Australian National University

Macroeconomics 1 (ECON1102)

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"Week 7 – Aggregate expenditure in the short run – the AE Model"

Answering macroeconomic questions

- Why are there business cycles?
- How can we lower unemployment?
- What causes inflation and how can it be lessened?
- What is the ‘right’ level of unemployment and inflation?
- These are the types of questions that macroeconomics considers. But how do we answer them?

Short-run macroeconomic models

- Any good economist will respond by saying that we need a model of the short-run macro-economy, i.e. the entire economy operating as a whole. We already have a *long-run model* for that which is the growth model of Solow-Swan.
- But the *short-run economy* can deviate from the long-run economy because of rigidities and uncertainties and other phenomena that occur during a shorter period but which do not generally apply during the long-run, e.g. that all elements of production and consumption will eventually adjust during a very long period but may not be able to do so in a short period.
- So we will now turn to developing and using two interconnected models of the short-run economy. The first is the Aggregate Expenditure Model (AEM) – considered now – and then, building on the AEM as a foundation will be the AD-AS model.

From accounting identity to theory

- We begin with the GDP expenditure accounting identity which says that:

$$\mathbf{Y = C + I + G + NX}$$

- Remember that this identity is true by definition. It has no theoretical power per se.
- However we will go from this identity and turn it into a theoretical construct that can be used as a model to explain and predict what happens in a real economy.
- We do this by reformulating each term above from a conceptual quantity into a phenomenon governed by their own variables and causality.

Theory building step 1: redefining the Y identity into the Aggregate expenditure model - AEM

- Let's convert 'Y' (output measured as GDP) to **Aggregate expenditure (AE):** i.e. a sum of spending by different sectors in the economy. This seems a very cosmetic change and it is perfectly consistent with the accounting identity itself.

- But by redefining Y as AE we are implicitly assuming that the relationship can now causally describe specific flows of resources in a macro-economy for a specific time period. And this leads us to the **Aggregate expenditure model (AEM):** a macroeconomic model that focuses on the short-run relationship between total spending and real GDP.

Theory building step 2: Making simplifying assumptions

So we now have $AE = C + I + G + NX$

We now make some simplifying assumptions, mainly to keep certain things constant so we can focus on the changes we are most interested in. In this case we assume that the *price level is constant for a given AE curve* – more on this later.

Theory building step 3: Defining equilibrium conditions

Since we are going to use this as part of a model for a short-run macro-economy, we also define a macro-equilibrium condition of: AE = Y (Aggregate expenditure = GDP)

The equilibrium condition

- Let's focus on the equilibrium condition a bit more.
- It says that the model (which is part of but not all of the economy – we need to have the AD-AS model for that, which we will get to next week) is in balance whenever total output (Y) is purchased by the sum of all spending groups (AE).
- Very roughly speaking, if AE<Y, then there is excess capacity in the economy, i.e. some output is being produced (or could be produced) for which is there are no buyers. If AE>Y then the economy is economy is effectively working above capacity, i.e. people are willing to buy more output than is available.
- These are very loose intuitions but we are beginning to see the purpose of this model which is to understand how and why an economy might move into states of under- and over-capacity, and how we might move the economy from such states back into balance (AE=Y)

More on equilibrium

- That assumption that there is an equilibrium condition itself implies that the macro-economy is a type of system that tends towards a stable equilibrium.
- Not all systems behave this way and some believe that macro-economies may be in this category, at least at certain times.
- Not stated explicitly but implicit is that idea that the equilibrium condition is ‘optimal’, i.e. the best possible. But this is not always the case.
- The Great Depression could be an example of where a whole economy might stabilize -- but at a very low level and one which should be moved away from.
- Tuck these thoughts away – we will return to them later.

Theory building steps 4 through 6

- Step 4: delineating basic causal relationships for each component (C,I,G,NX)
- Step 5: Further elaborate they way all the components add up to AE
- Step 6: ‘Run’ the AE model and see how it matches with our equilibrium condition.

AE = **C** + I + G + NX

Step 4 – defining causal relationships for each component.

What factors are most critical to affecting C in aggregate?

The five most important variables that help determine the level of consumption will be assumed to be:

- Current disposable income (YD)
- Expected future income
- Household wealth
- The price level
- The (real) interest rate (r)

Dynamics of consumption

- The choice of whether to consume or not (and thus make a consumer expenditure) is actually complex.
- Our model boils this choice down to these five basic factors, each of which have their own dynamics.
- Note that behind this are the neoclassical assumptions of economic agents being rational, maximizing and self-interested.
- These terms have variable definitions but basically consumers can be said to be hard-headed economizers, with no emotional leanings or crazy ideas. (This assumption about consumers is modified to varying degrees by Keynes and others, as we shall see later).

(1) Current disposable income (YD)

- Disposable income (YD) is the amount of money that consumers have available to devote to spending after they have paid their taxes and received transfer payments.
- "Current" refers to the time period under analysis – often the present.
- Of course much spending is unavoidable or *nondiscretionary* – things like rent, basic food requirements etc. – rather than *discretionary* (to use a consumer marketing term) – things like movies, gambling etc.
- Regardless of the type of spending, we can reasonably posit that consumer spending (C) will vary as YD varies. As YD goes up, C will go up. As YD falls, C will fall.

(2) Expected *future* income

- There is YD which is income consumers have *now* and then there is the income consumers expect to have in the *future*.
- If consumers *expect* to have more future YD than they have now, this tends to raise their current spending because they believe they can spend more (save less) now because their available resources will grow later.
- It works the opposite way too. Even with high current YD, consumers may cut back their spending now if they believe that future times will be lean.
- If expected future income is fairly close to current income, then we can probably say that the portion of YD spent will stay fairly stable over time. It is only when expected future income is significantly higher or lower that this stability may not hold.

An aside: Permanent Income Hypothesis (PIH)

- Economists have competing models of consumption/income patterns. Milton Friedman posited the permanent income hypothesis (PIH), i.e. the theory that people will spend money at a level consistent with their expected long term average income. This "permanent" income is what people feel can be safely spent rather than near future periods.
- If the PIH is true then it significantly weakens the impact of both current YD and near-term future expected income on current spending, something that also weakens ‘Keynesian’ spending models (models that Friedman does not believe in).
- [The evidence on the PIH is mixed at best and depends in part on how stable employment and wage patterns are in an economy. It can be hard to predict ‘permanent income’ in a highly casualised economy, for example. Also, it is not always clear that consumers do base current spending off of permanent income even if they have an idea of it.]

(3) Household wealth

- Wealth refers to the accumulation of income in the form of assets of various sorts, financial (e.g. savings deposits) and real (e.g. a home).
- Why does this have an impact on current spending?
- Wealth can be drawn upon to fund spending if need be and, ceteris paribus, higher levels of wealth will make consumers feel more comfortable spending more in a period than lower levels of wealth because of the buffer it provides. This is often referred to as the **'wealth effect'.** (It is distinct from effects on C of future and present *income*).
- The wealth effect depends in part upon the liquidity of the wealth held (a home has to be sold while savings can be immediately spent as needed) and, more importantly, on the permanence of the wealth, especially increases in wealth. So a one-time inheritance is thought to be less likely to increase current consumption than a long-term increase in the interest yield of a bond portfolio.

(4) Price level and (5) real interest rate (r)

- Consumption is also affected, in the short-run, by changes in the overall price level (which is the level of all prices – not individual relative prices; the latter will be moving up and down all the time).
- In the short-run, price level increases have four major '*channels*' that influence spending. (Always remember – this is short- not long-run)
- *(a) price inflation decreases the real value of household wealth*, leading to lowered consumption via the wealth effect.
- *(b) price inflation leads to an increased demand for cash* since rising prices requires more cash on hand for more frequent purchases.
- *(c) real interest rate falls with higher inflation (and falls with lower inflation).* A fall in (r) makes borrowing cheaper and raises debt-financed investment and consumption.
- *(d) domestic inflation will cause changes in international exchange rates and relative world prices and interest rates.* We'll focus on this a bit later.

The consumption function and MPC

- We can formalize our theory using a **consumption function.**
- Like the production function, this refers to the relationship between consumption and disposable income. In a very generic sense this could look like:
- $C = f(DI_{current}, DI_{future}$, wealth, inflation, interest rate).
- But we can assume most everything constant to reduce it to:
- C = f(DI). A very simple form of this, which we will be using, is a linear equation:
- C = A + (MPC * YD) where **marginal propensity to consume (MPC)** is the slope of the consumption function—the change in consumption divided by the change in disposable income.

MPC in detail

$$\text{MPC} = \frac{\text{Change in consumption}}{\text{Change in disposable income}}$$

$$= \frac{\Delta C}{\Delta YD}$$

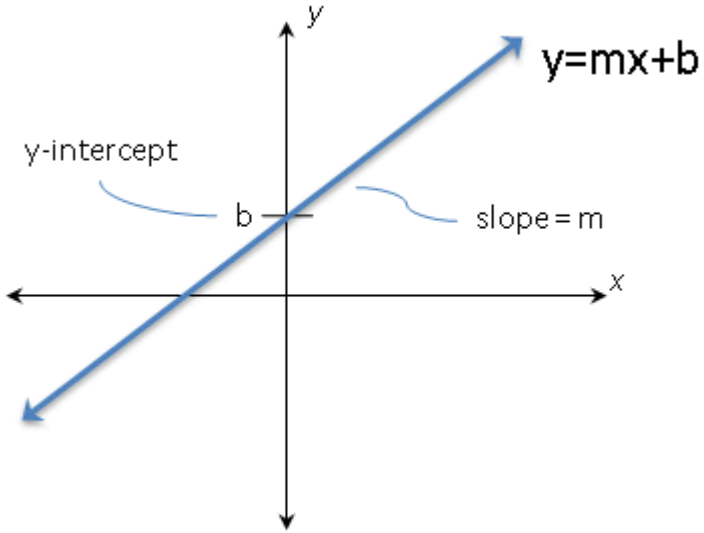
where C = consumption
and YD = disposable (after-tax) income

(and, of course, this is the slope of a line)

So if MPC = 0.9, say, that means 90 cents out of every additional dollar of YD is spent (the remaining 10 cents unspent, or saved.)

The linear consumption function in detail

- C = A + (MPC * YD). (This is a line, either in the form of y=mx+b as shown at right, or equally expressed as y=b+mx – our way of doing it).
- MPC is the slope (m). What's A? (b in the equation at right).
- Algebraically this is the **slope (or y) intercept** of the line.
- Intuitively A refers to **'autonomous' consumption** that occurs regardless of YD. We'll bore into this just a little later but human beings have to consume at least a bit regardless of what income they have – we all have to eat, even if you're broke – and this is 'autonomous'.

