

BASIC KEYNESIAN MODEL

- short-run, demand-driven model
- assumes fixed price level \Rightarrow firms operating in their "normal" production range (where don't need to raise price as Q expands)

To model demand at macro level:

Aggregate Expenditure (AE)

- is the "demand curve" in this model
- has same categories as Expenditure GDP:

$$AE = C + I_g + G + X_n$$

- initially assume $G = 0$ and $X_n = 0$ (no gov't and closed economy, so $X_n = 0$):

$$AE = C + I_g$$

\Rightarrow we model both C and I_g (outline their determinants), then put these together, get AE

Consumption Function

Model of Personal Consumption Expenditure:

- Durable Goods
- Non-Durable Goods
- Services

Major factors determining these:

- income
- prices
- interest rates
- wealth (*owned* assets) – **WEALTH EFFECT**
- consumer confidence

To model this, separate income (Y) from others:

C = factors other than income + part tied to income
(autonomous cons) + (induced cons)

Since part of consumption *directly* related to income, when the state of the economy changes, C *automatically* changes in *same* direction

- use a linear function to model this:

$C = a + bY$ **a** = intercept (value of C when $Y = 0$)
b = slope = $\Delta C / \Delta Y$
 = rate of change in C when $\uparrow Y = \$1$

a = autonomous consumption

- positive: when $Y = 0$, $C > 0$ (people use savings)

b = marginal propensity to consume (MPC)

- positive: as $Y \uparrow$, $C \uparrow$

- fraction: if $\uparrow Y = \$1$, $\uparrow C < \$1$

ex: if MPC = 0.8, if $\uparrow Y = \$1$, $\uparrow C = \$.80$, or, for every $\$1 \uparrow Y$, C rises by $\$.80$

Q: How does the consumption function shift?

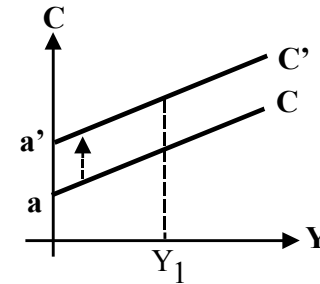
A: Anything that changes autonomous consumption (intercept) shifts the curve

Ex: Interest rates fall

\Rightarrow durable goods spending (part of C) *rises*

\Rightarrow *autonomous C rises \Rightarrow larger intercept*

\Rightarrow **parallel upward shift of C**



Technically: when $Y = 0$, autonomous C is greater
 A better way to understand this:

C can change *even if* Y does not (Δ autonomous C)

Interpret this as: for a given $Y (=Y_1)$, is greater C

Saving Function

- with **income identity**: $Y = C + S$

saving function derivable from consumption function using algebraic substitution:

$$Y = (a + bY) + S \quad \text{solving for S, gives:}$$

$$S = -a + (1 - b)Y$$

\Rightarrow intercept = **autonomous saving**

\Rightarrow slope = **marginal propensity to save (MPS)**

- extra saving when Y rises by $\$1$

Properties:

Autonomous saving = - autonomous consumption

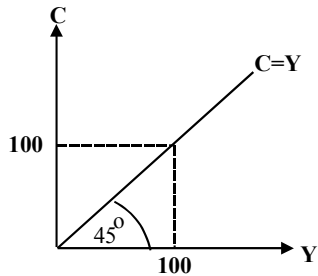
$MPS = 1 - MPC \Rightarrow MPC + MPS = 1$

Ex: if $C = 100 + 0.75Y$

$\Rightarrow S = -100 + 0.25Y$

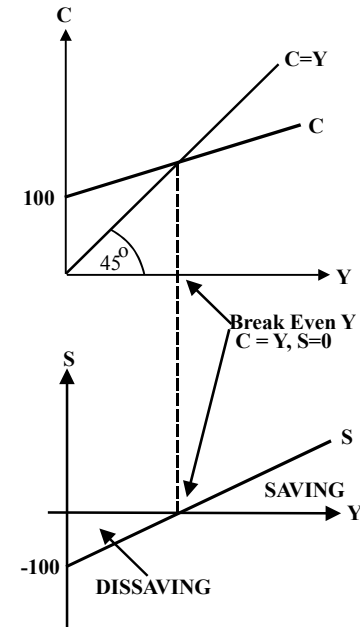
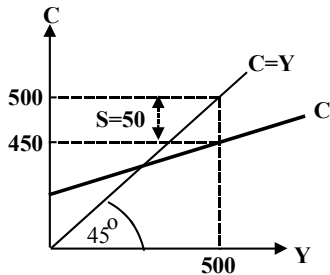
To derive this with a graph, need way to have $C=Y$

