

THE KEYNESIAN CROSS

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PRELIMINARIES

Total Expenditures (or Aggregate Demand) = $AD = C + I + G + NX$.

Total Output (or Income) = Y .

The Macro Dynamics

If $AD > Y \Rightarrow$ inventories deplete \Rightarrow production orders increase \Rightarrow output rises

If $AD < Y \Rightarrow$ inventories accumulate \Rightarrow production orders decrease \Rightarrow output falls

If $AD = Y \Rightarrow$ inventories stable \Rightarrow production orders don't change \Rightarrow output stable

In sum: output adjusts to meet the level of aggregate demand.

Thus the level of total output is *determined by* the level of aggregate demand.

Thus to find out Y , we need to know what AD is first.

Aggregate Demand

$$AD = C + I + G + NX$$

Consumption Spending (C) = dependent on income (and some other things, taxes, transfers, confidence, wealth, etc.)

Investment spending (I) = dependent on interest rates, etc.

Government spending (G) = dependent on Congress

Net Exports (NX) = dependent on exchange rates, etc.

The Circularity Problem

The problem is that we see immediately that AD is *itself* dependent on Y . That is because consumption is one of the major components of AD . And the amount of consumption is dependent on income, and income is in turn dependent on Y . So we need to know Y in order to know what AD is.

But then we are caught in a circular reasoning. We said (in the dynamics) that AD determines Y . But we said (in the consumption) that Y determines AD . So which is it?

Well, there is no circularity. What there is a simple problem of simultaneity, which is readily resolved mathematically.

EQUILIBRIUM OUTPUT

The Consumption Function

Notice that consumption is dependent on income. At the simplest, we can propose a linear relationship between consumption and income:

$$\begin{array}{ccc} C = & C_0 & + & cY \\ & \downarrow & & \downarrow \\ & \text{(autonomous)} & & \text{(induced)} \end{array}$$

(where C_0 = autonomous consumption, c = marginal propensity to consume).

e.g. letting $C_0 = \$50$ and $c = 0.8$, then:

$$C = 50 + 0.8Y$$

This is a linear function relating income to consumption, an "*if...then*" statement.

if $Y = \$100$, *then* $C = 50 + (0.8)100 = 50 + 80 = 130$

if $Y = \$200$, *then* $C = 50 + (0.8)200 = 50 + 160 = 210$

if $Y = \$300$, *then* $C = 50 + (0.8)300 = 50 + 240 = 290$

etc.

As income rises, consumption rises.

The Aggregate Demand Function

Let's take the most simplified model, where consumption is the only expenditure component dependent on income. Assume Investment, Government Spending, and Net Exports are independent of income. Since:

$$AD = C + I + G + NX$$

then plugging in $C = C_0 + cY$

$$AD = (C_0 + cY) + I + G + NX$$

or rearranging:

$$AD = [C_0 + I + G + NX] + cY$$

which is also a linear function. Notice that AD too is a linear function, an *if...then* statement, *if* Y is this, *then* AD is that.

Example: suppose we are given data:

- marginal propensity to consume (c) = 0.8
- autonomous consumption spending (C_0) = \$50
- Investment spending (I) = \$60
- Government spending (G) = \$80
- Exports (EX) = \$40
- Imports (IM) = \$30

then:

$$AD = [50 + 60 + 80 + (40 - 30)] + 0.8Y$$

or simply:

$$AD = 200 + 0.8Y$$

Just a simple linear function:

$$\text{if } Y = \$0, \text{ then } AD = 200 + (0.8)0 = 200 + 0 = 200$$

$$\text{if } Y = \$100, \text{ then } AD = 200 + (0.8)100 = 200 + 80 = 280$$

$$\text{if } Y = \$200, \text{ then } AD = 200 + (0.8)200 = 200 + 160 = 360$$

$$\text{if } Y = \$300, \text{ then } AD = 200 + (0.8)300 = 200 + 240 = 440$$

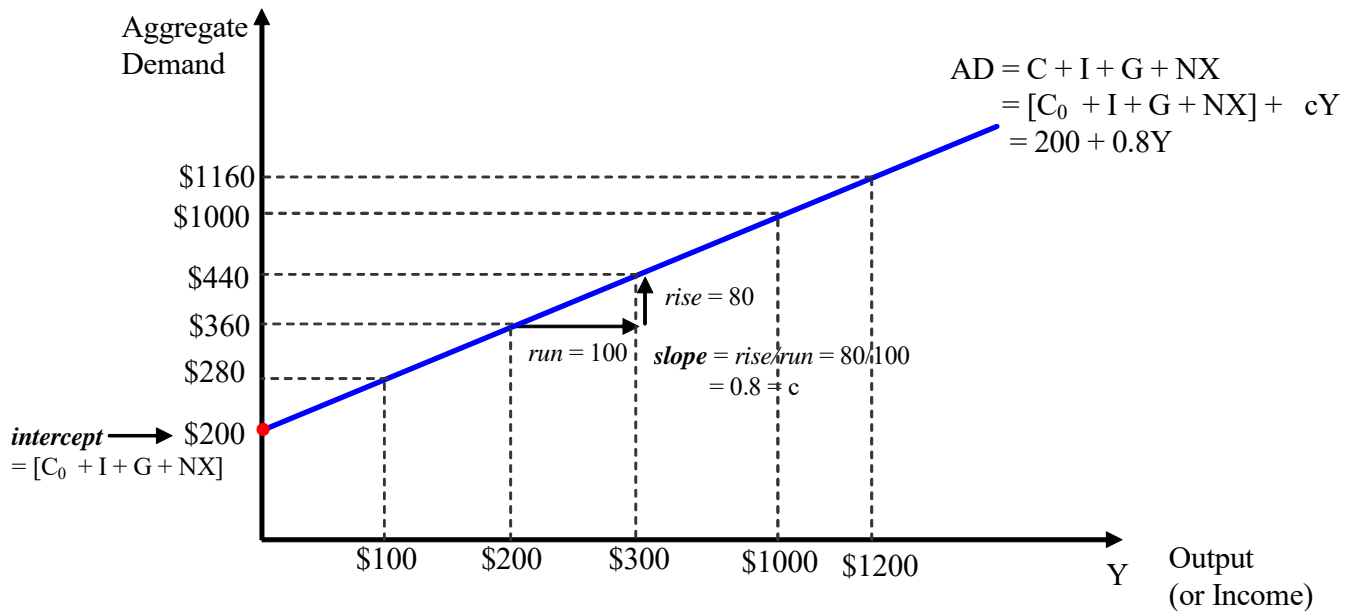
$$\text{if } Y = \$500, \text{ then } AD = 200 + (0.8)500 = 200 + 400 = 600$$

$$\text{if } Y = \$1000, \text{ then } AD = 200 + (0.8)1000 = 200 + 800 = 1000$$

$$\text{if } Y = \$1200, \text{ then } AD = 200 + (0.8)1200 = 200 + 960 = 1160$$

etc.

