonresidential investments (eg, offices, machines, computers, ...)
    ...and, remember, we also need to keep track of inventories!
- **Quantity of investment depends on interest rate** (ie, cost of financing investment)
  - Suppose you want to start a business and need to borrow $1M
  - You estimate annual return of 10%
  - If interest rate $r \geq 0.10$, you shouldn't undertake project; if $r < 0.10$, you should
  - Two remarks: (i) Same reasoning regardless of whether borrowing is needed; (ii) Same reasoning for individuals

# The investment function

- **Investment function** formalizes relationship b/w investment and interest rate

$$I = I(r)$$

- Investment functions make investment depend negatively on interest rate
  - Higher interest rates render more investment projects unprofitable
- Example of investment function:



# Nominal vs. Real interest rates

- Economists distinguish between **nominal** and **real interest rates**
  - Nominal interest rate: rate at which investors borrow (typically the one listed)
  - Real interest rate: nominal interest rate corrected for inflation

- **Relationship between nominal and real interest rates**:

$$i = r + \pi$$

$i$: nominal interest rate, $r$: real interest rate, $\pi$: inflation rate

- Eg, if nominal interest rate is 8% and inflation is 3%, real interest rate is 5%
  (borrowers' repayments fall in value by 3 percent per year)

- **Quantity of investment determined by real interest rate**, which captures true cost of borrowing

# Many types of interest rates

- If you look at the world around you, you'll notice many types of interest rates
  (eg, bank deposits, bank loans, credit card loans, mortgage loans, car loans, bonds, ...)

- Different interest rates reflect
  - **Bank spreads**: banks charge higher interest on loans that they pay for deposits. Spreads cover operating costs and may yield positive returns
  - **Term duration**: interest rates depend on loan duration (eg, 1 vs. 30-years loan) Long-term interest rates usually higher than low-term ones
  - **Credit risk**: interest rates depend on default probability (eg, gvt vs. junk bonds) Interest rates lower for more responsible borrowers and safer assets
  - **Tax treatment**: Different assets may offer different tax treatments. Eg, holders of local-gvt and state bonds do not pay federal taxes on income
  - **Callability**: Bonds where the borrower can decide to pay principal before maturity date pay higher interest

# Government spending, $G$

- **Government spending in the US accounts for $\approx$ 20% of GDP**
  - Federal gvt: guns, missiles, highways, federal gvt employees, ...
  - State and local gvts: schools, DMVs, police officers, firemen, ...
- Federal, state, and local gvts also make transfer payments, but these are not included in $G$ because do not directly affect demand of goods and services
  - Transfer payments: pension benefits, disability and unemployment insurance, ...
  - Recall that disposable income is $Y - T$. We think of $T$ as net taxes/transfers:
    - Tax: $T > 0$
    - Transfer: $T < 0$
- Whether the gvt runs a *balanced budget* (ie, $G = T$) is something we study in future lectures. **For now, we take $G$ and $T$ as given**

# Equilibrium in Goods and Services

# Demand and supply of goods and services

- Equations from discussion on demand of goods and services:

$$
\begin{aligned}
Y &= C + I + G && \text{(Resource constraint)} \\
C &= C(Y - T) && \text{(Consumption function)} \\
I &= I(r) && \text{(Investment function)} \\
G &= \overline{G} && \text{(Exogenous } G\text{)} \\
T &= \overline{T} && \text{(Exogenous } T\text{)}
\end{aligned}
$$

- Equations from (previous) discussion on supply of goods and services:

$$
Y = F(\overline{K}, \overline{L}) = \overline{Y} \qquad \text{(Production function)}
$$

# Equilibrium in the market for goods and services

- Combining resource constraint and consumption and investment functions:

$$Y = C(Y - T) + I(r) + G$$

- Using $\overline{G}$, $\overline{T}$ (fixed by policy) and $\overline{Y}$ (determined by fixed factors):

$$\overline{Y} = C(\overline{Y} - \overline{T}) + I(r) + \overline{G}$$

  **Supply of output equals output demand**, which is the sum of consumption, investment, and government purchases

- **Interest rate** $r$ is only variable not determined in last equation. It **adjusts so that goods and services market clears** (ie, to balance supply and demand)

