Lecture 9
Aggregate Expenditure II

1. An Expanded AE Model
2. The Multiplier

September 26, 2019

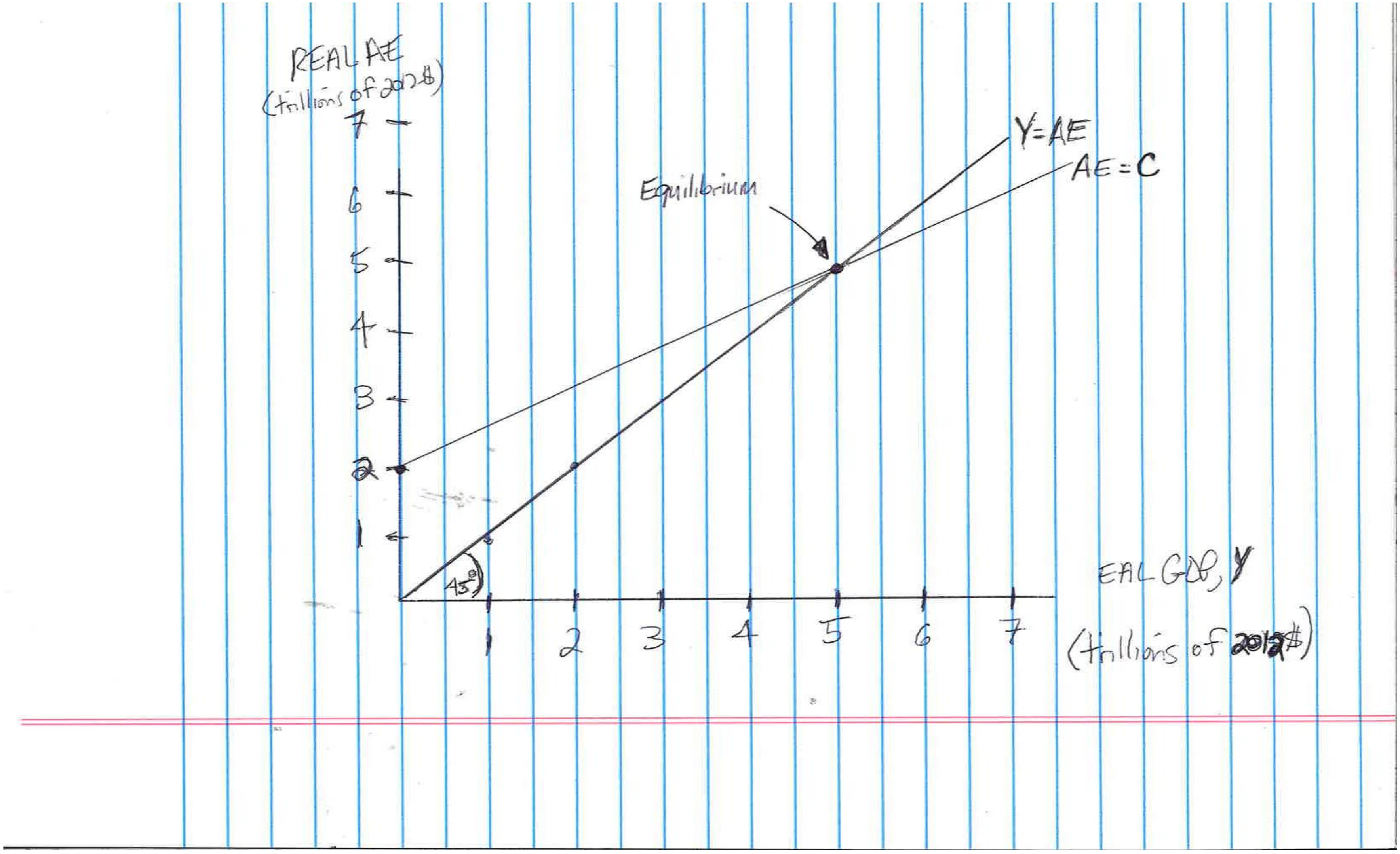
The AE Model Equilibrium: Graphical and Equation approach

- We began with a super simple model.
- No government, no foreign sector.
- Now we make it simpler:

  $G=X=M=I=0$

  $AE = C$

For AE = C, Equilibrium:
Where C intersects the 45 degree line



How do we Work Out Equilibrium Algebraically?

Super simple model: AE = C

C = $\bar{C}$ + b(y) assign values: $\bar{C}$ = 2 b=.6

Equilibrium: AE = Y super simple model: AE = C

Equilibrium: AE = C = Y C = Y

C = $\bar{C}$ + b(y) = Y

2 + .6(Y) = Y

One equation, one unknown, solve for Y

2 = .4Y Y = 5

Let us check, we can solve for C:

C = $\bar{C}$ + b(Y) C = 2 + .6(5) = 5

Now we can build on our super simple model

Only C is affected by the level of income, Y

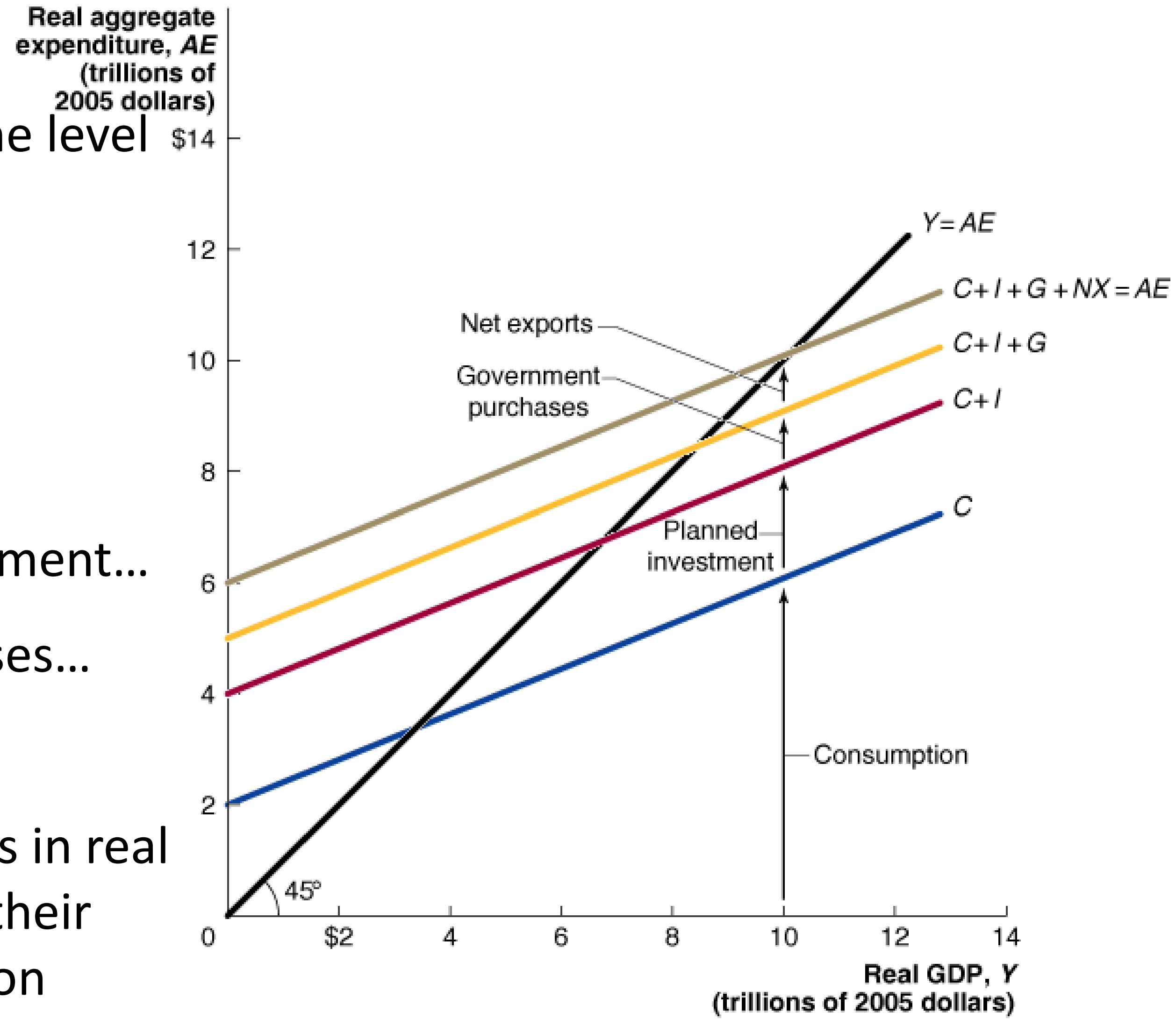
We assume all other expenditures are predetermined.