In particular, notice that the AD function is a linear function with *intercept* = $[C_0 + I + G + NX]$ and *slope* = c. That means we can plot it diagrammatically as a *line*.



Notice that the Aggregate Demand (AD) line is positively sloped - as income rises, aggregate demand rises. Notice also that its intercept is the collection of autonomous terms ($[C_0 + I + G + NX] = 200$) and its slope is the marginal propensity to consume ($c = 0.8$).

Equilibrium Output

The first thing to notice is that from outset, the equation does not seem to fulfill the stable equilibrium condition. For instance, when $Y = \$100$, $AD = \$280$. In other words, $AD > Y$. By the rules of the macrodynamics, output will rise. So $Y = \$100$ is *not stable*. Y will rise.

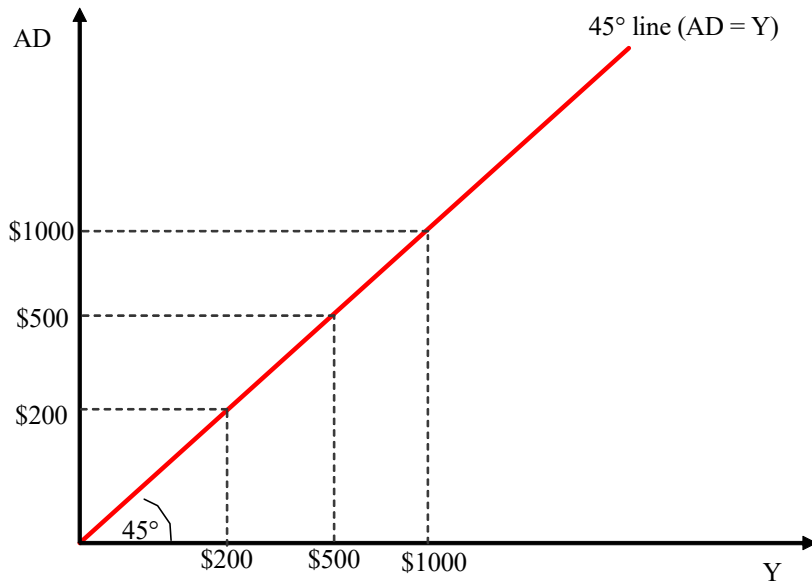
Conversely, notice that when $Y = \$1200$, $AD = \$1160$. Here we have it that $AD < Y$. By the rules of macrodynamics, output will fall. So $Y = \$1200$ is *not stable* either. Y will fall.

However, when $Y = \$1000$, $AD = \$1000$. Here $AD = Y$. Inventories neither accumulate nor deplete. By the rules of macrodynamics, output is stable. So Y will *not* change. We are at an **equilibrium output** level. The output of the economy will stay here.

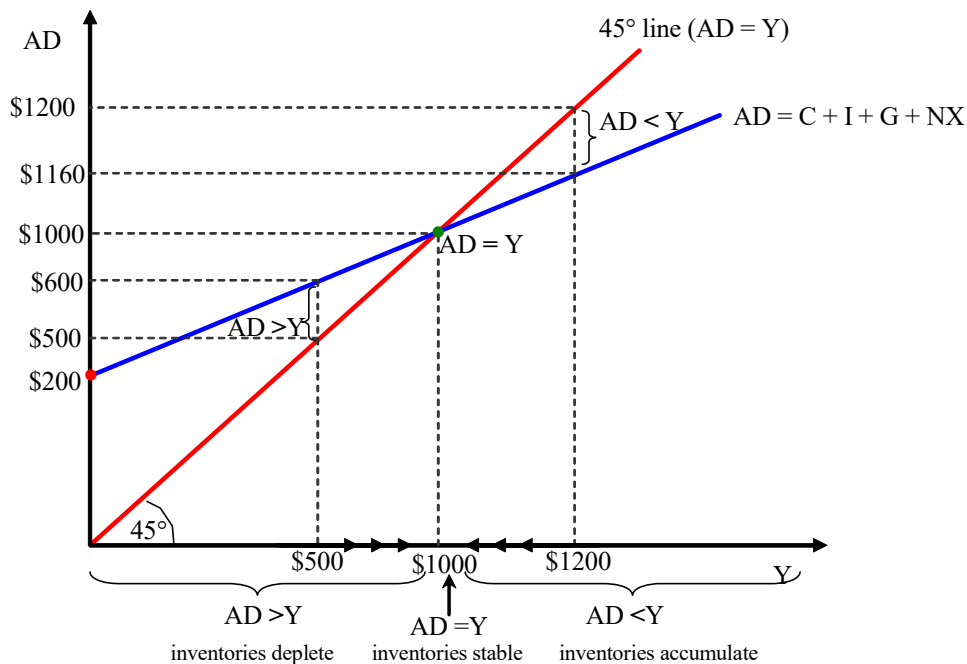
Notice that this equilibrium output is also a **gravitation point**. In other words, starting from below, say, at $Y = \$100$, we know Y will rise. Say, it rises to $\$200$. But at $\$200$, we *still* have it that $AD > Y$ ($360 > 200$), so output will continue rising. Y will rise and rise until it reaches the equilibrium output $Y = \$1000$. Conversely, starting from above, at $\$1200$, output will fall until it reaches $Y = \$1000$.

The equilibrium output level of $Y = \$1000$ is not only stable, it is a point of attraction by the macrodynamics. Wherever we start, total output *will* move adjust until it reaches it.

There is an easy way to decipher the equilibrium output diagrammatically. Suppose we draw a **45° line** from the origin. Geometrically, a 45° line bisects a right angle perfectly, so that any value on the horizontal axis is mapped to the same value on the vertical axis. So at *every* point on a 45° line, $AD = Y$.



Introducing the 45° line into our earlier diagram can help us quickly decipher the equilibrium output visually. For instance, in the diagram below. Equilibrium output will be where the Aggregate Demand (AD) line intersects the 45° line. At the intersection, $AD = Y$. At any level of output below that intersection, the AD curve is above the 45° line, implying that $AD > Y$ (and thus, dynamically, inventories are depleting, so output will be rising soon). Conversely, at any level of output above that intersection, $AD < Y$, (thus inventories are accumulating and output will soon fall.)