# Interest rate ensures goods and services market clears

$$\overline{Y} = C(\overline{Y} - \overline{T}) + I(r) + \overline{G}$$

- Because $I(r)$ depends negatively on $r$, the higher $r$, the lower $I$
- **Equilibrium interest rate is s.t. demand for goods & services equals supply**
- To better understand the role of $r$, we look at financial markets

# Financial markets

- Interest rate is both **cost of borrowing** and **return to lending**
  - You can either be borrower or lender

- Using the national accounting identity of a closed economy, we can write

$$\underbrace{Y - C - G}_{\equiv S \text{ (savings)}} = I$$

  Equation states that **flows into financial market (ie, savings) must balance flows out of financial markets (ie, investment)**

- We can also distinguish between private and public savings:

$$S = \underbrace{(Y - T - C)}_{\text{private savings}} + \underbrace{(T - G)}_{\text{public savings}} = I$$

# Equilibrium in financial markets

- Let's see how interest rate brings financial markets into equilibrium
- Start from

$$\overline{Y} = C(\overline{Y} - \overline{T}) + I(r) + \overline{G}$$

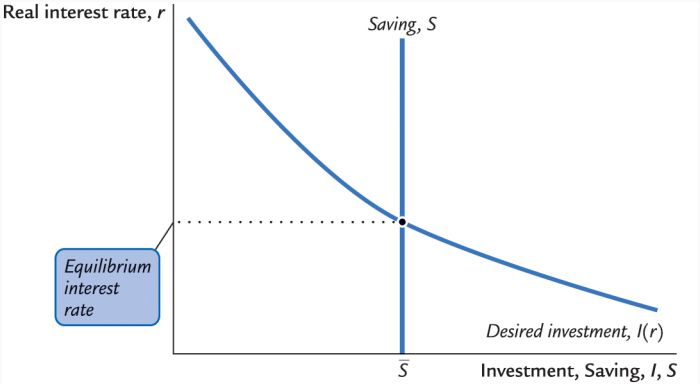
- Rearranging

$$\begin{aligned} & \overline{Y} - C(\overline{Y} - \overline{T}) - \overline{G} = I(r) \\ \iff \quad & \overline{S} = I(r) \end{aligned}$$

- LHS states that savings depend on income $Y$ and fiscal-policy variables $T, G$; RHS states investment depends on the interest rate $r$

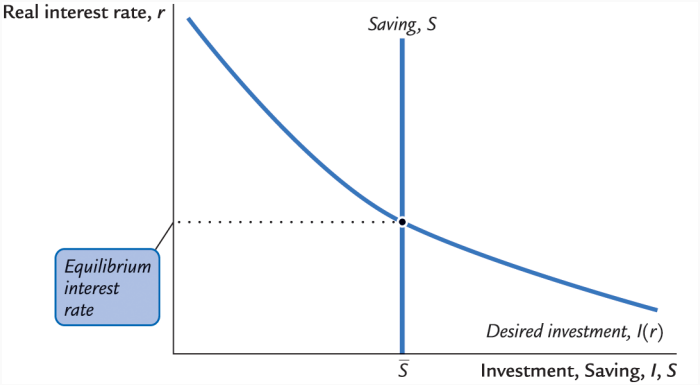
# Equilibrium in financial markets

- **Fixed supply of savings**, as reflected by vertical $S$ line
  - Model assumed $S$ independent of $r$ (will relax this assumption later)



