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**Principles of Economics**

# Model #2: An Economy with Government and a Foreign Sector (Updated 11-10-04)

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## Introduction

We're modeling the economy! We've done model #1, which introduced us to the structure of our models:

--We model the economy as though it's a giant market.
--Aggregate Expenditures measures total spending in the economy.
--Aggregate supply measures total production
--Equilibrium, where aggregate expenditures = aggregate supply, determines the size of the economy and the size of other important economic variables (such as consumption, savings, and unemployment).
--Events change equilibrium, causing the economy's production level and other things to change. This is how we simulate economic expansion and recession.

Shortcomings of model #1 are numerous. Two shortcomings—the lack of a government and foreign sectors—will be eliminated in model #2. Let's get to it.

## Simplifying Assumptions Made in All of Our Models: A review

No model of the economy can be as complex as the economy itself, and who would want it to be, anyway? Not me, that's for sure. I'd rather be swimming in bean dip. But I digress. Let's list some simplifying assumptions that we'll make in all of our models

Sometimes a simplified model is more useful than a complex model. For example, if you wanted to build a ship in a bottle, you wouldn't need a model of the submolecular structure of glass; you'd need some step by step instructions.

**Simplification #1:**

Reality: GDP is not equal to national income
Simplification: **GDP equals national income**

Since we shall always assume that GDP equals national income, we can use a common symbol—**Y**—to represent GDP and national income simultaneously.

Y = gross domestic product = national income

**Simplification #2:**

Reality: There's a whole bunch of things separating national income from disposable personal income.
Simplification: disposable personal income = national income – household taxes + transfer payments

We represent disposable personal income with the symbol $Y_d$. So:

**$Y_d = Y - T$**

"T" is net taxes.
T = household taxes – transfer payments

**Simplification #3:**

Reality: People can do many things with their disposable personal income.
Simplification: People can do only 2 things with their disposable personal income—spend it (on consumption) or save it.

We use S to represent personal savings. So:

**$Y_d = C + S$**

And now, Model #2

We are building 5 models of the economy. Let's look at a table that shows the five models that we'll be building, along with a list of simplifying assumptions for each model:

| | no government | no exports or imports | fixed interest rates | fixed prices | no long run |
|---|---|---|---|---|---|
| model 1 | X | X | X | X | X |
| **model 2** | | | **X** | **X** | **X** |
| model 3 | | | | X | X |
| model 4 | | | | | X |
| model 5 | | | | | |

Let's begin now with model #2.

**Model #2 of an Economy**

Let's display the major attributes of the model before we delve into it:

1. Aggregate Expenditures: Aggregate expenditures (AE) is the sum of consumption, investment, government purchases, and net exports

**AE = C + I + G + EX - IM**

2. Aggregate Supply: We are fixing prices in this model; that is, we will not let firms raise or lower their prices. This leaves them with only 1 job—produce the right amount of stuff to satisfy buyers:

> Production equals aggregate expenditures. If an event causes aggregate expenditures to rise, then firms increase production to meet the higher demand; the firms do NOT change prices. Using similar reasoning, if an event causes aggregate expenditures to fall, then firms reduce production; they do not change prices.
>
> Producers are pretty passive in this model, aren't they? This model (along with models #1 and #3) are sometimes called demand determined; if we know the level of desired expenditures, then we know the level of production, since the passive producers simply produce that amount of stuff.

3. Equilibrium Condition: We have equilibrium when total spending (aggregate expenditures, symbol: AE) equals total production (GDP, symbol: Y):

**Equilibrium: AE = Y**

So, here's our mission.

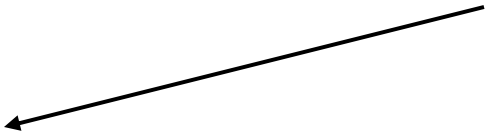
--First, we'll review the things that affect household spending—consumption (C).
--Next, we'll review the things that affect investment (I)
--Next, we'll discuss the things that affect government purchases, G, and we'll represent our model with a graph and an equation.
--Next, we'll discuss the things that affect exports and imports, EX and IM, and we'll represent our model with a graph and an equation.
--Then, we'll add the four models together to get a model of aggregate expenditures—in graph and equation form.
--Next, we'll find equilibrium in the economy by finding conditions where aggregate expenditures (demand) equals GDP (supply).
--Finally, we'll examine how events change equilibrium, and represent the changes with equations and graphs.

Recall that we thoroughly covered C and I in the notes file 1331-model1.

**Consumption (and personal savings): A Brief Review**

Things that Affect Consumption and Personal Savings
Below are three things that affect C and S.

In brief:
1. Amount of disposable personal income
   This is affected by:
   --amount of national income
   --amount of household taxes
   --amount of transfer payments
2. Amount of household wealth
3. Level of consumer confidence



Notice that government can affect consumption and savings through taxes and transfer payments.

Hey, we just modeled consumption and savings! Let's represent our model with a graph!
A consumption function:


Note about the consumption function:

1. It has an upward slope because more national income causes more consumption.
2. It can shift: a shift up (higher) means more consumption, and a shift down (lower) means less consumption.
3. An upward shift is caused by lower tax rates, more transfer payments, more consumer confidence, and/or more wealth.
4. A downward shift is caused by higher tax rates, lower transfer payments, lower consumer confidence, and/or lower wealth.

Hey, let's use an equation now to represent our consumption model!

A consumption function is an equation representing aggregate consumption in an economy. It is usually an equation of a line with an upward slope. Here's an example that I'm making up out of the blue for a hypothetical economy:

$C = 100 + .8(Y-T)$

where C is consumption, Y is national income, T is net taxes

Recall: T equals household taxes minus transfer payments. **Government actions affect T!!!**

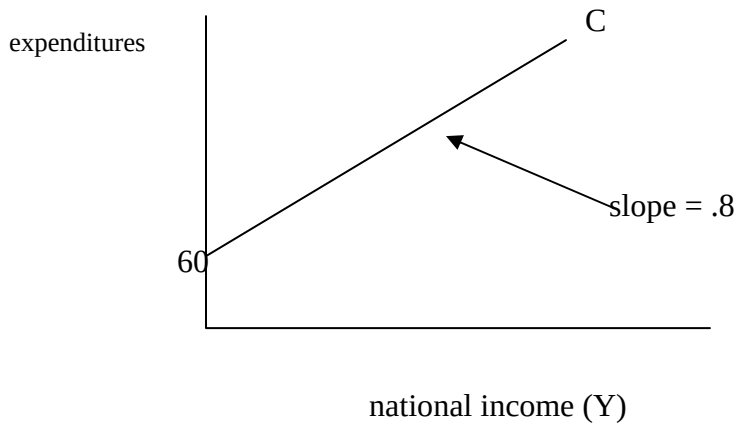
If we know net taxes, T, then we can graph this equation. Suppose we know that household taxes are 200 and transfer payments are 150.
Then $T = 200 – 150 = 50$. Let's plug this value for T into our equation:

$C = 100 + .8(Y – 50)$

Now simplify the equation

$C = 100 + .8Y – 40$ or $C = 60 + .8Y$

Our equation has a vertical intercept of 60 and a slope of .8, like so:




The marginal propensity to consume (MPC) measures the increase in consumption caused by a $1 increase in income. It equals the slope of the consumption function.