This diagram is sometimes called the "**Keynesian cross**", since it finds the equilibrium output by means of the intersection between the AD line and the 45° line

Calculating Equilibrium

How do we know which is the equilibrium level of output? That is what we use the **multiplier formula** for. We know that in equilibrium:

$$Y = AD$$

Since $AD = [C_0 + I + G + NX] + cY$, then:

$$Y = [C_0 + I + G + NX] + cY$$

collecting terms and solving for Y:

$$Y = \frac{1}{(1-c)} \times [C_0 + I + G + NX]$$

where $1/(1-c)$ is the multiplier, and $[C_0 + I + G + NX]$ the collection of autonomous terms (which also happens to be intercept of the AD line).

Example: using our old numbers, we know $AD = 200 + 0.8Y$. Setting $AD = Y$ and solving for Y:

$$Y = \frac{1}{(1 - 0.8)} \times [\$200]$$

$$= 5 \times [\$200]$$

$$= \$1000.$$

So our equilibrium output level is \$1000 (as depicted on the diagram, that is where the AD line intersects the 45° line).

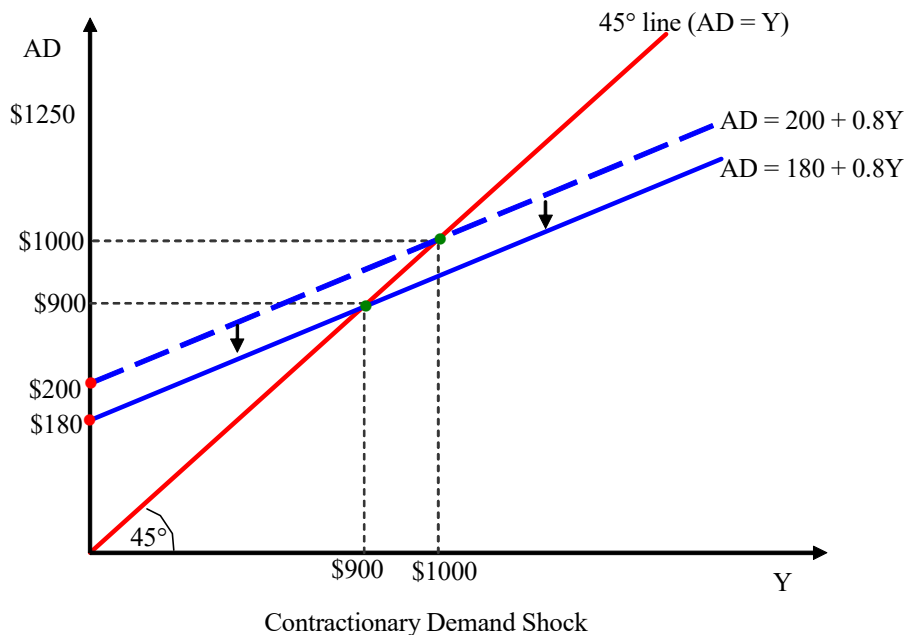
CHANGING AGGREGATE DEMAND

Shocks & Shifts

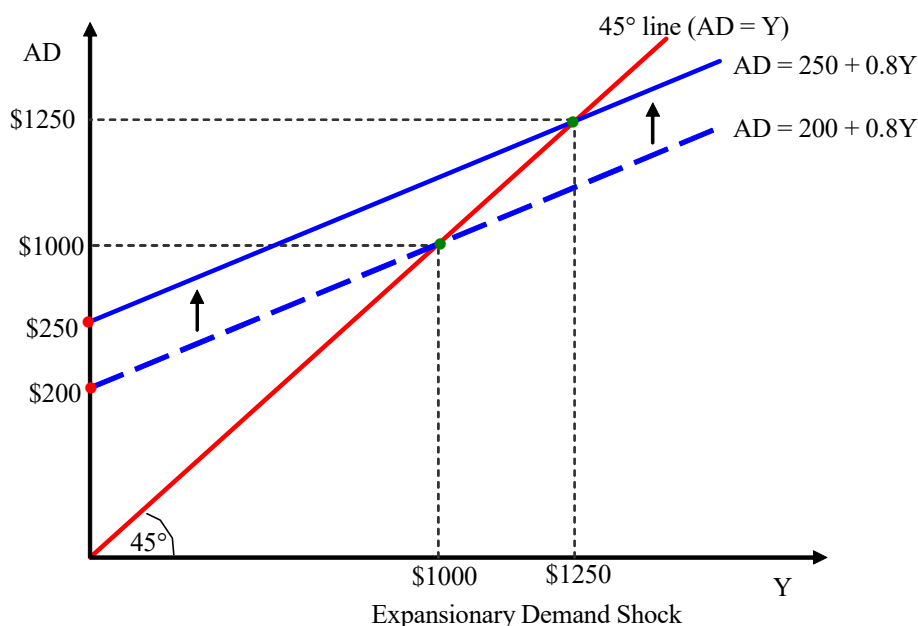
A shock to any of the elements of Aggregate Demand will shift the AD line and produce a new equilibrium (i.e. a new point of intersection with the 45° line)

Whenever there is a change in any of the autonomous terms (C_0 , I , G or NX), that necessarily means that the *intercept* changes.

e.g. suppose that consumer confidence falls, and autonomous consumption (C_0) declines by, say, \$20. In our case, the intercept now declines from \$200 to \$180, and thus output declines from $Y = \$1000$ to a new equilibrium $Y = 5 \times [\$180] = \900 . This is depicted as a vertical downward shift in the AD curve and thus a new intersection with the 45° line at \$900.



e.g. Suppose instead that there is a sudden \$50 increase in investment spending by firms. This will increase the intercept from \$200 to \$250. The equilibrium level of output rises from $Y = \$1000$ to $Y = \$1250$ (as $5 \times [\$250] = \1250).



A change in an autonomous component (C_0 , I , G or NX), changes the intercept and thus the equilibrium output.

Short-cut

For a short-cut, you don't have to re-calculate the output from scratch. If you know the size of the shock, you can use the short-cut formula:

$$\text{change in output} = \text{multiplier} \times [\text{change in autonomous terms}]$$

and then add or subtract the result from the previous equilibrium to get the new equilibrium.

e.g. when autonomous consumption declines by \$20:

$$\text{change in output} = 5 \times (-\$20) = -\$100.$$

subtracting the result from the previous equilibrium, i.e. $\$1000 - \$100 = \$900$, the new equilibrium.

e.g. when investment spending by firms rises by \$50:

$$\text{change in output} = 5 \times (+\$50) = +\$250.$$

adding the result from the previous equilibrium, i.e. $\$1000 + \$250 = \$1250$, the new equilibrium. Simple enough.