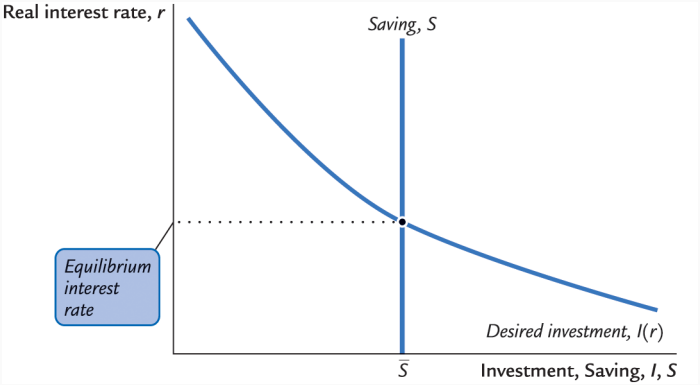
# Equilibrium in financial markets

- Downward-sloping investment curve: $\uparrow r \Longrightarrow \downarrow I$



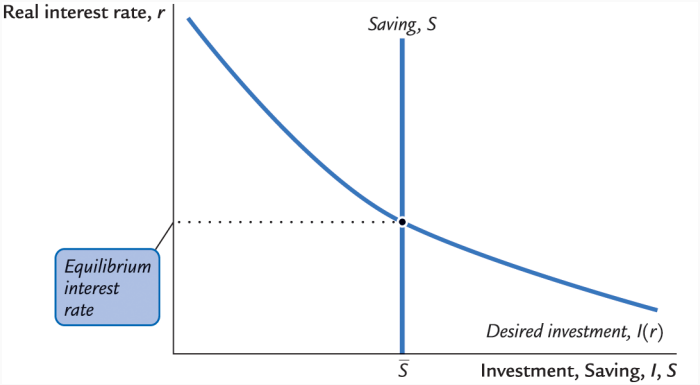
# Equilibrium in financial markets

- **Equilibrium interest rate** determined by intersection of $S$ and $I(r)$ curves
  - Equilibrium determined as in any other market: $Q$ is loans, $P$ is interest rate



# Equilibrium in financial markets

- Eq. interest rate balances households desire to save & firms desire to invest



# Fiscal policy: Two experiments

- In our basic model, **fiscal policy captured by** $(\overline{T}, \overline{G})$
  - $\uparrow \overline{G}$ or $\downarrow \overline{T}$: expansionary fiscal policy
  - $\downarrow \overline{G}$ or $\uparrow \overline{T}$: contractionary fiscal policy

- To understand role of fiscal policy, let's do two exercises:
  1. Increase $\overline{G}$ by $\Delta G$
  2. Decrease $\overline{T}$ by $\Delta T$

# Experiment I: Increase $\overline{G}$ by $\Delta G$

1. Gvt increases demand from $\overline{G}$ to $\overline{G} + \Delta G$ while keeping $\overline{T}$ fixed
2. Because factors of production are fixed, so is output $\overline{Y}$

   $\implies$ This means increase $\Delta G$ must be compensated by some reduction in demand
3. Disposable income $\overline{Y} - \overline{T}$ unchanged since $\overline{T}$ remains fixed; and so does $C$
   - Recall $C = C(\overline{Y} - \overline{T})$
4. Only possibility is $\Delta G = -\Delta I$ (increase in $G$ met by reduction in $I$)

   $\implies$ Since $I = I(r)$ depends negatively on $r$, for $I$ to fall, $r$ must increase

**Result**: Increase in $G$ with $T$ fixed causes interest rate $r$ to rise and investment $I$ to decrease; in other words, **public spending crowds out investment!**

# Experiment I: Increase in $G$ with $T$ fixed crowds out investment

$$S = \underbrace{(\overline{Y} - \overline{T} - \overline{C})}_{\text{private savings}} + \underbrace{(\overline{T} - \overline{G})}_{\text{public savings}} = I(r)$$

- Before experiment:

$$S_1 = (\overline{Y} - \overline{T} - \overline{C}) + (\overline{T} - \underbrace{\overline{G}}_{\equiv G_1}) = I(r_1)$$

- After experiment:

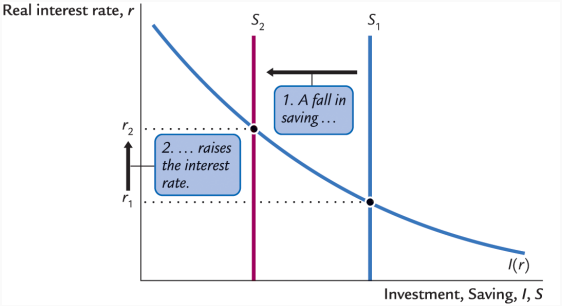
$$S_2 = (\overline{Y} - \overline{T} - \overline{C}) + (\overline{T} - \underbrace{[G_1 + \Delta G]}_{\equiv G_2}) = I(r_2)$$

  - Private savings unchanged
  - Lower public savings: $\overline{T} - G_2 < \overline{T} - G_1$

$\Longrightarrow$ **Lower savings**: $S_2 < S_1$

# Graphical representation of experiment I (Increase in $G$ with $T$ fixed)

- Increase in $G$ with fixed $\overline{T}$ leads to lower savings: $S_2 < S_1$ (left shift in $S$ curve)
- At initial interest rate, there's excess demands for loans: $I(r_1) > S_2$
  (firms want to invest more than households want to save)
- Interest rate adjusts until financial market reaches equilibrium: $I(r_2) = S_2$
  ($r_2$ balances firms' desires to borrow with households' desires to save)



# Experiment II: Decrease $\overline{T}$ by $\Delta T$

1. **Gvt decreases tax revenue from $\overline{T}$ to $\overline{T} - \Delta T$ while keeping $\overline{G}$ fixed**
2. Because factors of production are fixed, so is output $\overline{Y}$
3. Disposable income $\overline{Y} - T$ increases since $T = \overline{T} - \Delta T < \overline{T}$; and so does $C$
   - Recall $C = C(\overline{Y} - \overline{T})$
   - $C$ increases by an amount that depends on the MPC: $\Delta C = \text{MPC} \times \Delta T$
4. Because $\overline{Y}$ and $\overline{G}$ both fixed, only possibility is $\Delta C = -\Delta I$

   $\implies$ Since $I = I(r)$ depends negatively on $r$, for $I$ to fall, $r$ must increase

**Result**: Increase in $T$ with $G$ fixed causes interest rate $r$ to rise and investment $I$ to decrease; in other words, **lower taxes crowd out investment!**

# Experiment II: Reduction in $T$ with $G$ fixed crowds out investment

$$S = \underbrace{(\overline{Y} - \overline{T} - C(\overline{Y} - \overline{T}))}_{\text{private savings}} + \underbrace{(\overline{T} - \overline{G})}_{\text{public savings}} = I(r)$$

- Before experiment:

$$S_1 = (\overline{Y} - \underbrace{\overline{T}}_{\equiv T_1} - \underbrace{C(\overline{Y} - \overline{T})}_{\equiv C_1}) + (\overline{T} - \overline{G}) = I(r_1)$$

- After experiment:

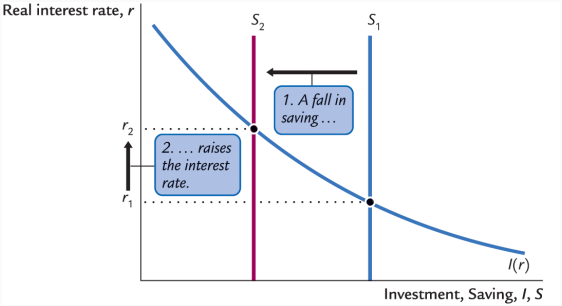
$$S_2 = (\overline{Y} - (\overline{T} - \Delta T) - \underbrace{C(\overline{Y} - [\overline{T} - \Delta T])}_{\equiv C_2}) + (\underbrace{[\overline{T} - \Delta T]}_{\equiv T_2} - \overline{G}) = I(r_2)$$

