EC313: Intermediate Macroeconomics

Chapter 3

Xiang LI
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Chapter 3: The Goods Market

The Composition of GDP

Consumption (C)

- the goods and services purchased by consumers
- the largest component of GDP

Investment (I)

- also called **fixed investment**
- Composed of nonresidential and residential investment
  - **Nonresidential investment**: purchases by firms of new plants or new machines
  - **Residential investment**: purchases by people of new houses or apartments
- Firms buy machines or plants to produce output in the future. People buy houses or apartments to get housing services in the future.

Government Spending (G)

- The purchases of goods and services by the federal, state, and local governments.
    - e.g. airplanes to office equipment, services provided by government employees, ...
- G does **not** include:
    - government transfers, like Medicare, food stamps, or social security payments
    - interest payments on the government debt

Exports (X) and Imports (IM)

- Exports: the purchases of U.S. goods and services by foreigners
- imports: the purchases of foreign goods and services by U.S. consumers, U.S. firms, and the U.S. government
- **net exports** (also called **trade balance**): $X - IM$
- **trade surplus**: $X > IM$
- **trade deficit**: $X < IM$
- Do you think America typically has a trade surplus or a trade deficit? (https://fred.stlouisfed.org/series/BOPGSTB)

- inventory investment:
  - the difference between goods produced and goods sold in a given year
  - A positive inventory investment means production was higher than sales in a given year
  - is typically small and can be ignored

if ignoring inventory investment, $Y = C + I + G + X - IM$

	Billions of Dollars	percent of GDP
GDP(Y)		
	14,660	100%
Consumption(C)		
	10,348	70.5%
Invsetment(I)		
Nonresidential	1,415	9.7%
Residential	341	2.3%
Government spending(G)		
	3,001	20.4%
Net Export(X-IM)		
Exports(X)	1,838	12.5%
Imports(IM)	-2,354	-16%
Inventory		
	71	0.5%

The Demand for Goods

Total Demand for Goods

- Denote the total demand for goods by Z: $Z \equiv C + I + G + X - IM$
- $\equiv$: this equation is an *identity*
- It *defines* Z as the sum of consumption, plus investment, plus government spending, plus exports, minus imports
- Here, we are trying to model the demand of human beings for goods
- How can we possibly represent all of human behavior (the goal of economics) with equations?
- We can't! So we make assumptions!

Total Demand for Goods

- Assumption 1: "the" good
  - all firms produce the same good, which can then be used by consumers for consumption, by firms for investment, or by the government
- With this (big) simplification, we need to look at only one market — the market for “the” good — and think about what determines supply and demand in that market

- Assumption 2: firms are willing to supply any amount of the good at a given price level
- This assumption allows us to focus on the role demand plays in the determination of output, and ignore the supply
- Assumption 3: closed economy
    - $X = 0, IM = 0$
- this assumption will also simplify our discussion because we won't have to think about what determines exports and imports.
- the demand for goods: $Z \equiv C + I + G$

Consumption (C)

What is the most important determinant of consumption?

- **disposable income**: income that remains once consumers have received transfers from the government and paid their taxes
- $C = C(Y_D)$
    - C: consumption
    - Y_D: disposable income
- **when disposable income increases, so does consumption**
    - this **positive linear relation** between C and Y_D can be characterized by:

$$C = c_0 + c_1 \times Y_D$$

Consumption (C)

$$C = c_0 + c_1 \times Y_D$$

- c_1: **propensity to consume**
  - the change C resulting from an additional dollar of Y_D
- c_1 is positive
  - An increase in Y_D is likely to lead to an increase in C
- c_1 is less than 1
  - People are likely to consume only part of any increase in Y_D and save the rest

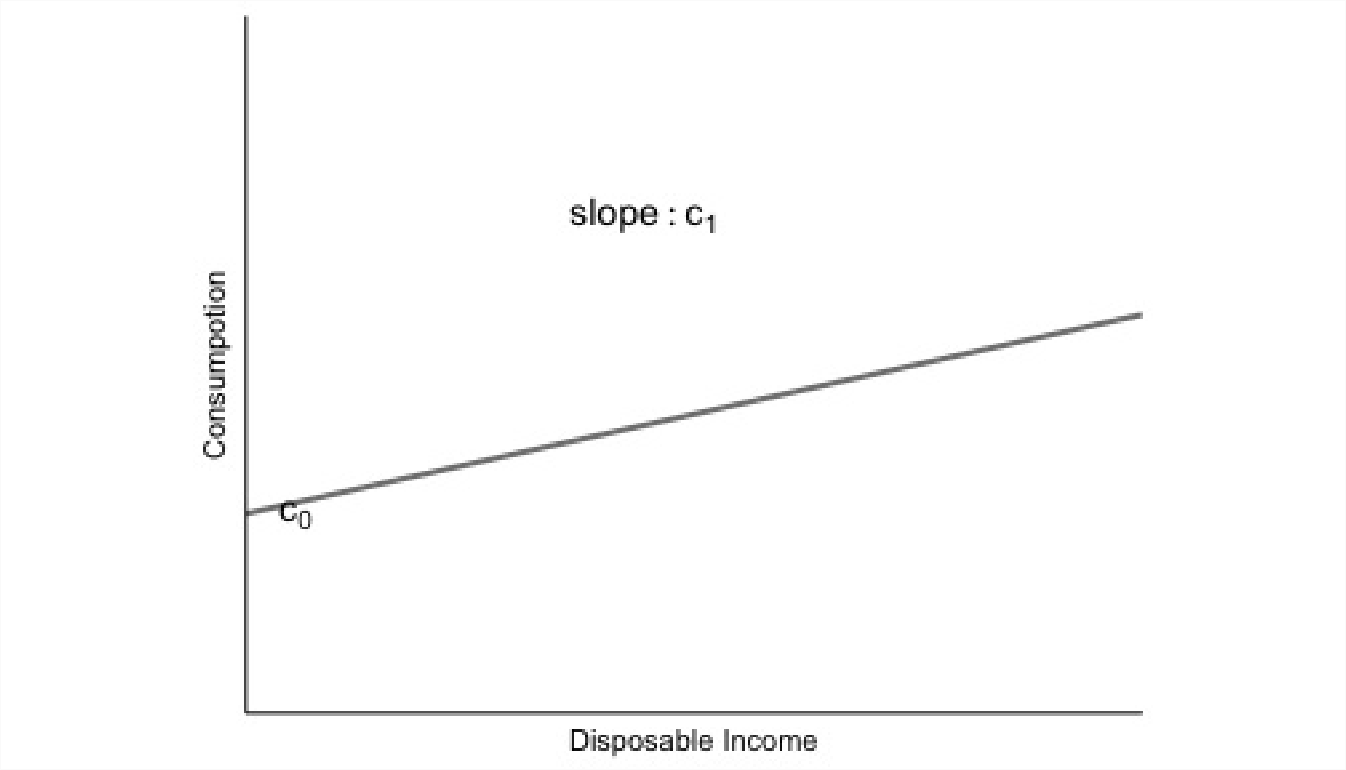
Consumption (C)