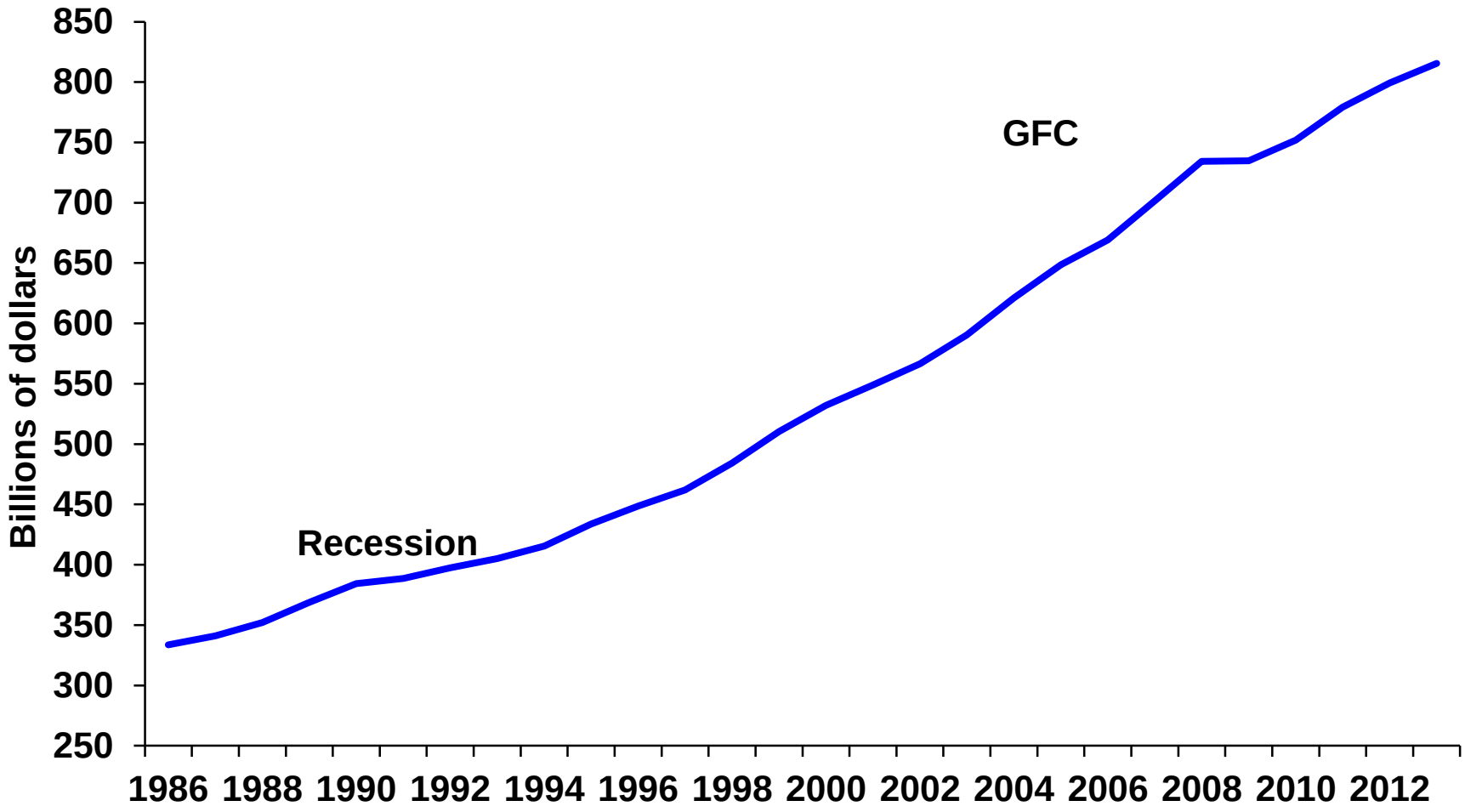


https://faculty.elgin.edu/dkernler/statistics/ch04/4-2.html

Scaling up to the whole economy

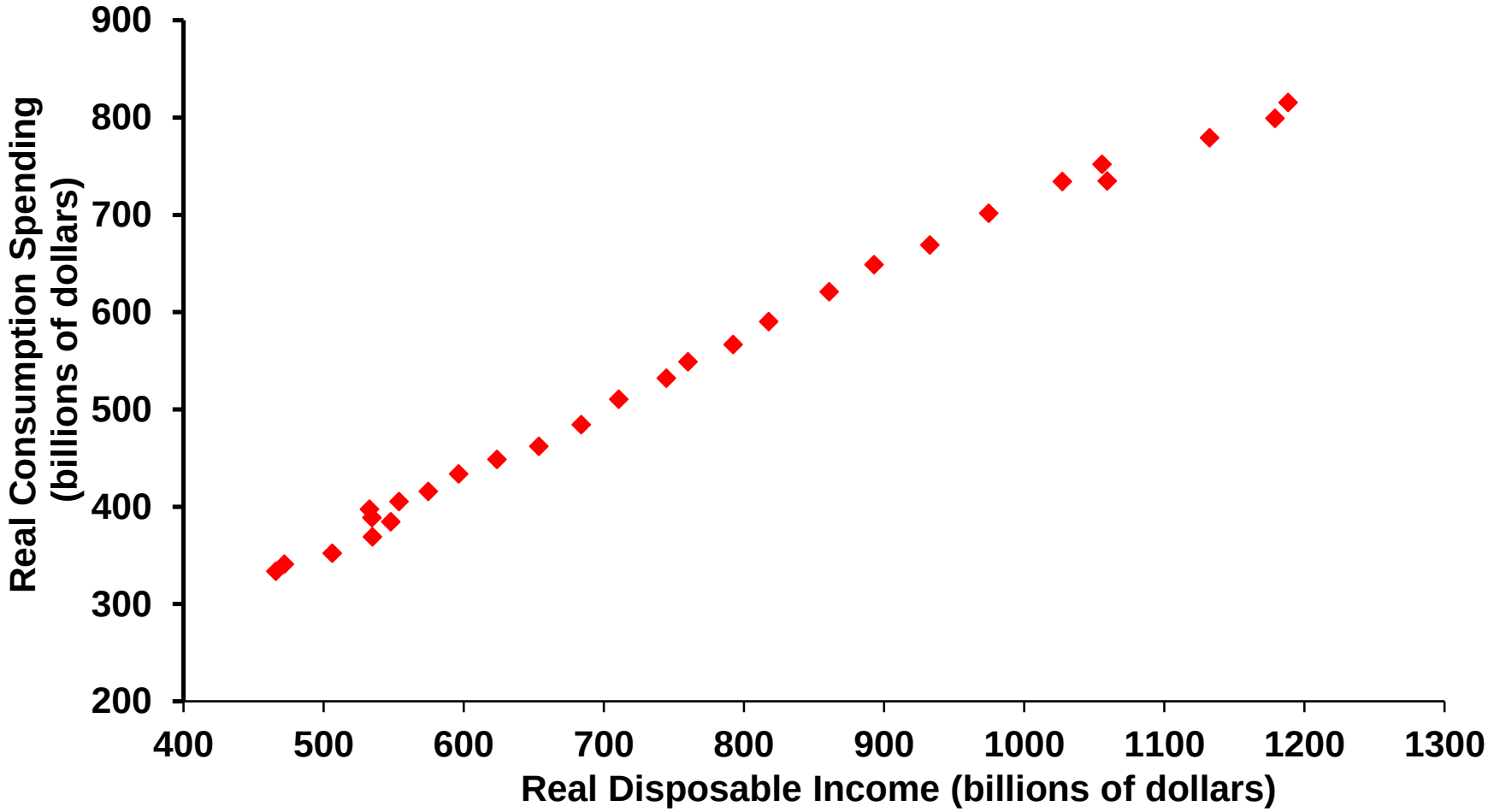
- We have been speaking implicitly about individual consumers thus far. But we really want to analyse the whole economy so we can simply say that the consumption function is a description of all ‘C’ out of ‘Y’.
- To make this possible we assume that all individual consumers are identical and thus we can simply add up all consumers across the economy.
- This is not as extreme a statement as it sounds; *On average*, this may be a decent description since differences between low MPC and high MPC consumers may cancel each other out and the broad data for most countries seem to fit pretty well. As we’ll see later in the course, though, we may have to focus on some of the differences more explicitly.

Real Consumption, Australia, 1986 - 2013



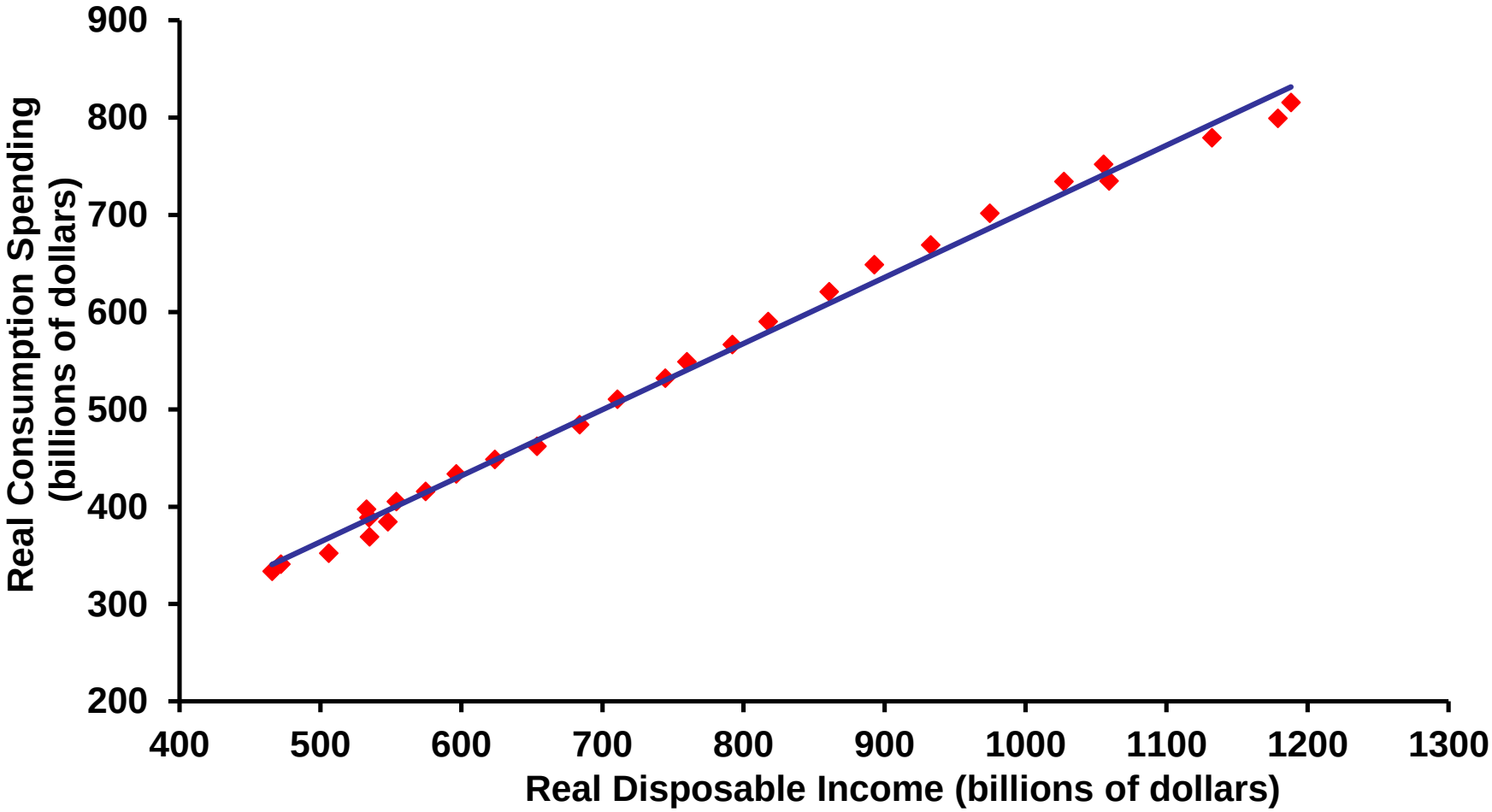
Source: Created from Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure And Product*, Cat. No. 5206.0, Table 8, Time Series Workbook, at <www.abs.gov. au>, viewed 6 January 2014.

The relationship between consumption and income, 1986 - 2013



Source: Created from Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0, Table 1 and Table 8, Time Series Workbooks, at <www. abs.gov.au>, viewed 7 January 2014.

The consumption function: Figure 9.2(b)



Moving from Disposable Income (YD) to National Income (NI)

We do not systematically track YD in the NIA. But we do track **National Income (NI).**

The relationship between YD and NI (simplifying a little bit) is:

- Disposable income (YD) = national income – net taxes

If we set NI = GDP (not strictly accurate but a simplification we can then say:

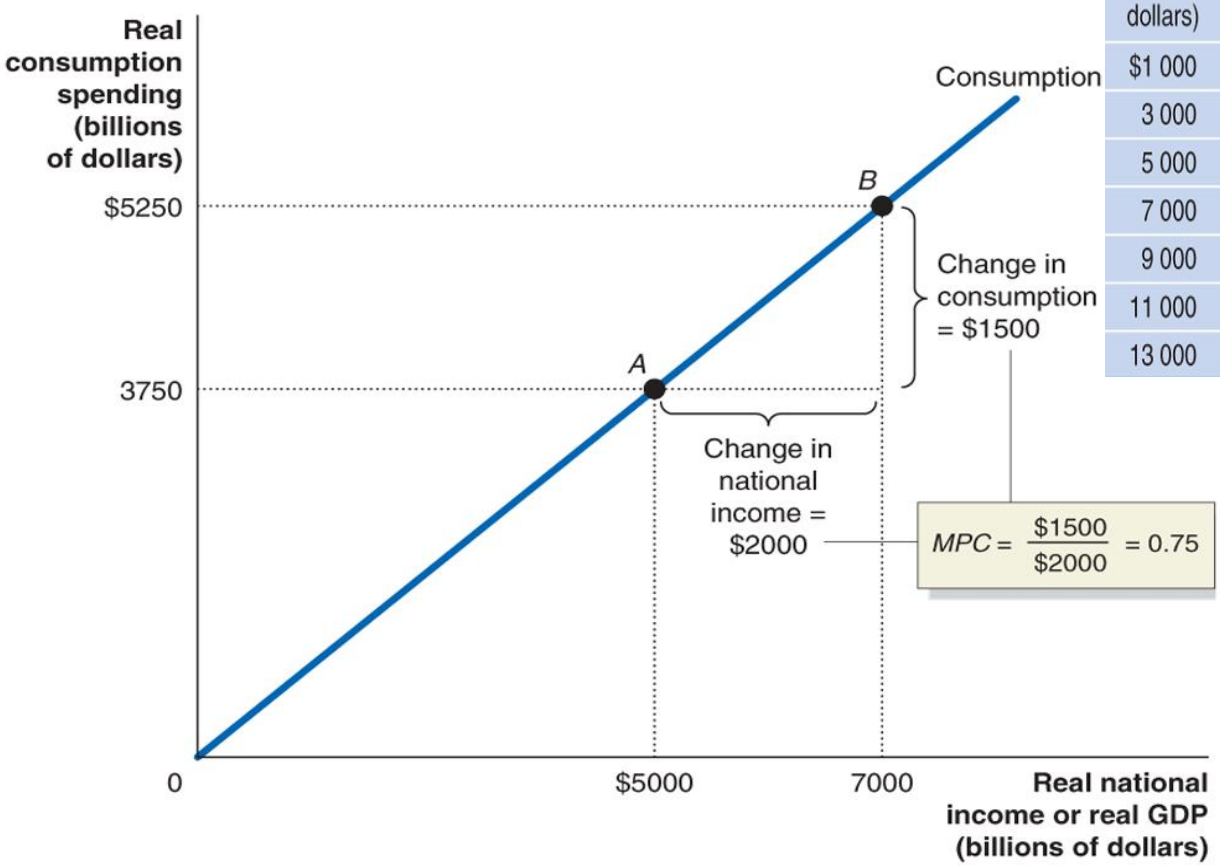
- National income = GDP = disposable income + net taxes

This allows, if we desire, to plug NIA data into our model – though for this class we will not go that far.

A simplifying assumption on taxes

- Because national income differs from disposable income only by net taxes, it would be nice to eliminate the tax term.
- We can do this by *assuming net taxes are a constant amount.* They are not so in actual fact as they vary in part with income, but the overall effect is not too great for our purposes.
- Making this assumption we can then graph the consumption function using national income, from the NIA, rather than some estimate of disposable income. (Though in our exposition we will just use to made-up data).
- We can also calculate the MPC, which is the slope of the consumption function, using either the change in national income or the change in disposable income and always get the same value.