Swings

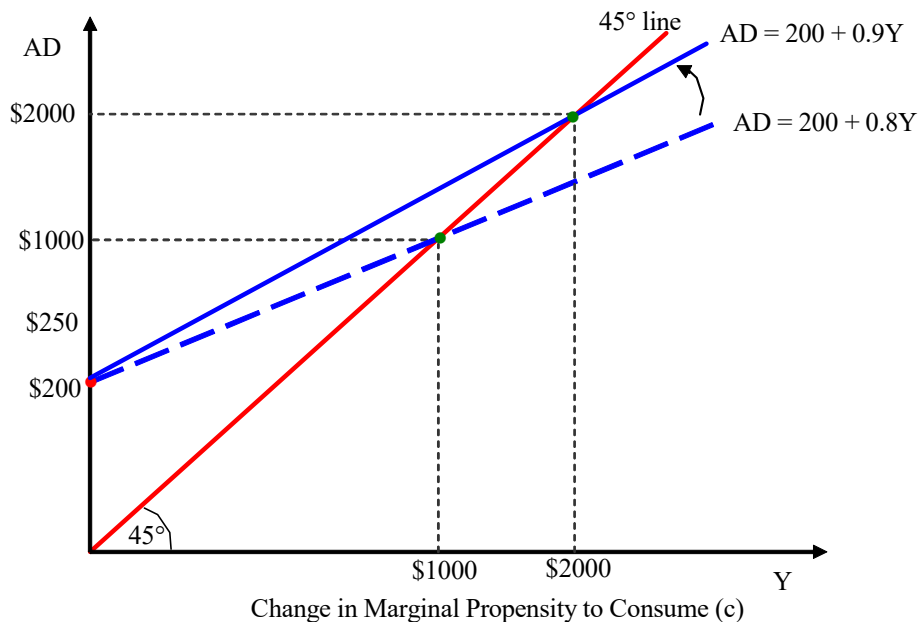
A change to the marginal propensity to consume (c) is slightly trickier as c is not in the intercept, but rather it is the *slope* of the AD line.

That means that a change in the marginal propensity to consume will lead to a *swing* in the AD line.

e.g. using our old numbers, suppose the marginal propensity to consume rises from $c = 0.8$ to $c = 0.9$. Supposing nothing else changes, then the new equilibrium will be

$$Y = \frac{1}{(1 - 0.9)} \times [\$200] = 10 \times [\$200] = \$2000.$$

Diagrammatically this is represented by keeping the intercept the same, but pivoting the AD curve to a steeper slope, thus yielding a new intersection with the 45° line at $\$2000$.



EQUILIBRIUM OUTPUT (Complex version)

Complex Model

We previously noted that AD formula is not so simple and that when we included taxes, transfers, propensity to import, etc. it became a big ugly thing. That is, including all our terms, the consumption function became:

$$C = C_0 + (c - ct)Y - cTX_0 + cTR$$

where t = marginal income tax rate, TX_0 is autonomous taxes and TR = net transfers. While our net exports was:

$$NX = EX - IM_0 - mY$$

where EX are exports, IM_0 are autonomous taxes and m the marginal propensity to import.

With these ugly terms, our aggregate demand formula:

$$AD = C + I + G + NX$$

became the following ugly thing:

$$AD = [C_0 + (c - ct)Y - cTX_0 + cTR] + I + G + [EX - IM_0 - mY]$$

But reorganizing it a bit, it becomes a little neater:

$$AD = [C_0 - cTX_0 + cTR + I + G + EX - IM_0] + (c - ct - m)Y$$

which, while still ugly, is at least recognizable as a linear function of Y , with intercept = $[C_0 - cTX_0 + cTR + I + G + EX - IM_0]$ and the slope = $(c - ct - m)$. Diagrammatically, it looks qualitatively similar.

Example:

marginal propensity to consume (c) = 0.8

marginal tax rate (t) = 0.15

marginal propensity to import (m) = 0.10

autonomous consumption spending (C_0) = \$50

autonomous taxes (TX_0) = \$40

net transfers (TR) = \$10

Investment spending (I) = \$60

Government spending (G) = \$80

Exports (EX) = \$40

autonomous imports (IM_0) = \$30

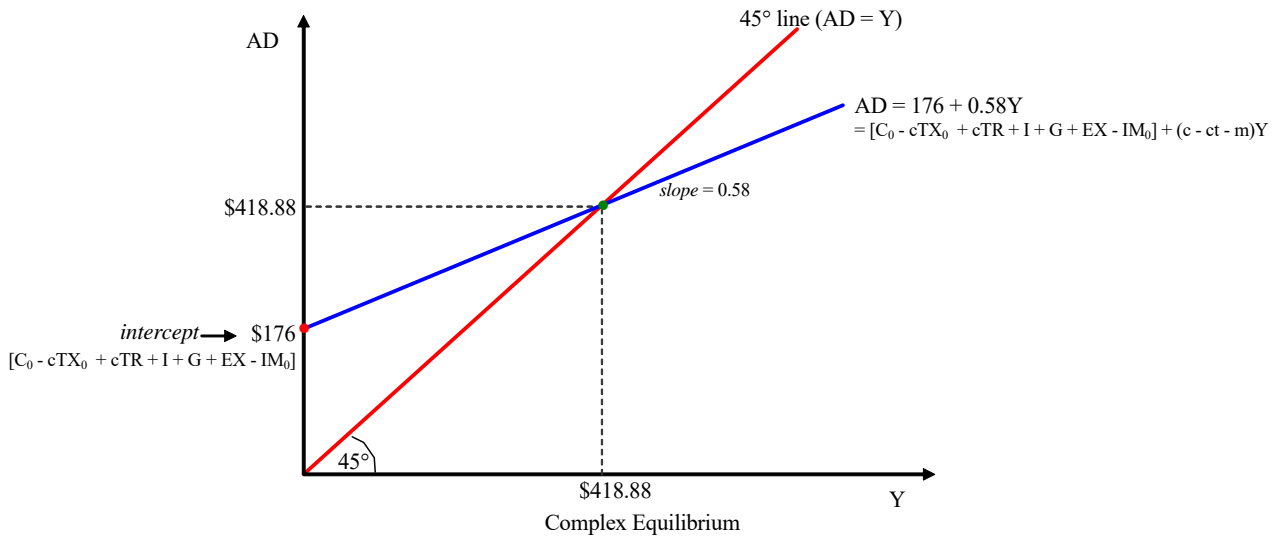
$$AD = [C_0 - cTX_0 + cTR + I + G + EX - IM_0] + (c - ct - m)Y$$

