Economics 302 (Sec. 001) Intermediate Macroeconomic Theory and Policy

(Spring 2011)

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Lecture 3

Monday, January 30, 2012

Real Sector & Keynesian Cross

- Composition of output (accounting)
- Aggregate Demand
- Equilibrium
- Paradox of Thrift

3-1 The Composition of GDP

$$Y \equiv C + I + G + X - IM$$

Table 3-1 The Composition of U.S. GDP, 2006

		Billions of dollars		Percent of GDP	
	GDP (Y)	13,246		100.0	
1	Consumption (*C*)	9,269		70.0	
2	Investment (*I*)	2,163		16.3	
	Nonresidential		1,396		10.5
	Residential		767		5.8
3	Government spending (*G*)	2,528		19.0	
4	Net exports	–763		–5.8	
	Exports (X)		1,466		11.0
	Imports (IM)		–2,229		–16.8
5	Inventory investment	49		0	

Source: Survey of Current Business, April 2007, Table 1-1-5.

3-1 The Composition of GDP

- Consumption (*C*) refers to the goods and services purchased by consumers.

- Investment (*I*), sometimes called fixed investment, is the purchase of capital goods. It is the sum of nonresidential investment and residential investment.

- Government Spending (*G*) refers to the purchases of goods and services by the federal, state, and local governments. It does not include government transfers, nor interest payments on the government debt.

3-1 The Composition of GDP

- Imports (*IM*) are the purchases of foreign goods and services by consumers, business firms, and the U.S. government.

- Exports (*X*) are the purchases of U.S. goods and services by foreigners.

3-1 The Composition of GDP

- **Net exports (*X* – *IM*)** is the difference between exports
  and imports, also called the **trade balance**.

$$Exports = imports \Leftrightarrow trade\ balance$$

$$Exports > imports \Leftrightarrow trade\ surplus$$

$$Exports < imports \Leftrightarrow trade\ deficit$$

- **Inventory investment** is the difference between production and sales.

3-2 The Demand for Goods

We now move from accounting to modeling.

The total (or "aggregate") demand for goods is written as:

$$Z \equiv C + I + G + X - IM$$

Where *C, I, G, X, IM* are now all "planned" amounts of expenditures.

To determine *Z*, some simplifications must be made:

3-2 The Demand for Goods

- Assume that all firms produce the same good, which can then be used by consumers for consumption, by firms for investment, or by the government.
- Assume that firms are willing to supply any amount of the good at a given price, *P,* and demand in that market.
  Assume that the economy is *closed*, then both exports and imports are zero.
- Under the assumption that the economy is closed, $X = IM = 0$, then:

$$Z \equiv C + I + G$$

3-2 The Demand for Goods

Consumption (*C*)

- Disposable income, (Y_D), is the income that remains once consumers have paid taxes and received transfers from the government.

$$C = C(\underset{(+)}{Y_D})$$

The function $C(Y_D)$ is called the **consumption function**. It is a **behavioral equation**, that is, it captures the behavior of consumers.

$$C = c_0 + c_1 Y_D$$

3-2 The Demand for Goods

Consumption (*C*)

This function has two **parameters**, c_0 and c_1:

- c_1 is called the (marginal) **propensity to consume**, or the effect of an additional dollar of disposable income on consumption.
- c_0 is the intercept of the consumption function.

Disposable income is given by:

$$Y_D \equiv Y - T$$

3-2 The Demand for Goods

Consumption (*C*)