We've finished our review of consumption. Let's move to our second (and last in model #1) type of expenditure—investment.

**Investment: A Brief Review**

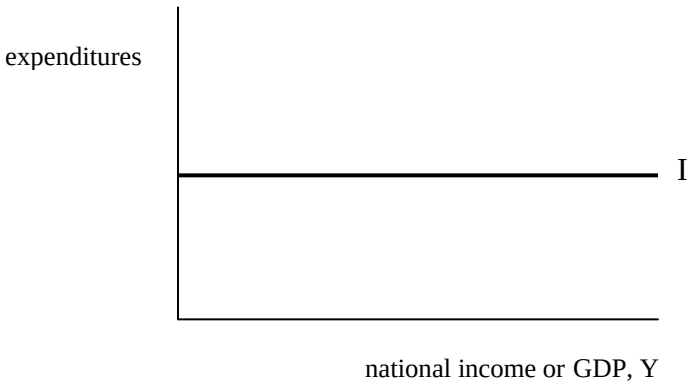
Things that Affect Investment:

1. Interest rates
2. Confidence of producers in their futures

(By the way, here in model #2, we can ignore the effects of interest rates on investment, since we are assuming that interest rates are constant. But don't forget about the investment-interest rate link when we get to model #3! Oh, what a tragedy—like missing your singing lesson with Britney Spears!)

Let's draw a graph to represent investment:

The investment function shows how investment varies with Y:



Hey, that's a pretty dull function; it's horizontal. But over time, it can shift:

--*It shifts when interest rates change.* If interest rates fall, investment rises, so the investment function shifts up. Same logic: if interest rates rise, the investment function shifts down.

--*It shifts when producer confidence changes.* If producer confidence rises, then they will invest more, and the investment function shifts up. Same logic: if producer confidence falls, then the investment function shifts down.

How about an equation to represent investment? Here's an example of one:

I = 75

We draw this equation as a horizontal line with vertical intercept at 75.

This equation will change if interest rates change or if producer confidence changes.
*Example*: If interest rates fall then the new equation might be I = 85.
*Another example*: if producer confidence falls then the new equation might be I = 65.

Hey, we've finished modeling the two types of spending in model #1—consumption and investment. Let's look the new stuff for model #2—Government Purchases, Exports, and Imports

**Government Purchases, G**

Recall that government purchases includes any final good or service bought by governments, such as tanks and school buildings. (Transfer payments are NOT included.)

Things that Affect Government Purchases:

In brief:
1. Decisions by government officials

In detail:

*1. Decisions by Government Officials*

We assume for simplicity that G is *exogenous*—that nothing within our model changes it. This equivalent to believing that only government officials can change G, and in our model, we, as modelers, must go into the model and manually change the value of G if we wish it to change.

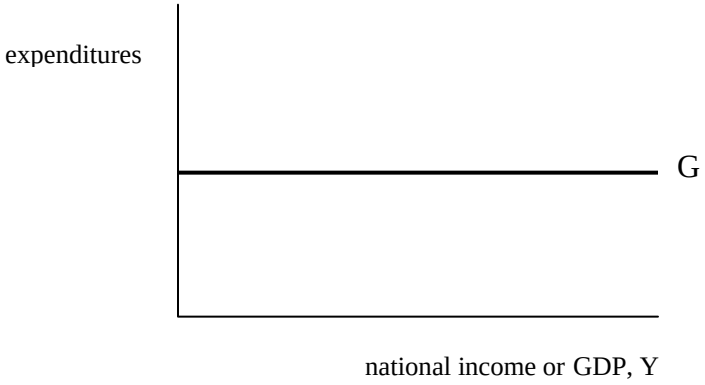
*Hey…what about GDP (Y)? Doesn't G change when Y changes?*

Well, this is true in the real world U.S., especially with some state governments that must always balance their budgets. If Y falls, then tax revenue tends to fall, and these governments must cut G to keep their budgets balanced. But for simplicity's sake we will ignore this, and assume that G does not change simply because Y changes.

Remember—the Federal government does not have to balance its budget. We will often assume that G changes without any change in net taxes, T

Well, we've finished modeling government purchases using words. Let's draw a graph to represent Government purchases:

The government purchases function shows how G varies with Y:




Hey, that's a pretty dull function; it's horizontal. But over time, it can shift:

> --*It shifts when government officials change it*. If we, the modelers, wish to see what will happen if government officials change G, then we must manually go and shift the curve; a higher curve simulates more G, and a lower curve simulates less G.

How about an equation to represent Government purchases? Here's an example of one:

> G = 75
>
> We draw this equation as a horizontal line with vertical intercept at 75.
>
> This equation will change if we want to simulate a change in G by government officials. *Example*: If government officials buy more stuff then the new equation might be G = 85.

Well, we've finished modeling G. Now, a brief digression: the budget deficit and the national debt.

<u>The Budget Deficit</u>

Recall that in reality the budget deficit in any given year equals the amount that government must borrow in a year; this is the difference between total spending by government and revenue from taxes and fees:

reality: budget deficit = (G + transfer payments) – (tax and fee revenue)

Simplifying assumptions in model #2: Since we have no fees in our model, the budget deficit reduces to this:

budget deficit = (G + transfer payments) – (tax revenue)

We can rearrange this equation:

budget deficit = G – (tax revenue – transfer payments)

Recall that the thing in parentheses in the above equation is net taxes, T:

**budget deficit = G – T**

If G-T is negative, then that's a budget surplus.

What can we say about the budget deficit?

--higher G causes a higher budget deficit
--lower tax revenue causes a higher budget deficit
--higher transfer payments causes a higher budget deficit

--lower G causes a lower budget deficit
--higher tax revenue causes a lower budget deficit
--lower transfer payments causes a lower budget deficit

The Budget Deficit and the National Debt

The national debt is the total amount that the Federal government owes to everyone else. This debt can accumulate over many many years. Whenever the government runs a budget deficit, it borrows money and adds to the national debt. If, on the other hand, the government runs a budget surplus, then it reduces (pays down) the national debt. Hence:

National debt = sum of all past budget deficits – sum of all past budget surpluses

Current U.S. national debt: approximately 5 trillion dollars

Enough about debt and deficits for now. Let's discuss exports and imports

## Exports And Imports, EX and IM

Exports, EX

Recall that exports are purchases of our economy's final goods and services by folks in other countries. What affects exports? (We shall view this from the point of view of the United States)

In Brief:

1. National incomes of other countries
2. The value of the dollar relative to foreign currencies

In detail

*1. National Incomes of Other Countries*
Foreigners need income to buy our goods and services. If they have more income, then they buy more of our stuff

Higher national incomes in other countries→ higher U.S. exports
Lower national incomes in other countries→lower U.S. exports

*2. The Value of the Dollar Relative to Foreign Currency*
Suppose the dollar is strong relative to foreign currency. This means that foreigners must trade a lot of their own currency to get U.S. dollars. This will make American goods and services—our exports—more expensive—and U.S. exports will be low.