A relationship between consumption and national income



National income or GDP (billions of dollars)	Net taxes (billions of dollars)	Disposable income (billions of dollars)	Consumption (billions of dollars)	Change in national income (billions of dollars)	Change in disposable income (billions of dollars)
$1 000	$1000	$0	$750	—	—
3 000	1000	2 000	2250	2000	2000
5 000	1000	4 000	3750	2000	2000
7 000	1000	6 000	5250	2000	2000
9 000	1000	8 000	6750	2000	2000
11 000	1000	10 000	8250	2000	2000
13 000	1000	12 000	9750	2000	2000

The slope of the consumption function between point A and point B is equal to the change in consumption – $1500 billion- divided by the change in national income – $2000 billion – or 0.75.

AE = C + **I** + G + NX

- Now let's move to modeling the behavior of **I**.
- First we have to determine S – savings – because this determines the amount of money available to I.
  - If Y represents national income (and GDP), C represents consumption, S represents saving and T represents net taxes, we can write: $Y = C + S + T$
  - And changes can be expressed as: $\Delta Y = \Delta C + \Delta S + \Delta T$

To simplify, we can assume that net taxes for business are always a constant amount, in which case the change in net taxes equals zero so that:

$$\Delta Y = \Delta C + \Delta S$$

MPS

- Given this relationship we can now define the **Marginal propensity to save (MPS)** i.e. the change in saving divided by the change in disposable income.

$$\frac{\Delta Y}{\Delta Y} = \frac{\Delta C}{\Delta Y} + \frac{\Delta S}{\Delta Y}$$

And we can further say that:

1 = MPC + MPS

Which is to say each incremental dollar is consumed and whatever is left over is saved.

Scaling up to the whole economy

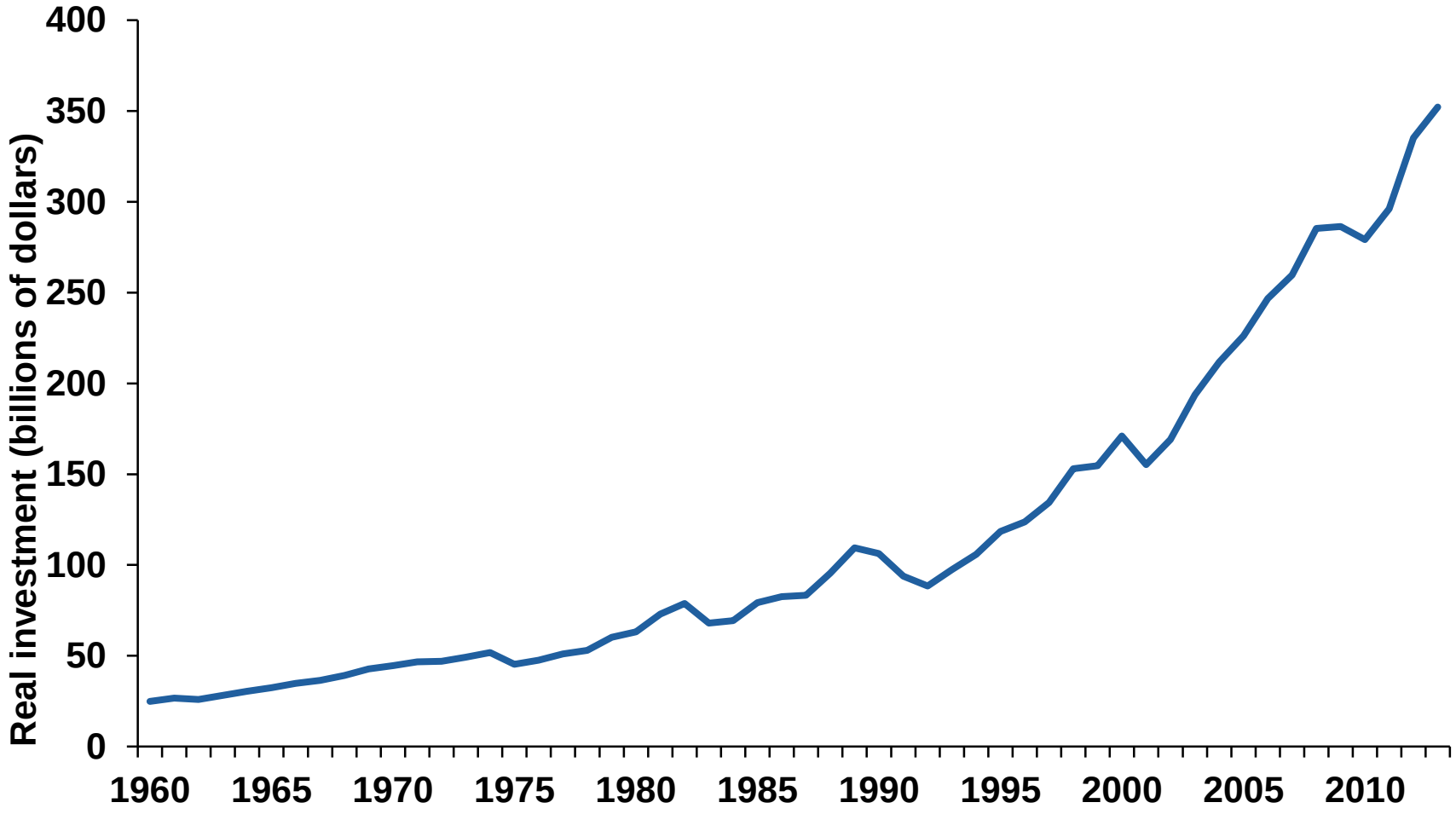
- As with consumption this applies to individual investment decisions. But, as with consumption, we can assert the following relationships to be able to add up all individual investment into a total 'I':

- National income = consumption + saving + net taxes.

- Change in national income = change in consumption + change in saving + change in net taxes.

- And we can drop out the net taxes by assuming they are constant. This again allows us to plug NIA data into our model and then predict relationships, based on those data, between consumption, savings and, hence, investment in aggregate.

Real investment, Australia, 1960 - 2013



Source: Created from Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0, Table 2, Time Series Workbook, at <www.abs.gov.au>, viewed 7 January 2014.

S = I?

- Recalling Solow-Swan we might be tempted to say that we are done with I since in that model all savings (S) are invested in a given period (I) .
- Solow-Swan posits that S=I (all savings are invested) and having described both total (S) and marginal savings behaviours (MPS) we could stop now, it seems.
- However, as with consumption, *in the short-run* there are a number of complications we need to incorporate into the investment decision.
- In other words, investors take a number of factors into account when deciding to invest. All S is available for I but not all is ‘actively’ invested…

Planned v actual investment

- This short-run economic model does not allow for ‘idle funds’ strictly speaking. That is, savings just don’t sit in some corner doing nothing. Businesses do ‘spend’ the excess funds.
- But some investment is planned and the rest is unplanned. The key is **inventories** i.e. goods that have been *produced* but not yet *sold.*
- *Actual investment will equal planned investment only when there is no unplanned change in inventories*. (i.e. $I_{actual} = I_{planned} + I_{unplanned}$)
- So all savings (surplus funds) in this model are converted into some form of business asset but some of these assets during a period may sit idle in the form of unsold inventories.
- E.g. a furniture company may produce 100,000 tables, planning to sell them all but if it only sells 60,000, it will have unplanned inventories of 40,000 tables.

Planned and unplanned inventories

- *Planned inventories* are OK and are part of *planned investment*. Most business require some stock on hand to ensure that they meet demand and not miss out on any sales due to not having stock available for the customer.
- However unplanned inventory holding occurs when planned sales do not materialize. So we can say that:
- *Actual I = Planned I + unplanned change in inventories.*
- If that last term is zero, actual and planned I are equal. But typically there will be some unplanned inventory stock.
- Note: the trend in modern production is to minimize inventory by ‘on-demand’ production.

Just as we did with C, we now turn to the four most important variables that determine the level of planned investment (I):

- (1) Expectations of future profitability
- (2) The real interest rate
- (3) Taxes
- (4) Cash flow
- (5) Price level

(1) Expectations of future profitability

- Like consumers, investors (businesses) operate under uncertainty.
- Thus firms base their current investment spending on what they expect their profitability to be going forward.
- Our model assumes the businesses plan in a rational way, i.e. by forecasting future profits and planning current spending based on objective evidence and inferences from past experience.
- However expectations of profitability can be affected by many things, some of them nonrational (e.g. emotional states such as optimism or pessimism).
- This is a major focus on Keynesian schools of thought, which we'll focus on later. Keynes himself referred to nonrational business decisions as 'animal spirits'.

(2) The real interest rate (r)

- The cost of money – the real interest rate – also affects current investment decisions.
- This is true for consumers as well but is especially important for business since debt finance is generally much more used in that sector (remember the loanable funds model).
- Of course the key is the real interest rate (r) – adjusted for inflation – rather than the nominal interest rate (i).
- Real interest rates r and I are inversely related: as r rises, I falls, ceteris paribus.
- Keynes has a lot to say about this relationship too.

(3) Taxes

- Investment behaviour is also affected by taxes.
- A company income tax takes money from a firm's bottom line and raises the required return they must earn on any investment, generally discouraging investment.
- There are also tax incentives that encourage investment.
- Generally firms must have a rate of return on their invested capital that at least equals the after-tax cost of their capital.
- As tax (T) rises, after-tax real rates rise by T and ceteris paribus this causes businesses to invest less.

(4) Cash flow

- Cash flow = cash income – cash outflow.
- Very simply we can say that for firms:
- Profit = Total Revenues – Total Costs
- (i.e. PR = TR – TC)
- If these are all in cash then we can estimate net cash flows.
- Cash is important because it represents liquid funds that firms can use to fund I. The less cash there is the less I there is.
- Note that in practice firm cash management is much more subtle. But simplicity will serve our purposes fine.

$$r_t = i_t - E_t \pi_{t+1}$$

ex ante (i.e. expected) real interest rate

nominal interest rate

expected inflation rate

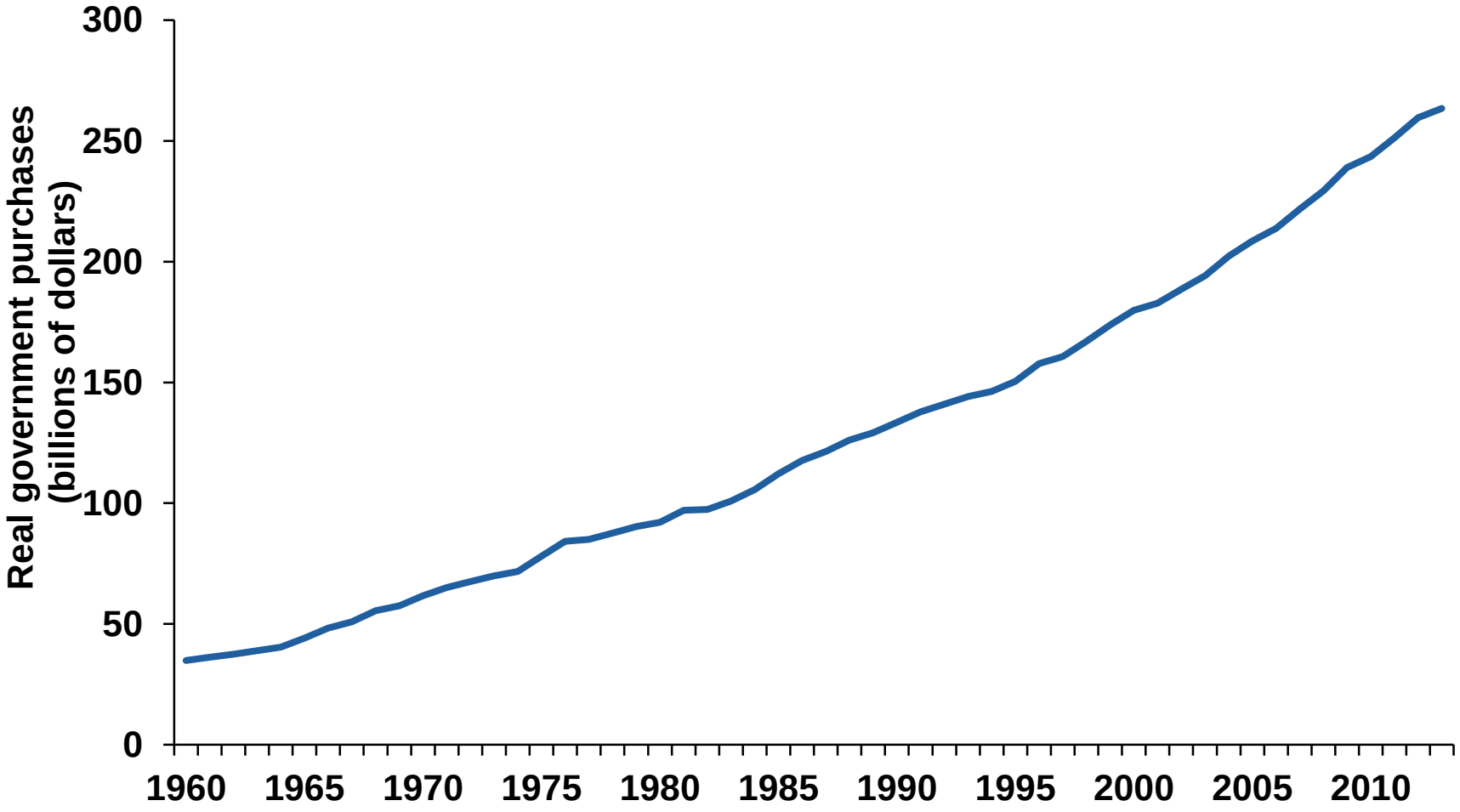
(5) Price level

- As with consumption, the price level affects business investment too. So r may adjust for 'real' economic reasons, through the loanable funds market, and this has an impact on I. But r may also adjust in the short-run purely due to changes in price level (inflation) and this has the same effect on I (e.g. r falls, I rises) but through a different channel, i.e. the effect of inflation on the real rate, ceteris parabus.
- I is also affected, as with C, the increased need for holding cash – i.e. greater inflation requires more frequent purchases which requires more money held in cash rather than invested.
- Changes in domestic price levels relative to world price levels and exchange rates also affect I. These effects we will consider in more detail later.
- [Note that we don't really posit a 'wealth effect' for I like there is for C since business assets are all devoted to making a profit and it is profitability and return on investment that drives I decisions.
- In other words an independent wealth effect is not present for I as it is for C.]