$$C = c_0 + c_1 \times Y_D$$

- if $Y_D = 0$, then $C = c_0$
- c_0: what people would consume if their Y_D were equal to zero
- c_0 is positive
  - with or without income, people still need to eat!
- How to consume without income?
- because people can sell their assets or borrow

Consumption (C)

consumption function: $C = c_0 + c_1 \times Y_D$



- linear relation: the relation between C and Y_D is represented by a straight line

Consumption (C)

$$C = c_0 + c_1 \times Y_D$$

- intercept with the vertical axis: c_0
- slope is c_1, and is less than 1
    - this straight line is flatter than a 45-degree line
- if the value of c_0 **increases**(**decreases**), then this straight line shifts **up**(**down**) by the same amount

Consumption (C)

- define disposal income Y_D: $Y_D \equiv Y - T$
  - Y: income
  - T: taxes
- rewrite $C = c_0 + c_1 \times Y_D$ as:

$$C = c_0 + c_1 \times (Y - T)$$

- consumption C is a function of income Y and taxes T
  - Higher income Y increases consumption C, but less than one for one
  - Higher taxes T decrease consumption C, also less than one for one

Investment (I)

- we take investment as given to keep our model simple: $I = \bar{I}$
- when we try to study of the effects of changes in production Y, we assume that changes in Y will not affect investment
- **exogenous variables**: variables are not explained within the model but are instead taken as given
- In Chapter 5 we will introduce a more realistic treatment of investment, and drop the bar from $\bar{I}$:)

Government Spending (G)

- In our models, government behavior is entirely defined by Taxes T and Government Spending G
- **fiscal policy**: the choice of Taxes T and Government Spending G by the government
- Again, to keep our model simple, we take Taxes T and Government Spending G as exogenous and given
- Because we will (nearly always) take G and T as given, we won't use a bar to denote their values :)
- **exogenous variables**: so far, we have $\bar{I}, T, G$

The Determination of Equilibrium Output

Demand for Goods

- we have seen: $Z \equiv C + I + G$
- rewrite C as $c_0 + c_1 \times (Y - T)$:

$$Z \equiv c_0 + c_1 \times (Y - T) + I + G$$

- rewite I as $\bar{I}$:

$$Z \equiv c_0 + c_1 \times (Y - T) + \bar{I} + G$$

- the demand for goods Z depends on income Y, taxes T, investment $\bar{I}$ and government spending G

Equilibrium in the Goods Market

- **equilibrium** in the goods market requires that the **production** (or, the **supply**) of the good Y equals the **demand** for the good Z
- equilibirum condition equation: $Y = Z$
- rewrite Z as $\equiv c_0 + c_1 \times (Y - T) + \bar{I} + G$:

$$Y = c_0 + c_1 \times (Y - T) + \bar{I} + G$$

Equilibrium in the Goods Market

$$Y = c_0 + c_1 \times (Y - T) + \bar{I} + G$$

- **In equilibrium**, **production** Y (the left-hand-side (LHS) of the equation), is equal to demand (the right-hand-side(RHS)). Demand in turn depends on **income** Y, which is itself equal to production
- Why can we use the same symbol Y for production and income?
- recall Chapter 2, we looked at GDP either from the production side or from the income side
- Production and income are identically equal

Equilibrium in the Goods Market

$$Y = c_0 + c_1 \times (Y - T) + \bar{I} + G$$

- If equilibrium output Y is what we want to solve for, and Y is on both sides of our equation, what do we do?
  - Using Algebra
  - Using Graphs

Equilibrium: Using Algebra

- $Y = c_0 + c_1 \times (Y - T) + \bar{I} + G$
- $Y = c_0 + c_1 Y - c_1 T + \bar{I} + G$
- $(1 - c_1)Y = c_0 + \bar{I} + G - c_1 T$
- solve for output Y:

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

- at equilibirum, the level of output Y equals $\frac{1}{1-c_1}[c_0 + \bar{I} + G - c_1 T]$, so that production equals demand

Equilibrium: Using Algebra

$$Y = \frac{1}{1-c_1}[c_0 + \bar{I} + G - c_1 T]$$

- here, the equilibrium level of variable Y depends on other variables in the model, i.e. c_1, c_0, $\bar{I}$, G, T; therefore, Y is called **endogenous variabele**
- variables $\bar{I}$, G, T are **exogenous variable**, because the level of them are taken as given
- variables c_0, c_1 characterize the relationships among endogenous and exogenous variabele, and called **parameters**

Equilibrium: Using Algebra

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

- $[c_0 + \bar{I} + G - c_1 T]$: **Autonomous spending**
  - part of the demand for goods that does not depend on output Y
- $c_0 > 0$
- $\bar{I} > 0$
- sign of $G - c_1 T$ is uncertain
- what is the sign of autonomous spending?