Dollar appreciates in value (strengthens) → lower U.S. exports

On the other hand, suppose the dollar is weak relative to foreign currency. This means that foreigners must trade only a little of their own currency to get U.S. dollars. This will make American goods—our exports—cheaper—and U.S. exports will be high.

Dollar depreciates in value (weakens) → higher U.S. exports

You may be wondering what causes the dollar to be strong or weak relative to foreign currency. Sorry—you'll have to wait for model #3.

*Hey…what about GDP (Y)? Doesn't EX change when Y changes?*

You might think that when our economy grows, that we can produce more exports, so exports should rise. But no! We need someone to buy the danged stuff! Our own level of Y does not by itself change our level of exports!

Well, we've finished modeling exports using words. Let's draw a graph to represent exports:

The exports function shows how EX varies with Y:


Hey, that's a pretty dull function; it's horizontal. But over time, it can shift:

--*It shifts when national incomes in other countries change*. If we, the modelers, wish to see what will happen if national incomes in other countries change, then we

must manually go and shift the curve; a higher curve simulates more income in other countries, and a lower curve simulates less income in other countries.

--*It shifts when the value of the dollar changes relative to foreign currencies.* When the dollar depreciates, the curve shifts up; when the dollar appreciates, the curve shifts down.

How about an equation to represent exports? Here's an example of one:

EX = 200

We draw this equation as a horizontal line with vertical intercept at 200.

This equation will change if we want to simulate a change in EX caused by a change in incomes in other countries or a change in the value of the dollar relative to foreign currencies. *Example*: If foreign economies boom then the new equation might be EX = 250.

Well, we've finished modeling exports. Let's turn to imports

Imports, IM

Recall that imports are our economy's purchases of final goods and services produced in other countries. What affects imports? (We shall view this from the point of view of the United States)

In Brief:

1. U.S. national income
2. The value of the dollar relative to foreign currencies

In detail

*1. U.S. national income*

We need income to buy goods and services, including those made abroad. If we have more income, they we buy more foreign stuff

Higher U.S. national income→ higher U.S. imports
Lower U.S. national incomes →lower U.S. imports

*2. The Value of the Dollar Relative to Foreign Currency*

Suppose the dollar is strong relative to foreign currency. This means that Americans can easily buy foreign currency with their powerful dollars. This will make foreign goods—our imports—cheaper—and U.S. imports will be high.

Dollar appreciates in value (strengthens) → higher U.S. imports

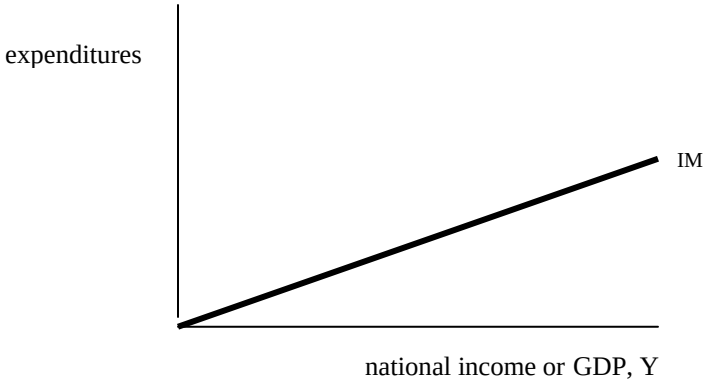
On the other hand, suppose the dollar is weak relative to foreign currency. This means that Americans must trade a lot of dollars to get foreign currency. This will make foreign goods more expensive—and U.S. imports will be low.

Dollar depreciates in value (weakens) → lower U.S. imports

You may be wondering what causes the dollar to be strong or weak relative to foreign currency. Sorry—you'll have to wait for model #3.

Well, we've finished modeling imports using words. Let's draw a graph to represent imports:

The imports function shows how IM varies with Y:




This is an upward-sloping line, showing how higher income in our economy causes imports to rise.

Over time, the imports function can shift:

> --*It shifts when the value of the dollar changes relative to foreign currencies.* When the dollar depreciates, the curve shifts down; when the dollar appreciates, the curve shifts up.

How about an equation to represent exports? Here's an example of one:

> IM = .1Y

We draw this equation as an upward-sloping line with vertical intercept at 0 and a slope of .1. The slope of the imports function is the marginal propensity to import: the fraction of an extra dollar of national income that is spent on imports.

> This equation will change if we want to simulate a change in IM caused by a change in the value of the dollar relative to foreign currencies. *Example*: If the dollar appreciates then the new equation might be IM = .15Y

Well, we've finished modeling imports. Now we're ready to combine our knowledge of all types of spending into a model of aggregate expenditures.

**Aggregate Expenditures, AE**

Aggregate expenditures in model #2 is the sum of consumption and investment and government purchases and net exports:

**AE = C + I + G + (EX – IM)**

The level of AE depends upon all of things that determine consumption and investment and government purchases and net exports:

These affect consumption:
- --level of disposable income
  - --level of national income
  - --level of household taxes
  - --level of transfer payments
- --level of consumer confidence
- --level of household wealth

These affect investment
- --level of interest rates
- --level of producer confidence

These affect government purchases:
- --decisions by government officials on level of purchases

These affect net exports, EX – IM
- --value of the dollar relative to foreign currency
- --national income
- --other countries' national incomes

Let's graph aggregate expenditures. This involves summing the consumption function graph and the investment function graph and the government purchases graph and the exports graph, then subtracting the imports graph. Here it is—the aggregate expenditures graph!

Over time, the AE curve in model #2 can shift, if any of these things change:

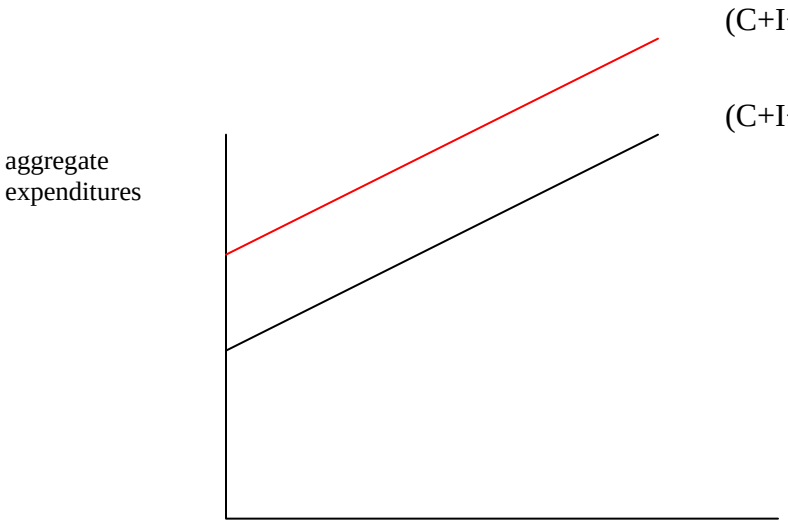
--level of disposable income
    --level of household taxes
    --level of transfer payments
--level of consumer confidence
--level of household wealth
--level of interest rates
--level of producer confidence
--level of government purchases, set by government officials
--value of U.S. dollar relative to foreign currency
--level of incomes in foreign countries

Notice that national income is NOT on the list of things that shift the AE curve. This is because national income is on the horizontal axis of the graph; if it changes we move along the AE curve—we don't shift it.