AE = C + I + **G** + NX

- Now let's turn to G: government purchases.
- As with the National Income Accounts, we do not double-count transfers (e.g. pensions, unemployment benefits) but simply count net purchases by government.
- All spending by federal, state, territory and local governments is included in net G purchases, e.g. consumption goods, and investment goods such as infrastructure projects.
- Government revenue largely comes from taxes. If a government spends more than it receives in taxes it is running a budget deficit; if it spends less than it receives in taxes it is running a budget surplus.
- We will consider a model of government finance later so we'll put deficit versus surplus spending aside for now.

Real government purchases, Australia, 1960-2013



Source: Created from Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0, Table 2, Time Series Workbook, at <www.abs.gov.au>, viewed 8 January 2014.

AE = C + I + G + **NX**

Finally NX. The three most important variables that determine the level of net exports (NX) (= X-M) are:

- *(1) The price level in Australia relative to the price levels in other countries.* If Australian inflation is lower than in other countries, the Australian price level is falling relative to the price level in the rest of the world, and thus world relative export prices for Australian goods fall and Australian exports rise. Meanwhile foreign imports become more expensive in Australia and they fall, ceteris paribus.
- X rises, M falls and NX rises. The opposite holds when Australian inflation is higher than that prevailing in other countries.

An example of world relative price levels

- Say the world price level and Australia's price level both start out at 100. Let's also say that both the world and Australia have a 3% inflation rate. This means next year, Australia and the world will have a price level of 103.

Australian price level/world price levels →103/103 = 1

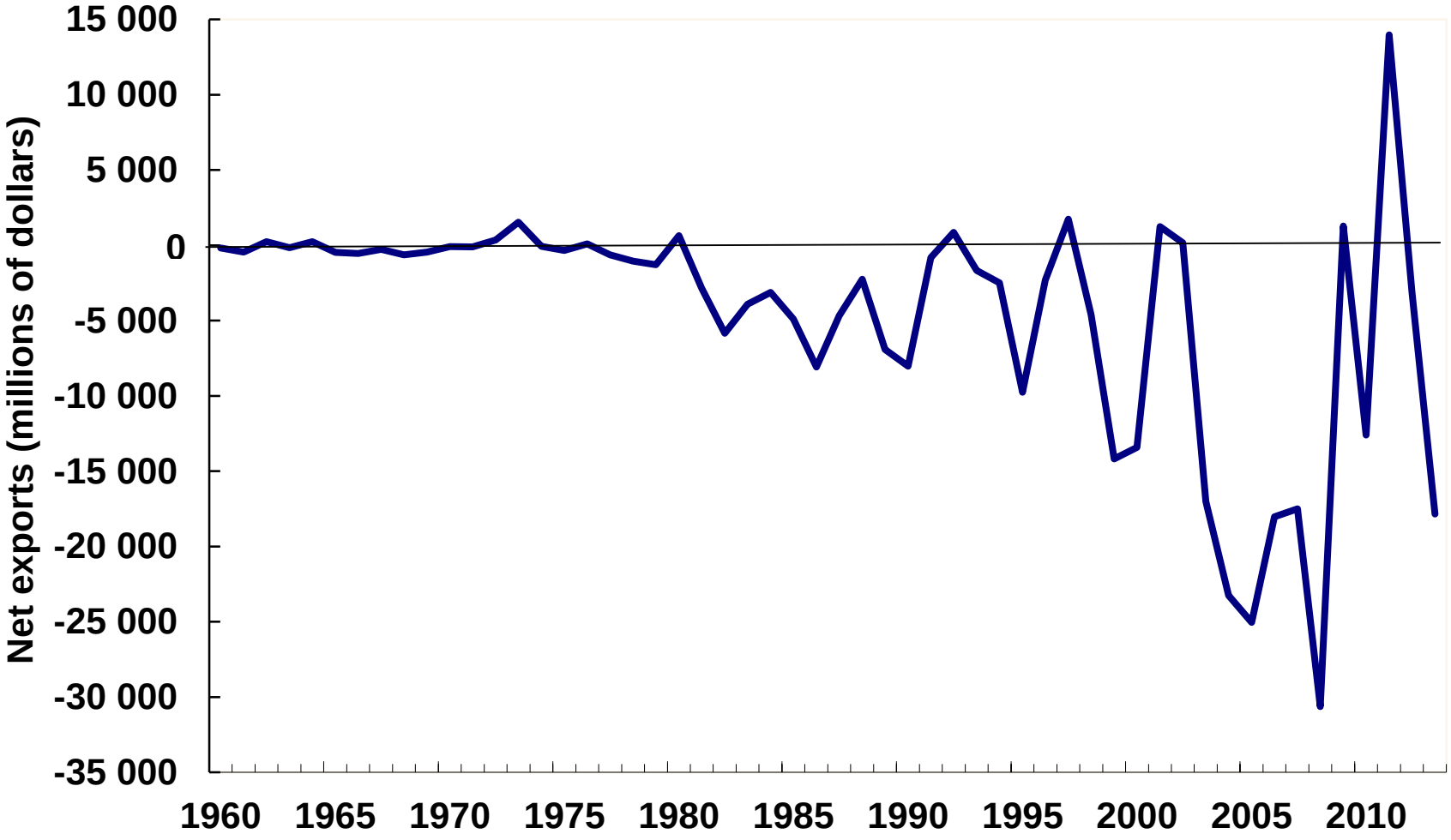
- But now suppose Australian inflation falls to 0% while the world price level continues to rise at 3%. Another year passes and Australia's price level will still be 103 while the world's price level will be 106 (rounded)

Australian price level/world price level → 103/106 = 97 (rounded)

Australian goods are now, in world terms, cheaper.

- *(2) The economic growth rate in Australia relative to the economic growth rates in other countries.* If Australian GDP is growing faster than that of other countries, so is Australian income and ceteris paribus some of that incremental income will be used to buy desired imports. M rises, while X stays the same and NX falls. The opposite holds when Australian growth is lower than other countries.
- *(3) The exchange rate between the dollar and other currencies.* **Exchange rate:** The value of one country's currency in terms of another country's currency. If the Australian dollar rises relative to another country's currency – i.e. **appreciates** – then foreign import prices fall in Australian dollar terms and become cheaper in Australia while Australian products become more expensive in the other country. X falls, M rises and NX falls. The opposite holds with a dollar **depreciation**.

Net exports, Australia, 1960 - 2013



Source : Created from Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0, Table 13, Time Series Workbook, at <www.abs.gov.au>, viewed 8 January 2014.

Components of aggregate expenditure (AE) Australia 2013

Expenditure category	*Expenditure ($ billions) for year 2012/13*	*Percentage (%) of aggregate expenditure*
Consumption	834.43	54.8
Investment	357.12	23.4
Government	342.22	22.5
Net Exports	-10.73	-0.7
Total	1523.04	100.0

Source: Derived from: Australian Bureau of Statistics (2013), *Australian National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0, Table 9, at <www.abs.gov.au>, viewed 7 January 2013.

Solved Problem **1**

The four components of aggregate expenditure

Explain the impact of each of the following changes on the components of aggregate expenditure (AE).

In each case, specify which of the four components of AE will be impacted and explain what happens to AE when:

a) Real interest rates increase.
b) Two of Australia's major trading partners, China and Japan, experience high economic growth relative to Australia.
c) The business sector becomes pessimistic about future profits.
d) Most households believe their income prospects are positive for the foreseeable future.

Solved Problem **1**

- (a) Real interest rates impact both the consumption (C) and investment (I) components of AE
- The higher the real interest rate, the more expensive it is for both firms and households to finance borrowing.
- Households borrow to finance spending on items such as cars and consumer durables (for example, white goods and media systems). A higher interest rate is likely to negatively impact this spending. In addition, the opportunity cost of spending rises as the returns to saving increase.
- Firms typically finance most of their investment through borrowing, hence an increase in the real interest rate will result in a decrease in investment spending.
- Thus C falls, I falls and thus AE falls.

Solved Problem **1**

(b): China and Japan are major consumers of Australia's resources. Economic growth in China and Japan is typically associated with increasing demand from these nations for Australian resources, hence there will be a positive impact on Australia's net exports. NX rises and thus AE rises.

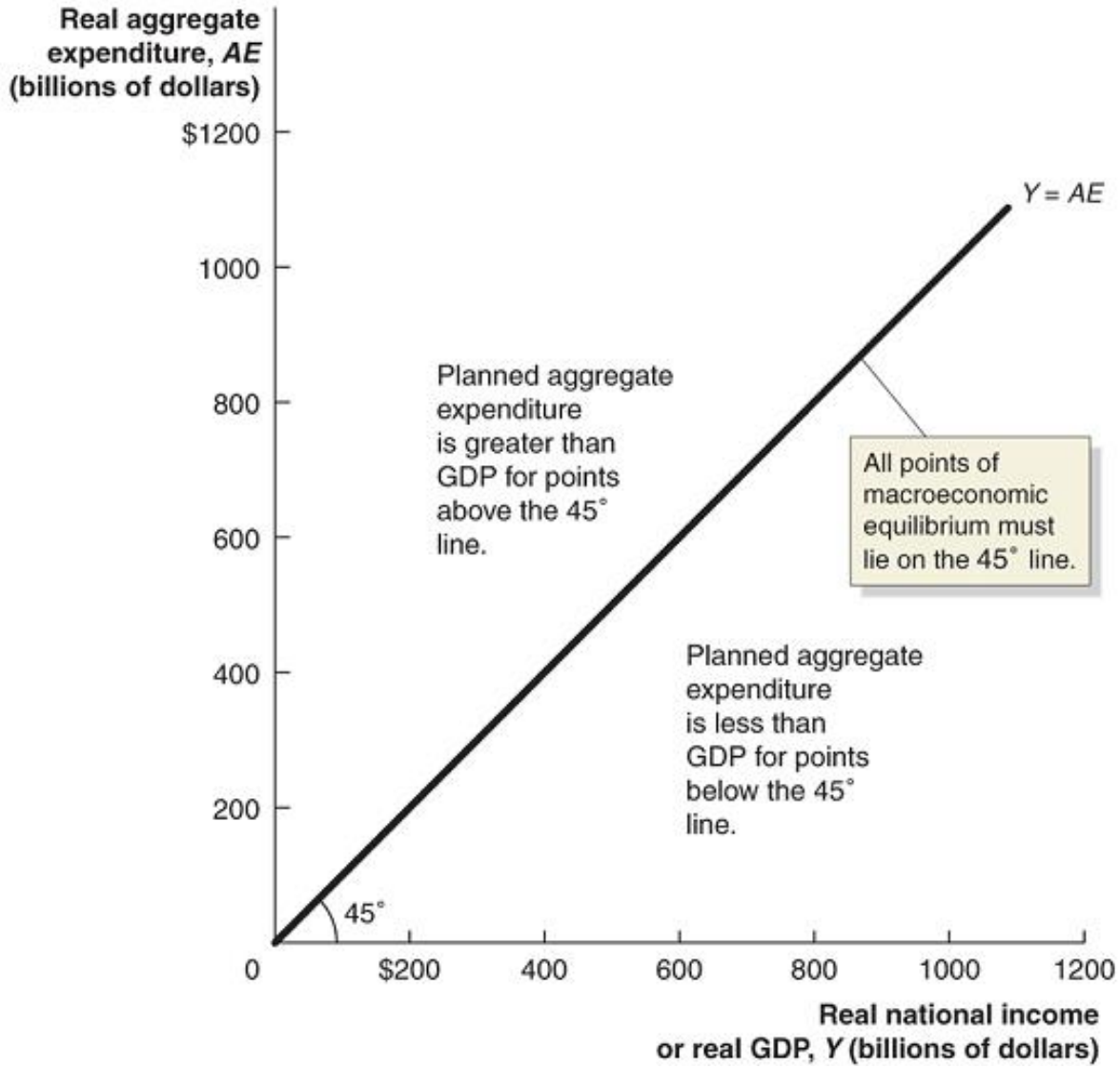
(c): Business sector expectations impact the investment component of AE. If the business sector is pessimistic about future profits, firms will not plan to increase production, hence there is likely to be a negative impact on I. I falls and hence AE falls.

(d): Positive expectations amongst households regarding future income prospects are likely to lead to increased spending in the present. C rises and hence AE rises.