we add planned investment…

… government purchases…

… and net exports.

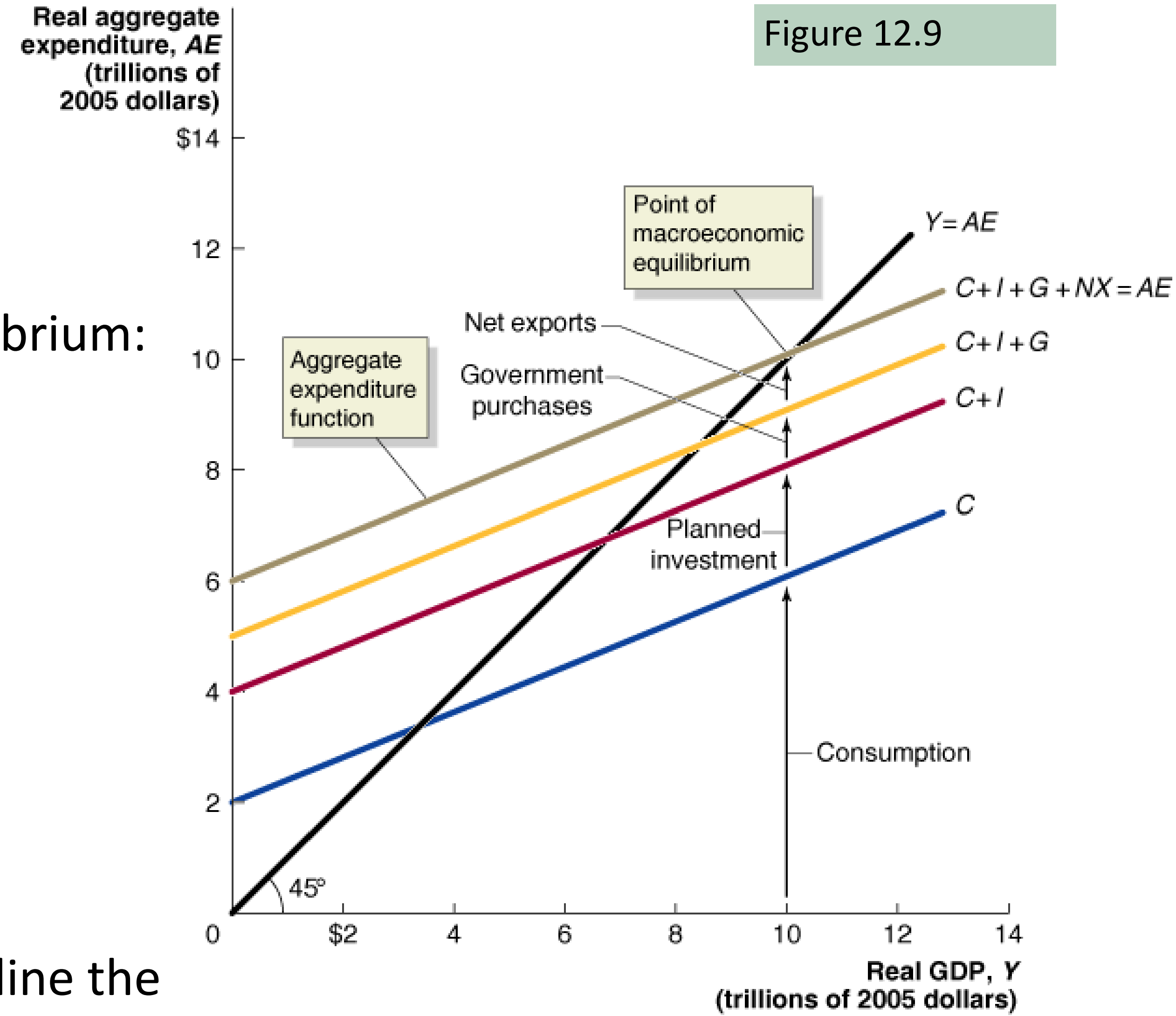
These are vertical shifts in real expenditure, because their values do not depend on income.