The AE curve in model #2 shifts up if:
--disposable income rises
    --household taxes fall
    --transfer payments rise
--consumer confidence rises
--household wealth rises
--interest rates fall
--producer confidence rises
--level of government purchases, set by government officials, rises
--value of U.S. dollar relative to foreign currency falls (depreciates)
--level of incomes in foreign countries rises

Note also that in model #2, interest rates will never change, since we assume that they are constant.

Here's an example of the AE curve shifting up

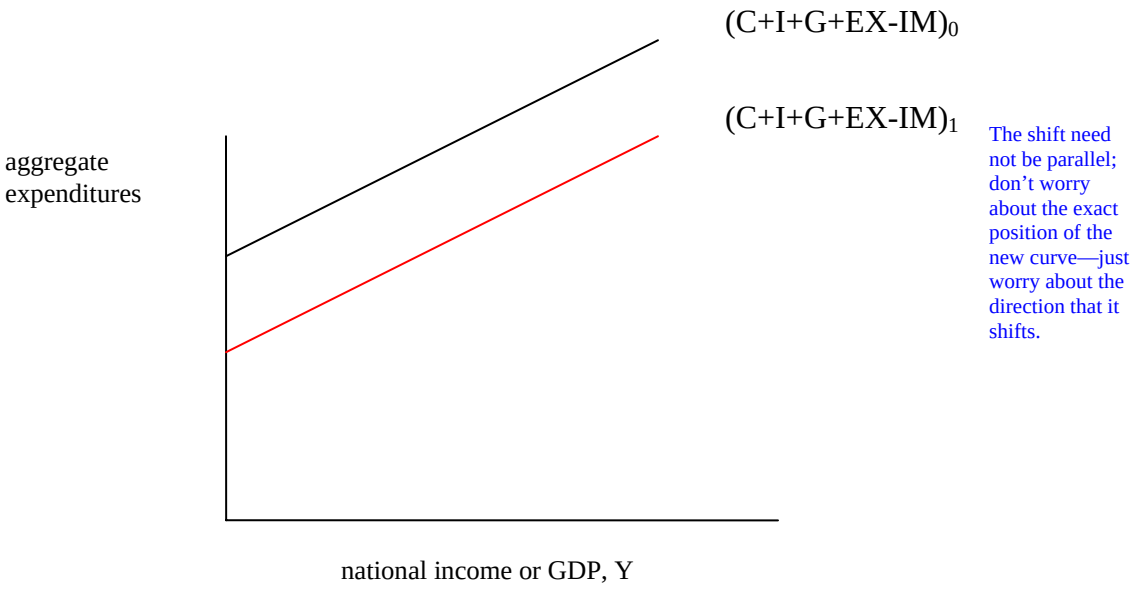



The shift need not be parallel; don't worry about the exact position of the new curve—just worry about the direction that it shifts.

The AE curve in model #2 shifts down if:

--disposable income falls
    --household taxes rise
    --transfer payments fall
--consumer confidence falls
--household wealth falls
--interest rates rise
--producer confidence falls
--level of government purchases, set by government officials, falls
--value of U.S. dollar relative to foreign currency rises (appreciates)
--level of incomes in foreign countries falls

Here's an example of the AE curve shifting down




Now that we've graphed aggregate expenditures in model #2, let's represent AE **algebraically**:

**The Algebra of Aggregate Expenditures**

We must add C + I + G + EX – IM to get AE. Here's an example:

*Example*: A hypothetical economy has

| | |
|---|---|
| consumption function | $C = 500 + .9Y_d$ |
| investment function | $I = 600$ |
| government purchases function | $G = 200$ |
| exports function | $EX = 300$ |
| imports function | $IM = .1Y.$ |
| net taxes are | $T = 100$ |

What is its AE function?

$AE = C + I + G + EX – IM$

$AE = 500 + .9(Y – 100) + 600 + 200 + 300 - .1Y$

$AE = 1600 + .9Y – 90 - .1Y$

**$AE = 1510 + .8Y$**

We graph this AE function with a straight line with vertical intercept of 1510 and slope of .8

What happens if an event changes AE? Well, the equation changes:

Example: Consider the hypothetical example in the box above. But now, government officials raise G from G = 200 to G = 250. What's the new AE function?

$AE = C + I + G + EX – IM$

$AE = 500 + .9(Y – 100) + 600 + \mathbf{250} + 300 - .1Y$

$AE = 1650 + .9Y – 90 - .1Y$

**$AE = 1560 + .8Y$**

We've finished modeling aggregate expenditures—the "demand" part of our model. Now, let's review the model of the "supply" part—aggregate supply.

**Aggregate Supply in Model #2**

This model is quite straightforward, given our assumption that prices are fixed:

Producers will produce the amount of goods and services, Y, that buyers want.

If , over time, something happens that makes buyers want more stuff (i.e. if aggregate expenditures rises over time), then Y will rise over time to match the increase in demand.

Similarly, if , over time, something happens that makes buyers want less stuff (i.e. if aggregate expenditures falls over time), then Y will fall over time to match the reduction in demand.

This model is so simple that we have no graph or equation to represent it. Aggregate supply is simply represented by the symbol that represents GDP—Y

So, now that we've modeled aggregate expenditures and aggregate supply, how do they interact—that is, what determines the level of GDP—the size of the economy? Well, that's our next topic.

**Equilibrium in Model #2**

The economy is said to be in equilibrium when aggregate expenditures equals GDP. This is the point where producers are producing the exact of amount of goods and services that buyers want. At equilibrium, there is no unsold production building up in firms' inventories, and there are no shortages of production requiring firms to reduce inventories.

In equilibrium:

Amount of goods and services *demanded* = amount of goods and services *produced*

In other words:

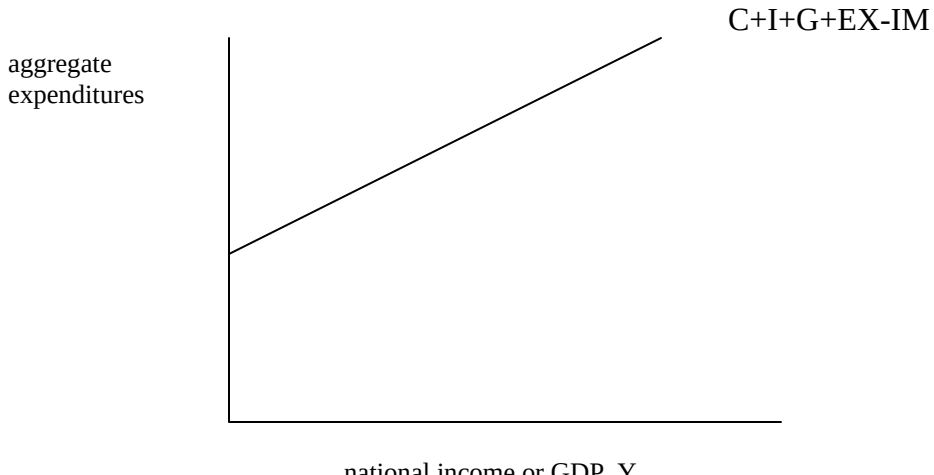
aggregate expenditures = aggregate supply