Equilibrium: Using Algebra

$$[c_0 + \bar{I} + G - c_1 T]$$

- the government is running a **balanced budget** when $T = G$
- when $T = G$:
    - $c_0 + \bar{I} + G - c_1 T = c_0 + \bar{I} + (1 - c_1)G$
    - because we have assumed that $c_1 < 1$
    - and since $c_0 > 0$ and $\bar{I} > 0$
    - autonomous spending is positive

Equilibrium: Using Algebra

$$[c_0 + \bar{I} + G - c_1 T]$$

- the government is running a **budget deficit** when $T < G$
  - when $T < G$, autonomous spending is positive (why?)
- the government is running a **budget surplus** when $T > G$
  - when $T > G$, sign of autonomous spending is ambiguous (why?)
- Only if the government were running a very large budget surplus — if taxes were much larger than government spending — could autonomous spending be negative

Equilibrium: Using Algebra

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

- we have seens that the propensity to consume $0 < c_1 < 1$
- hence $\frac{1}{1-c_1} > 1$
- for this reason, $\frac{1}{1-c_1}$ is called **multiplier**, because it **multiplies** autonomous spending $[c_0 + \bar{I} + G - c_1 T]$

Equilibrium: Using Algebra

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

Example: if c_0 increases by 1 billion dollars, how much will output Y increases?

- $\Delta Y = \Delta c_0 \times multiplier = 1 \times \frac{1}{1-c_1} > 1$
- here, autonomous spending increases by 1 billion, but output increases by more than 1 billions!
- a multiplier greater than 1 implies that, in equilibrium, output increases (or decreases) more than the increase (or decrease) in autonomous spending!

Equilibrium: Using Algebra

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

Example: if $c_1 = 0.6$, and c_0 increases by 1 billion dollars, how much will output Y increases?

- $\Delta Y = \Delta c_0 \times multiplier = 1(billion) \times \frac{1}{1-0.6} = 2.5(billion)$
- here, autonomous spending increases by 1 billion, but output increases by 2.5 billions!

Equilibrium: Using Algebra

Example: Government spending increases by 500 million dollars and $c_1 = 0.5$. Solve for the change in equilibrium output associated with this increase in government spending.

- $\Delta Y = \Delta G \times multiplier = 500 \times \frac{1}{1-0.5} = 500 \times 2 = 1000(million)$
- any change in autonomous spending — from a change in investment, to a change in government spending, to a change in taxes — will change output by more than its direct effect on autonomous spending

Group Work II

Q1: suppose $c_0 = 100, c_1 = 0.6, \bar{I} = 150, G = 150, T = 100.$

- What is equilibrium output?
- $Y = \frac{1}{1-c_1}(c_0 + G + \bar{I} - c_1 T)$
- $Y = \frac{1}{1-0.6}(100 + 150 + 150 - 0.6 * 100)$
- $Y = 2.5 * 340 = 850$

Group Work II (cont'd)

Q1: suppose $c_0 = 100, c_1 = 0.6, \bar{I} = 150, G = 150, T = 100.$

- What is disposable income?
- $Y_D = Y - T = 850 - 100 = 750$
- What is consumption?
- $C = c_0 + c_1 Y_D = 100 + 0.6 * 750 = 550$

Group Work II (cont'd)

Q1: suppose $c_0 = 100, c_1 = 0.6, \bar{I} = 150, G = 150, T = 100.$

- If c_0 decreases to 50, what is the change in equilibrium output?
- $\Delta Y = (\frac{1}{1-0.6}) \times \Delta c_0 = 2.5 * (-50) = -125$
- What is demand when $c_0 = 100$? Does it equal output?
- Yes, in equilibrium, $Z = Y$ so $Y = 850$