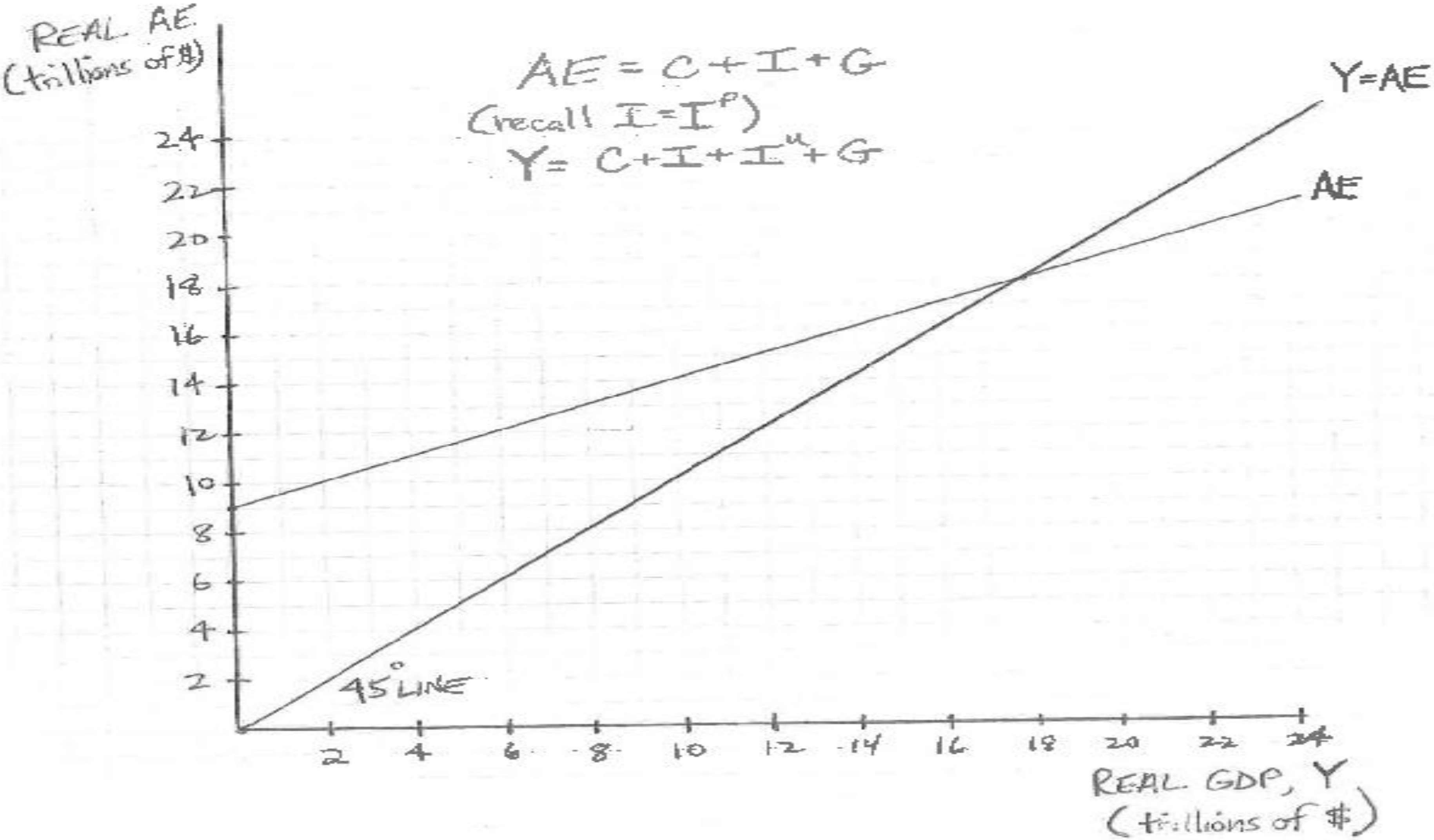
We now can identify equilibrium for the entire economy

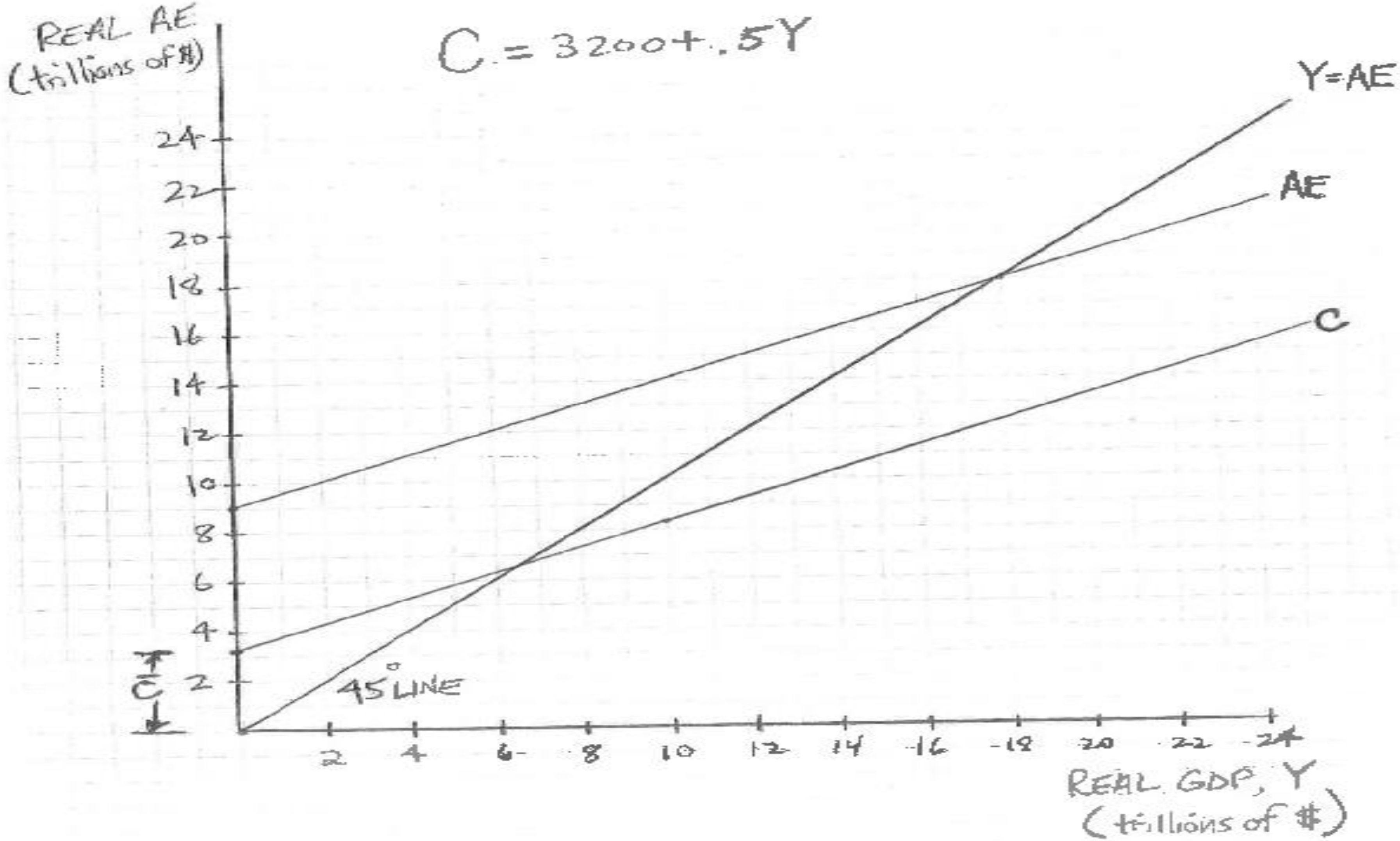
Macroeconomic equilibrium:

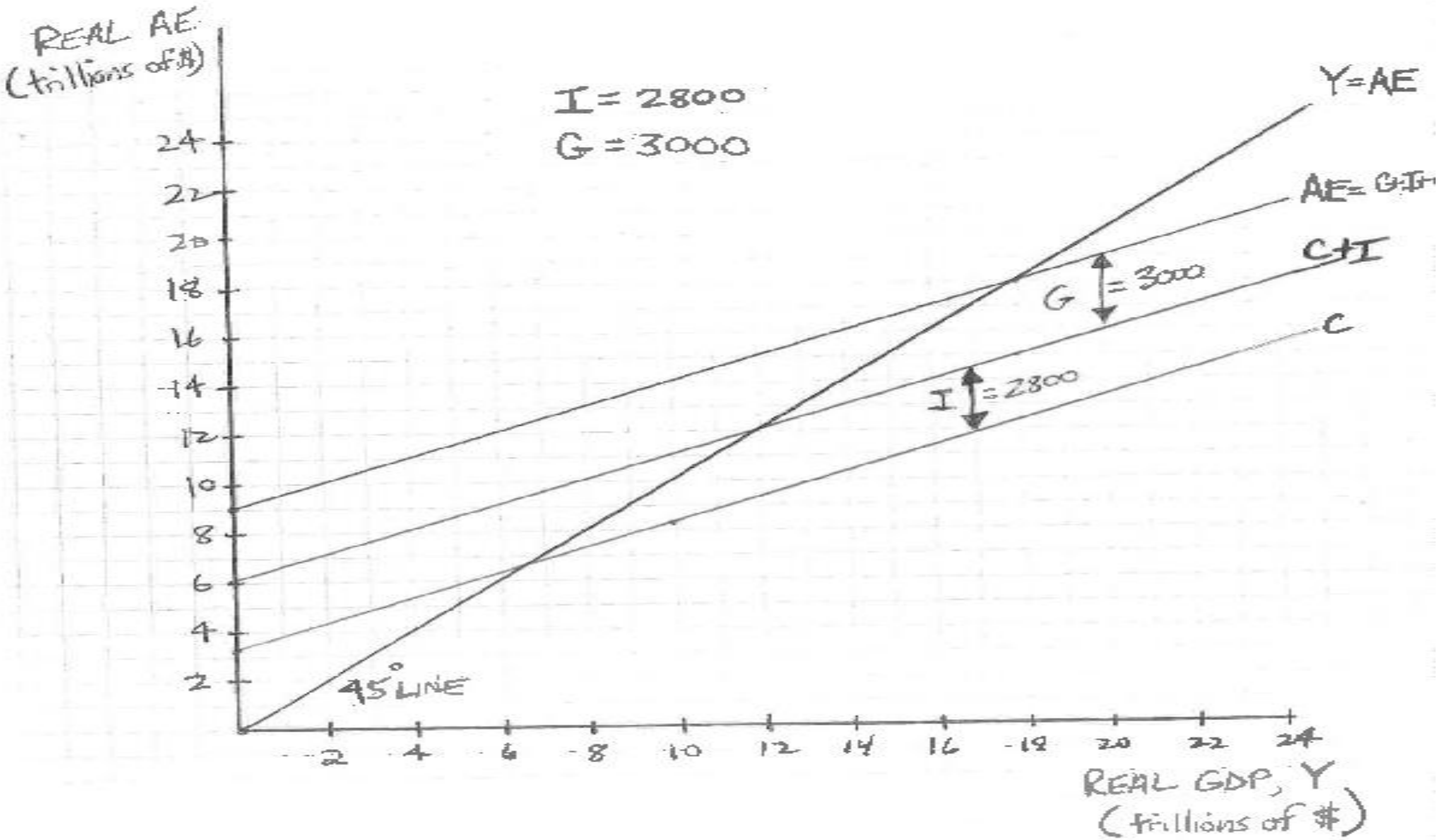
1. Income equals expenditure, i.e. $Y = C + I + G + NX$



We call this top-most line the *aggregate expenditure function.*

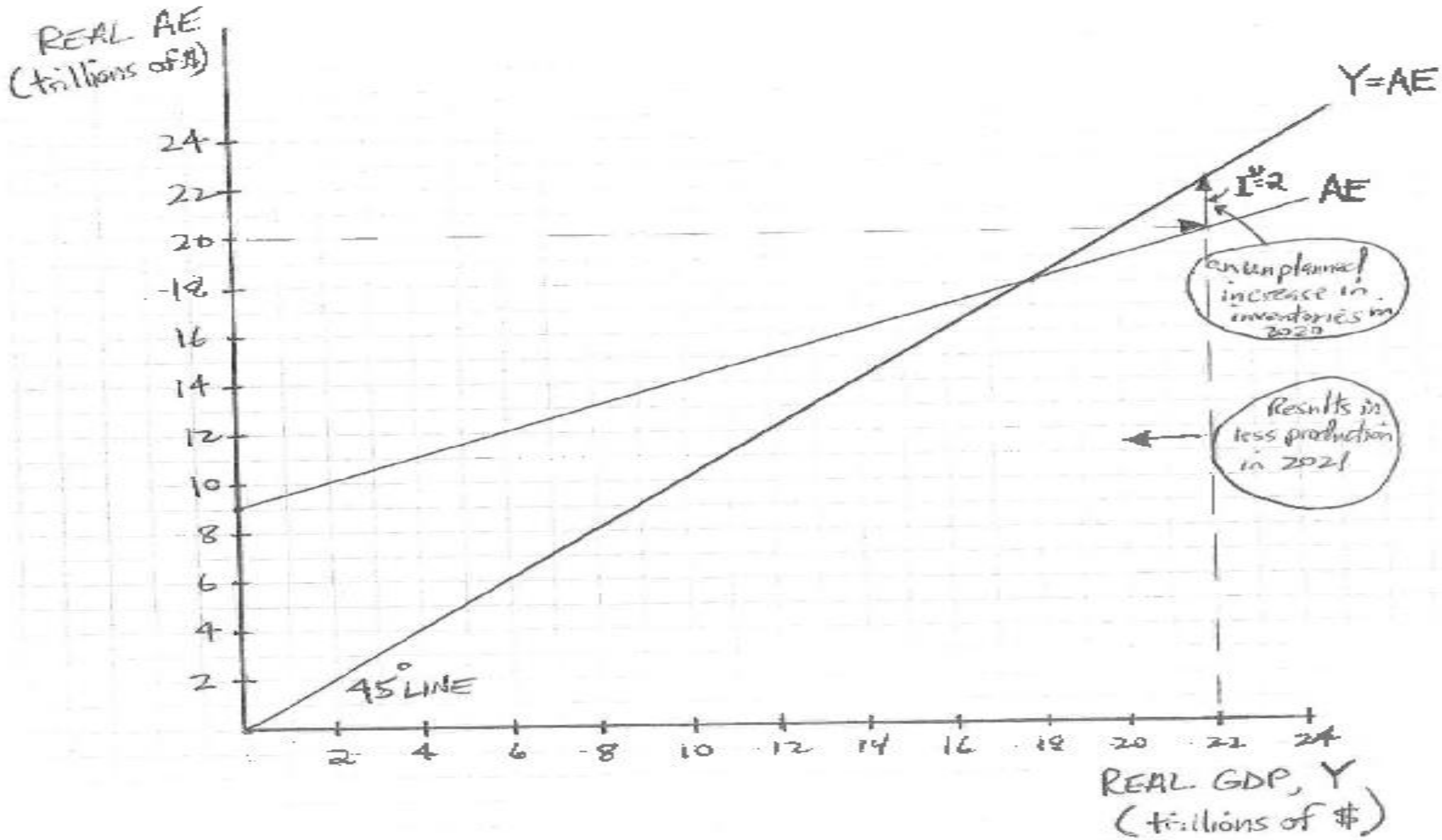

REAL AE
(trillions of $)
AE = C + I + G
(recall I = I^p)
Y = C + I + I^u + G
Y=AE
AE
24
22
20
18
16
14
12
10
8
6
4
2
45° LINE
2
4
6
8
10
12
14
16
18
20
22
24
REAL GDP, Y
(trillions of $)