Using Symbols, for model #2:

| **Equilibrium condition: AE = Y** |
|---|

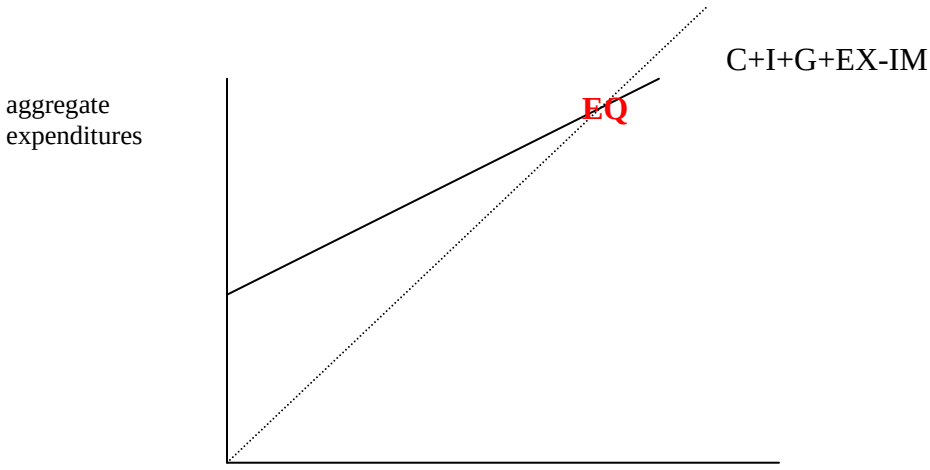
Equilibrium condition graphed

I shall redraw an aggregate demand function on the graph below. There is only one point on the AE curve where aggregate expenditures equals GDP. Where is it?



Hmmm…we're looking for the point at which aggregate expenditures, which are measured on the vertical axis, equal GDP, measured on the horizontal axis. Where is this point? We find it by adding a 45-degree line to the graph. The point at which the AE curve crosses the 45-degree line is the point where aggregate expenditures = Y!!!!!!

Voila:




The dashed line is the 45 degree line, and the point labeled 'EQ,' where the 45 degree line crosses the AE curve, represents equilibrium in our economy.

Big deal, you say. Yes, it is a big deal! Because now we know how big the economy is and how much consumption and savings there are in the economy, and a whole bunch of other stuff!!!! This is more exciting than a Michael Bolton concert!

Don't believe me? Well, let's figure out equilibrium using algebra, and you'll see. Gosh, this is more fun than eating corn dogs with Bill Clinton!

**The Algebra of Equilibrium**

*Example:*
A hypothetical economy has
consumption $C = 200 + .8Y_d$
investment I = 300
government purchases G = 400
exports EX = 500
imports IM = .1Y
net taxes = 200
(Also, this economy has fixed interest rates and prices.)

a) What is the equilibrium level of GDP?

Here's the equilibrium condition: AE = Y

Let's figure out AE: AE = C + I + G + (EX – IM)

Substitute our economy's equations: AE = 200 + .8(Y-200) + 300 + 400 +500 - .1Y

Simplify: AE = 1400 + .8Y – 160 - .1Y

Simplify some more to get the AE equation: AE = 1240 + .7Y

Now use the equilibrium condition and set AE = Y: 1240 + .7Y = Y

Subtract .7Y from both sides: 1240 = .3Y

Divide both sides by .3: **Y = 4133.333333**

b) What is the equilibrium level of consumption?

Here's the consumption function: $C = 200 + .8Y_d$

We know that Y is 4133.333 and T is 200: **C** = 200 + .8(4133.33 - 200) **= 3346.66666**

c) What is the equilibrium level of personal savings?

Disposable income equals Consumption + Savings: $Y_d = C + S$

Recall that disposable income = national income minus net taxes: $Y – T = C + S$

We calculated Y and C earlier and we know T: 4133.33 - 200 = 3346.66 + S

Do the math: **S = 586.66666**

d) What is the equilibrium level of net exports? Net exports = EX - IM

Substitute from our economy's equations: Net exports = 500 - .1Y

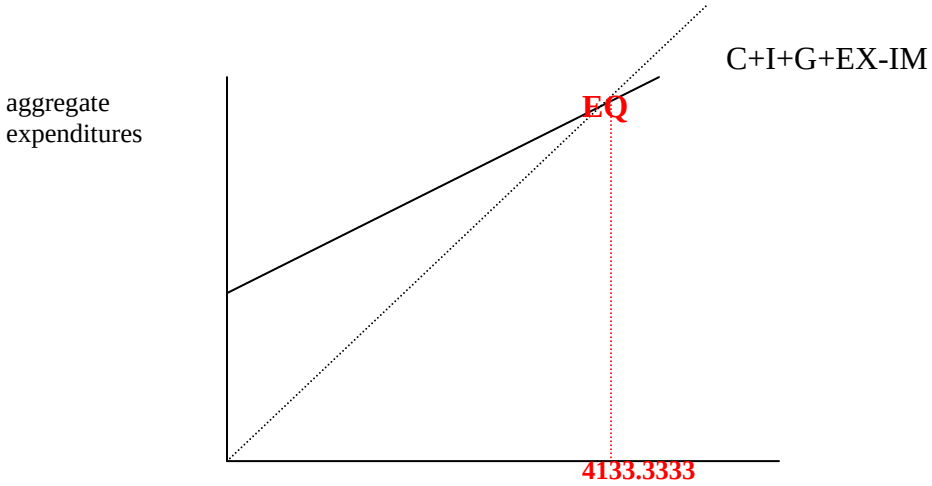
We calculated Y earlier: **Net exports** = 500 - .1(4133.33) = **86.6666**

e) What is the equilibrium budget deficit? Budget deficit = G –T

Substitute from our economy's equations: **Budget deficit** = 400 – 200 = **200**

f) Show the equilibrium size of the economy on a graph

No problem, dude! Look below.




**Events Changing Equilibrium in Model #2:**

We've seen how to graph and calculate equilibrium in the economy using model #2. But the economy doesn't stay at one equilibrium for long; events occur that change equilibrium. When that happens, we might expect output, consumption and savings and a bunch of other stuff to change.

Let's do some **forecasting**—predicting what will happen if an event affects the economy.

*Example: Government increases transfer payments (without raising taxes)*
Effects:

1st: Net taxes, T, fall
2nd: Disposable personal income, $Y_d$, rises
3rd: Consumption rises. (So does savings.)
4th: Producers respond to the higher spending by increasing production: Y rises
5th: Producers need more workers to produce the higher level of GDP: cyclical unemployment falls.

What else happens?