- use of 45° line



\Rightarrow for any Y , height to 45° line is value of C

- add consumption function, use height difference to get value of Savings (S)



- vertical distances match each other
- saving function derivable from consumption function \Rightarrow **Implied Saving Function**

To complete AE (demand), must model investment
Investment= Gross Private Domestic Investment

- Equipment & Software
- Business (non-residential) construction
- Residential construction
- Δ Business Inventories

$I_g = f(\text{interest rates, expected } \underline{\text{future}} \text{ profit, taxes})$

Note: $I_g \neq f(Y) \Rightarrow I_g \text{ is } \textit{autonomous}$

- there is no induced investment

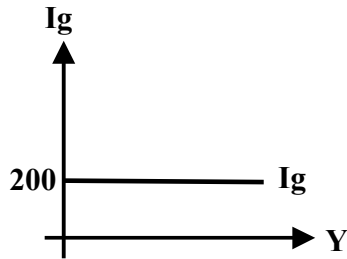
\Rightarrow no slope term (related to Y) - *intercept only*

ex: $I_g = 200$

- value changes from different interest rates, etc.

- when graph this - get horizontal line at 200

(constant value \Rightarrow constant height)



Since modeling *equilibrium* (sustainable) Y , need to re-consider I_g since part of it is inventories

Equilibrium \Rightarrow inventories *at* desired levels

$$I_{\text{tot}} = I_p + I_u$$

Total investment = planned I (when inventories at desired levels) + unintended I (difference between actual and expected inventories)

If $I_u > 0$ is inventory *accumulation*

\Rightarrow sales below expectations

When $I_u < 0$, inventory *decumulation*

\Rightarrow sales greater than expected

When $I_u \neq 0$, firms will either sell off (>0) or build up (<0) inventories \Rightarrow *not at equilibrium*

AE = C + Ip - *planned* aggregate expenditures

To get AE, add C and I_p for any Y

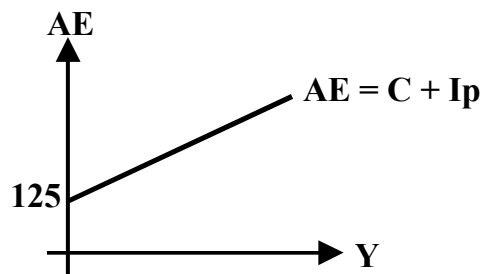
Ex: $C = 100 + 0.75Y$

$$I_p = 25$$

$$AE = C + I_p$$

$$= (100 + 0.75Y) + 25$$

$$\underline{AE = 125 + 0.75Y}$$



Q: If this is a demand function, why is it upward sloping?

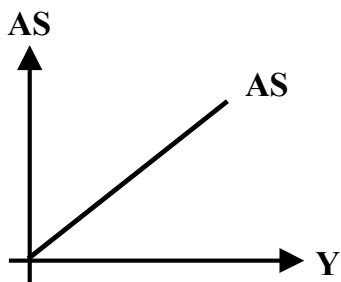
A: It is graphed relative to Y : as $Y \uparrow$, $AE \uparrow$

To model Aggregate Supply (AS):

In this model:

$$\mathbf{AS = real\ GDP = Y}$$

To draw a curve where $AS = Y$, use 45° line



NOTE: IS NO THEORY OF AS!!

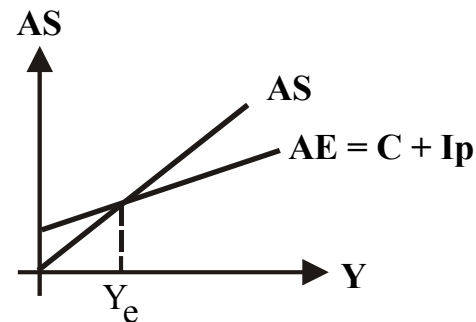
- major limitation of this model

Equilibrium: Supply/Demand Equilibrium

\Rightarrow Need $AS = AE$

\Rightarrow **production = planned expenditure**

\Rightarrow **no unintended inventory ($I_u = 0$)**



$Y_e =$ **equilibrium real GDP** \Rightarrow sustainable output

This determines:

- Output and Income
- Employment and the unemployment rate
- Capacity utilization in manufacturing
- Hours per week

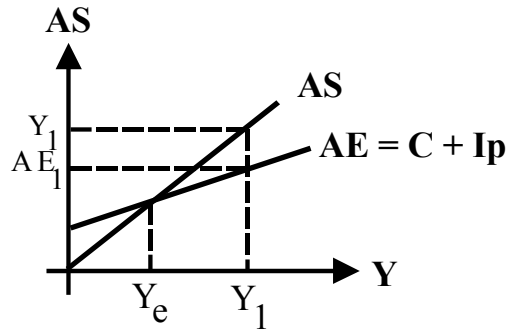
THERE IS NO GUARANTEE THAT Y_e OCCURS AT FULL EMPLOYMENT

- Less than full-employment equilibrium

- Keynes' contribution to macro

Why is this an equilibrium (and sustainable)?

Assume that actual Y (Y_1) $>$ Y_e



At Y_1 : production exceeds *planned* expenditure
 - too little spending to buy what is produced
 - inventories accumulate ($I_u > 0$) – start of an *inventory cycle*

Firms respond by cutting production. As they do:

- Employment falls (layoffs)
- Unemployment rises
- Y declines from Y_1

Output falls until inventories back to desired levels

$\Rightarrow Y \downarrow$ back to Y_e

$\Rightarrow Y_1$ too high to be sustained

Y_1 could possibly be full employment Y

Since inventory accumulation NOW signals declining output in the FUTURE, it is called a **LEADING ECONOMIC INDICATOR**
 - track these to forecast the economy

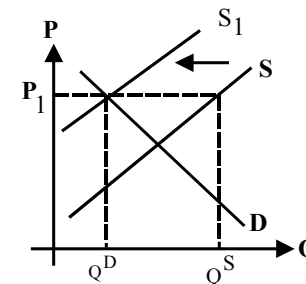
Rising inventories, or a higher inventory-to-sales ratio, signals *future* cutbacks in production and employment (possibly a recession)

- when GDP data released, we examine category: Δ Business Inventories, see if it signals inventory accumulation that not desired. If so:

- Adds to current quarter GDP
- Will bring about slower future growth in GDP

MICRO BASIS OF THIS:

Inventory accumulation $\Rightarrow Q^S > Q^D$



Occurs when $P > P_e$ at Y_1

\Rightarrow price level is too high to support Y_1

Short-run response: $\downarrow S$ to S_1

- this causes less employment, more unemployment

Exercise:

Replicate this analysis for when $Y < Y_e$

Cause and Effect of Equilibrium

Alternative equilibrium condition:

$Y = AE \Rightarrow C + S = C + I_p$, so

In equilibrium: $S = I_p$

\Rightarrow amount of non-spending by households (S)
exactly offset by spending added by business (I_p)

- Circular Flow result

If $AE < Y \Rightarrow C + I_p < C + S$, or

$\Rightarrow S > I_p$

Inadequate expenditure *caused* by too little
business spending to offset non-spending by
households - causes Y to fall

Equilibrium changes when AE changes

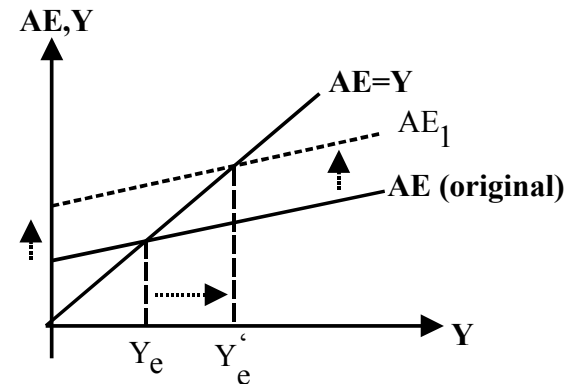
\Rightarrow changes in "other things" of C and/or I_p

Application:

Decline in interest rates as FED \uparrow money supply

As interest rates fall: $\uparrow C$ (durable goods), $\uparrow I_p$
(factory, equipment, housing)