Defining macroeconomic equilibrium

- We now have to consider what puts this system in equilibrium.
- An obvious equilibrium solution condition is the point where total output is equal to total expenditure, (Y=AE) (or NI=AE using NIA data).
- A graph called the *45° line diagram* can be used to illustrate this macroeconomic equilibrium.
- The 45° line measures real national income against planned real aggregate expenditure.
- For this reason sometimes the model is also known as the **Keynesian Cross**.

The relationship between planned aggregate expenditure and GDP on a 45° line diagram



Graphing macroeconomic equilibrium

- All points of macroeconomic equilibrium (as we have defined it) must lie along the 45° line because all along that line AE = Y and that is our equilibrium definition – all output is 'bought' in effect .

- At points above the 45° line, aggregate expenditures are greater than GDP and AE represents 'too many dollars chasing too few goods'. At points below the 45° degree line, aggregate expenditures are less than GDP and there is GDP left over, 'unsold' so to speak.

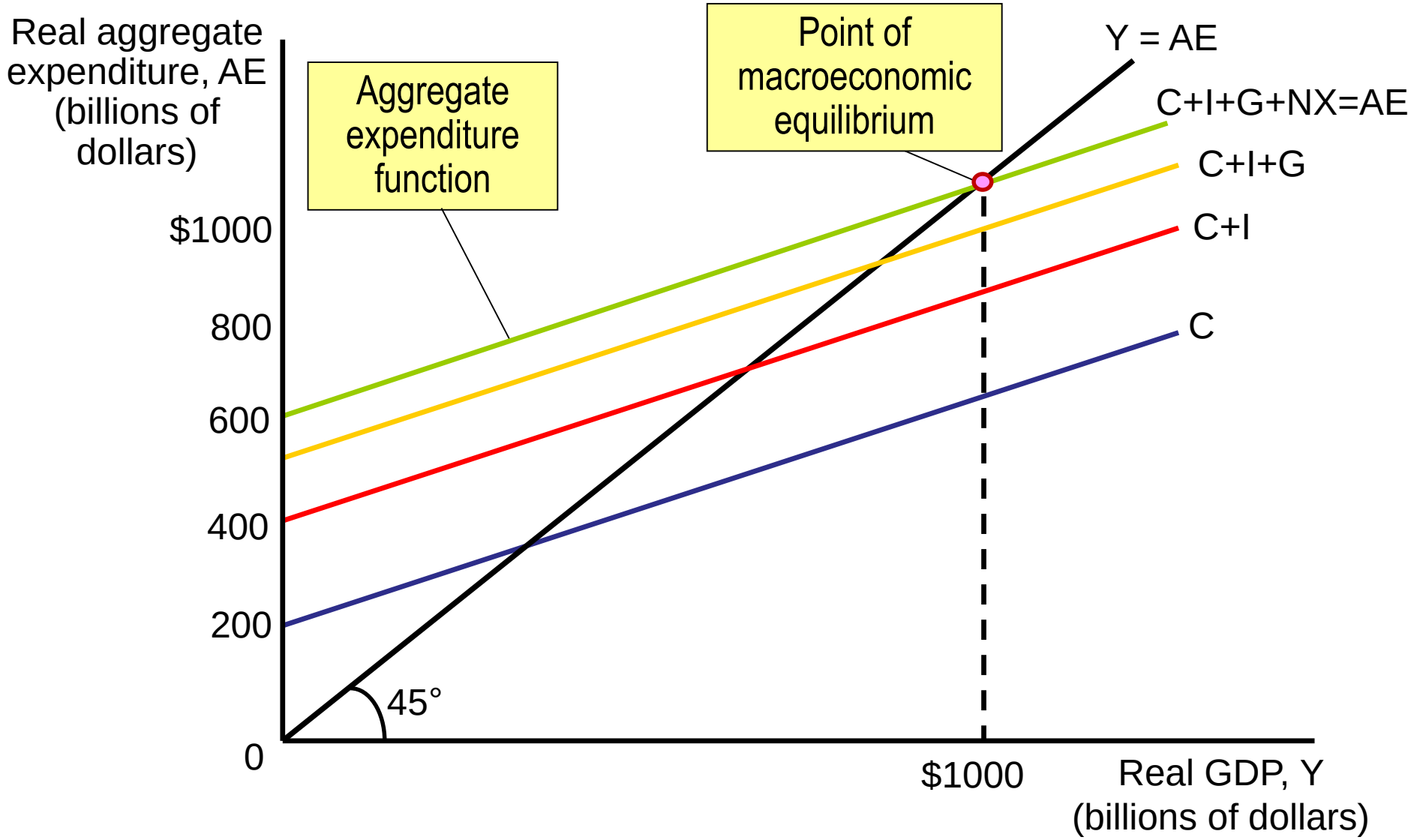
- The key balancing element in the AE model is inventories. Arithmetically it is unplanned inventories that put AE under or over the 45° line. (Our AD-AS model will be more complex).

The relationship between aggregate expenditure and GDP

If…	*Then…*	*And…*
Aggregate expenditure is **equal** to GDP	inventories are **unchanged**	the economy is in **macroeconomic equilibrium.**
Aggregate expenditure is **less** than GDP	inventories **rise**	GDP and employment **decrease.**
Aggregate expenditure is **greater** than GDP	inventories **fall**	GDP and employment **increase.**

- Now let's add AE to this graph.
- The quantities of planned investment, government purchases and net exports are constant because by using a linear form we assumed that the variables they depend on are constant. (We can, of course, use more complex forms but will keep it simple here).
- So, the total of planned aggregate expenditure at any level of GDP is just the amount of consumption at that level of GDP plus the sum of the constant amounts of planned investment, government purchases and net exports.
- We successively add each component of spending to the consumption function line to arrive at the line representing aggregate expenditure and there we find the equilibrium of AE = Y (in this case $1000).

Macroeconomic equilibrium on the 45° line diagram



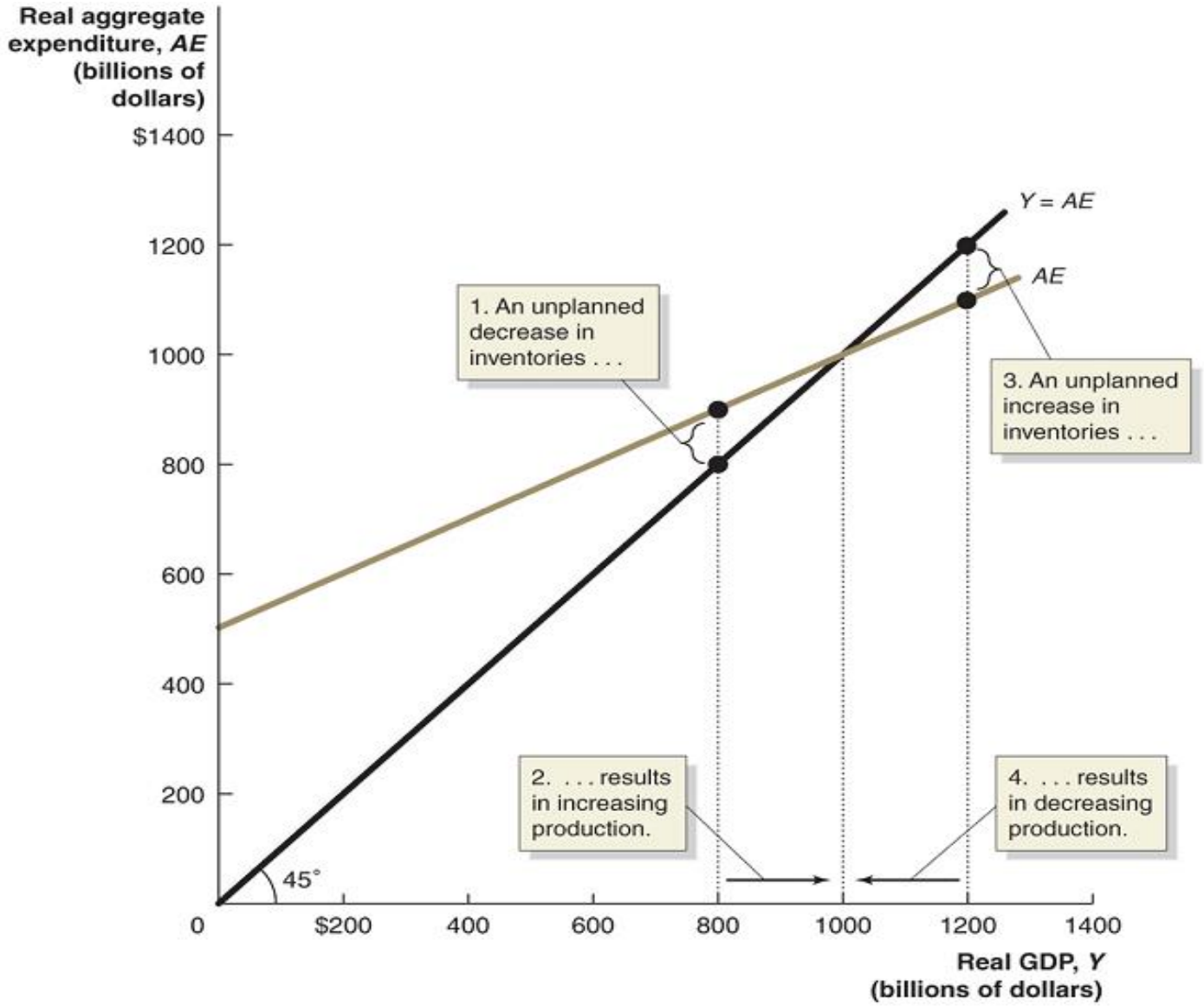
- Macroeconomic equilibrium overall occurs where the AE line crosses the 45° line. In this case, that occurs at a GDP of $1000 billion.
- If GDP is less than $1000 billion, the corresponding point on the AE line is above the 45° line, planned aggregate expenditure is greater than total production, firms will experience an unplanned decrease in inventories and GDP will increase.
- If GDP is greater than $1000 billion, the corresponding point on the AE line is below the 45° line, planned aggregate expenditure is less than total production, firms will experience an unplanned increase in inventories and GDP will decrease.

Investment

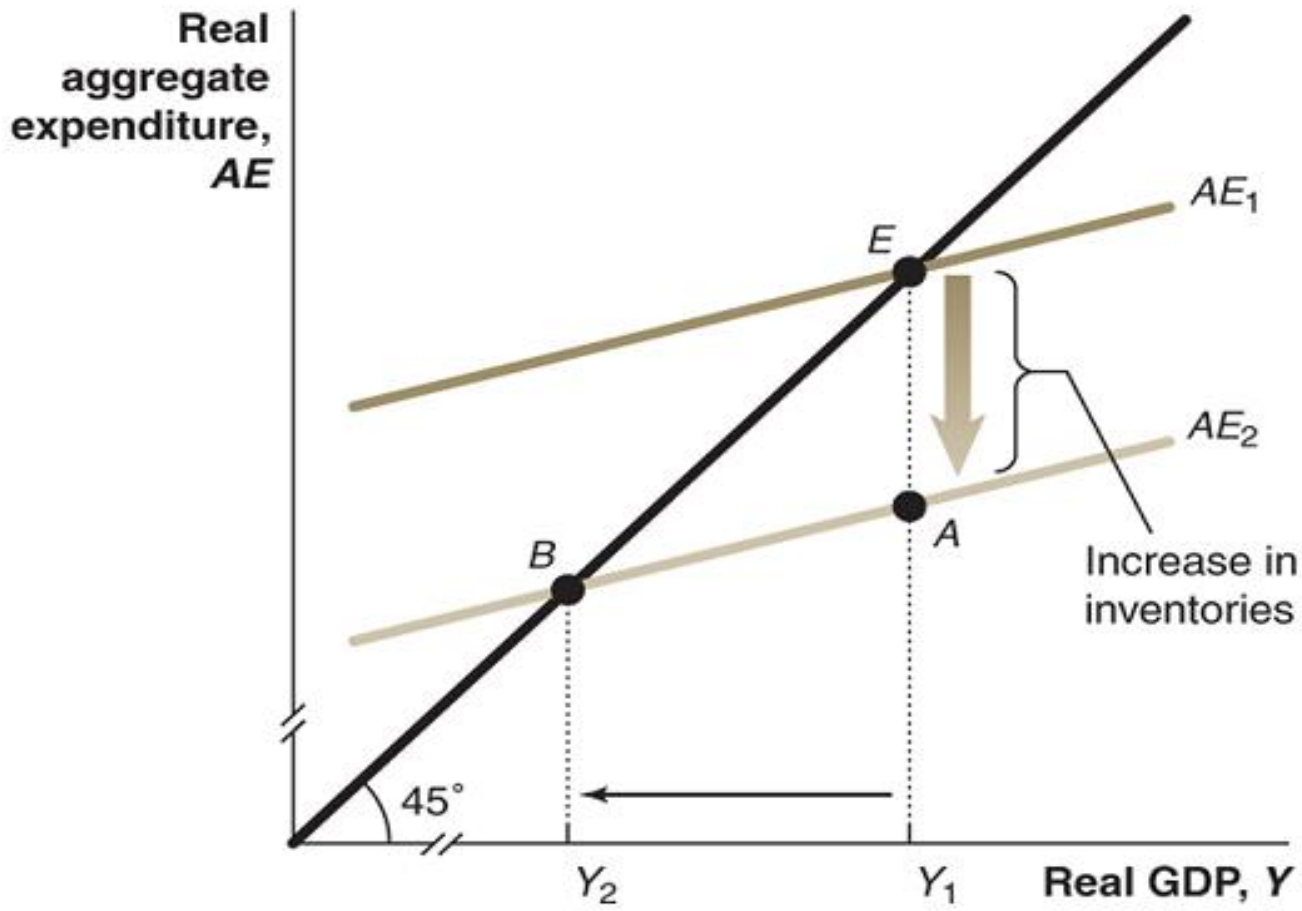
- In this simple model, I, while not the largest of AE components, is nonetheless critical to equilibrating the overall economy because inventories are a pivot point and of course these are determined by overall I levels. (As we said earlier there are no ‘idle’ funds but in disequilibrium we will have unplanned investment in the form of inventories).