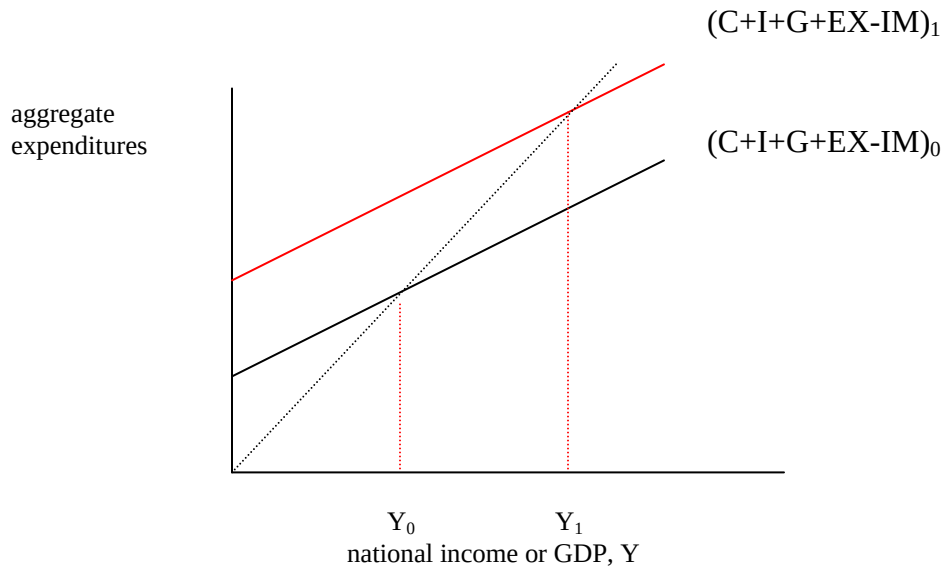
--imports rise due to the higher U.S. national income. This causes net exports to fall. (Or if the economy had a trade deficit, then the trade deficit will increase).

Recall that when EX-IM is negative that's a trade deficit. Here EX-IM could get more negative.

--the budget deficit, G –T, rises, since T has fallen. (Or if the government had a budget surplus, then it has shrunk.)

Recall that when G-T is negative that's a budget surplus. Here G-T could get less negative.

On a graph, we'd have the AE curve shifting up and a higher level of Y established at the intersection of the new AE curve and the 45-degree line:




*Another Example: Government reduces military spending*
Effects:

1st: G falls.
2nd: Aggregate expenditures fall, since G is a big part of AE
3rd: Producers respond to the lower expenditures by reducing production: Y **falls**
4th: Producers need fewer workers to produce the lower level of GDP: cyclical unemployment rises.

What else happens?

--consumption falls due to the lower U.S. national income. (Personal savings falls too.)

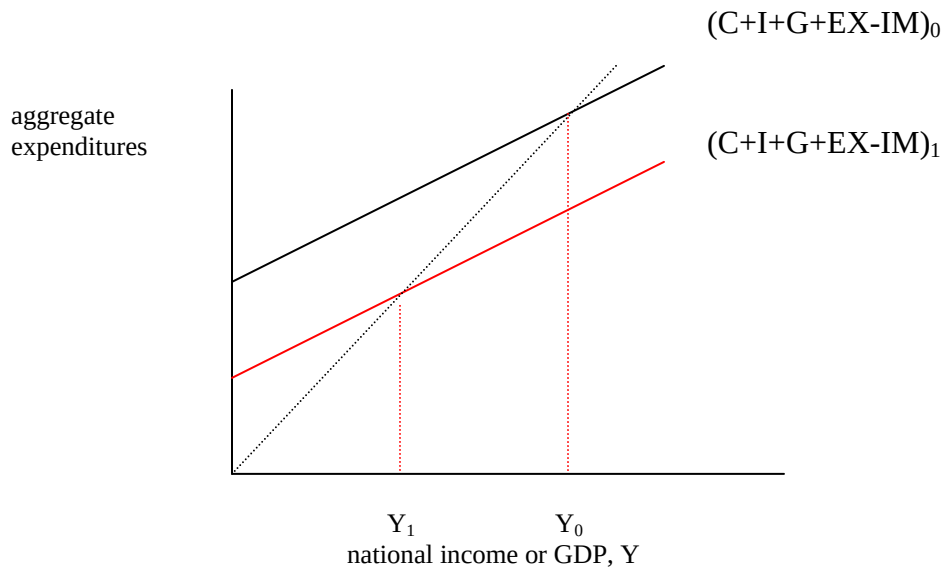
--imports fall due to the lower U.S. national income. This causes net exports to rise (or the trade deficit to fall).

Recall that when EX-IM is negative that's a trade deficit. Here EX-IM could get more negative.

--the budget deficit, G –T, falls, since G has fallen. (Or if the government had a budget surplus, then it has increased.)

Recall that when G-T is negative that's a budget surplus. Here G-T could get less negative.

On a graph, we'd have the AE curve shifting down and a lower level of Y established at the intersection of the new AE curve and the 45-degree line:




Fiscal Policy

The previous two examples involve fiscal policy. **Fiscal policy is when government changes its taxes or spending to try to affect the economy.** In the above two examples, we've seen that fiscal policy can affect GDP, unemployment, consumption, personal savings, the budget deficit, and net exports. Pretty powerful stuff!

Poor fiscal policy can cause a recession! Some blame Japan's current recession on poor fiscal policy in that country; they raised taxes at a bad time.

**The Algebra of Events Changing Equilibrium**

Graphs are nice, but it's hard to remember how an event changes all of those things—Y,C, S, net exports, budget deficit, etc. Well, if we express the model using algebra instead of graphs, then we don't need to remember all of that stuff—we can calculate all of it! Oh, this is better than mowing the lawn with an Exacto knife!

We shall do three separate detailed examples of events changing equilibrium: an event that changes G, an event that changes EX, and an event that changes T. We will see how each of these events separately affects the hypothetical algebraic economy that we developed earlier on pages 17 and 18.

Recall our algebraic example from pp. 17-18, which I repeat here:

*Example from pp 17-18:*
A hypothetical economy has
consumption C = 200 + .8$Y_d$
investment I = 300
government purchases **G = 400**
exports EX = 500
imports IM = .1Y
net taxes = 200

We found, as you recall:

Original Equilibrium:
**Y = 4133.333333** **C = 3346.66666** **S = 586.66666**
**Net exports** = **86.6666** **Budget deficit** = **200**

Well, let's simulate an increase in military spending. That dude G.W. Bush wants to increase military spending; so **let's increase G in our model from 400 to 600**! Weeeeee!

***Effect of an Increase in G from 400 to 600 on our hypothetical economy***

a) What is the NEW equilibrium level of GDP?

Here's the equilibrium condition: AE = Y

Let's figure out the new AE: AE = C + I + G + (EX – IM)

Substitute our economy's equations: AE = 200 + .8(Y-200) + 300 + **600** +500 - .1Y

Simplify: AE = 1600 + .8Y – 160 - .1Y

Simplify some more to get the new AE equation: **AE = 1440 + .7Y**

Now use the new equilibrium condition and set AE = Y: 1440 + .7Y = Y

Subtract .7Y from both sides: 1440 = .3Y

Divide both sides by .3: new **Y = 4800** **←Y rose from 4133.33 to 4800**

b) What is the NEW equilibrium level of consumption?