$$= [\$50 - (0.8)(\$40) + (0.8)(\$10) + \$60 + \$80 + \$40 - \$30] + (0.8 - (0.8)(0.15) - 0.1)Y$$

or simply:

$$AD = \$176 + (0.58)Y$$

so the new AD curve is just a straight line with intercept 176 and slope 0.58



The general formula for the equilibrium output in this complex case is:

$$Y = \frac{1}{(1 - c + ct + m)} \times [C_0 - cTX_0 + cTR + I + G + EX - IM_0]$$

which is really just:

$$Y = \frac{1}{(1 - 0.58)} \times [\$176]$$

so the equilibrium output is merely:

$$Y = 2.38 \times [\$176] = \$418.88.$$

as shown in the diagram above.

Shocks & Shifts

Shocks & swings are only a tad more complicated, but essentially the same as before. Changes in the autonomous terms C_0 , TX_0 , TR , I , G , EX and IM_0 will lead to shifts in the intercept (albeit one must be careful with signs & if the term might have a c attached).

A change in c , t or m will change the slope of the AD line and the corresponding equilibrium. There is only a slight complication in that changing marginal propensity to consume (c) will change the slope *and* the intercept because c enters both, so you have to account for both.

Here are some examples of **expansionary shocks** (i.e. changes which lead to an increase equilibrium output)

Shift intercept up:

- an increase in consumer confidence (raises C_0)
- a stock market or real estate bubble (raises consumer wealth, thus C_0)
- tax rebate/autonomous cut/rise in exemption (fall in TX_0)
- introduction of a new government transfer program (TR , can be positive or negative)
- increase in government spending programs (raise G)
- lower interest rates, which prompts more investment spending by firms (raise I)
- lower exchange rates, which raise exports and lower imports (raise EX , lower IM_0).

Swing curve out:

- a decline in the savings rate (raise marginal propensity to consume, c)
- a cut in income tax rates (reduce t)
- introduction of new tariffs on imports (lower propensity to import, m).

For **contractionary shocks** (i.e. shocks which lead to a decrease in equilibrium output) just consider the opposite - lower confidence, higher interest rates, tax increases, etc.

Introduction of new transfer programs (TR) can go either way, depending on how they are structured on net and the current configuration of the economy (e.g. ratios of payers to recipients, e.g. old people vs. young people, unemployed vs. employed, etc.)

THE KEYNESIAN REVOLUTION

Unemployment Equilibrium

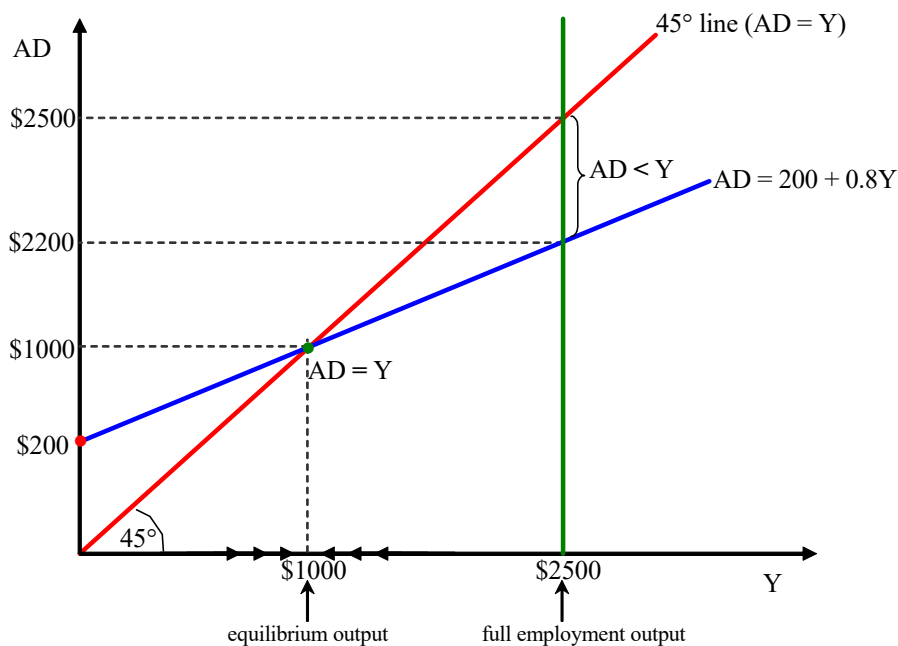
The Keynesian cross diagram shows us that equilibrium output is determined by aggregate demand. Wherever AD is, the equilibrium level of Y can be deduced at the intersection.

Of particular importance to note is that this equilibrium output level *may be below full employment*.

e.g. suppose that *if* every person is employed, then the total level of output would be \$2500. How is this pertinent to our equilibrium? It isn't. That is because our equilibrium will settle where $AD = Y$. And the level of output where $AD = Y$ may be above, at or below full employment.

e.g. in the diagram below, $AD = 200 + 0.8Y$. That implies the equilibrium level of output is \$1000, which is well below the full employment level of \$2500.

If for some reason output was accidentally raised to \$2500, the full employment level, it would not stay there. That is because when $Y = \$2500$, then $AD = \$200 + (0.8)(\$2500) = \$2200$. That is, at the full employment level of output, $AD < Y$. Inventories are accumulating, so by the macro-dynamics, *output will fall* below full employment and continue falling until $Y = \$1000$.

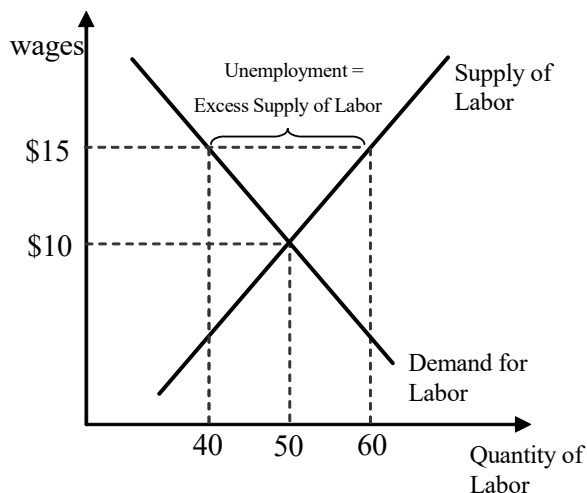


This summarizes a central point of economist **John Maynard Keynes** in his *General Theory* (1936): namely, that it is perfectly possible for the economy as a whole to move towards and settle at an *unemployment equilibrium* - that is, at a level of output which is *below* full employment - and stay put there.