REAL AE
(trillions of $)
C = 3200 + .5Y
Y=AE
AE
C
24
22
20
18
16
14
12
10
8
6
4
2
C̄
45° LINE
2
4
6
8
10
12
14
16
18
20
22
24
REAL GDP, Y
(trillions of $)


REAL AE
(trillions of $)
I = 2800
G = 3000
Y=AE
C+I
C
G = 3000
I = 2800
45° LINE
24
22
20
18
16
14
12
10
8
6
4
2
2
4
6
8
10
12
14
16
18
20
22
24
REAL GDP, Y
(trillions of $)

In year 2020, producers create output well above equilibrium expenditure:

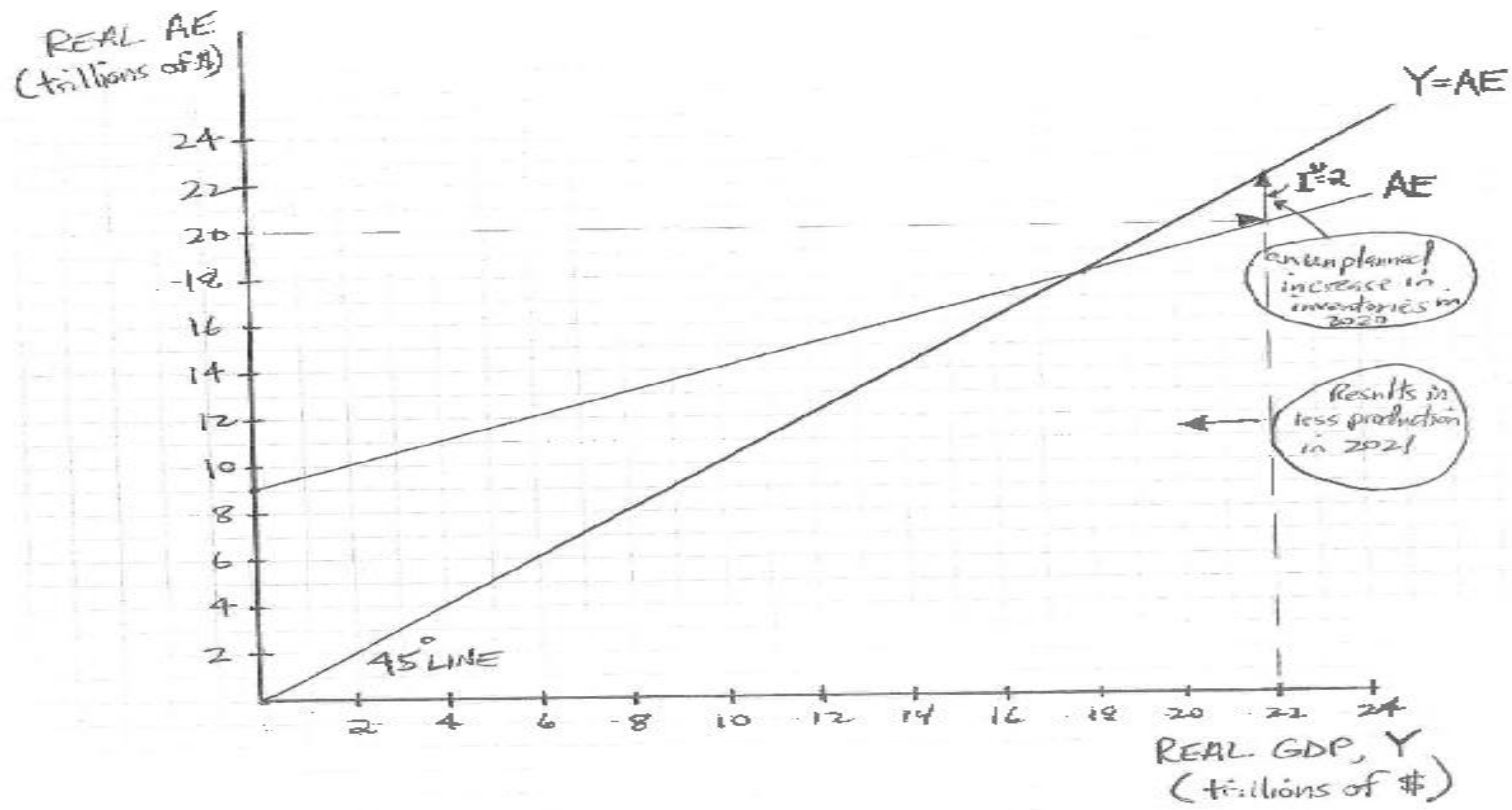
Y	$\bar{C}$	b(Y)	I	G	AE
17,000	3,200	8,500	2,800	3,000	17,500
18,000	**3,200**	**9,000**	**2,800**	**3,000**	**18,000**
19,000	3,200	9,500	2,800	3,000	18,500
20,000	3,200	10,000	2,800	3,000	19,000
21,000	3,200	10,500	2,800	3,000	19,500
22,000	**3,200**	**11,000**	**2,800**	**3,000**	**20,000**


REAL AE
(trillions of $)
Y=AE
AE
I=2
an unplanned increase in inventories in 2020
Results in less production in 2021
45° LINE
24
22
20
18
16
14
12
10
8
6
4
2
2
4
6
8
10
12
14
16
18
20
22
24
REAL GDP, Y
(trillions of $)

Producers Cutback Production:
We posit that two years later, **equilibrium**
(But check out what happened to jobs)

YEAR	Y	AE	I^u		U rate
2020	22,000	20,000	2,000		4.5%
2021	20,000	19,000	1,000		5.5%
2022	18,000	18,000	0		6.5%

Suppose, in 2020, both producers
and Government POLICY MAKERS
respond to the unbalanced level of production and spending



The AE model: we assume 'slack' We assume sticky prices

- Our analysis focuses on the total rise for output, that we will get from an initial increase in aggregate expenditures. If all factories are operating all day, and everyone is working, the economy has no capacity to produce additional output.

- What about stable prices? In the AE model we assume that the economy responds to strength or weakness SOLELY by increasing or decreasing production. In the real world, a surging economy can lift prices as well as production—and an economy in free fall likely witnesses falling prices.

Why Might Washington Policymakers Use the Visible Hand of Fiscal Stimulus?