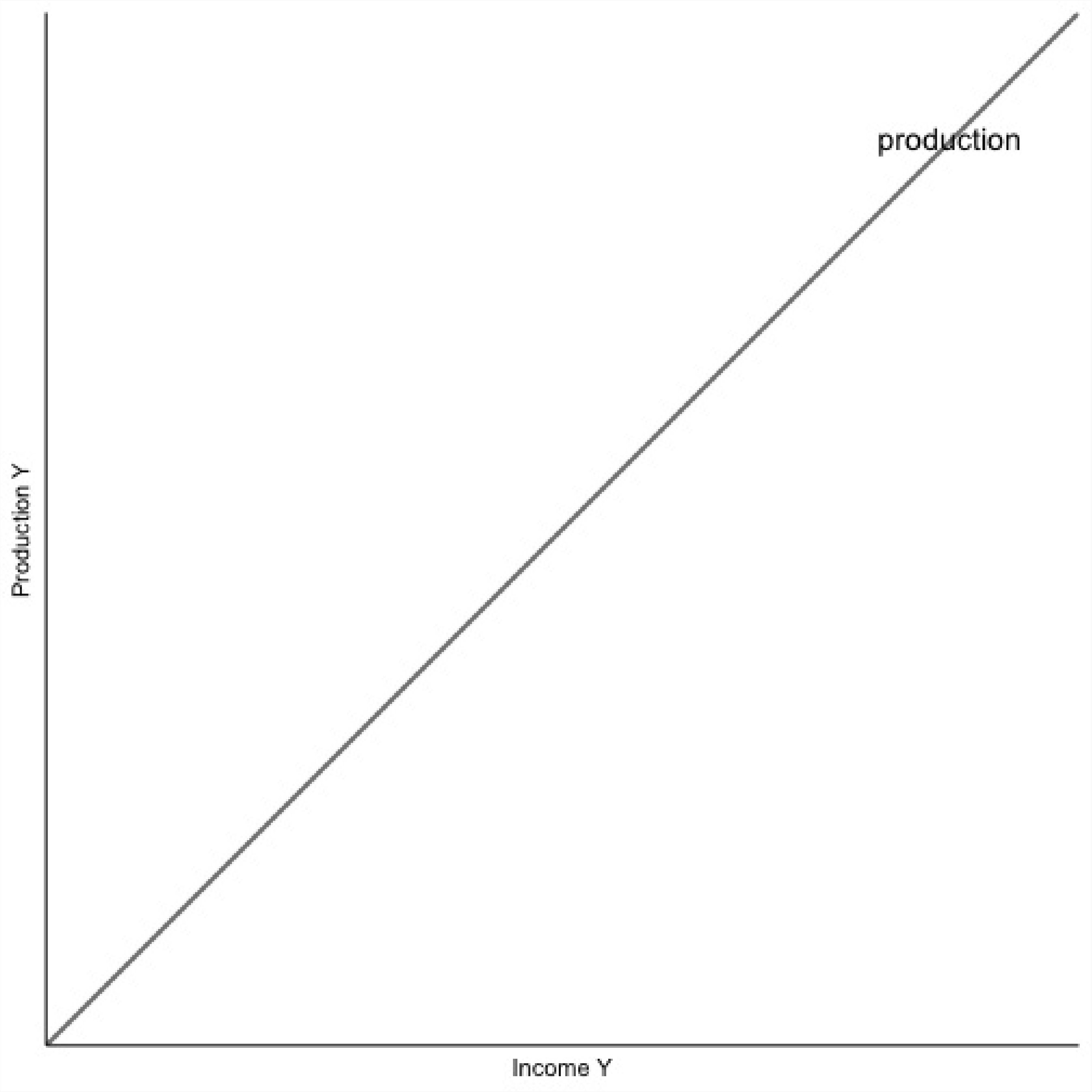
Equilibrium: Using Graph

First, plotting production as a function of income:

- measure production on the vertical axis, and measure income on the horizontal axis
- recall that production and income are identically equal
- hence, the relation between production Y and income Y is the 45-degree line, the line with a slope equal to 1

Equilibrium: Using Graph

slope equals 1



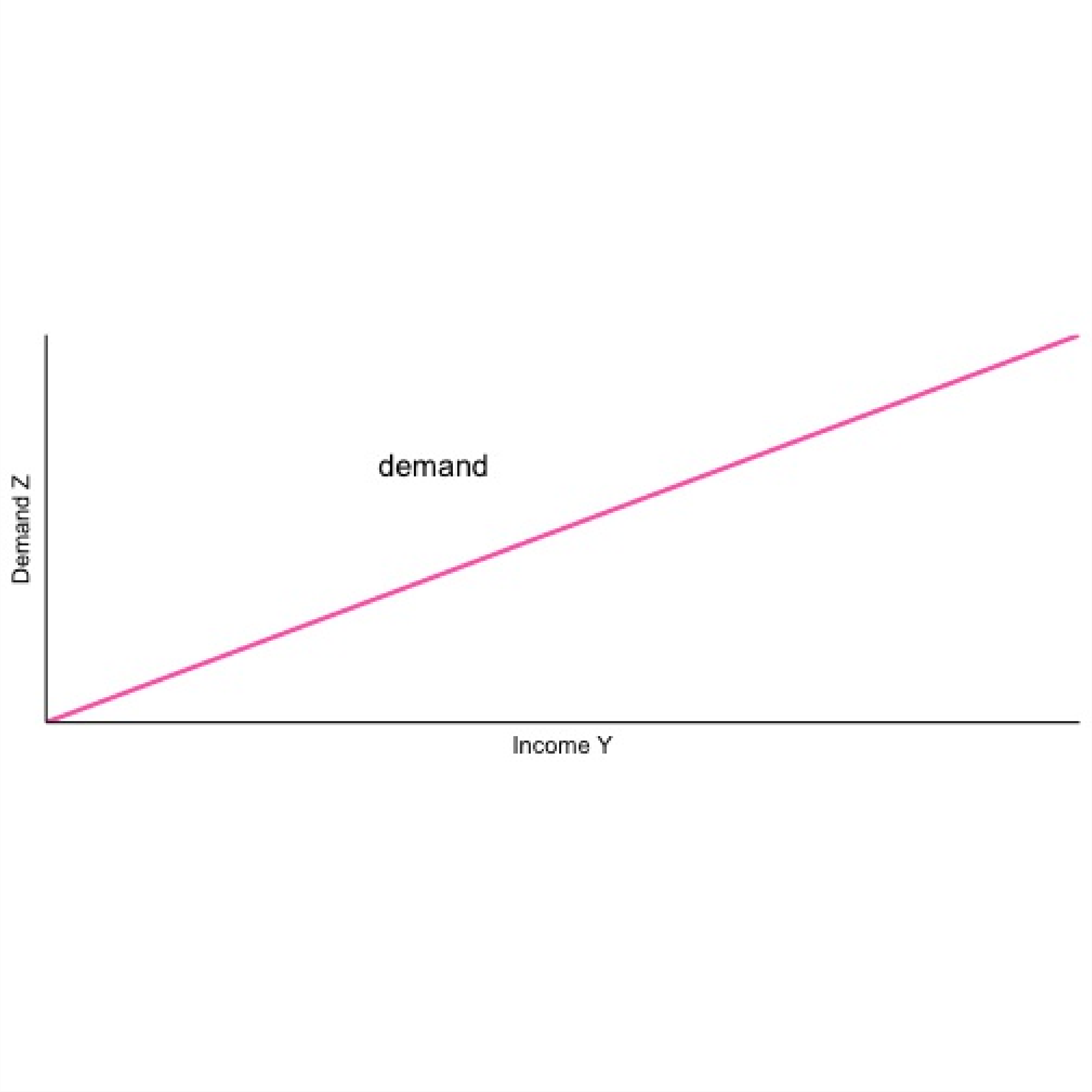
Equilibrium: Using Graph

Second, plot demand as a function of income:

- measure demand on the vertical axis, and measure income on the horizontal axis
- recall that: $Z = (c_0 + \bar{I} + G - c_1 T) + c_1 Y$, and $0 < c_1 < 1$
- the relationship between demand Z and income Y is a line that is upward sloping but has a slope of less than 1