- At points *above* the 45° line, planned aggregate expenditures are greater than GDP, so inventories will *fall*, leading to an increase in production and hence I. At points *below* the 45° degree line, planned aggregate expenditures are less than GDP, firms will experience an unplanned *increase* in inventories, leading to a decrease in production and hence I.

Macroeconomic equilibrium

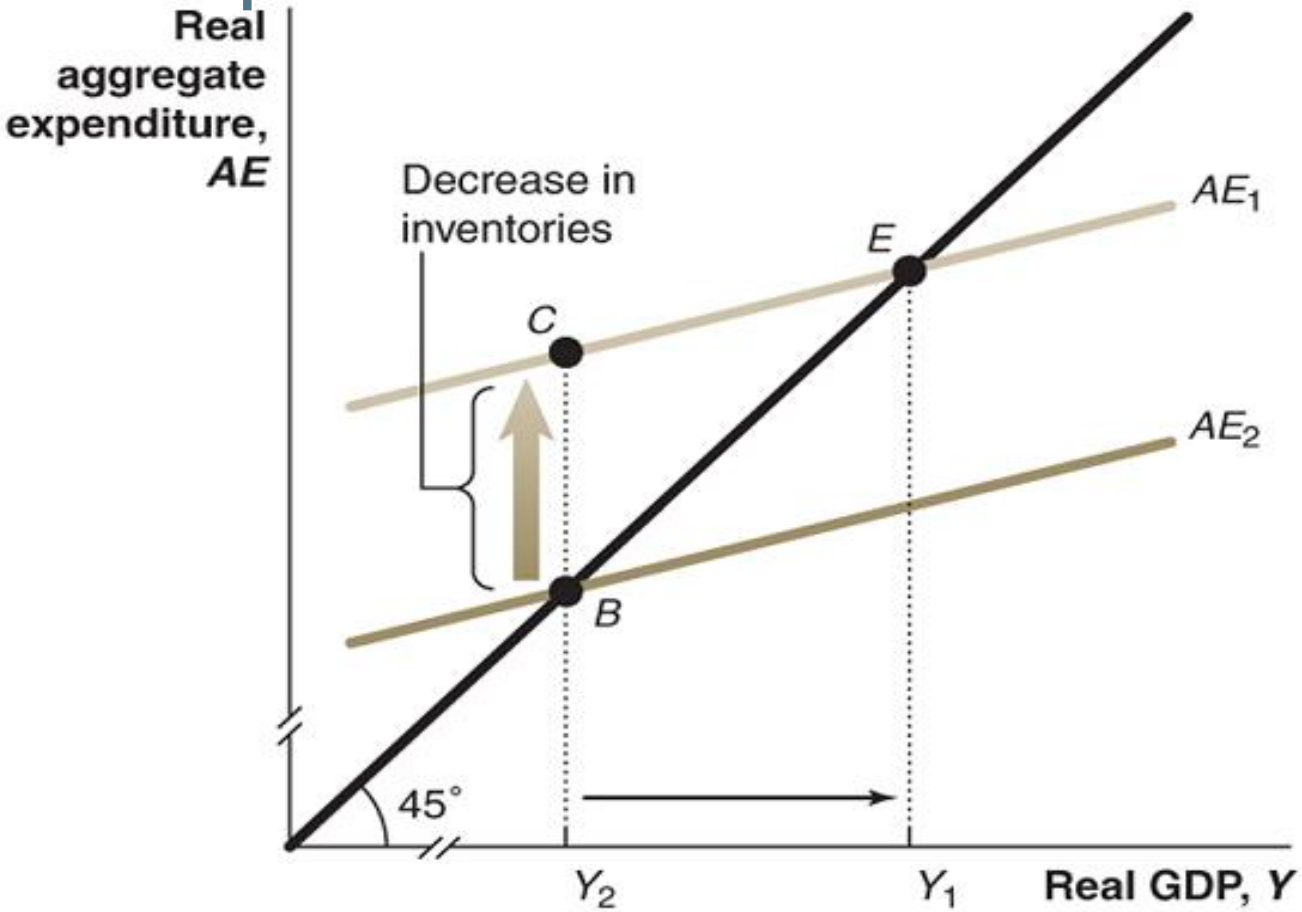


A comparative static: a fall in AE



A decrease in aggregate expenditure causes a decrease in GDP.

A comparative static: a rise in AE



An increase in aggregate expenditure causes an increase in GDP.

Inventories and business cycles

- Whenever aggregate expenditure is less than real GDP, some firms will experience an unplanned increase in inventories. So in recessions, inventories tend to rise.

- When the economy is experiencing a recession the shortfall in aggregate expenditure is equal to the unplanned increase in inventories. Inventories, of course, tend to fall in expansions.

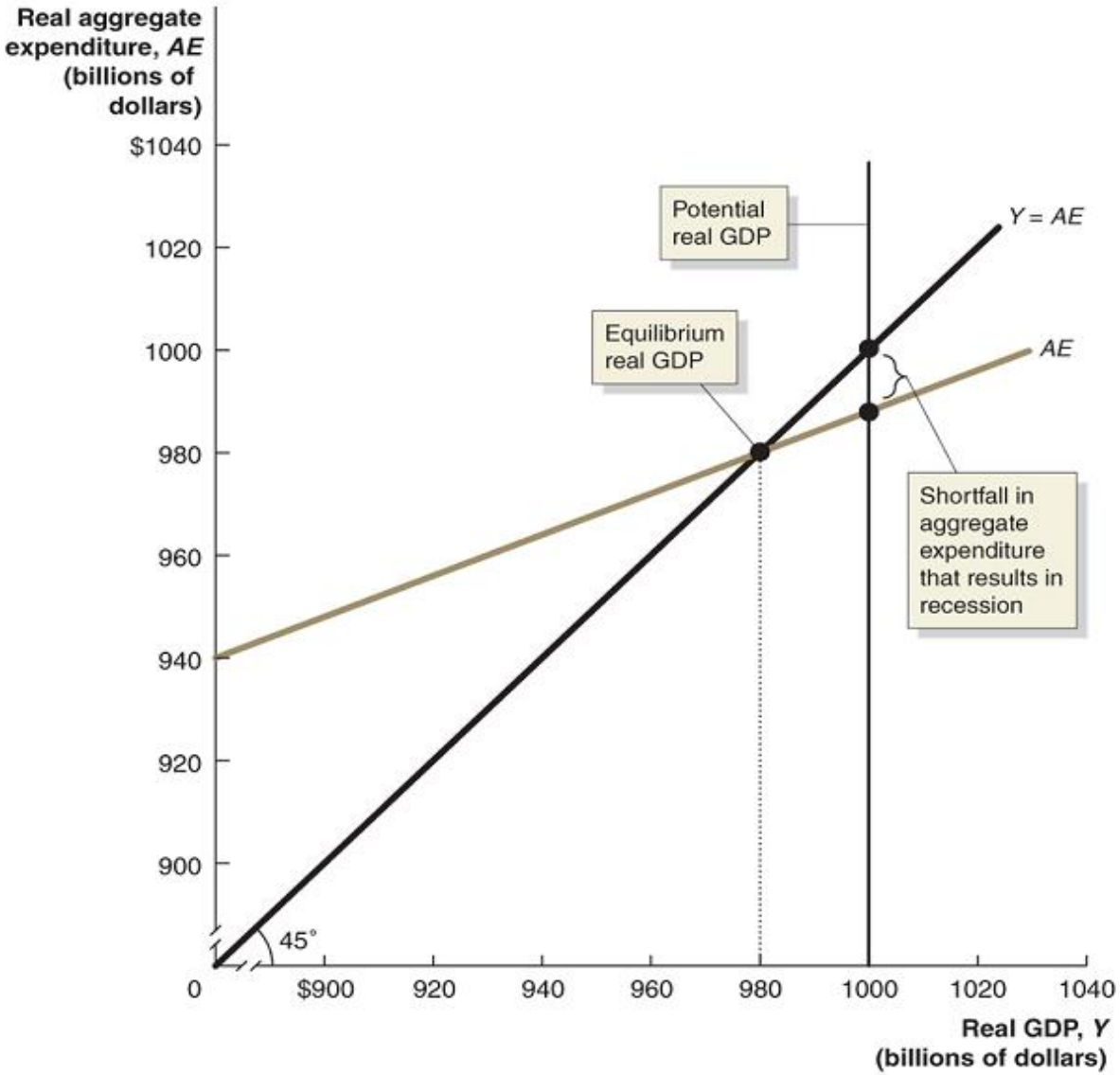
- We can look at inventories causally too, i.e ‘excess’ inventories tend to drag the economy down, while ‘deficient’ inventories tend to drag the economy up. Why? I will remain low until firms ‘work off’ their excess inventories, with the reverse holding if they need to build up stock.

Depicting business cycles using the 45° line diagram

- Macroeconomic equilibrium can occur at any point on the 45° line. Where AE= potential GDP the economy is in macroeconomic balance. We can add to this diagram a vertical line indicating potential real GDP allowing us to indicate how this relates to overall economic capacity.

- If there is insufficient aggregate spending (AE), equilibrium will occur below potential GDP: the economy will be in a contraction or recession. If total AE is above potential GDP then the economy will be in a boom, or ‘overheated’. Either way the result will be a business cycle, up or down, lasting until equilibrium is restored.

Showing a recession on the 45° line diagram



- When the aggregate expenditure line intersects the 45° line at a level of GDP below potential GDP, the economy is in recession.
- The figure shows potential GDP is $1000 billion, but because planned aggregate expenditure is too low, the equilibrium level of GDP is only $980 billion, where the AE line intersects the 45° line.
- As a result, some firms will be operating below their normal capacity and unemployment will be above the natural rate of unemployment. We can measure the shortfall in planned aggregate expenditure as the vertical distance between the AE line and the 45° line at the level of potential GDP.

Macroeconomic equilibrium (billions of dollars)

REAL GDP (*Y*)	CONSUMPTION (*C*)	PLANNED INVESTMENT (*I*)	GOVERNMENT PURCHASES (*G*)	NET EXPORTS (*NX*)	PLANNED AGGREGATE EXPENDITURE (*AE*)	UNPLANNED CHANGE IN INVENTORIES	REAL GDP WILL …
$8 000	$6200	$1500	$1500	–$500	$8 700	–$700	increase
9 000	6850	1500	1500	–500	9 350	–350	increase
10 000	7500	1500	1500	–500	10 000	0	be in equilibrium
11 000	8150	1500	1500	–500	10 650	+350	decrease
12 000	8800	1500	1500	–500	11 300	+700	decrease

Two-way causality

- The AE model is very simple and the direction of causality is not clear. Do inventories cause business cycles or the other way around?
- Our comparative statics suggest that a change in AE lowers Y. But it could also be the case that changes in Y lower AE. This is what causal direction refers to, i.e. determining what comes first as cause and what follows as effect. Our model is more mechanical than explanatory and can go either way – or both ways.
- The more complete AD-AS model we will build next week will have much more causality built into it and we will use it to properly analyze short-run business cycles.
- The AE model is the foundation for the AD-AS model.