Figure 3 - 1

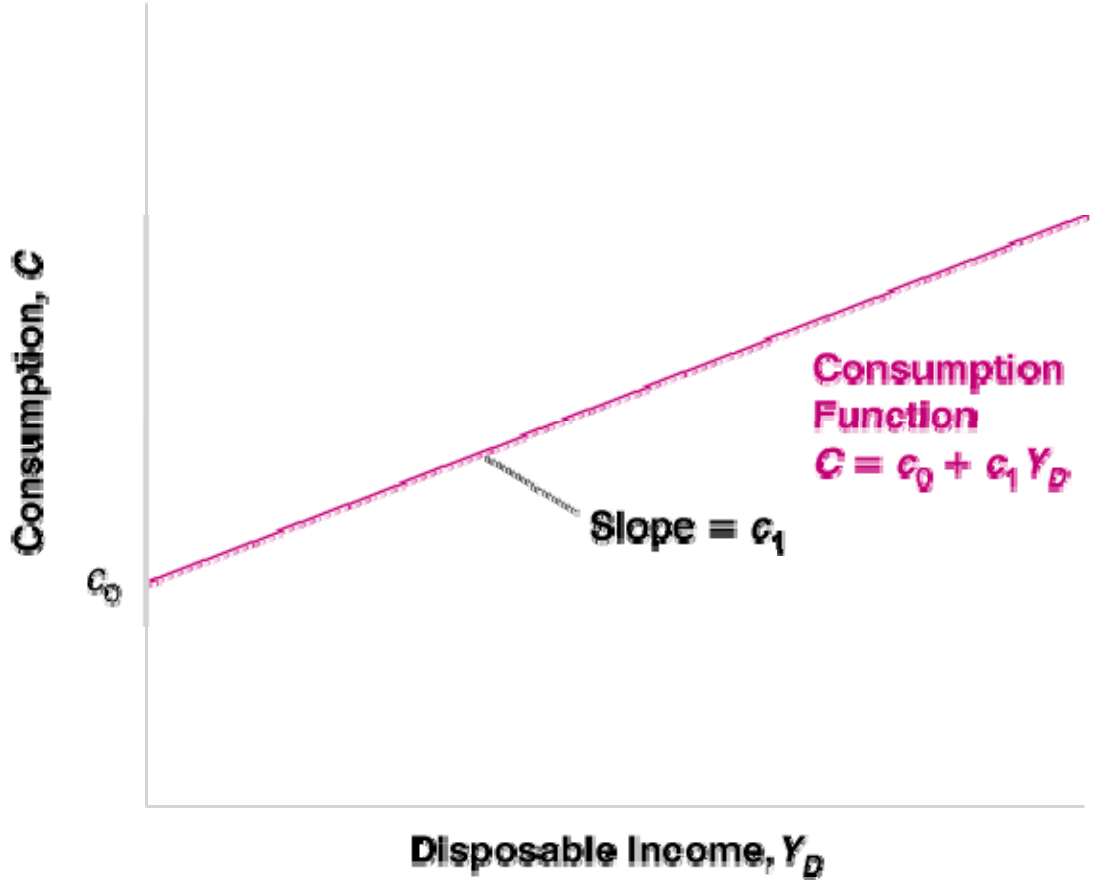
Consumption and Disposable Income

Consumption increases with disposable income but less than one for one.

$$C = C(Y_D)$$

$$Y_D \equiv Y - T$$

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



3-2 The Demand for Goods

Investment (I)

- Variables that depend on other variables within the model are called endogenous. Variables that are not explain within the model are called exogenous. Investment here is taken as given, or treated as an exogenous variable:

$$I = b_0$$

Government Spending (G)

Government spending, *G*, together with taxes, *T*, describes **fiscal policy**—the choice of taxes and spending by the government.

3-2 The Demand for Goods

- Textbook assumes both G and *T* are also exogenous. In the derivation, I take only G as exogenous , with T partly exogenous
  - Governments do not behave with the same regularity as consumers or firms.
  - Macroeconomists must think about the implications of alternative spending and tax decisions of the government.

$$G = GO_0 \qquad T = t_0 + t_1 Y$$

3-3 The Determination of Equilibrium Output

•Assuming that exports and imports are both zero, the demand for goods is the sum of consumption, investment, and government spending:

$$Z \equiv C + I + G$$

Then:

$$Y = Z = (c_0 + c_1 Y_D) + (b_0) + (GO_o)$$

3-3 The Determination of Equilibrium Output

•Equilibrium in the goods market requires that production, *Y*, be equal to the demand for goods, *Z*:

$$Y = Z$$

The **equilibrium condition** is that, production, *Y*, be equal to demand. Demand, *Z*, in turn depends on income, *Y*, which itself is equal to production. Then:

$$Y = (c_0 + c_1(Y - (t_0 + t_1 Y))) + (b_0) + (GO_o)$$

3-3 The Determination of Equilibrium Output

Macroeconomists always use these three tools:

1. Algebra to make sure that the logic is correct

2. Graphs to build the intuition

3. Words to explain the results

3-3 The Determination of Equilibrium Output

Using Algebra

Rewrite the equilibrium equation:

$$Y = Z = (c_0 + c_1(Y - (t_0 + t_1 Y))) + (b_0) + (GO_o)$$

$$Y = c_1(1 - t_1)Y + \Lambda_0 \qquad \Lambda_0 \equiv c_0 - c_1(t_0) + b_0 + GO_o$$

$$Y - c_1(1 - t_1)Y = \Lambda_0 \qquad Y[1 - c_1(1 - t_1)] = \Lambda_0$$

$$\boxed{Y_0 = \bar{\gamma}\Lambda_0} \qquad \bar{\gamma} = \frac{1}{[1 - c_1(1 - t_1)]}$$

3-3 The Determination of Equilibrium Output

Using Algebra

- The equilibrium equation can be manipulated to derive some important terms:
  - The term $\Lambda_0 \equiv c_0 - c_1(t_0) + b_0 + GO_o$ is that part of the demand for goods that does not depend on output, it is called **autonomous spending**. If the government ran a **balanced budget**, then *T*=*G*.
  - Because the propensity to consume (c_1) is between zero and one, $\bar{\gamma} = \frac{1}{[1 - c_1(1 - t_1)]}$ is a number greater than one. For this reason, this number is called the **multiplier**.

3-3 The Determination of Equilibrium Output

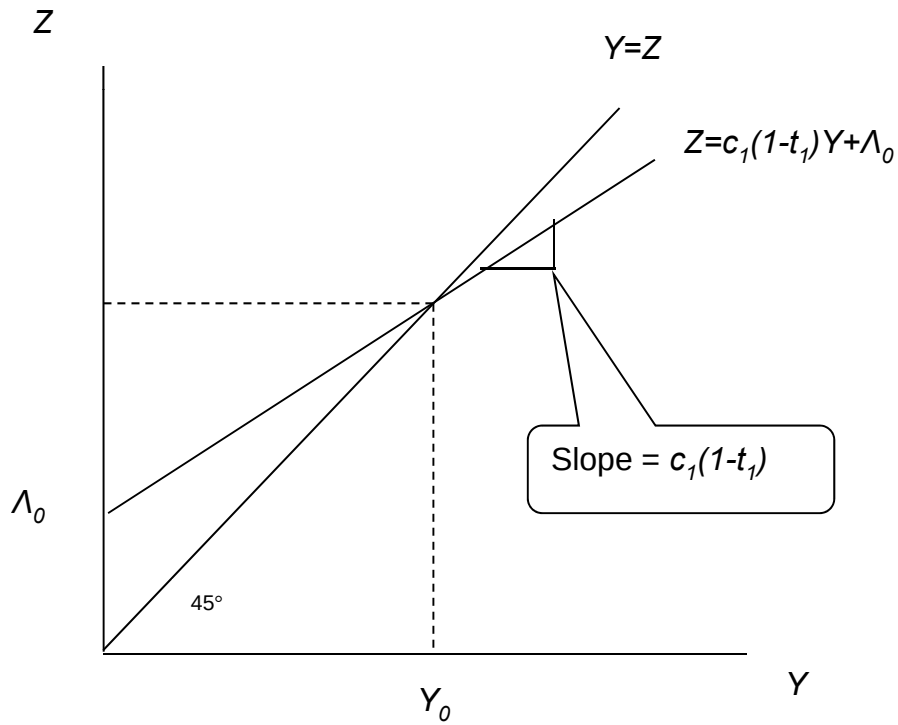
Using a Graph

$$Z = \Lambda_0 + c_1(1 - t_1)Y$$

Equilibrium in the Goods Market

Equilibrium output is determined by the condition that production be equal to demand.

- First, plot production as a function of income.
- Second, plot demand as a function of income.
- In Equilibrium, production equals demand.