Equilibrium: Using Graph

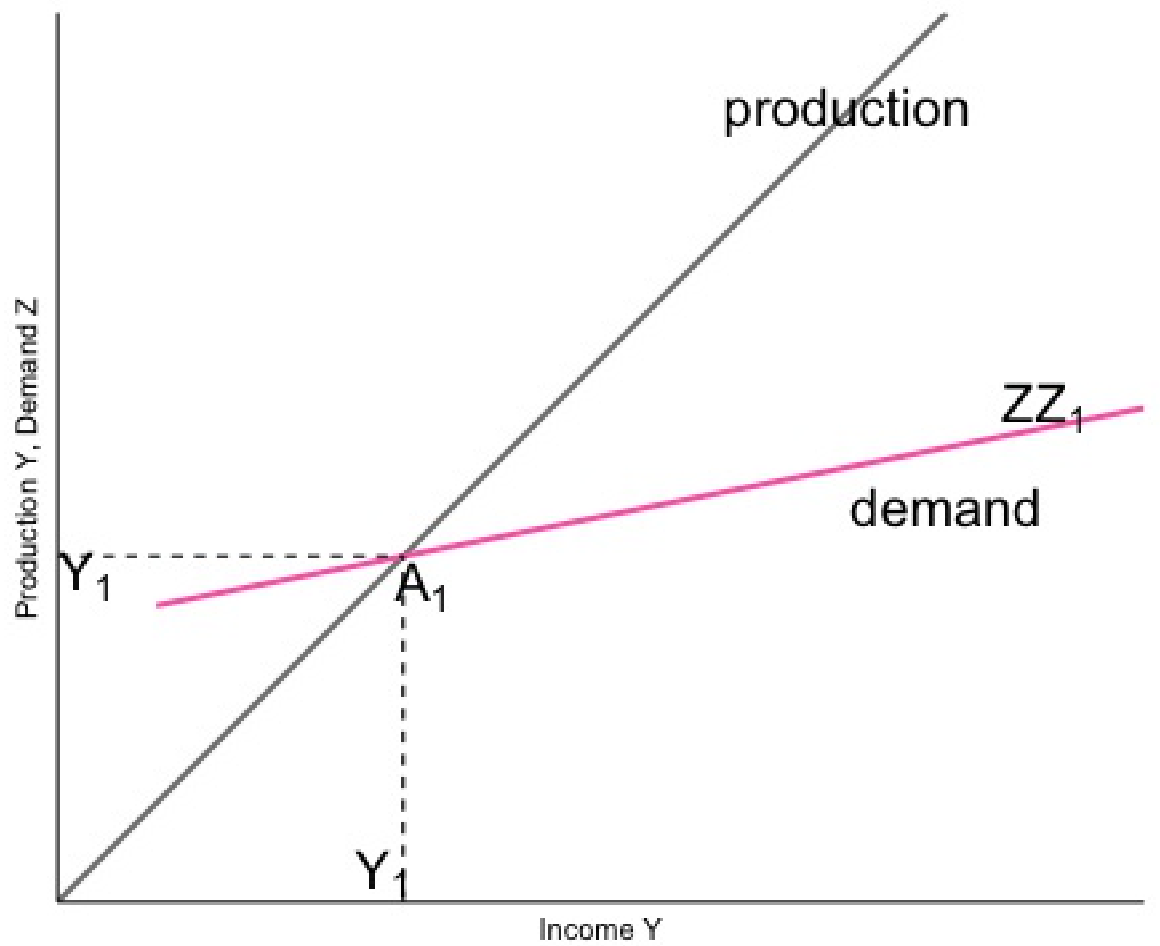
slope is between 0 and 1:



Equilibrium: Using Graph

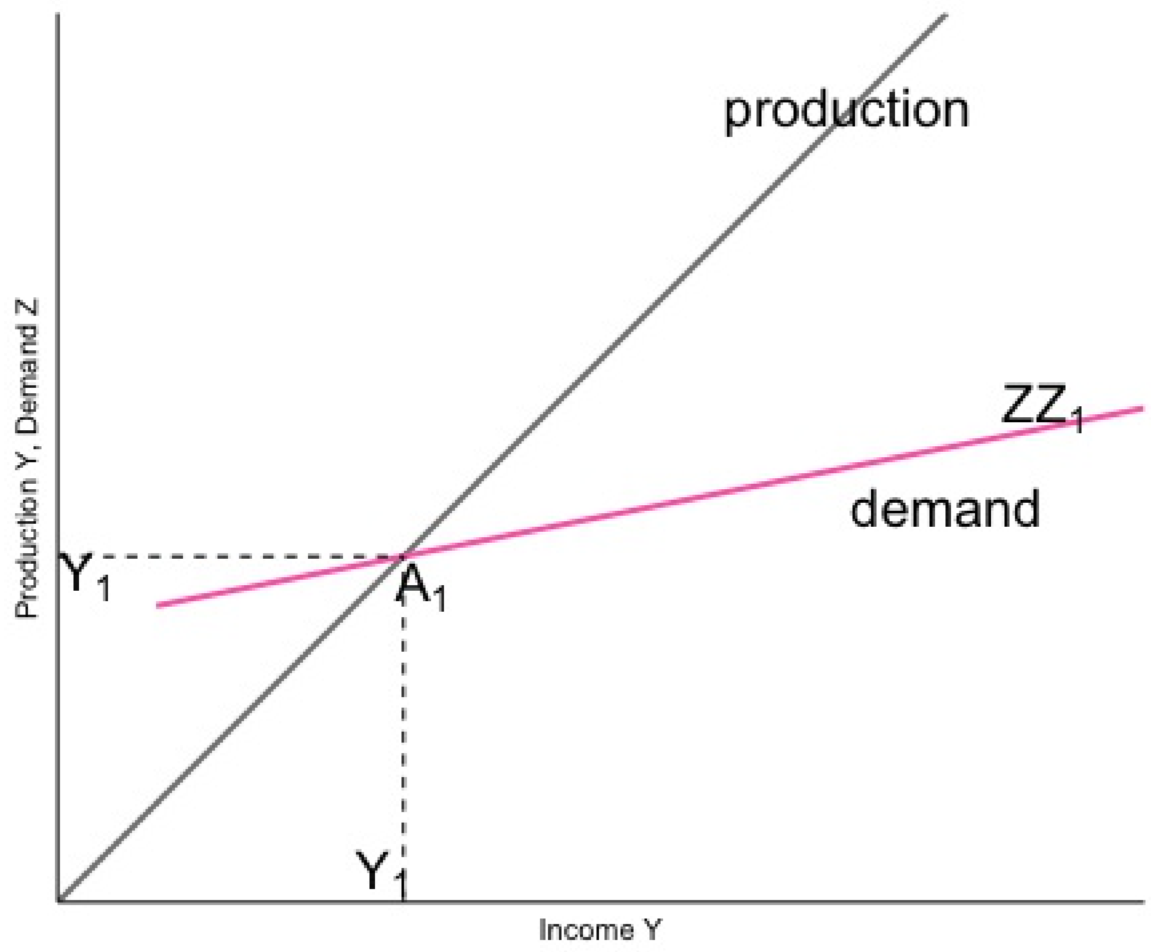
at point A_1: in equilibrium, production equals demand