- The AE model assumes:

  AMPLE RESOURCES, SO THERE IS ROOM TO PRODUCE ABOVE IDENTIFIED EQUILIBRIUM

  STICKY WAGES AND PRICES, SO EVEN IF WE HAVE UNEMPLOYMENT, WE DON'T SEE FALLING WAGES MOVING OUTPUT COSTS DOWN AND EMPLOYMENT UP

- **The AE Model drives the economy to an equilibrium, but NOT NECESSARILY AN IDEAL EQUILIBRIUM.**
- **The equilibrium may leave many people jobless.**

How Might Policymakers change the equilibrium in this super simple model?

- AE = C + I + G
- Policymakers decide upon the level for ‘G’
- Policymaker could vote to build more bridges or install battery filling stations on U.S. highways.
- We can replay the dynamics 2020 to 2021, with Washington increasing G, GOVERNMENT SPENDING

In 2020, Y =$22 trillion, I^u = $2 trillion
Firms cut back production to $20 trillion
Policymakers increase G by $1 trillion

- Recall we all are making new plans for the future based upon news about the recent past.
- Companies have too much stuff, and they are cutting production.
- Washington sees that companies will be cutting and want to limit the rise for joblessness, so they decide to increase government spending.

Businesses
and policy maker react:

- In 2020 G = \$3,000 or 15% of real GDP (Y)
- 2020 AE = $(3200 + (0.5 \times Y)) + 2,800 + 3,000 =$ \$20,000

- In 2021 G is increased to \$4,000

  Producers, RESPOND TO HIGH Inventories and cut production of many items.

  Policy makers, however, increase G by \$1 trillion, to \$ 4 trillion.

  We posit that Y, total production, equals \$20,000 in 2021

Now we calculate end of 2021 values for AE and I^u

- 2021 Y = $20 trillion and G = $4 trillion
- AE = (3,200 + 10,000) + 2,800 + $4,000 = $20,000
- AE = Y therefore $I^u = 0$
- We are in a new HIGHER equilibrium
- UNEMPLOYMENT IS AT 5.5%

The AE Model: The multiplier and the multiplier effect

- A change in autonomous spending clearly shifts output. We increased G by $1 trillion
- How much will Y shift?
- That is what we examine as we develop the multiplier analysis

Suppose we Increase in Autonomous Investment Spending

- **Assumption**: Increase in the "State of Confidence" of business firms
- **Why?** After a Presidential election there is an improved outlook for the economy
- **Effects:** Firms increase autonomous investment spending

Effects on the Model

- Define:

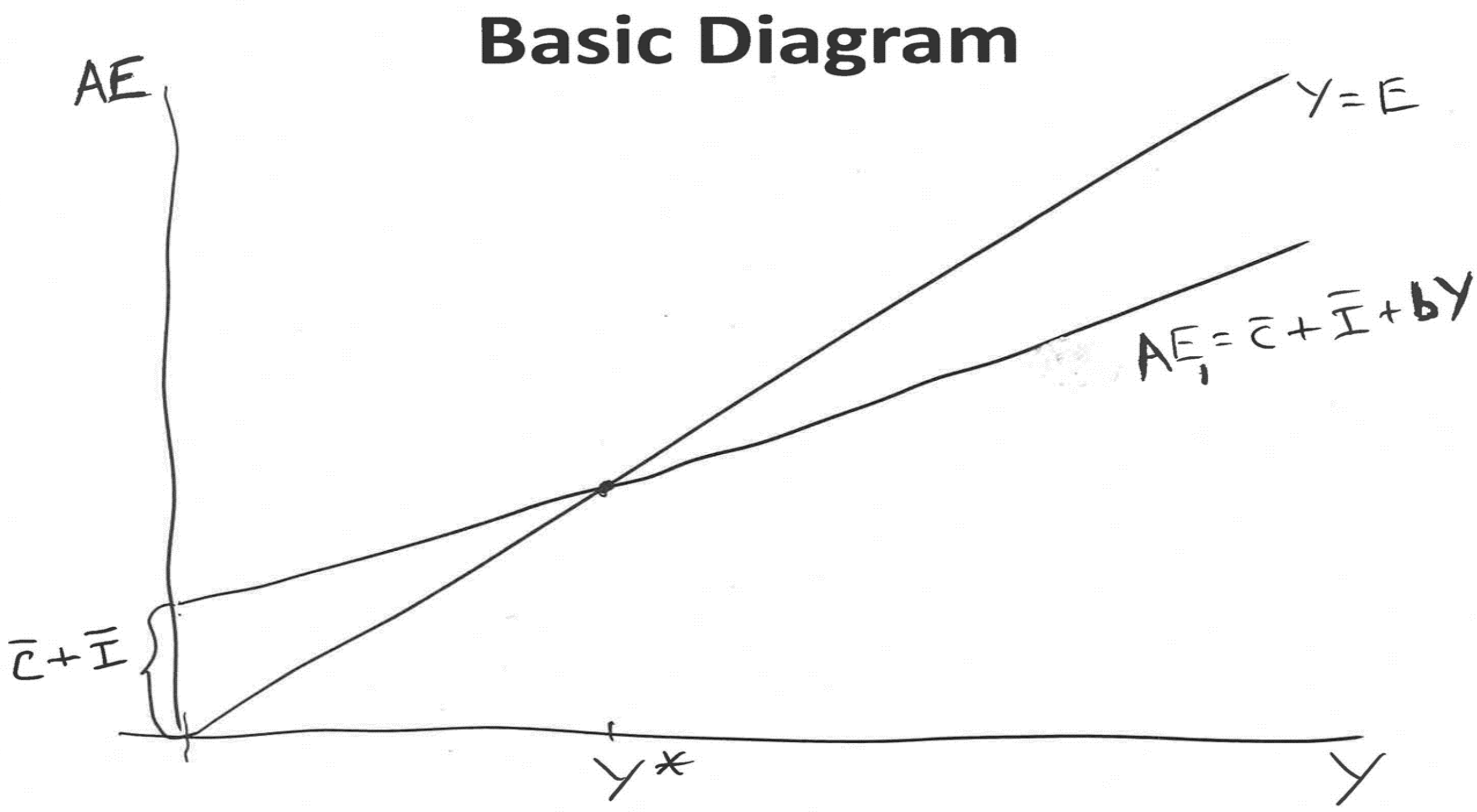
$$\bar{I} = \text{ Original Level of Autonomous Investment Spending}$$