  - Private savings increase: if disposable income increases by $\Delta T$ and household only spends MPC $\times \Delta T$, private savings increase by $(1 - \text{MPC}) \times \Delta T$
  - Public savings decrease: $T_2 - \overline{G} < T_1 - \overline{G}$

$\Longrightarrow$ **Lower savings**: $S_1 > S_2 = S_1 - \Delta C$ (savings decrease by $\Delta C = \text{MPC} \times \Delta T$)

# Graphical representation of experiment II (Decrease in $T$ with $G$ fixed)

- Decrease in $T$ with fixed $\overline{G}$ leads to lower savings: $S_2 < S_1$ (left shift in $S$ curve)
- At initial interest rate, there's excess demands for loans: $I(r_1) > S_2$
  (firms want to invest more than households want to save)
- Interest rate adjusts until financial market reaches equilibrium: $I(r_2) = S_2$
  ($r_2$ balances firms' desires to borrow with households' desires to save)



# Lesson from fiscal policy experiments

- **Main lesson**: Either an increase in government spending or a decrease in tax revenue, with all else equal, crowds out investment
- **Lesson remains valid in more complicated models**
  (where savings are still a function of $r$ and other factors affect investment/savings decisions)
- **Lesson also justifies economists' concerns over budget deficits**
  (which result from government spending too much or raising too little revenue)
  - Increasing $G$ or reducing $T$ unilaterally reduces investment
  - Lower investment leads to lower capital stocks
  - Output increasing in level of capital
  - Standard of living increasing in output
  - $\downarrow$ Investment $\implies \downarrow$ Living standards

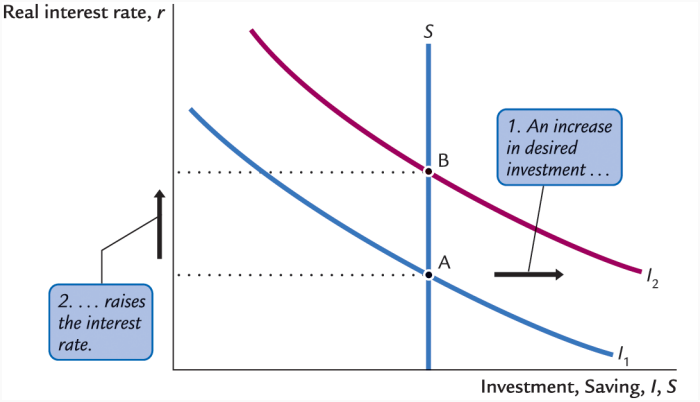
# Changes in investment demand

- **Demand for investment can change for several reasons:**
  - Arrival of new technologies (eg, computers make us more productive)
  - Gvt encourages/discourages investment (eg, tax cuts for productive investment)
- **What does it mean that our desired investment changes?**
  - Willing to pay more/less for $1 of investment
  - In other words, willing to take higher/lower interest rate
- **Represent changes in investment demand via shifts in $I(r)$ curve**

# Increase in investment demand

- Suppose gvt encourages investment through tax cuts for investment goods

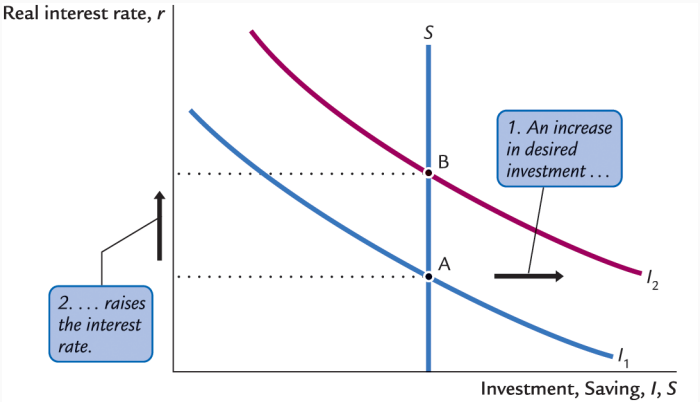
$\Longrightarrow$ Desired level of investment increases and $I$ curve shifts upward
(investment demand higher at any given interest rate)