- equilibrium output occurs at the intersection of the 45-degree line and the demand function



Equilibrium: Using Graph

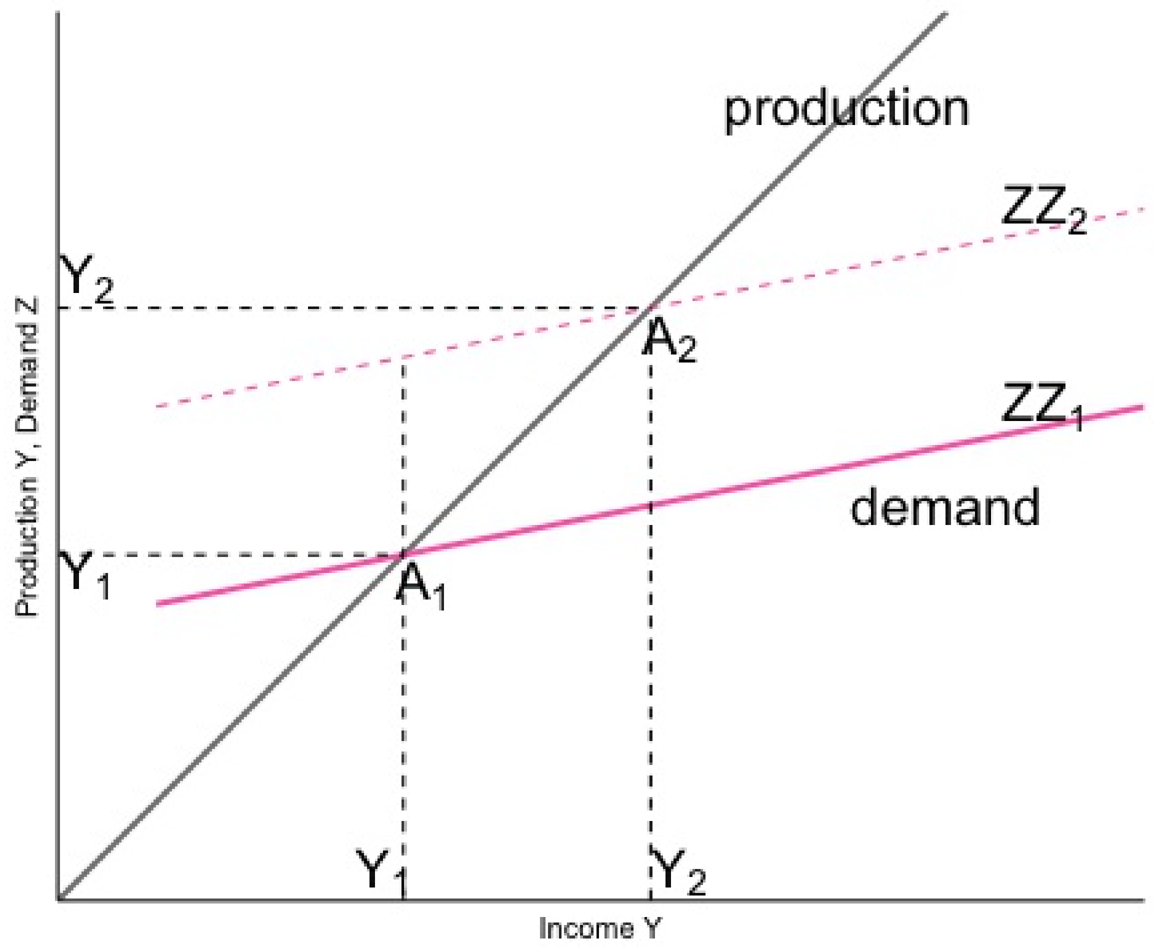
To the left of A_1, demand exceeds production; to the right of A_1, production exceeds demand