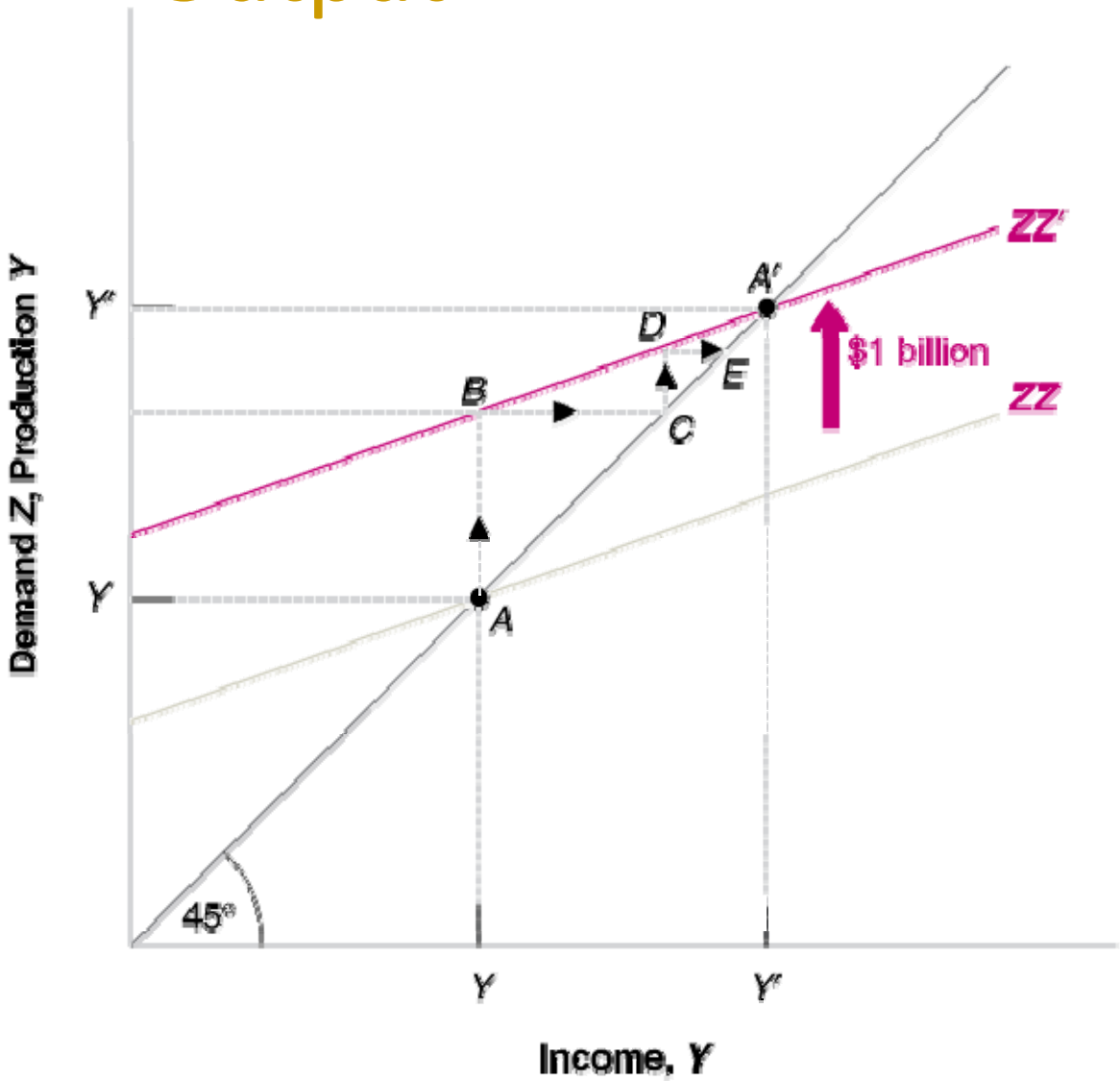
3-3 The Determination of Equilibrium Output