Keynes vs. the Classics

Keynes turned economics on its head. It was long believed before Keynes that unemployment was a simple labor market problem. After all, **unemployment**, by definition, is an excess supply of labor, i.e. too many people seeking work, not enough jobs out there. This, it was believed, was caused by wages being too high.

The old "Neoclassical" reasoning can be summarized by a simple demand-and-supply diagram in the labor market. e.g. in the diagram below, when wages are \$15, demand for labor (i.e. jobs available) is 40 but supply of labor (i.e. people seeking work) is 60. There is an excess supply - unemployment - of 20.



The classical "fix" to unemployment is simply a matter of allowing the wage to fall from \$15 to \$10. At \$10, demand for labor = supply of labor, and thus there is no excess supply, and thus no unemployment. If there was unemployment at any time, it is simply a temporary situation or because the market, the price mechanism, was not being "allowed" to do its job for some reason, esp. that wages were being kept artificially too high. Such arguments were articulated by prominent economist at the height of the Great Depression of the 1930s. For instance:

"With perfectly free competition among work-people and labour perfectly mobile, the nature of the relationship will be very simple. There will always be at work a strong tendency for wage rates to be so related to demand that everybody is employed. Hence, in stable conditions *every one will actually be employed*. The implication is that such unemployment as exists at any time is due wholly to the fact that changes in demand conditions are continually taking place and that frictional resistances prevent the appropriate wage adjustment from being made

instantaneously."

(Arthur Cecil Pigou, *Theory of Unemployment*, 1933: p.252).

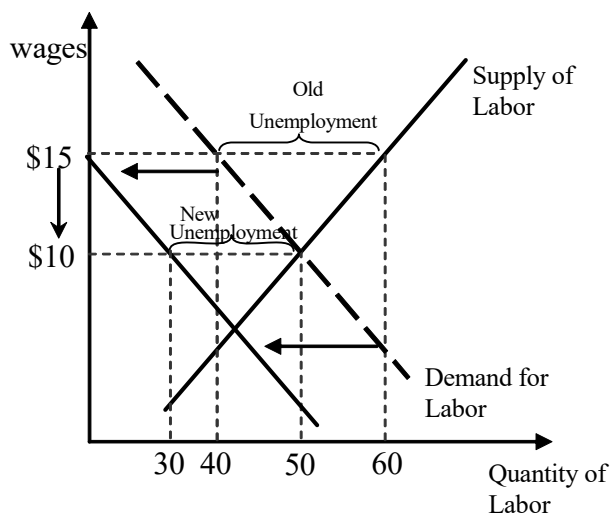
(yes that is our dear old Pigou of the Pigouvian tax.). Here's another example:

"But in general it is true to say that a greater flexibility of wage rates would considerably reduce unemployment....If it had not been for the prevalence of the view that wage rates must at all costs be maintained in order to maintain the purchasing power of the consumer, the violence of the present depression and the magnitude of the unemployment that accompanied it would have been considerably less...[We must] realize that a policy which holds wage rates rigid when the equilibrium rate has altered is a policy which creates unemployment."

(Lionel Robbins, 1935, "The Problem of Stabilization", *Lloyds Bank Review*)

Keynes pointed out one elementary problem with this logic: namely, that the demand for labor curve depends on the output firms want to produce. And, in the aggregate, firms want to produce the output needed to meet aggregate demand. If wages fall, that means workers earn less - and workers are consumers, so that means their consumption demand declines. By the multiplier logic given earlier, if consumption declines, aggregate demand declines, and thus firms (by the inventory macro dynamics) will cut back production. That means when wages fall, by this $AD \rightarrow Y$ causality, labor demand falls. That is, the labor demand curve *shifts left*, which means unemployment *persists*.

e.g. when we push wages from \$15 to \$10, that means *demand* for consumer goods declines, which means, by the macro-dynamics, labor demand falls (shifts left), so that, once wages reach \$10, supply of labor is 50, yes, but demand for labor is now 30. We *still* have unemployment of 20.



So the old "fix" to unemployment does not work. Pushing wages down will *not* eliminate unemployment. It will simply reduce aggregate demand and thus production declines, and the gaping hole of unemployment remains.

Keynes's explanation helped make sense of the Great Depression of the 1930s, where wages were tumbling, but unemployment, far from being reduced, actually increased. Neoclassical economists like Pigou and Robbins scrambled to explain what was going on - some blamed unions for keeping wages "still too high", or that unemployed workers were simply being too fussy, not willing to accept the lower wages, and preferred to continue looking for other jobs. Some even suggested that workers had spontaneously decided to take a huge collective holiday! None of this made sense - unemployment kept climbing and climbing - 5%, 10%, 15%, up to nearly a staggering 30%, one-third of the US workforce out of work. Adam Smith's "Invisible Hand", the "Law of Markets", the magic of price mechanism, did not seem to be working!

Keynes's logic made sense: total output was "stuck" at low levels *because* aggregate demand was stuck at low levels. Attempts to lower wages did not and could not fix that - indeed, it might make it worse. Market theory and the price mechanism are all very fine for an individual market - for computers, for fish, or for wool, where there's scarcity. But when it comes to aggregate output and employment *as a whole*, the market system is *not self-correcting*. The price mechanism simply can't fix unemployment by itself.

The problem with the Neoclassical theory, Keynes asserted, is that they never understood this connection between aggregate demand and total output. Neoclassicals just looked at an individual industry or the labor market by itself, and drew their conclusions by simply assuming the economy as a *whole* worked the same way. But it was a false analogy.

"If this is the groundwork of the argument (and, if it is not, I do not know what the groundwork is), surely it is fallacious. For the demand schedules for particular industries can only be constructed on some fixed assumption as to the nature of demand and supply schedules of other industries and as to the amount of the aggregate effective demand. It is *invalid*, therefore, to transfer the argument to industry *as a whole* unless we transfer our argument that the aggregate effective demand is fixed. Yet this assumption reduces the argument to an *ignoratio elenchi*....

But if the [Neoclassical] theory is not allowed to extend by analogy its conclusions in respect of a particular industry to industry as a whole, it is *wholly unable to answer the question* what effect on employment a reduction in money-wages will have. For it has no method of analysis wherewith to tackle the problem. Professor Pigou's *Theory of Unemployment* seems to me to get out of the Classical Theory all that can be got out of it; with the result that the book becomes a striking demonstration that this theory has *nothing to offer*, when it is applied to the problem of what determines the volume of actual employment as a whole."