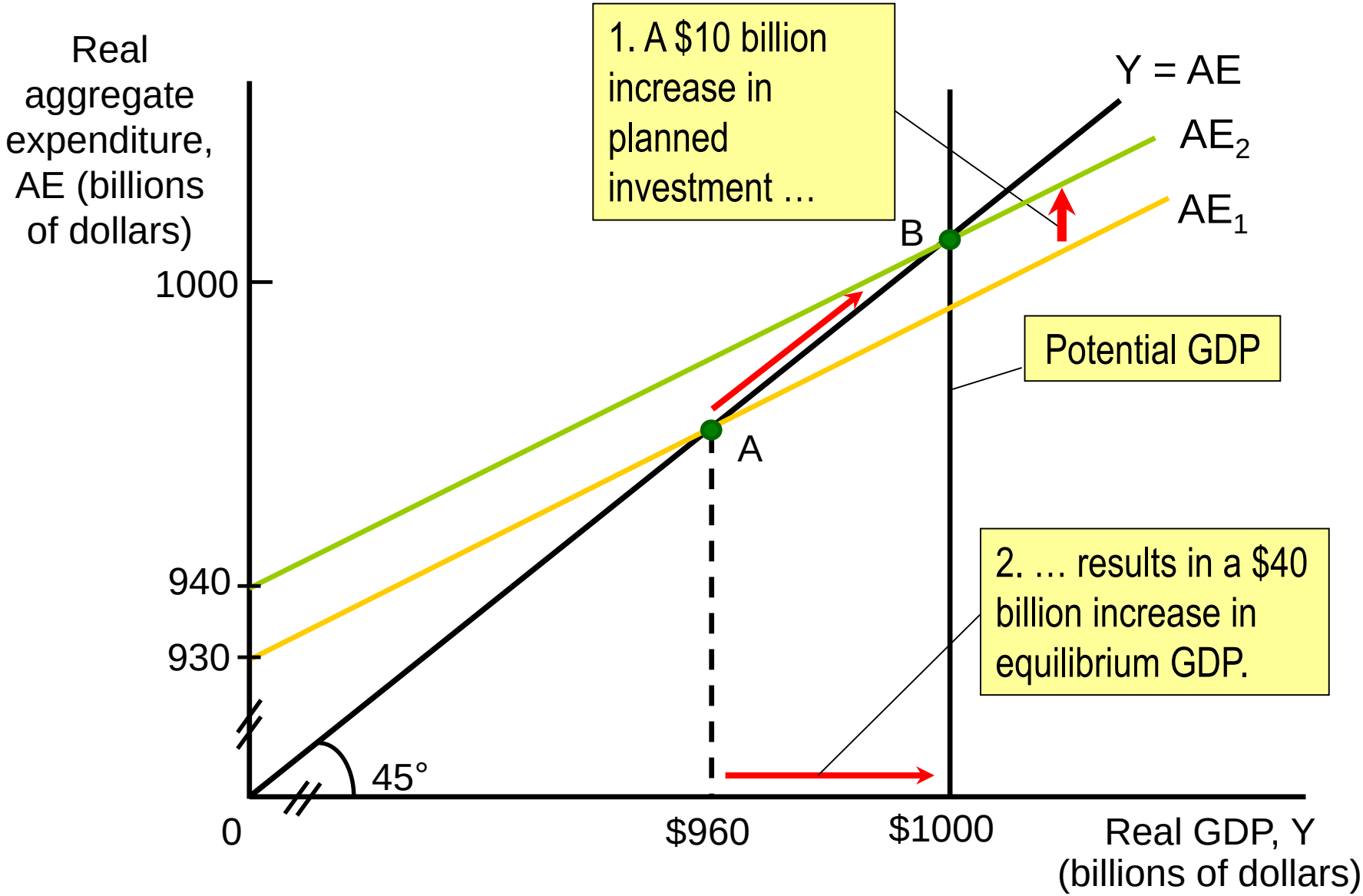
Autonomous v induced consumption

- Let's focus back on C. Because C is so big relative to the other components changes in GDP have a much greater impact on consumption than on planned investment, government purchases or net exports. The consumption function intersects the vertical axis – its y intercept -- at a point above zero due to autonomous consumption. Some definitions:
- **Autonomous consumption:** Consumption that is independent of income (and the intercept term for a linear equation).
- **Induced consumption:** Consumption that is determined by the level of income (and the slope of the line).

The multiplier effect

- **Autonomous expenditure:** Expenditure that does not depend on the level of GDP.
- **Induced expenditure:** Expenditure that does depend on the level of GDP.
- Autonomous expenditure creates a leveraging effect in which an incremental increase in spending yields a proportionately greater effect on GDP than the amount of spending itself. There is thus a **multiplier:** *The increase in equilibrium real GDP divided by the increase in autonomous expenditure* and a **multiplier effect:** *The process by which an increase in autonomous expenditure leads to a larger increase in real GDP.*

The multiplier effect: Figure 9.12



Summarising the multiplier effect

1. The multiplier effect occurs when autonomous expenditure increases *or* decreases.
2. The multiplier effect makes the economy more sensitive to changes in autonomous expenditure than it would otherwise be.
3. The larger the MPC, the larger the value of the multiplier.
4. The formula for the multiplier we are using here is *over-simplified* because it ignores the effect that an increasing GDP can have on imports, inflation and interest rates.

A formula for the multiplier

Of course we do not need to stick to geometrical analysis to calculate the effect. The formula is:

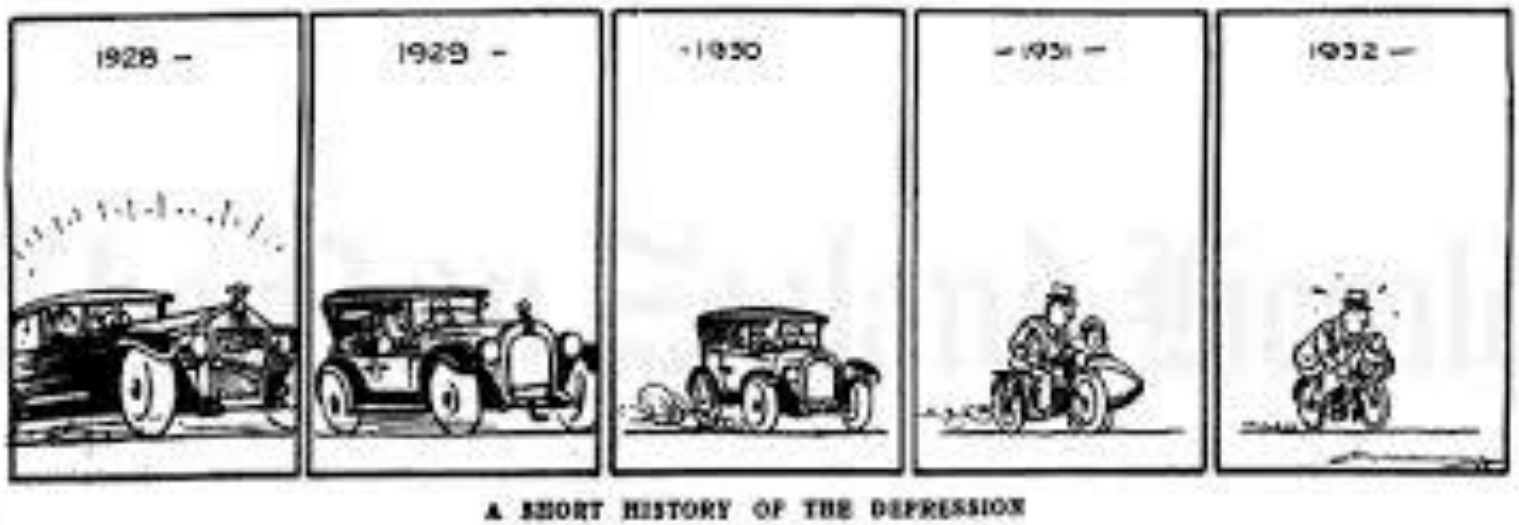
$$\text{Multiplier} = \frac{\text{Change in equilibrium real GDP}}{\text{Change in autonomous expenditure}}$$

$$\text{Multiplier} = \frac{1}{1 - \text{MPC}}$$

The intuition behind the multiplier effect

- Basically an increase in autonomous spending sets off a series of ‘rounds’ of expenditure where the total effect is greater than the initial effect because of the way that autonomous spending circulates through the economy.
- So if MPC is 0.8 (and by definition MPS = 0.2) and $1000 is injected into the economy, the first recipient of that money will save $200 dollars of it and spend $800 on a new computer, say. The computer retailer saves $160 of that $800 and spends $640 on new stock. The computer wholesaler saves $128 of that $640 and spends $512 on office stationery. The stationery store saves $103 dollars and spends $409 somewhere else...
- Although the initial injection was only $1000, it created ($1000+$800+$640+$512+$409)=$3361 in spending so far, and will eventually lead to $5000 total in spending as the money circulates around.
- The multiplier is 1/(1 - MPC), so if the MPC is 0.8, the multiplier is 5. $1000 in influx money creates $5000 in spending.

The multiplier in reverse: The Great Depression of the 1930s.



http://thegreatdepressionnz.weebly.com/new-zealand-responds.html

Of course multipliers work in reverse too. This is what happened during the Great Depression. Falling I led to falling employment, falling wages, falling income and falling C and each ‘autonomous’ fall in AE was magnified by the leverage of the multiplier. This was one justification for increased G – to counteract such a negative multiplier.

Solved Problem **2**

Using the multiplier formula

Use the information in the table on the following slide to answer the questions below.

a) What is the equilibrium level of real GDP?

b) What is the MPC?

c) Suppose government purchases increase by $500 billion. What will be the new equilibrium level of real GDP? Use the multiplier formula to determine your answer.

Solved Problem **2**

Using the multiplier formula

In $billions

Real GDP (Y)	Consumption (C)	Planned Investment (I)	Government Purchases (G)	Net Exports (NX)	Planned Aggregate Expenditure (AE)
6000	5000	1500	1500	-500	
8000	6500	1500	1500	-500	
10 000	8000	1500	1500	-500	
12 000	9500	1500	1500	-500	
14 000	11 000	1500	1500	-500	

Solved Problem **2**

Using the multiplier formula

(a): First we have to fill in the last column of the table. We find macroeconomic equilibrium by calculating the level of planned aggregate expenditure for each level of GDP.

We can see that macroeconomic equilibrium occurs when real GDP equals $12 000 billion.

Real GDP (Y)	Consumption (C)	Planned Investment (I)	Government Purchases (G)	Net Exports (NX)	Planned Aggregate Expenditure (AE)
6000	5000	1500	1500	-500	7500
8000	6500	1500	1500	-500	9000
10000	8000	1500	1500	-500	10 500
12 000	9500	1500	1500	-500	12 000
14 000	11 000	1500	1500	-500	13 500

Solved Problem 2

Using the multiplier formula

(b) Calculate the MPC. So for every $2000 increase in Y (e.g. the first row from $6000 to $8000) there is a $1500 increase in C (again from the first row, $5000 to $6500). (Since this is a linear equation this calculation, or one like it from any two points, will be sufficient to calculate MPC which is the slope of the line).

$$\text{MPC} = \frac{\Delta C}{\Delta Y}$$

$$\text{MPC} = \frac{\$1500 \text{ billion}}{\$2000 \text{ billion}} = 0.75$$

Solved Problem **2**

Using the multiplier formula

(c) This solutions has two steps. First calculate the multiplier.

$$\text{Multiplier} = \frac{1}{1 - \text{MPC}}$$

$$= \frac{1}{1 - 0.75} = 4$$

Solved Problem **2**

Using the multiplier formula

(c) continued… then use the multiplier formula to calculate the new equilibrium level of GDP.

- The change in equilibrium GDP is equal to the change in government expenditure multiplied by 4.
- Change in equilibrium GDP = $500 x 4 = $2000 billion.
- Therefore the new level of equilibrium GDP = $12 000 billion + $2000 billion = $14 000 billion.

Shifts in AE and changes in the price level

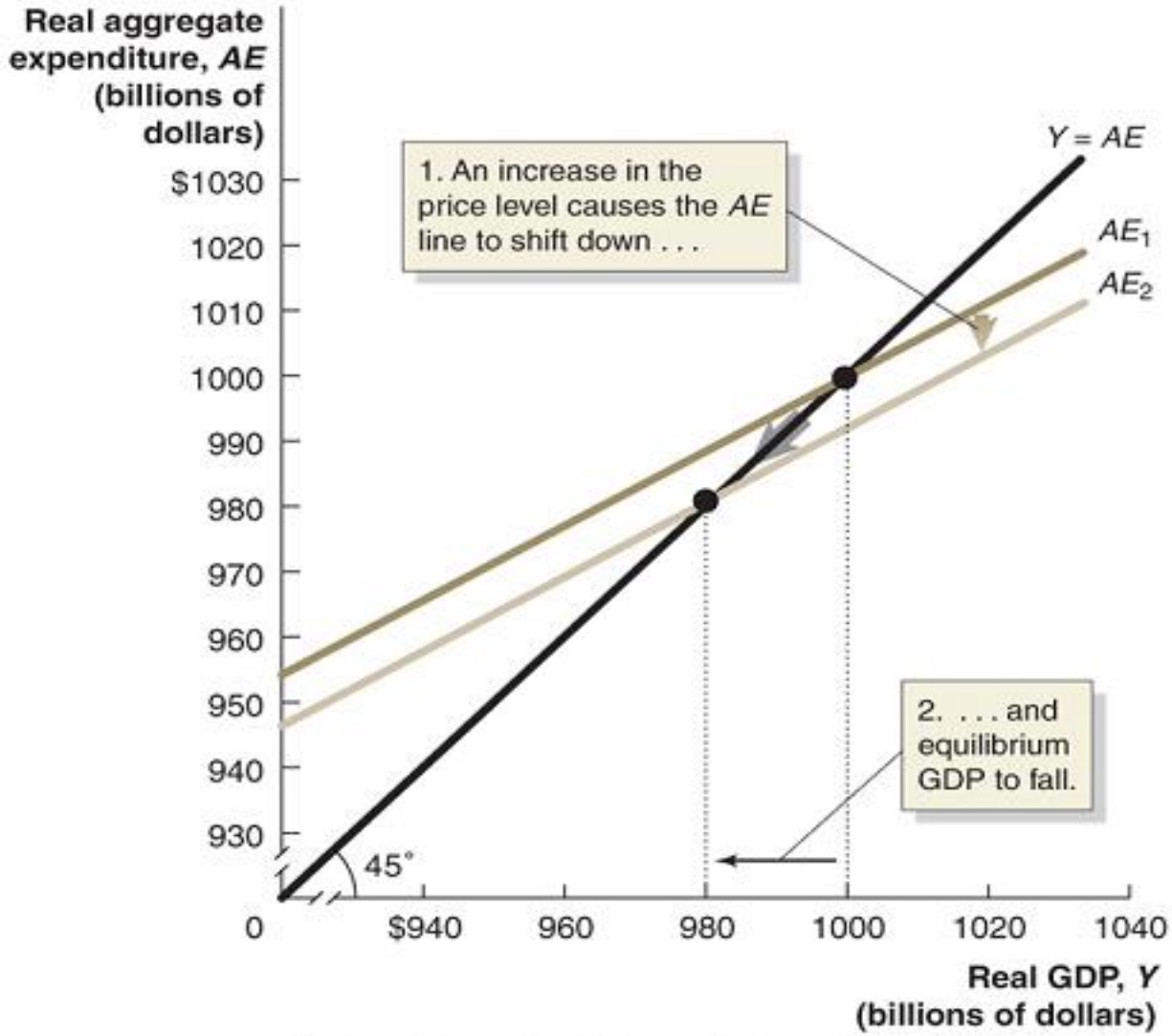
An inverse relationship exists between changes in the price level and changes in AE:

(1) Increases in the price level decrease consumption by decreasing real wealth, causing aggregate expenditure to fall; a falling price level has the reverse result.