Using a Graph

Figure 3 - 3

The Effects of an Increase in Autonomous Spending on Output

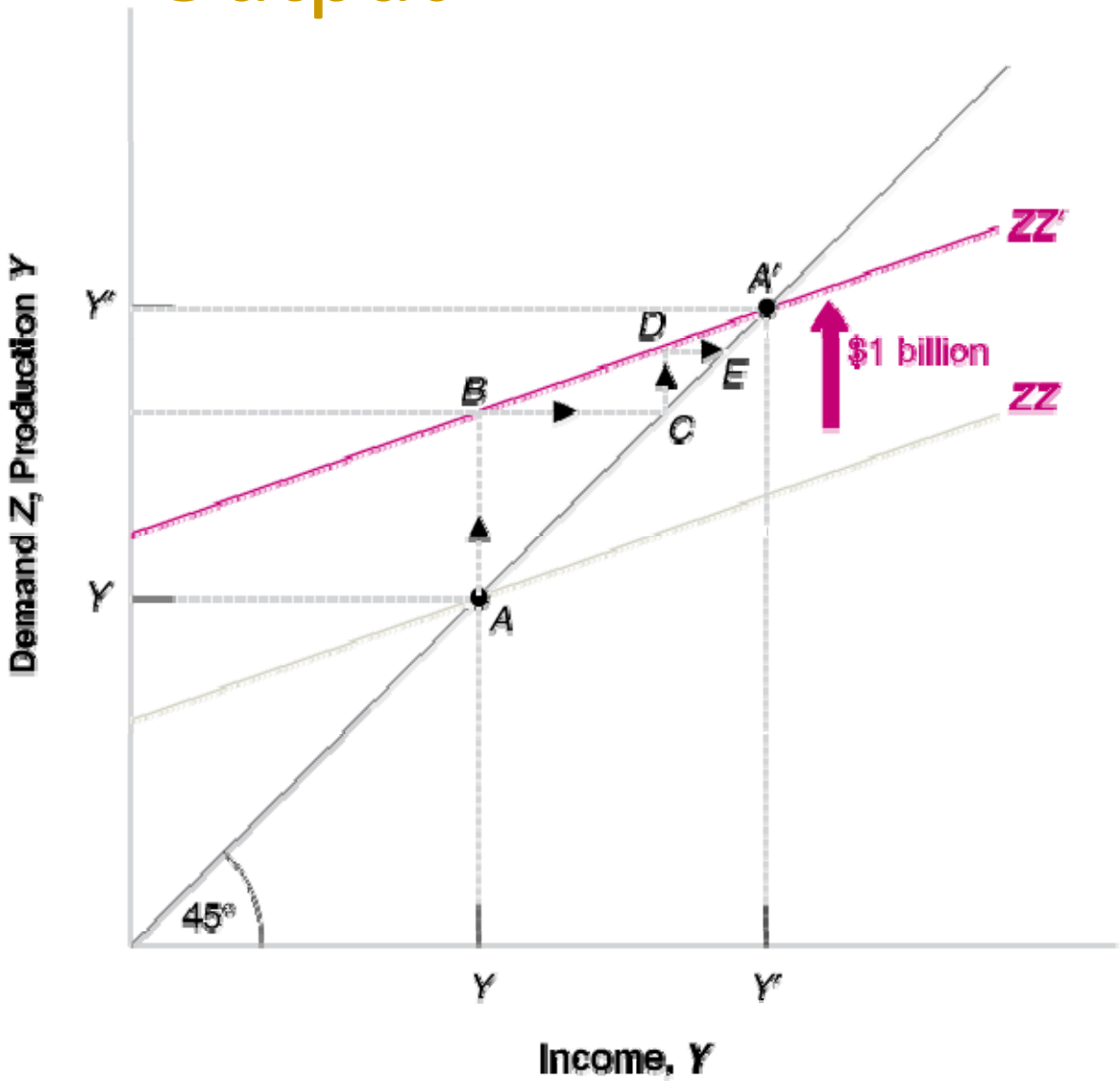
Set $t_1 = 0$ An increase in autonomous spending has a more than one- for-one effect on equilibrium output.