# Increase in investment demand

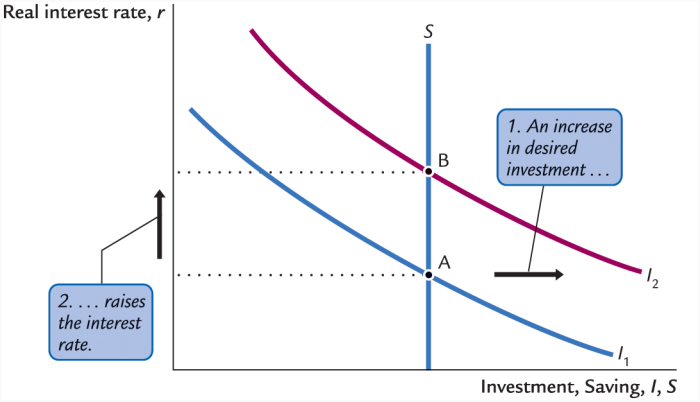
- Suppose gvt encourages investment through tax cuts for investment goods

$\Longrightarrow$ Because savings supply is fixed, new equilibrium interest rate is higher



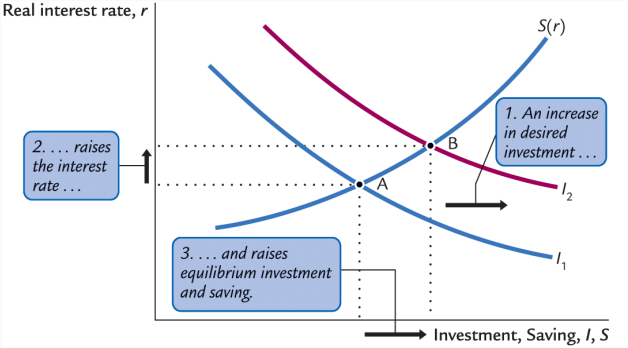
# Increase in investment demand

- Suppose gvt encourages investment through tax cuts for investment goods
- Despite higher desire for investment, eq. level of investment unchanged
  (this result follows from assuming $S$ doesn't depend on $r$)



# Increase in investment demand with upward-sloping savings curve

- Suppose gvt encourages investment through tax cuts for investment goods, and also that savings positively depend on interest rate (ie, $\uparrow r \implies \uparrow$ S)
- Now, higher desire for investment raises both eq. interest rate & investment
  (households lower their consumption in response to higher return on savings)



# Taking stock

# Taking stock

- Discussed **demand for goods and services in closed economy**
- **Key (accounting) identity**, $Y = C + G + I$, doesn't admit causal interpretation
- Introduced simple **consumption functions**, $C = C(Y - T)$
  - Eg, linear consumption function: $C = C_{\min} + \gamma(Y - T)$, where $\gamma \in [0, 1]$
- Introduced **marginal propensity to consume**: how much consumption $C$ increases when disposable income $(Y - T)$ increases by \$1
  - Formally, MPC $:= \mathrm{d}C/\mathrm{d}(Y - T)$
  - With linear consumption function, MPC $= \gamma$

# Taking stock

- Introduced simple **investment functions**, $I = I(r)$
  - Which make investment negatively depend on interest rate $r$
- Discussed **nominal vs. real** and many other types of **interest rates**
  - Nominal interest rate adjusts real interest rate for inflation: $i = r + \pi$
  - Interest rates vary with: spreads, maturity, risk, tax treatment, callability, ...
- Studied **equilibrium in demand for goods and services**
  - Interest rate adjusts to clear market
  - Financial markets are key to understand market-clearing role of interest rate
  - Expansionary fiscal policy can crowd out investment
  - Changes in demand for investment alter eq. interest rate and may or may not affect eq. level of investment (depending on whether supply of savings fixed)

Questions?

# Thank You!

(Email: luisperez@smu.edu)

(Website: https://luisperezecon.com)