$$\bar{\bar{I}} = \text{ New Level of Autonomous Investment Spending}$$

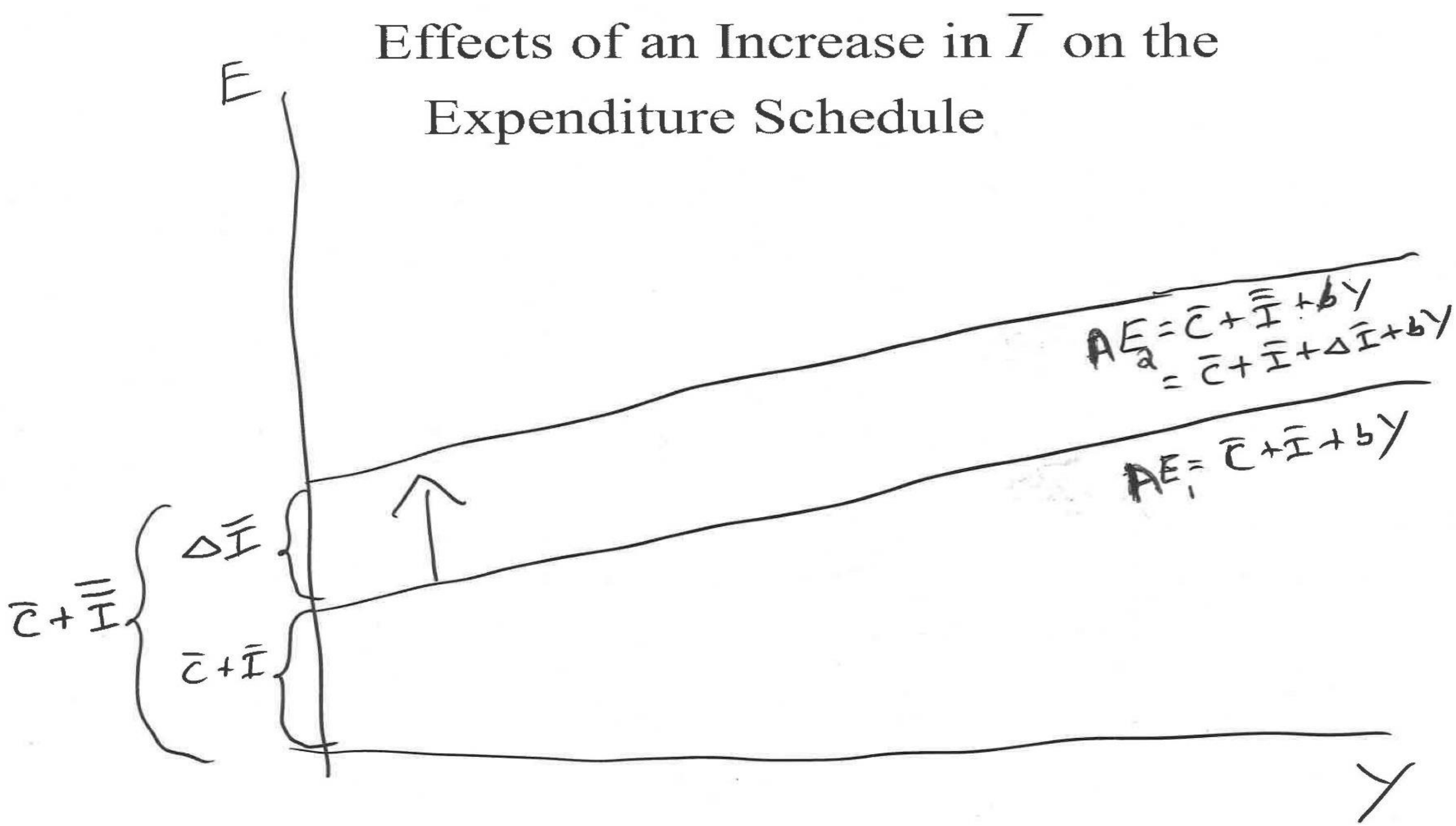
$$\underbrace{\Delta\bar{I}}_{\text{change in autonomous investment spending}} = \underbrace{\bar{\bar{I}}}_{\text{new level}} - \underbrace{\bar{I}}_{\text{original level}} > 0$$

- What is the Effect on Y or GDP?

To restate: we begin with a closed economy, (no X-Y), with no government. Y* is equilibrium.
Both autonomous C and I have one value. They are not a function of Y.
Note: The sum of $\overline{C} + \overline{I}$ identifies the intercept for the AE line.
The marginal propensity to consume, **b**, determines the slope of the **AE line**.



Now suppose JHU’s APL Invents a 500 mile range/10 minute recharge Battery. This elicits a substantial increase for planned investment.

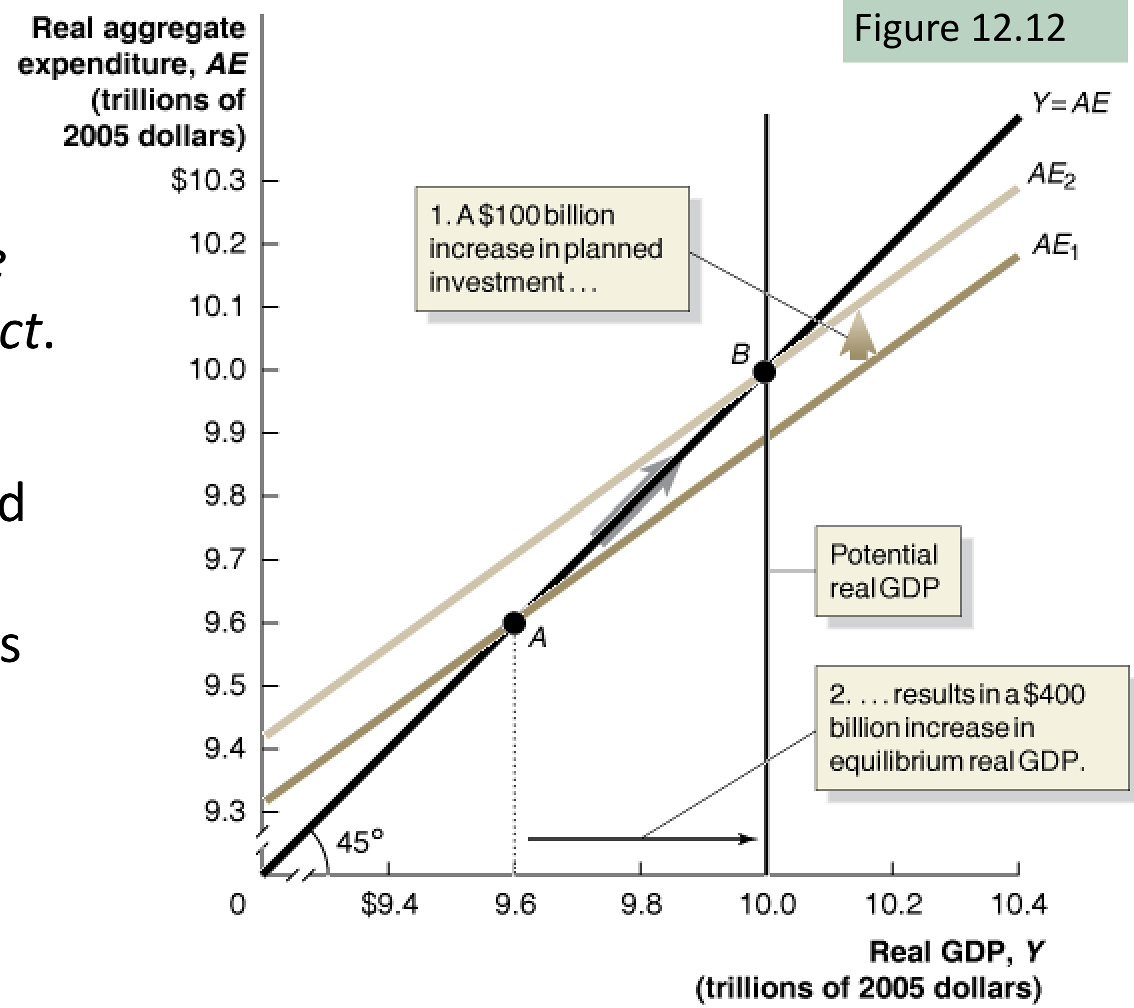


An increase in an autonomous expenditure: AE line shifts upward.