3-3 The Determination of Equilibrium Output

Using a Graph

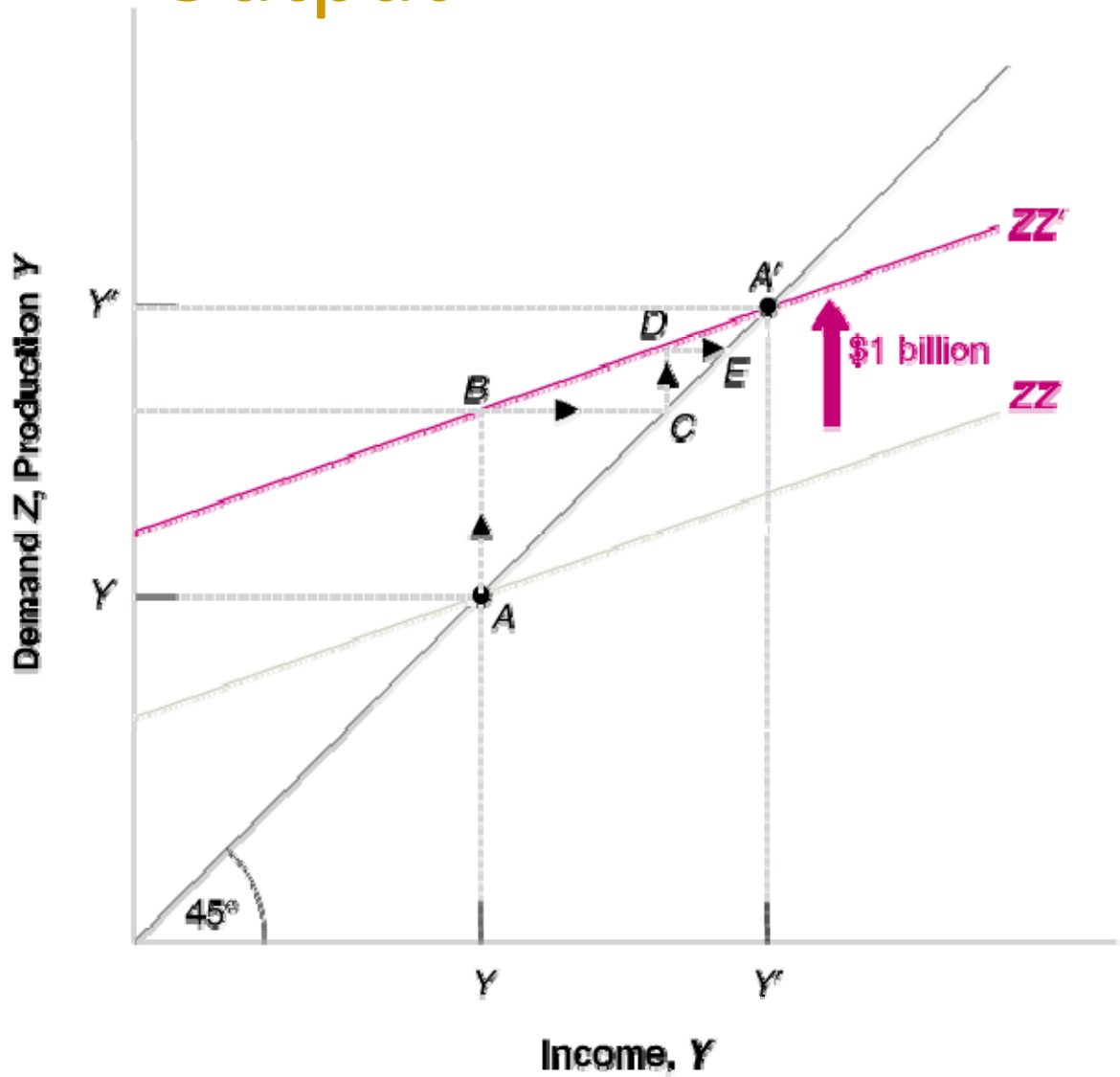
- The first-round increase in demand, shown by the distance *AB* equals $1 billion.
- This first-round increase in demand leads to an equal increase in production, or $1 billion, which is also shown by the distance in *AB.*
- This first-round increase in production leads to an equal increase in income, shown by the distance in *BC*, also equal to $1 billion.