Here's the consumption function: C = 200 + .8$Y_d$

We know that Y is 4800 and T is 200:

**C** = 200 + .8(4800 - 200) **= 3880** **←C rose from 3346 to 3880**

c) What is the NEW equilibrium level of personal savings?

Disposable income equals Consumption + Savings: $Y_d = C + S$

Recall that disposable income = national income minus net taxes: $Y - T = C + S$

We calculated Y and C earlier and we know T: $4800 - 200 = 3880 + S$

Do the math: **S = 720** **← S rose from 586.66 to 720**

d) What is the NEW equilibrium level of net exports? Net exports = EX - IM

Substitute from our economy's equations: Net exports = 500 - .1Y

We calculated Y earlier: **Net exports** = 500 - .1(4800) = **20**

**net exports fell from 86.66 to 20**

e) What is the NEW equilibrium budget deficit? Budget deficit = G –T

Substitute from our economy's equations: **Budget deficit** = 600 – 200 = **400**

**the budget deficit rose from 200 to 400**

Let's summarize what happened to the economy in the table below; then we'll comment on it.

| | **G** | Y | C | S | net exports | budget deficit |
|---|---|---|---|---|---|---|
| original values | **400** | 4133.33 | 3346.66 | 586.66 | 86.66 | 200 |
| new values, with G higher | **600** | 4800 | 3880 | 720 | 20 | 400 |

Comment:
G rose by $200 (from 400 to 600) due to the higher military spending, yet GDP and national income rose by a much larger amount--$666.66 (from $4133.33 to $4800). Why? Well, notice that C rose by quite a bit.

Somehow, the increase in G also caused an increase in C, which made Y rise by a larger amount. This effect—the ripple effect of a change in G on the rest of aggregate expenditures (in this case, C) is known as the government purchases multiplier effect:

The government purchases multiplier effect causes the short run change in Y to be larger than the short run change in government purchases.

Here's the intuition behind the government purchases multiplier effect. When G rose by $200, this meant that there was an increase of $200 in spending on military goods—lets' say on tanks. Well, the tank producers will have to increase production by $200 worth of stuff.

The producers will hire more workers, and these workers will have more income to spend, *causing consumption to rise*. Hence the increase in G causes an increase in consumption.

Consider this equation:

change in G x the government purchases multiplier = change in Y

Some tricky math would let us actually derive the size of the government purchases multiplier, but we'll skip that math and I'll just tell you what it is:

| government purchases multiplier = 1 / (1 – slope of AE curve) |
|---|

*Government purchases multiplier example*:
In our algebraic example from above, the slope of the AE curve is .7 so:

government purchases multiplier = 1 / ( 1 - .7) = 3.3333

This is useful information. It's a shortcut to tell us how much Y will change for any change in G. Let's do two examples using our algebraic example from above.

Example: If G falls by 100, then Y will fall by 100 x 3.333 = 333.333

Example: If G rises by 20 then Y will rise by 20 x 3.333 = 66.666

Now, let's do our second algebraic example of events changing equilibrium, this time looking at a change in net exports:

Recall our original algebraic example from earlier in these notes, which I re-repeat here:

*Example from pp 17-18:*
A hypothetical economy has
consumption $C = 200 + .8Y_d$
investment I = 300
government purchases G = 400
exports EX = **500**
imports IM = .1Y
net taxes = 200

We found, as you recall:

Original Equilibrium
**Y = 4133.333333** **C = 3346.66666** **S = 586.66666**
**Net exports** = **86.6666** **Budget deficit** = **200**

Well, let's simulate an increase in national incomes of other countries. **Let's increase EX in our model from 500 to 700**! Wowww Weeeeee!

***Effect of an Increase in EX from 500 to 700 on our hypothetical economy***

a) What is the NEW equilibrium level of GDP?

Here's the equilibrium condition: AE = Y

Let's figure out the new AE: AE = C + I + G + (EX – IM)

Substitute our economy's equations: AE = 200 + .8(Y-200) + 300 + 400 +**700** - .1Y

Simplify: AE = 1600 + .8Y – 160 - .1Y

Simplify some more to get the new AE equation: **AE = 1440 + .7Y**

Now use the new equilibrium condition and set AE = Y: 1440 + .7Y = Y

Subtract .7Y from both sides: 1440 = .3Y

Divide both sides by .3: new **Y = 4800** **←Y rose from 4133.33 to 4800**

b) What is the NEW equilibrium level of consumption?

Here's the consumption function: $C = 200 + .8Y_d$

We know that Y is 4800 and T is 200:

**C** = 200 + .8(4800 - 200) **= 3880** **←C rose from 3346 to 3880**

c) What is the NEW equilibrium level of personal savings?

Disposable income equals Consumption + Savings: $Y_d = C + S$

Recall that disposable income = national income minus net taxes: Y – T = C + S

We calculated Y and C earlier and we know T: 4800 - 200 = 3880 + S

Do the math: **S = 720** **← S rose from 586.66 to 720**

d) What is the NEW equilibrium level of net exports? Net exports = EX - IM

Substitute from our economy's equations: Net exports = 500 - .1Y

We calculated Y earlier: **Net exports** = 700 - .1(4800) = **220**

**net exports rose from 86.66 to 220**

e) What is the NEW equilibrium budget deficit? Budget deficit = G –T

Substitute from our economy's equations: **Budget deficit** = 400 – 200 = **200**

**the budget deficit is unchanged**

Let's summarize what happened to the economy in the table below; then we'll comment on it.

| | **EX** | Y | C | S | net exports | budget deficit |
|---|---|---|---|---|---|---|
| original value | **500** | 4133.33 | 3346.66 | 586.66 | 86.66 | 200 |
| new value, with EX higher | **700** | 4800 | 3880 | 720 | 220 | 200 |

Comment:
EX rose by $200 (from 400 to 600) due to the higher foreign national incomes, yet GDP and national income rose by a much larger amount--$666.66 (from $4133.33 to $4800). Why? Well, notice that C rose by quite a bit.

Somehow, the increase in EX also caused an increase in C, which made Y rise by a larger amount. This effect—the ripple effect of a change in EX on the rest of aggregate expenditures (in this case, C) is known as the export multiplier effect:

The export multiplier effect causes the short run change in Y to be larger than the short run change in exports.

Here's the intuition behind the export multiplier effect. When EX rose by $200, this meant that there was an increase of $200 in spending on export goods—lets' say on microchips. Well, the microchip producers will have to increase production by $200 worth of stuff. The producers will hire more workers, and these workers will have more income to spend, *causing consumption to rise*. Hence the increase in EX causes an increase in consumption.

Consider this equation:

change in EX x the export multiplier = change in Y

Some tricky math would let us actually derive the size of the export multiplier, but we'll skip that math and I'll just tell you what it is:

| export multiplier = 1 / (1 – slope of AE curve) |
|---|

*Export multiplier example*:
In our algebraic example from above, the slope of the AE curve is .7 so:

export multiplier = 1 / ( 1 - .7) = 3.3333

This is useful information. It's a shortcut to tell us how much Y will change for any change in EX. Let's do two examples using our algebraic example from above.