Real GDP increases by *more* than AE; the *multiplier effect*.

The value of the increase in equilibrium real GDP divided by the increase in autonomous expenditures is known as the *multiplier*.

Figure 12.12



Multiplier

- Observe from the diagram that

$$\Delta Y > \Delta \bar{I}$$

- Question: Why is the change in Income bigger than the change in Autonomous Investment Spending?

- **Reason :** Increases in Autonomous Investment Spending give rise to increases in Induced Consumption Spending

The underlying cause of the multiplier effect

- Autonomous increase in expenditure increases output. Output equals income.
- Some portion of income received (wages + profits) is spent. INDUCED CONSUMPTION
- How much? The Marginal propensity to consume.
- This spending raises output and income, which, again raises spending…MORE INDUCED CONSUMPTION…

Components of Aggregate Expenditure

$$E = C + I = \bar{C} + \bar{I} + bY$$

Autonomous Spending

Induced Spending

The multiplier effect in action: with MPC = .75

1. Real GDP up by increase in autonomous expenditure.
2. Income=Autonomous expenditure earned: (MPC) X (Income) spent
3. We repeat…

Table 12.4

	Additional Autonomous Expenditure (investment)	Additional Induced Expenditure (consumption)	Total Additional Expenditure = Total Additional GDP
Round 1	$100 billion	$0	$100 billion
Round 2	0	75 billion	175 billion
Round 3	0	56 billion	231 billion
Round 4	0	42 billion	273 billion
Round 5	0	32 billion	305 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 10	0	8 billion	377 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 15	0	2 billion	395 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 19	0	1 billion	398 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round *n*	0	0	$400 billion

How we add up the multiplier effect?

INITIAL INCREASE IN PLANNED INVESTMENT = $100 BILLION

+ MPC X (INITIAL INCREASE) = 0.75 X $100

+ MPC X (MPC X (INITIAL INCREASE)) = 0.75 X (0.75 X $100)

+ MPC X (MPC X (MPC X (INITIAL INCREASE)))…..

= $100 BILLION X (1 + MPC + MPC^2 + MPC^3 + MPC^4 …..)

A formula for the multiplier

This becomes the infinite sum:

$$\text{Total change in GDP} = \$100 \text{ billion} + MPC \times \$100 \text{ billion} + MPC^2 \times \$100 \text{ billion} + MPC^3 \times \$100 \text{ billion} + MPC^4 \times \$100 \text{ billion} + \ldots)$$

Which we can rewrite as:

$$\text{Total change in GDP} = \$100 \text{ billion} \times (1 + MPC + MPC^2 + MPC^3 + MPC^4 + \ldots)$$

by factoring out the initial $100 billion increase in investment.

Since MPC is less than 1, the expression in parentheses is:

$$\frac{1}{1 - MPC}$$

In our case, MPC = 0.75; so the multiplier is 1/(1-0.75) = 4. A $100 billion increase in investment eventually results in a $400 billion increase in equilibrium real GDP.

The general formula for the multiplier is:

$$\text{Multiplier} = \frac{\text{Change in equilibrium real GDP}}{\text{Change in autonomous expenditure}} = \frac{1}{1 - MPC}$$

Eventual effect of the multiplier

We cannot say how long this adjustment to macroeconomic equilibrium will take—how many "rounds", back and forth.

But we can calculate the value of the multiplier, as the eventual change in real GDP divided by the change in autonomous expenditures (planned investment, in this case):

$$\frac{\Delta Y}{\Delta I} = \frac{\text{Change in real GDP}}{\text{Change in investment spending}} = \frac{\$400 \text{ billion}}{\$100 \text{ billion}} = 4$$

With a multiplier of 4, each $1 increase in planned investment (or any other autonomous expenditure) eventually increases equilibrium real GDP by $4.

Remember: MPC determines multiplier

- Redo the analysis, with a surge in precautionary saving.
- MPC falls to 0.5

- $100 billion rise in autonomous investment
- Multiplier = 1/(1-MPC) = 2
- Y increases by $200 billion, not $400 billion

Implications

- **Principle**: A change in Autonomous Spending has a **"multiplier"** effect on Real Income

- **Observations**:
  - **Size of multiplier** depends on **b**, which is the MPC
  - **Reason**: the **larger is b**, the **greater is the induced consumption spending** that takes place in the secondary stage

What about in the real world? ‘Size of the multiplier” debate is furious

- Maybe the MPC = 0.5, not 0.75, for policy changes
- An MPC of 0.5, and we get a multiplier of 2 not 4.
- What is the MPC, for a one time tax cut?

  If you think you only get the one check,

  you may react differently, spending only a small portion of the funds.

  if the tax cut goes to Bill Gates, is he likely to spend as much of it as if it goes to a struggling family with 4 in college?

Some Classical Economists Argue the Multiplier is **ZERO**

RICARIDAN EQUIVALENCE

IF THE GOVERNMENT CUTS TAXES, WE MUST THINK ABOUT HOW HOUSEHOLD ‘**EXPECTATIONS**’ CHANGE

“I can’t spend this tax cut, cause I know they will raise my taxes later”

How does Ricardian Equivalence Square with the Facts?

- Poorly.

- Households may save some portion the tax cut. But a multiplier of zero doesn’t square with the facts.

Size of the multiplier? We need to consider 'slack'

- International Monetary Fund did a study of nations in the aftermath of the Great Recession. They estimate multiplers of 1.5% in slack conditions.

Does the table, below, correctly analyze the Trump Stimulus?

(Assume MPC = 0.5)

		add stimulus	
		value to	
		2017:Q4:	Q4/Q4 growth
	2017:Q4	2018:Q4	rate for Y
Y	$18.50	$18.87	2%
MPC	0.5		
1-MPC	0.5		
Autonomous Spending Change*	1%		
Size of Stimulus*	2%		
Size of Stimulus**	$0.37		
*as % of Y			
$ trillions			

The stimulus, in theory, builds on the growth that was already expected to occur.

		pre-stimulus	add stimulus	
		expectation	value to	
		for Y, in 2018	expected level	Q4/Q4 growth
	2017:Q4	2018:Q4	2018:Q4	rate for Y
Y	$18.50	$18.87	$19.24	4%
MPC	0.5			
1-MPC	0.5			
Autonomous Spending Change*	1%			
Size of Stimulus*	2%			
Size of Stimulus**	$0.37			
*as % of Y				
$ trillions				