(2) A price rise in Australia relative to price rises in other countries will cause net exports to fall, causing aggregate expenditure to fall; a falling price has the reverse result.

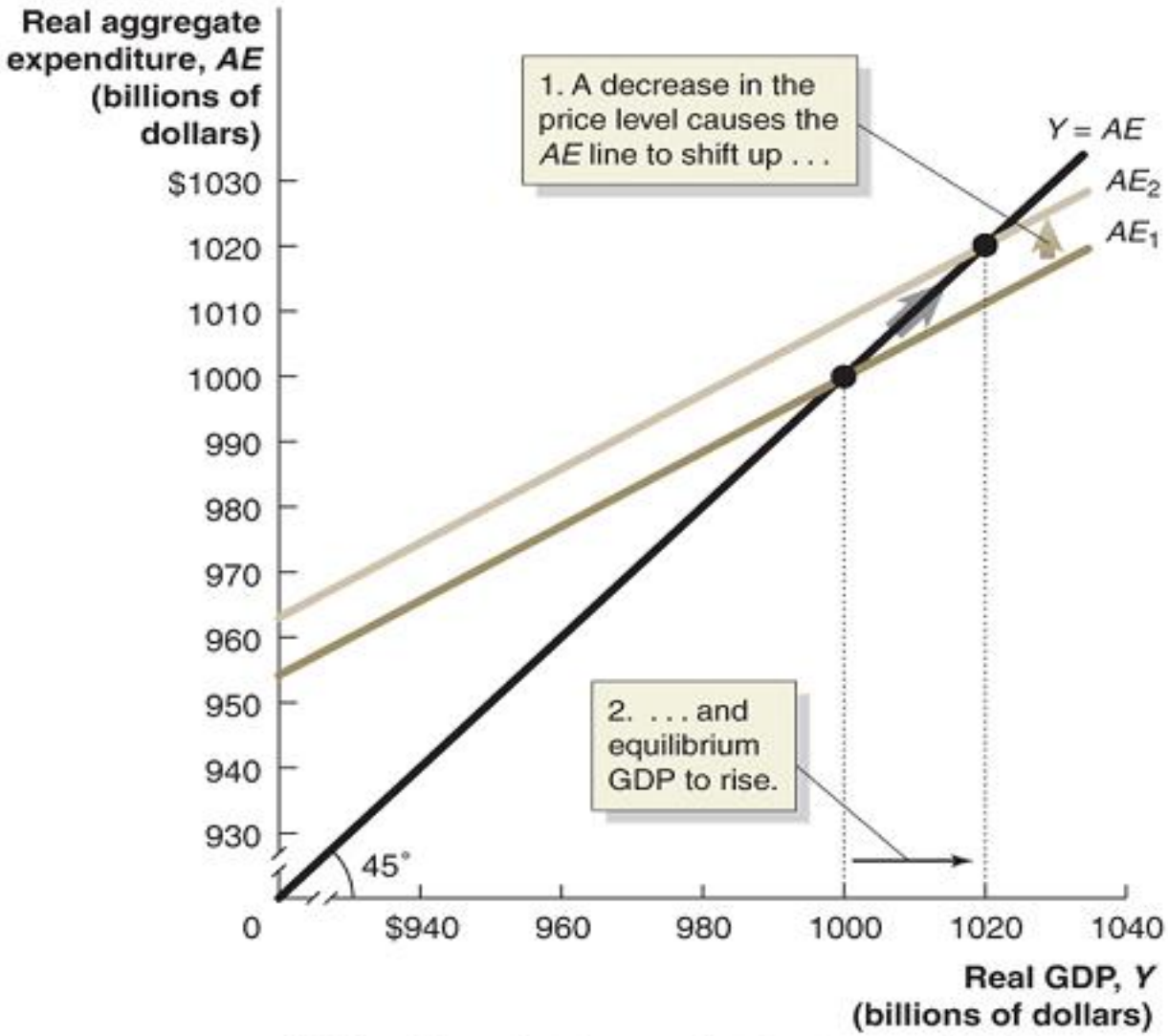
(3) If prices rise and the central bank (RBA) does not increase the availability of funds (using ‘accommodative policy’), interest rates will rise, reducing investment spending; a falling price has the reverse result.

The effect of a change in the price level on real GDP: – higher prices



(a) The effect of a higher price level on real GDP

The effect of a change in the price level on real GDP: – lower prices



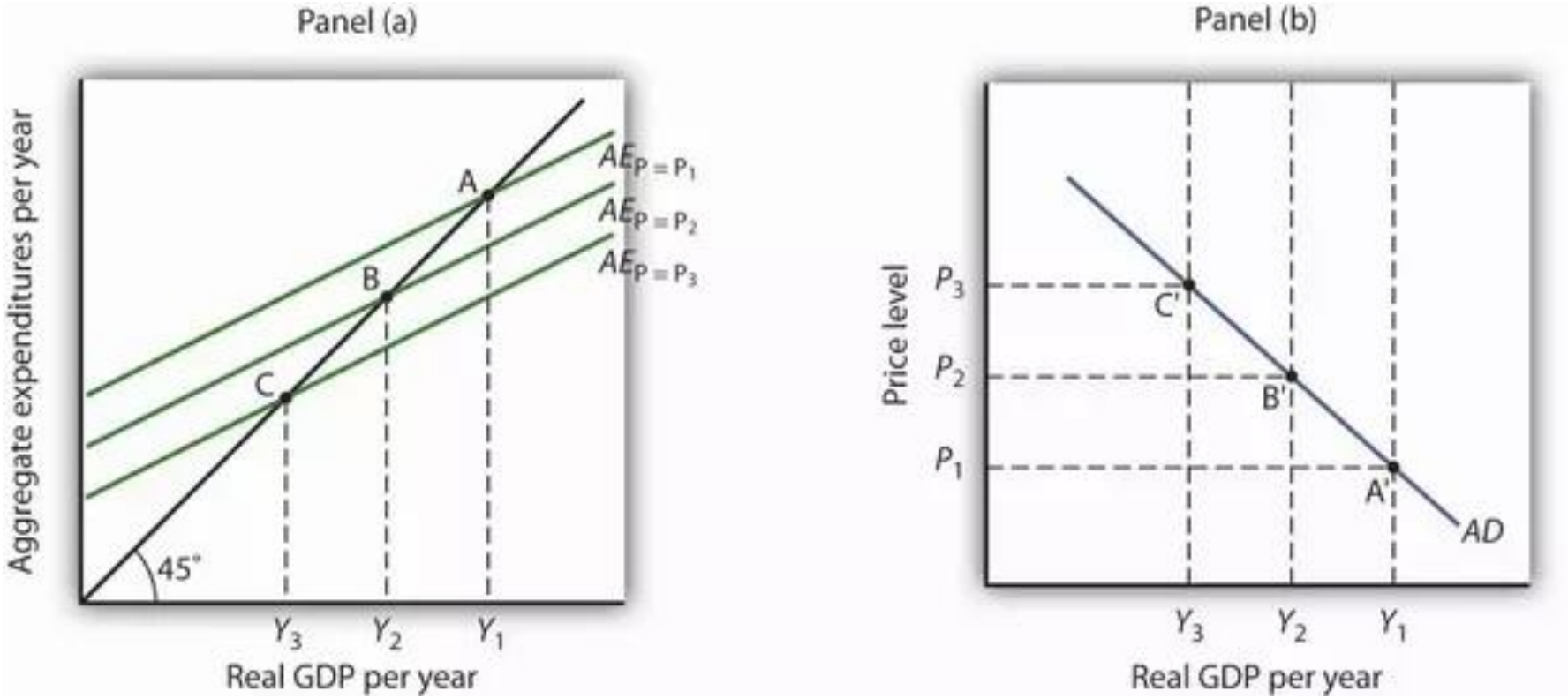
(b) The effect of a lower price level on real GDP

Price levels in the AE model

- It was noted earlier that price levels are assumed to be fixed as a simplifying assumption.
- Aren't we contradicting ourselves?
- No. *Price levels are fixed for a given AE curve.* We have to make this assumption to be able to have such a curve at all.
- But we can vary price levels in our comparative statics – which is what we have just done. And this causes the curve to shift up or down accordingly.

Aggregate Demand

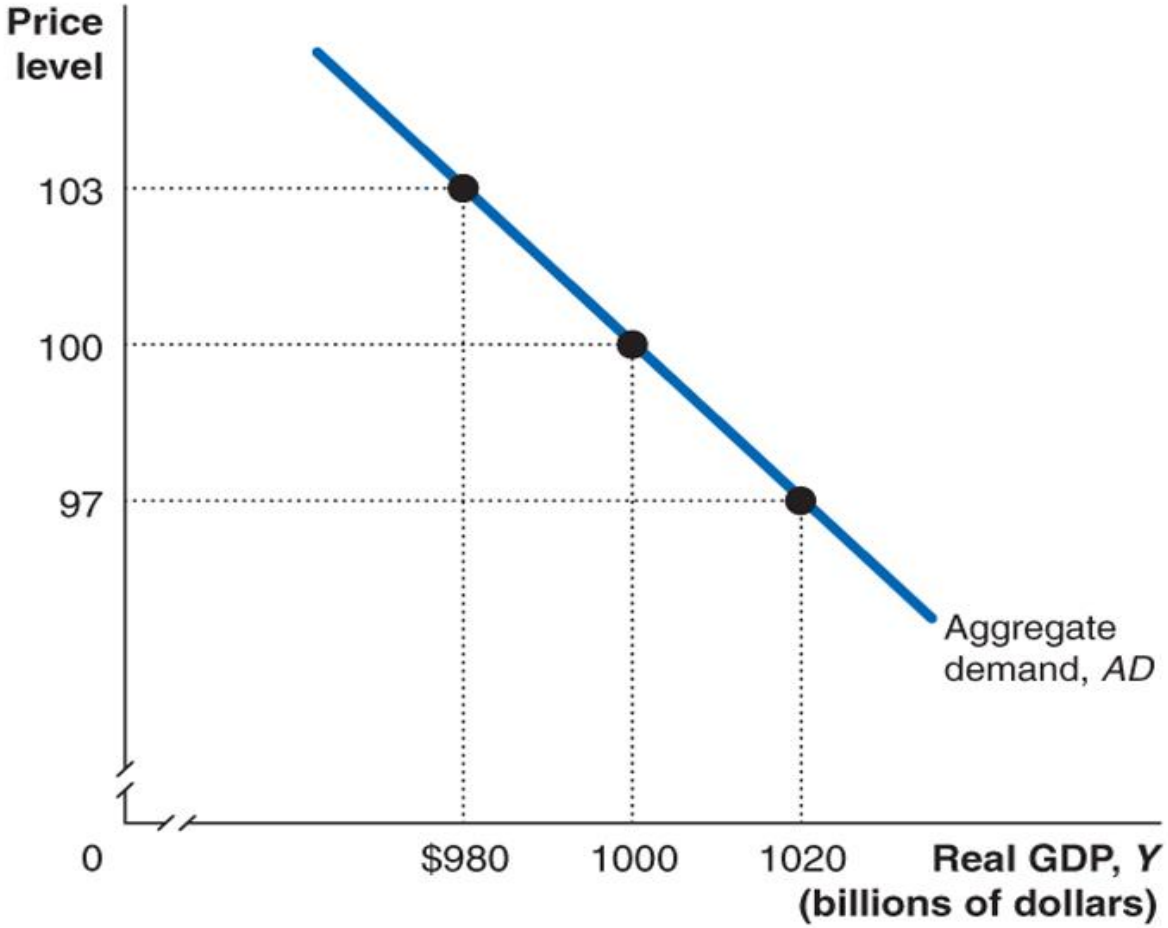
- And using this insight, we can now begin to build our aggregate demand – aggregate supply model (AD-AS).
- The **Aggregate Demand (*AD*) curve** is a curve that shows the relationship between the price level and the quantity of real GDP demanded by households, firms and the government.
- The aggregate demand curve shows the relationship between the price level and the level of planned aggregate expenditure in the economy. In our model and example (next slide) when the price level is 97, real GDP is $1020 billion. An increase in the price level to 100 causes consumption, investment and net exports to fall, which reduces real GDP to $1000 billion.



https://www.quora.com/What-is-the-difference-between-Aggregate-Expenditure-AE-and-Aggregate-Demand-AD-The-functions-for-both-AE-AD-are-the-same-when-it-comes-in-answering-questions-Should-there-be-a-different-explanation-using-either-AE-or-AD

The aggregate demand curve

Prive level	Equilibrium real GDP
97	$1020 billion
100	1000 billion
103	980 billion



A note on AD versus microeconomic 'demand curves'

- The use of supply and demand terminology can be confusing. A *microeconomic demand curve* shows the relationship between willingness to pay (WTP) for a particular good/service (price) and how much they are willing to buy at that price (quantity), given tastes, income etc. If we 'add up' all individual market micro demand curves we can derive the 'total' WTP for all goods and services across the economy on average. But this simply focuses on C and WTP.
- The AD curve is very different. It shows how AE varies with differing price levels across an entire economy. AD includes all components of spending – C+I+G+NX – and has nothing to do with WTP but the relationship between different price levels and AE.

Next stop: AS

- With this AD curve in place, we next move to adding an Aggregate Supply (AS) curve.
- That too, is different from the standard micro-supply curve.
- With these two elements in place we can have a complete model of the short-run macroeconomy.
- More on that next time.