$\Rightarrow \uparrow AE$ as *autonomous* C and I rise



\uparrow autonomous spending $\Rightarrow \uparrow AE \Rightarrow \uparrow Y_e$

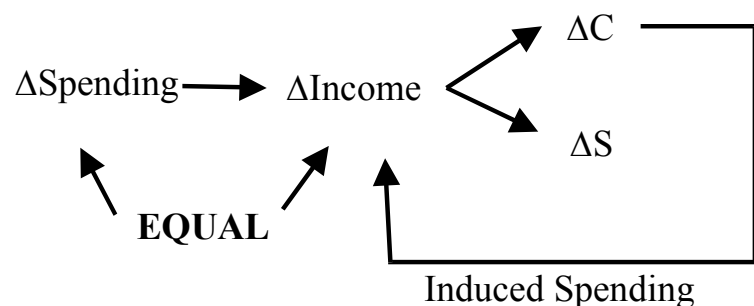
This is called **Expansionary Monetary Policy**
 \Rightarrow FED stimulates economy by raising interest-
sensitive spending $\Rightarrow \uparrow Y_e$

THE MULTIPLIER

Idea: when *autonomous* spending changes, income changes in the same direction

Intuition: ultimately, the change in income will *equal* the change in autonomous spending
- Generally *false!*

When spending changes, a *process of adjustment* occurs - not a one-time adjustment (with intuition)



$\Delta\text{Spending} \rightarrow$ equal ΔY *initially*

As Y rises, spending *automatically* rises-as does S

$\Delta C = \text{MPC} \cdot \Delta Y$ (induced spending change)

$\Delta S = \text{MPS} \cdot \Delta Y$ (induced leakage change)

Q: How much will Y ultimately rise?

A: Use equilibrium condition: $S = I_p$

Assume that I_p rises by \$200

New equilibrium \Rightarrow need $\uparrow S = 200$ (so $S=I_p$ again)

How do we generate $\uparrow S = 200$? Thru $\uparrow Y$

If $\text{MPS} = 1/5$, then for every $\uparrow Y = \$5$, $\uparrow S = \$1$

\Rightarrow to get $\uparrow S = \$200$ when $\text{MPS} = 1/5$,

need Y to rise by *5 times* that amount

\Rightarrow need $\uparrow Y = \$1,000$

$\Delta Y_e = \text{multiplier} \cdot \Delta I_p$ (original $\Delta\text{spending}$)

$= \text{multiplier} \cdot \200 (the ΔI_p)

$= \$1,000$

\Rightarrow multiplier (k) = 5 with an MPS of $1/5$

$k = 1/\text{MPS} = 1/(1 - \text{MPC})$ since $\text{MPC} + \text{MPS} = 1$

The multiplier quantifies the multiple by which *equilibrium* Y changes as spending changes

ex: if $k = 5 \Rightarrow$ when spending rises by \$1, Y_e rises by \$5

A More Concrete View

Assume the $MPC = 4/5$, $\Delta I_p = +200$

Δincome	$\Delta C = MPC \cdot \Delta Y$	$\Delta S = MPS \cdot \Delta Y$
+200	+160	+40
+160	+128	+32
+128	+102.4	+25.6
...
~ \$500 after only 3 rounds		
...
+ \$1,000	+ \$800	+ \$200

Note: induced spending ($\uparrow C$) gets *smaller*

To understand this better, view two extreme cases

(1) Let $MPC = 1 \Rightarrow k = +\infty$

Why so large a multiplier?

When income rises by \$1, get $\uparrow C = \$1$

\Rightarrow never-ending rise in Y_e since is no $\uparrow S$, and impossible to get $\uparrow S = \uparrow I_p$ again

\Rightarrow *no induced leakage*

MPS = 0

ΔY	$\Delta C = 1 \cdot \Delta Y$	$\Delta S = 0 \cdot \Delta Y$
+200	+200	0
+200	+200	0

With no induced S (a leakage), is nothing to slow the process down $\Rightarrow k = +\infty$

The larger is the MPC (smaller MPS), the greater is the multiplier (be able to explain why)

A large multiplier is bad - it makes the economy volatile - get large ΔY_e whenever spending changes

(2) Let $MPC = 0 \Rightarrow k = 1$ (intuition correct)

If $MPC = 0 \Rightarrow MPS = 1$

Δincome	$\Delta C = 0 \cdot \Delta Y$	$\Delta S = 1 \cdot \Delta Y$
+200	0	+200

Get entire $\uparrow S = +200$ in *one* round

As a result, $k = 1/MPS = 1/1 = 1$

$\Rightarrow \Delta Y_e = \Delta I_p$

\Rightarrow *Intuition assumes no induced spending*

\Rightarrow greater is MPS, smaller is multiplier

RULES:

- If add induced spending, multiplier rises
- If add any induced leakage, multiplier falls

Imports (leakage) - lower multiplier

Income Taxes (leakage) - lower multiplier

Another Way to View Multiplier

Micro: When demand for a single good changes, it alters the demand for *all* of its compliments

If X = durable good ("big ticket item")

↓ Demand for X has large ripple effects throughout the entire economy

Macro: this is the multiplier effect

DURABLE GOODS SPENDING IS A LEADING INDICATOR OF THE ECONOMY (thru ripple effects that occur in future time periods)

Actual Applications of the Multiplier

Multipliers exist at:

- National level
- International level
- Regional level
- State level
- Local level

Idea: Δ spending at particular level of economy (ex: state) has *magnified* impact on economic activity there

Ex: firm locates in RI with payroll of \$1 mil/month

Δ RI activity > \$1 mil/month

Q: How does this come about?

A: When factory built, suppliers and other stores locate nearby

⇒ total \$ activity > \$1 mil/month

If, in future, factory closes, process reverses
⇒ loss of factory AND loss of suppliers AND local businesses (ex: restaurants, bars, other stores) fail

Downtowns with lots of vacant stores - example of this - multiplier in reverse

This causes:

- Local property values to fall
- Home sales decline
- Out-migration of persons
 - Hurts tax base
 - Raises entitlement spending locally

Examples:

- Import competition causing US firms to close
- Defense cutbacks

ADDING FOREIGN TRADE: OPEN ECONOMY CHANGES

When we include foreign trade in the model (an *open economy*), demand and the multiplier change. This provides another means by which *Ye in the US* can change

Demand:

Since Aggregate Expenditure includes the expenditure categories for GDP, it becomes:

$$\mathbf{AE = C + I_p + \underline{NX}}$$

where: NX is net exports, equal to exports (X) minus imports (M)

In the Flexible Exchange Rate notes we saw:

$$\mathbf{X = f(\text{exchange rate}, Y_{\text{FOR}})}$$

$$\mathbf{M = f(\text{exchange rate}, Y)}$$

where: Y_{FOR} is *foreign* income and Y is US income (these are demand functions, which depend on price and income)

From this:

- Since both the exchange rate and foreign income are autonomous, exports are autonomous (equal to a single value)
- Graphing exports gives a horizontal line that can shift for changes in either the exchange rate or Y_{FOR}
- Since imports depend on US income, this is a type of induced spending. Since M is a function of Y , *the slope of AE changes* when this is included in the model
- Money spent on imports flows out of the US economy, so it has a negative sign in NX : higher imports lower NX , decreasing AE as well. Imports are thus an induced leakage.

Q: How does AE change when graphed?

A: Generally *both* the intercept and slope change.

Intercept Change:

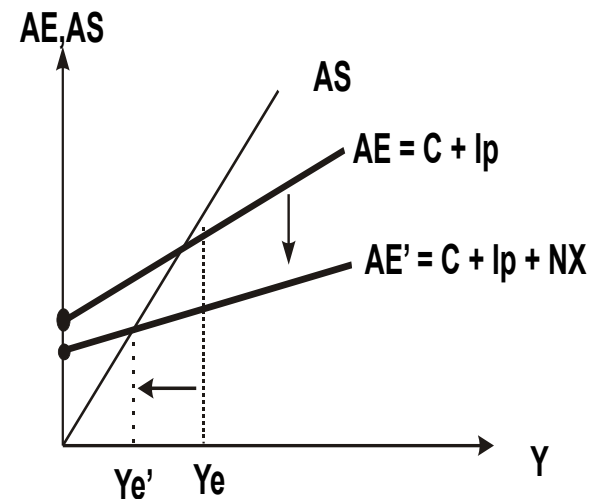
Unless autonomous exports (X_A) are equal to autonomous imports (M_A):

- higher intercept when $X_A > M_A$
 - lower intercept if $X_A < M_A$
- (explain these in terms of leakages/injections)

Slope Change:

As Y rises, although more \$ is spent, the part going to imports “leaks” out of the US economy. It is the Marginal Propensity to Import (MPM).

Leakage amounts: $MPS + MPM$ (higher total)
Induced spending: MPC (less than before)



In the graph:
- **lower intercept** with $X_A < M_A$
- **lower slope** since with imports, as $Y \uparrow$ AE for US goods is now less than before

MULTIPLIER:

Since the slope of AE changes with imports, the multiplier in an open economy is lower than that in a closed economy.