(John Maynard Keynes, *The General Theory of Employment, Interest and Money*, 1936: p.259-60)

In contrast to the Neoclassicals, John Maynard Keynes had a tool to explain the total level of output and employment - the very Keynesian cross we have been playing with, with its identification of aggregate demand as the determinant of output, via the multiplier and macro-dynamics,

Keynesian Economic Policy

The Keynesian Revolution in economic policy quickly ensued. Governments realized that if aggregate demand is low, and output is low and the price mechanism did not seem to be able to push it up again, then *someone* has to step in and increase aggregate demand. Whether it is consumers, firms, foreigners or the government itself, spending has to rise. And the government can play with all sorts of tools - direct government spending, taxes, interest rates, exchange rates, etc. to try to push aggregate demand up. If it does so, then output will indeed increase.

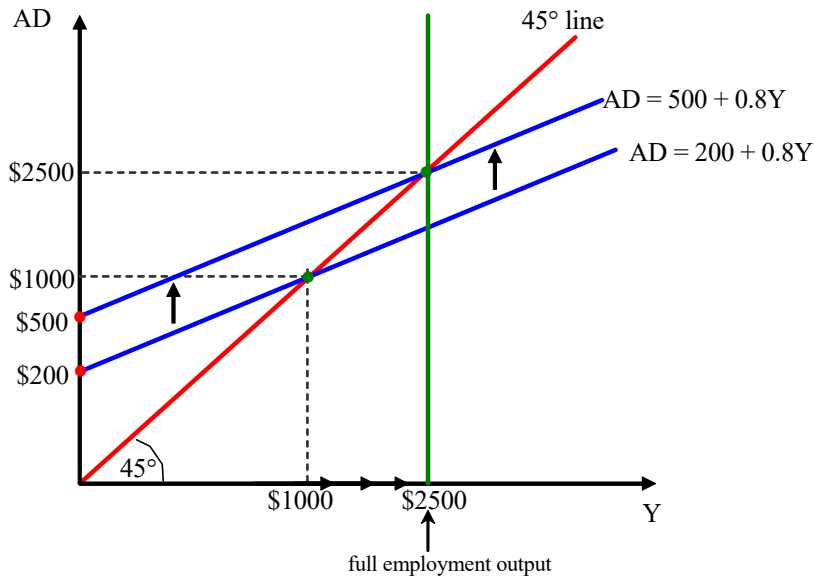
The tools at their disposal are:

Fiscal Policy (Congress): using government spending (G), autonomous taxes (TX_0), income taxes (t) and transfer programs (TR) to influence aggregate demand. Some fiscal measures (e.g. G), have a direct impact on aggregate demand; other measure (e.g. taxes & transfers) affect it indirectly by influencing personal disposable income of consumers and thus consumption demand.

Monetary Policy (Federal Reserve): adjustment in interest rates to influence investment spending by firms (I). Other tools classified as monetary policy include Fed adjustment of reserve requirement ratios, discount window rates, TARP, etc., which will also affect bank loan rates and thus investment spending.

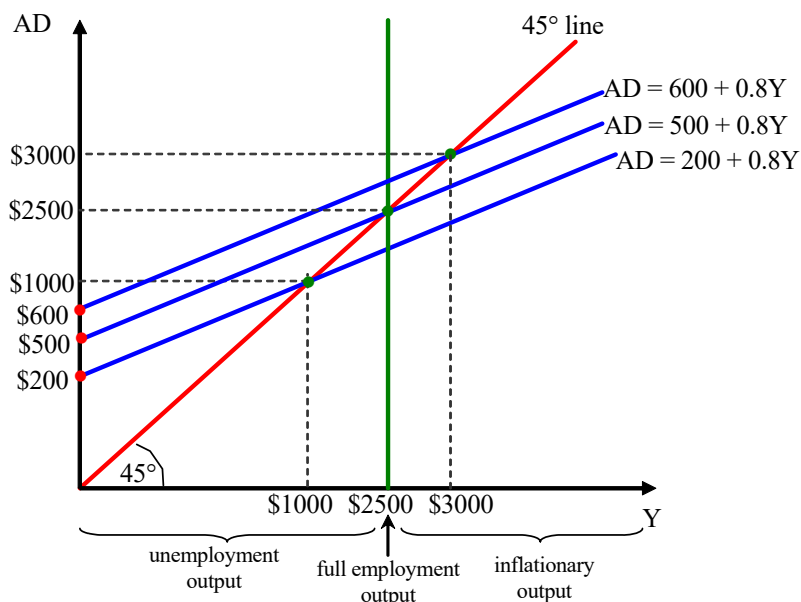
External Policy (Treasury): adjustments in exchange rates to influence exports (EX) and imports (IM). Adjustments in tariffs/quotas are usually done by Congress, and can also be used to manipulate exports & imports.

e.g. given the previous data, say the government increases spending by 300, raising autonomous components to 500, then the new aggregate demand is curve shifts up from $AD = \$200 + 0.8Y$ to $AD = 500 + 0.8Y$. The new equilibrium will rise from the old stagnant $Y = \$1000$ to the new full employment $Y = \$2500$ (as $5 \times \$500 = \2500). Full employment will be reached in a jiffy.



So by this engineered increase in aggregate demand, *now* output will move out of its unemployment equilibrium to its full employment level.

Of course, it is possible to overshoot the target. Say, if expenditure rises by 600, then aggregate demand rises too much. The new equilibrium will be $Y = 5 \times [\$600] = \3000 , which *above* full employment level of output. Firms will *try* to increase output up to \$3000, but once they exceed \$2500, they will start having problems meeting that aggregate demand as there is not enough unemployed resources out there to hire. Firms will start poaching each other's workers. What you have, in this case, Keynes warned, is **inflation**. At this point the government should manipulate things in a contractionary direction (higher interest rates, higher taxes, higher exchange rates) to bring aggregate demand back down to the ideal situation: full employment, no more and no less.



FROM KEYNESIAN CROSS TO AD-AS

How do we get from the straight-line Aggregate Demand function of the Keynesian cross to the downward-sloping Aggregate Demand curve of the Business Cycle AD-AS model?

Inflation and AD

To get our AD curve, we simply need to account for *inflation*, that is, a general rise in the price of all goods.

Where does inflation come in? We already mentioned that if aggregate demand exceeds full employment (or full capacity) level of output, then inflation would be unleashed. What impact does inflation have on aggregate demand?