Equilibrium: Using Graph

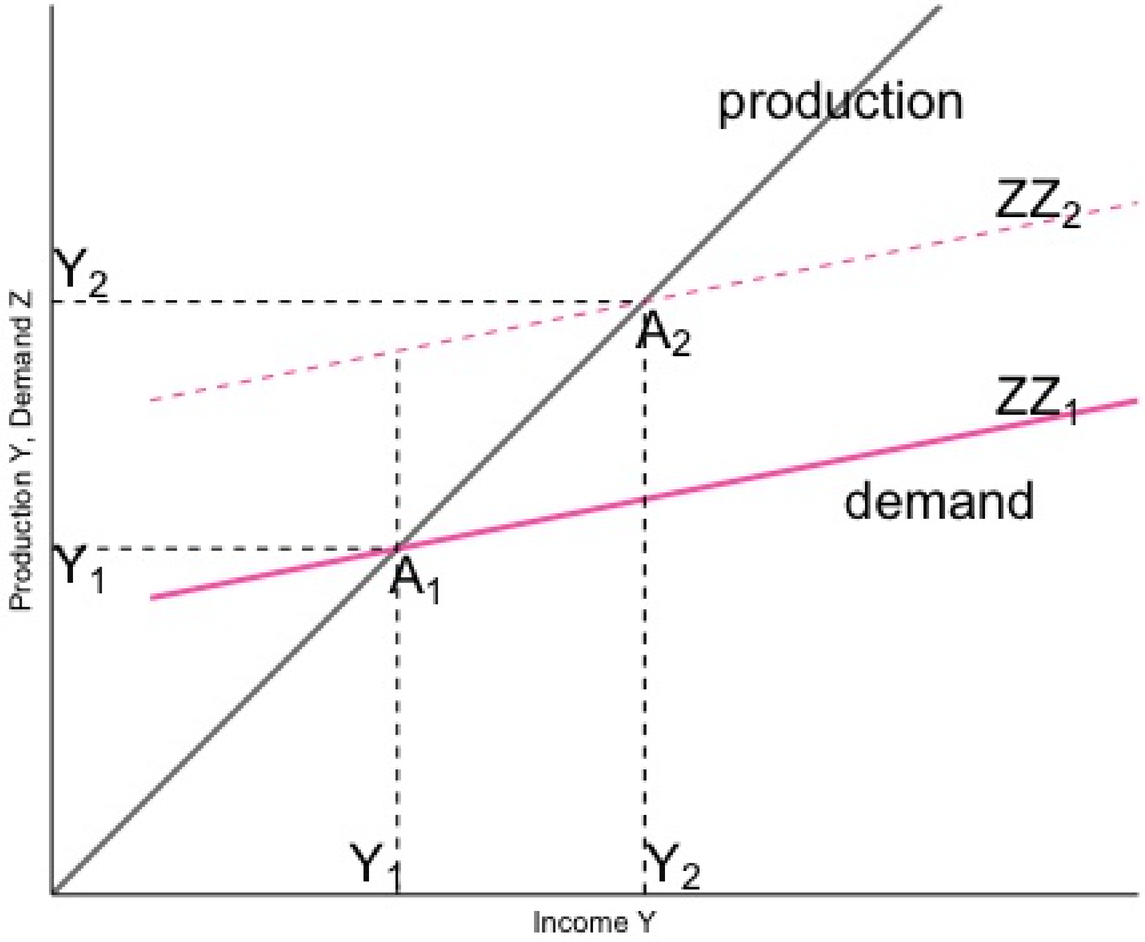
Suppose c_0 increases by 1 billion dollars:

- $Z = (c_0 + \bar{I} + G - c_1 T) + c_1 Y$ will increase by 1 billion dollars
- the demand curve shifts up by \$1 billion



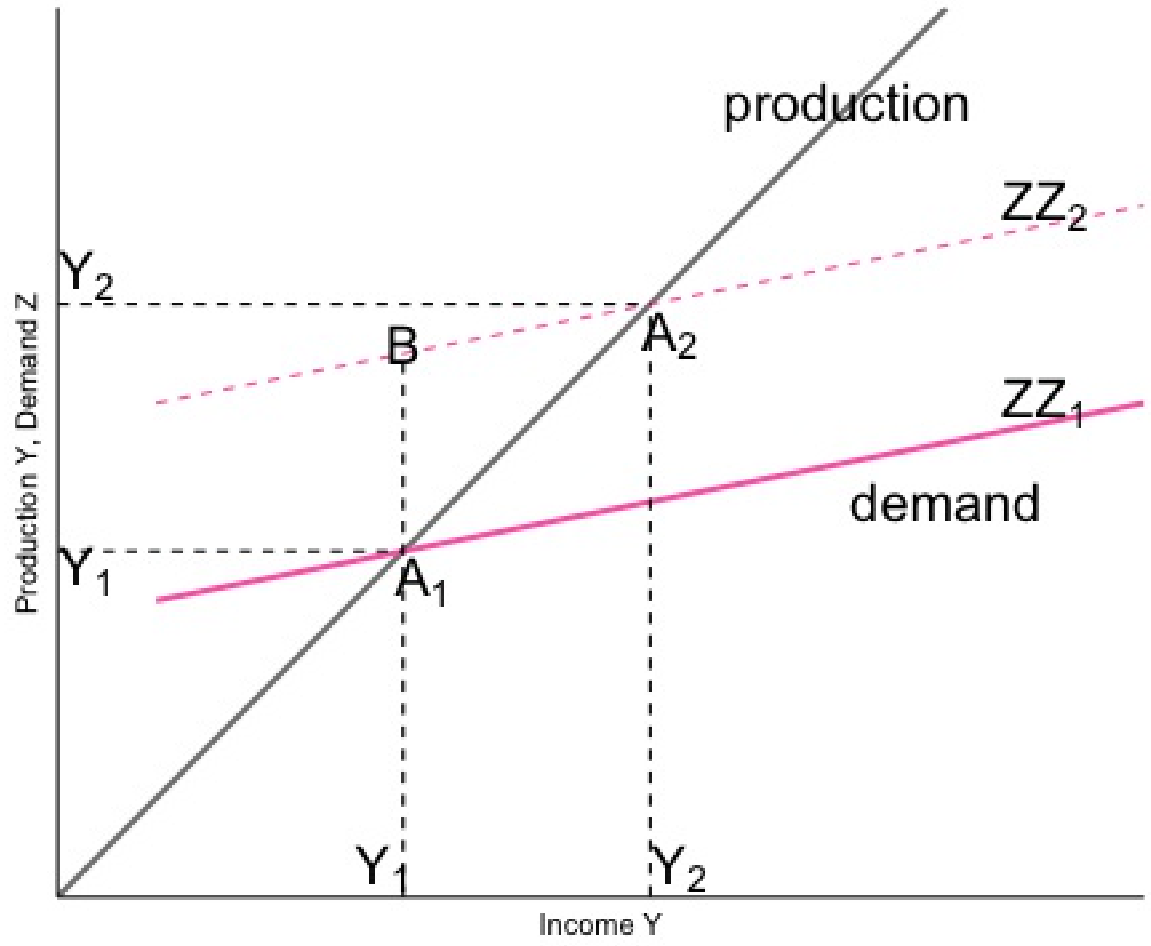
Equilibrium: Using Graph

- new equilibrium: A_2
- new equilibirum output: Y_2
- increase in output: $Y_2 - Y_1$