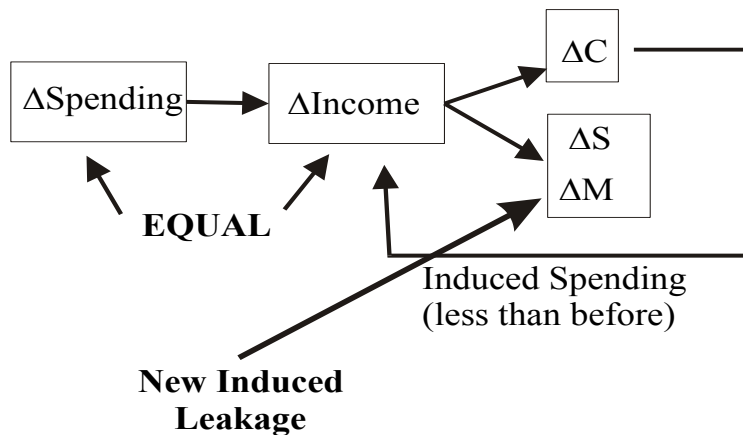
CLOSED ECONOMY MULTIPLIER:

$$k = 1/\text{MPS} = 1/(1 - \text{MPC})$$

OPEN ECONOMY MULTIPLIER:

$$k = 1/(\text{MPS} + \text{MPM})$$

- The denominator is the sum of *two* leakage propensities, from savings and imports
- In a test question, if you are given the MPC and not the MPS, the MPS can be calculated using the formula: $\text{MPS} = 1 - \text{MPC}$



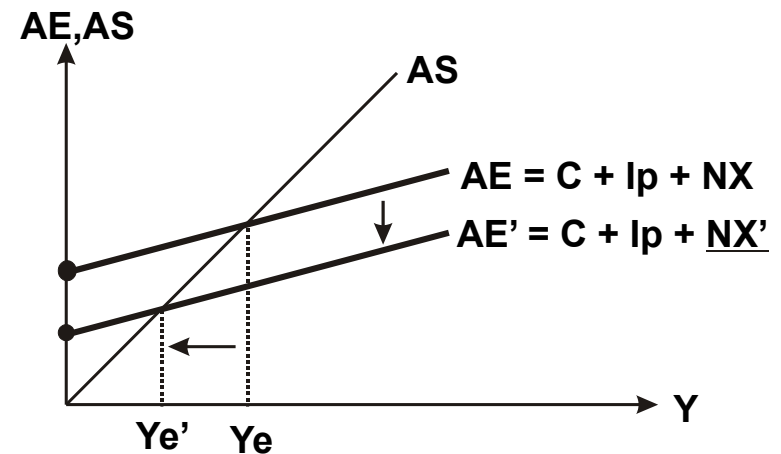
Exercise 1:

Assume that the economies of our major trading partners slow. Analyze this in terms of the basic macro model.

Answer:

This indicates an autonomous decline in Y_{FOR} that will lower the demand for US exports.

$$\downarrow X \rightarrow \downarrow NX \rightarrow \downarrow AE$$



As AE falls, the decline in spending gets the multiplier, lowering Y_e . Employment and income in the US fall, unemployment rises

Exercise 2:

Assume that the US dollar depreciates relative to other currencies. Illustrate the effects of this change in the macro model, following the example above. (note: refer to the Flexible Exchange Rate online notes for help with this)

Exercise 3:

Assume that US interest rates rise relative to those in other countries (the result of, say, tighter monetary policy). Does this alter AE and Y_e in the US? Outline the reasons for your response.

Exercise 4:

If the US inflation rate should rise relative to the inflation rates in the countries of our major trading partners, will this alter AE and Y_e in the US? If so, how?

PROBLEMS

(1) Use the following data, where Y =real output and C =personal consumption expenditures, and assume that $I_p=15$:

Y	C
540	540
560	555
580	570
600	585
620	600
640	615
660	630

- (a) What is the value of equilibrium Y ?
- (b) When $Y = 560$, how much is unintended investment?
- (c) What is the value of the MPS ?
- (d) What is the value of the multiplier?

(2) If nominal income is \$15,000 and the CPI is 118, what is the value of *real* income?

(3) If the CPI is 250 in year 1 and 275 in year 2, what is the inflation rate for year 2?