3-3 The Determination of Equilibrium Output

Using a Graph

- The second-round increase in demand, shown by the distance in *CD*, equals $1 billion times the propensity to consume.
- This second-round increase in demand leads to an equal increase in production, also shown by the distance *DC*, and thus an equal increase in income, shown by the distance *DE.*
- The third-round increase in demand equals $\$c_1$ *billion, times* c_1*, the marginal propensity to consume; it is equal to* $\$c_1 \times c_1 = \$\ c_1^2$*billion.*



3-3 The Determination of Equilibrium Output

Using a Graph

- Following this logic, the total increase in production after, say, n + 1 rounds, equals $1 billion multiplied by the sum:

- $1 + c_1 + c_1^2 + \ldots + c_1^n$

- Such a sum is called a geometric series.

Change in Equilibrium: Total Differentials

$$Y_0 = \bar{\gamma}\Lambda_0 \qquad \bar{\gamma} = \frac{1}{[1 - c_1(1 - t_1)]}$$

$$\Lambda_0 \equiv c_0 - c_1(t_0) + b_0 + GO_o$$

$$\Delta Y = \bar{\gamma}\Delta\Lambda$$

$$\Delta Y = \bar{\gamma}[\cancel{\Delta a_0} - c_1\cancel{\Delta t_0} + \cancel{\Delta b_0} + \Delta GO]$$

$$\boxed{\Delta Y = \bar{\gamma}\Delta GO}$$

3-3 The Determination of Equilibrium Output

Using Words

- To summarize:
  - An increase in demand leads to an increase in production and a corresponding increase in income. The end result is an increase in output that is larger than the initial shift in demand, by a factor equal to the multiplier. To estimate the value of the multiplier, and more generally, to estimate behavioral equations and their parameters, economists use **econometrics**—a set of statistical methods used in economics.

3-3 The Determination of Equilibrium Output

How Long Does It Take for Output to Adjust?

- Describing formally the adjustment of output over time is what economists call the dynamics of adjustment.
  - Suppose that firms make decisions about their production levels at the beginning of each quarter.
  - Now suppose consumers decide to spend more, that they increase c_0..
  - Having observed an increase in demand, firms are likely to set a higher level of production in the following quarter.
  - In response to an increase in consumer spending, output does not jump to the new equilibrium, but rather increases over time.

3-4 Investment Equals Saving: An Alternative Way of Thinking

$$S \equiv Y_D - C \equiv Y - T - C$$

$$Y \equiv C + I + G$$

$$Y - T - C \equiv I + G - T$$

$$S \equiv I + G - T \qquad I \equiv S + (T - G)$$

3-4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium

$$I = S + (T - G)$$

The equation above states that equilibrium in the goods market requires that investment equals saving—the sum of private plus public saving.

This equilibrium condition for the goods market is called the **IS relation**. What firms want to invest must be equal to what people and the government want to save.

Investment Equals Saving: An Alternative Way of Thinking

- Consumption and saving decisions are one and the same.

$$S = Y - T - C$$
$$S = Y - T - c_0 - c_1(Y - T)$$
$$S = -c_0 + (1 - c_1)(Y - T)$$

- The term (**1–c_1**) is called the **propensity to save.** In equilibrium

$$I = -c_0 + (1 - c_1)(Y - T) + (T - G)$$

Rearranging terms, we get the same result as before:

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

"The Paradox of Thrift"

- Set government to zero (no G, no T):

$$S \equiv Y - C = Y - (c_0 + c_1 Y)$$

$$\Delta S = \Delta Y - \Delta c_0 - c_1 \Delta Y = -\Delta c_0 + (1 - c_1)\Delta Y$$

$$\Delta Y = \bar{\gamma} \Delta c_0 \qquad \Delta S = -\Delta c_0 + (1 - c_1)\bar{\gamma}\Delta c_0$$

$$\bar{\gamma} = \frac{1}{[1 - c_1]} \qquad \boxed{\Delta S = -\Delta c_0 + \Delta c_0 = 0}$$

3-5 Is the Government Omnipotent? A Warning

- Changing government spending or taxes is not always easy.
- The responses of consumption, investment, imports, etc, are hard to assess with much certainty.
- Anticipations are likely to matter.
- Achieving a given level of output can come with unpleasant side effects.
- Budget deficits and public debt may have adverse implications in the long run.