Equilibrium: Using Graph

- $\Delta c_0 = 1$
- $\Delta Y = \Delta c_0 \times \frac{1}{1-c_1} = 1 \times \frac{1}{1-c_1} > 1$
- multiplier effect: $\Delta Y > \Delta c_0$
- distance between Y_1 and Y_2 is larger than the shift of demand curve (distance between A_1 and B)



Equilibrium

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

- The size of the multiplier $\frac{1}{1-c_1}$ is directly related to the value of the propensity to consume c_1
- The higher the propensity to consume, the higher the multiplier
- A reasonable estimate of the propensity to consume in the United States today is around 0.6
- This implies that the multiplier is equal to $\frac{1}{1-c_1} = \frac{1}{1-0.6} = 2.5$

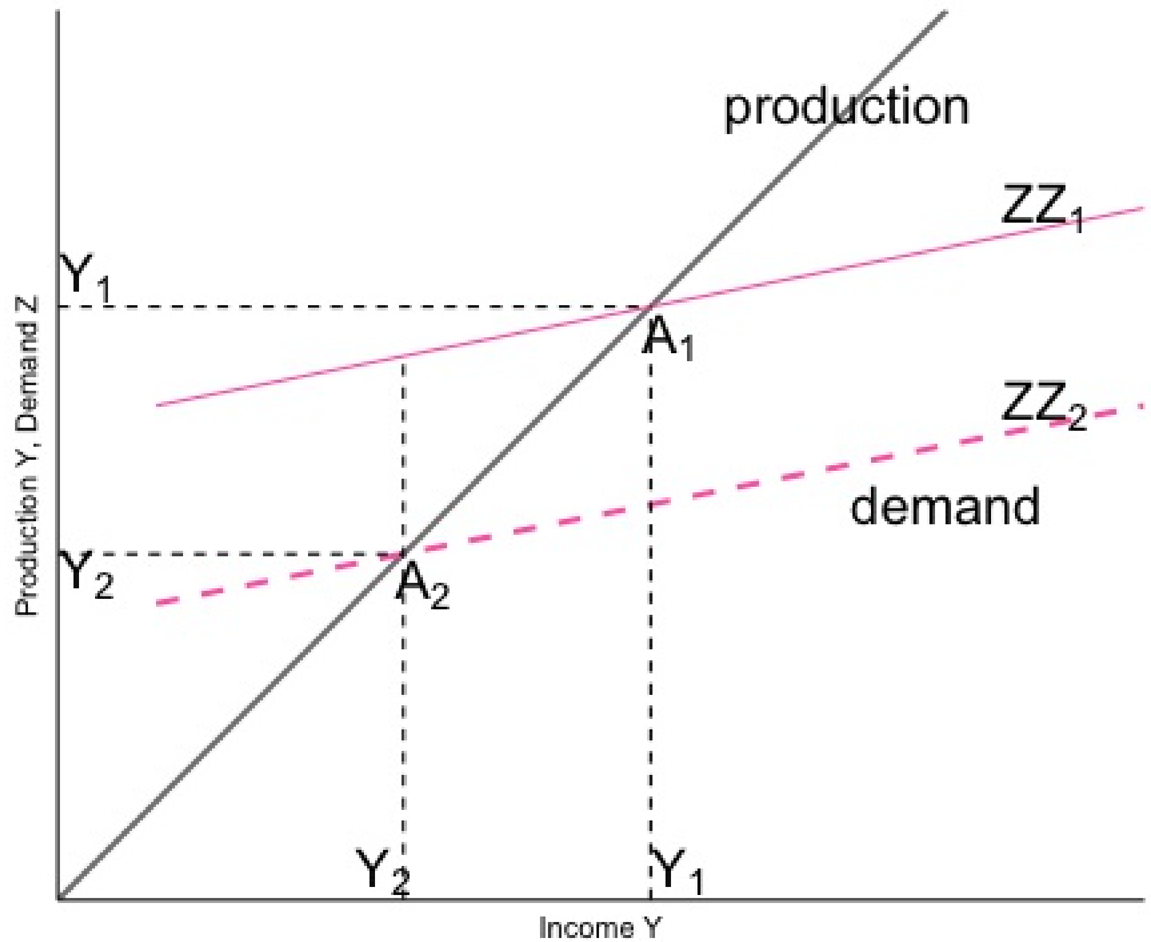
Group Work II

Q2: Government spending **decreases** by \$500 million. (1) Graphically show the impact of this reduction of government spending on equilibrium output.

- step 1, label y-axis varibale and x-axis variable: production Y and demand Z; income Y
- step 2, plotting production Y as a function of income Y: $Y = Y$
- step 3, plot demand Z as a function of income Y: $Z = (c_0 + \bar{I} + G - c_1 T) + c_1 Y$
- step 4, decide how demand (ZZ) curve is affected by this event

Group Work II (cont'd)

- ZZ curve shifts **down** by $500 million:



Group Work II (cont'd)

Q2: Government spending decreases by \$500 million. (2) Graphically explain the multiplier effect of this reduction of government spending.

- at equilibirum, the level of output $Y = \frac{1}{1-c_1}[c_0 + \bar{I} + G - c_1 T]$
- hence, $\Delta Y = \frac{1}{1-c_1} \times \Delta G$
- multiplier effect: $\Delta Y > \Delta G$ (why?)
- how to graphically represent ΔG in your graph?
- how to graphically represent ΔY in your graph?

Group Work II (cont'd)

- multiplier effect: distance between A_2 and B is smaller than $|Y_2 - Y_1|$