Example: If EX falls by 100, then Y will fall by 100 x 3.333 = 333.333

Example: If EX rises by 20 then Y will rise by 20 x 3.333 = 66.666

Now, let's do one last example of events changing equilibrium, this time looking at a change in net taxes:

Recall our algebraic example from earlier in these notes, which I repeat here:

*Example from pp 17-18:*
A hypothetical economy has
consumption $C = 200 + .8Y_d$
investment I = 300
government purchases G = 400
exports EX = 500
imports IM = .1Y
net taxes = **200**

We found, as you recall:
**Y = 4133.333333** **C = 3346.66666** **S = 586.66666**
**Net exports** = **86.6666** **Budget deficit** = **200**

Well, let's simulate a tax cut. **Let's cut T in our model from 200 to 0**! I have to go weeeeee weeeeee!

***Effect of a reduction in T from 200 to 0 on our hypothetical economy***

a) What is the NEW equilibrium level of GDP?

Here's the equilibrium condition: AE = Y

Let's figure out the new AE: AE = C + I + G + (EX – IM)

Substitute our economy's equations: AE = 200 + .8(Y-**0**) + 300 + 400 +500 - .1Y

Simplify: AE = 1400 + .8Y – 0 - .1Y

Simplify some more to get the new AE equation: **AE = 1400 + .7Y**

Now use the new equilibrium condition and set AE = Y: 1400 + .7Y = Y

Subtract .7Y from both sides: 1400 = .3Y

Divide both sides by .3: new **Y = 4666.66** **←Y rose from 4133.33 to 4666.66**

b) What is the NEW equilibrium level of consumption?

Here's the consumption function: $C = 200 + .8Y_d$

We know that Y is 4800 and T is now 0:

**C** = 200 + .8(4666.66 - 0) **= 3933.333** **←C rose from 3346 to 3933**

c) What is the NEW equilibrium level of personal savings?

Disposable income equals Consumption + Savings: $Y_d = C + S$

Recall that disposable income = national income minus net taxes: $Y - T = C + S$

We calculated Y and C earlier and we know T is 0: 4666.66 - 0 = 3933 + S

Do the math: **S = 733.333** **← S rose from 586.66 to 733**

d) What is the NEW equilibrium level of net exports? Net exports = EX - IM

Substitute from our economy's equations: Net exports = 500 - .1Y

We calculated Y earlier: **Net exports** = 500 - .1(4666.66) = **33.33**

**net exports fell from 86.66 to 33.33**

e) What is the NEW equilibrium budget deficit? Budget deficit = G –T

Substitute from our economy's equations: **Budget deficit** = 400 – 0 = **400**

**the budget deficit rose from 200 to 400**

Let's summarize what happened to the economy in the table below; then we'll comment on it.

| | **T** | Y | C | S | net exports | budget deficit |
|---|---|---|---|---|---|---|
| original value | **200** | 4133.33 | 3346.66 | 586.66 | 86.66 | 200 |
| new value, with T lower | **0** | 4666.66 | 3933.33 | 733.33 | 33.33 | 400 |

Comment:
Let's see: net taxes fell by $200, initially giving households $200 more income to spend or save. Even if they spent the whole $200, this would only by itself raise spending and GDP by $200. Yet GDP rises much more than that—from 4133.33 to 4666.66. Why?

Somehow, the reduction in net taxes also caused an additional increase in C, which made Y rise by a larger amount. This effect—the ripple effect of a change in net taxes on the rest of aggregate expenditures (in this case, C) is known as the tax multiplier effect:

The tax multiplier effect causes the short run change in Y to be larger than the short run change in net taxes.

Here's the intuition behind the export multiplier effect. When T fell by $200, this meant that there was an initial increase in spending by households—lets' say on clothes. Well, the clothes producers will have to increase production. The producers will hire more workers, and these workers will have more income to spend, *causing consumption to rise more*. Hence the tax reduction causes a ripple effect that increases consumption quite a lot—by more than the initial tax cut.

Consider this equation:

change in net taxes x the tax multiplier = change in Y

Some tricky math would let us actually derive the size of the tax multiplier, but we'll skip that math and I'll just tell you what it is:

| tax multiplier = -MPC / (1 – slope of AE curve) |
|---|

Notice that the tax multiplier is negative! This is because a tax reduction causes Y to rise, and a tax hike causes Y to fall.

*Tax multiplier example*:
In our algebraic example from above, the MPC is .8 and the slope of the AE curve is .7 so:

tax multiplier = -.8 / ( 1 - .7) = -2.6666

This is useful information. It's a shortcut to tell us how much Y will change for any change in T. Let's do two examples using our algebraic example from above.

Example: If T falls by 100, then Y will change by -100 x -2.6666 = 266.666

Example: If T rises by 20 then Y will change by 20 x -2.6666 = -53.33333

Well, we've spent 8 pages going over very specific algebraic examples of events changing equilibrium. Perhaps you can see how macroeconomic models provide important insight for policymakers in government who may try to steer the future course of the economy.

Let's step back and take a more general look at what we've discovered about the government and its ability to use fiscal policy—changing in its taxes or spending—to affect the economy.

**Another Look at Fiscal Policy**

We've seen in models #1 and #2 that it's changes in spending—aggregate expenditures—that cause the economy to grow or shrink over the short run. Higher spending induces

higher production—a growing economy (expansion). Lower spending causes lower production—a shrinking economy (recession).

Well, government has three spending and taxing tools that can change spending:

To Increase Spending: Government can cut taxes or raise transfer payments, causing consumption to rise. Or government can raise its own spending on goods and services, G. Any of these actions are known as expansionary fiscal policy, since they increase aggregate expenditures and Y, expanding the economy.

To Reduce Spending: Government can raise taxes or cut transfer payments, causing consumption to fall. Or government can cut its own spending on goods and services, G. Any of these actions are known as contractionary fiscal policy, since they reduce aggregate expenditures and Y, contracting the economy.

Countercyclical fiscal policy

We have seen that spending drives the economy. If spending rises then the economy grows; if spending falls then the economy shrinks.

Well, suppose that government forecasts falling spending by consumers, firms (who invest) and/or foreigners (who buy our exports). This could cause a recession! What can government do?

→How about increasing their own spending (G or transfer payments) to try to counteract the reduction in other spending. Or how about cutting taxes to buttress household spending?

If government does any of these things then they are engaging in *countercyclical* fiscal policy—changing taxes and government spending to try to avoid a recession.

Now consider the opposite to a reduction in spending--an unsustainable boom in spending by households, firms, and/or foreigners. Believe it or not, this can be bad for the economy (causing inflation, as we'll see in model #4), causing an overheated economy. What can government do?

→How about reducing their own spending (G or transfer payments) to try to counteract the increase in other spending. Or how about raising taxes to discourage household spending?

If government does any of these things then they are engaging in *countercyclical* fiscal policy—changing taxes and government spending to try to avoid a recession or an overheated economy

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Well, we've finished model #2. What a blast! I've had a lot of fun writing 30 pages of notes! Next, we'll construct model #3, in which we'll add money and interest rates into the model.