The intuition is that when the prices of all goods go up, people can afford less so they consume less. But this reasoning is *wrong*.

Remember, inflation arises because firms are trying to push output above full employment and the only way an individual firm can do so is by poaching workers from other firms, that is, by offering higher wages. *Because* they can't actually afford to pay higher wages (squeezes their profit margins), they raise prices of goods. So wages and prices move proportionally up at the same time. Indeed, so price inflation and wage inflation go up together. But if wages go up at the same rate as prices of consumer goods, their purchasing power is unchanged, i.e. consumers are *not* worse off.

So ask the question again: what effect does inflation have on the economy?

There are three channels we mentioned in the Business Cycle notes:

(1) **Wealth Effect** as the price level rises, the value of people's *dollar-denominated* wealth (i.e. cash-under-the-mattress, bank deposits, bonds, etc.) declines. Since people feel "poorer", they will reduce consumption demand.

(2) **Interest Rate Effect** (or "Money Demand Effect") A little tricky. Essentially, when price levels rise, people need to withdraw cash from their bank deposits more frequently. That means banks need to set aside higher cash reserves. They raise the extra cash by curbing their lending, calling back loans, selling bonds, etc. But if banks are a bit less willing to lend, that means bank loan rates rise, making it more difficult for firms to finance their investment spending projects. So firm investment declines.

(3) **Exchange Rate Effect**: if the (dollar) price of domestic goods rises, that means domestic goods are less attractive to foreigners, and they will buy less of ours (and, conversely foreign goods are more attractive to domestic buyers, so we buy more of theirs). So exports decline and imports rise. Taken together, net exports decline.

All these things conspire together:

	⇒	Consumer demand declines	(Wealth Effect)	⇒	
inflation	⇒	Investment demand declines	(Interest Rate effect)	⇒	AD falls
	⇒	Net Exports decline	(Exchange Rate Effect)	⇒	

So the impact can be cleanly seen diagrammatically. Let us take the Consumer Price Index (CPI) as our measure of the price level. Let us start with the index at $P = 100$. Using our old data, suppose:

when $P = 100$, then $C_0 = \$50$, $I = \$60$, $G = \$80$, $EX = \$40$, $IM = \$30$.

$$\begin{aligned} AD &= [50 + 60 + 80 + (40 - 30)] + 0.8Y \\ &= [200] + 0.8Y \end{aligned}$$

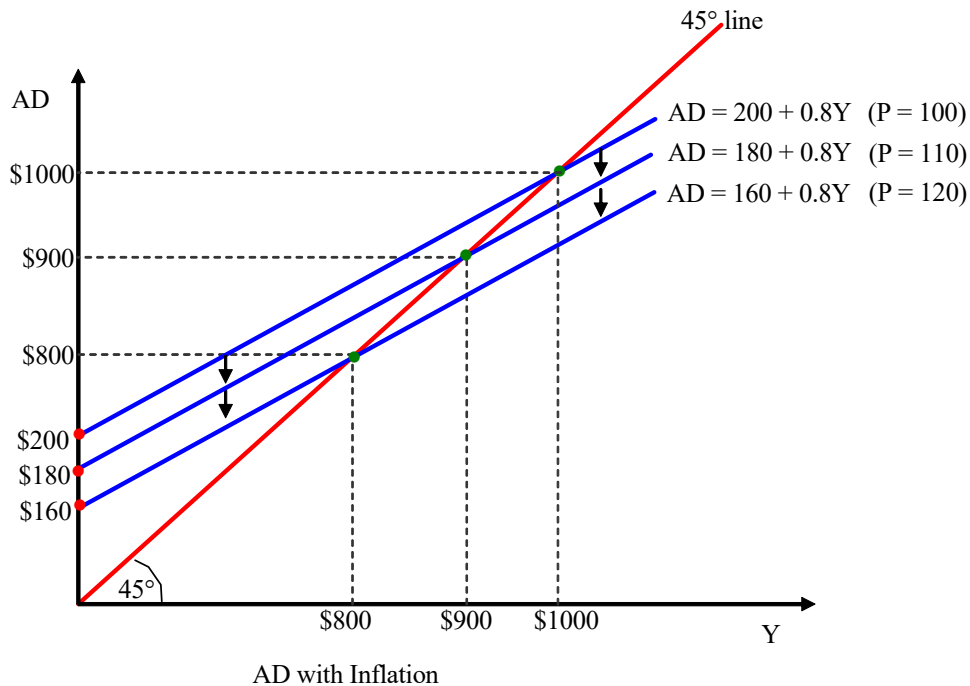
Now let's raise the prices to $P = 110$. Suppose autonomous consumer demand falls to \$45, investment falls to \$50 and net exports fall to 5. Then:

$$\begin{aligned} AD &= [45 + 50 + 80 + 5] + 0.8Y \\ &= [180] + 0.8Y \end{aligned}$$

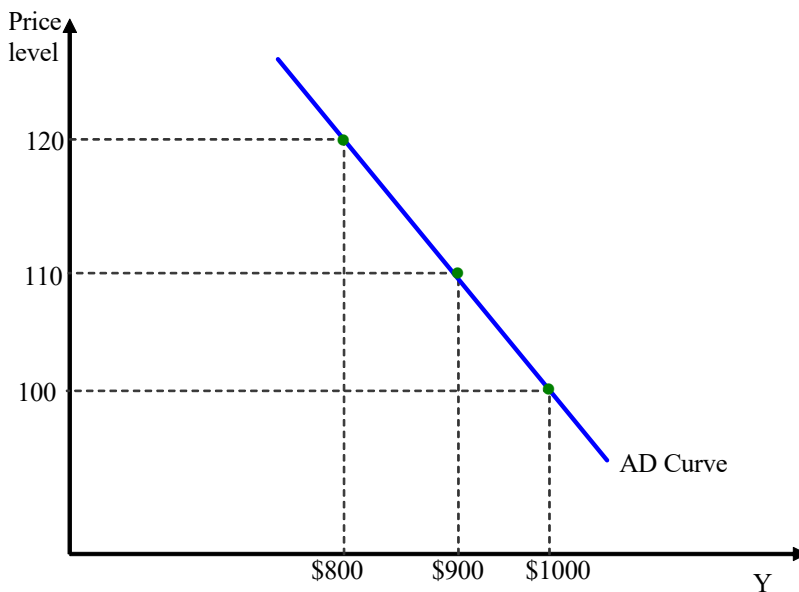
Now let's raise the prices further to $P = 120$. Suppose autonomous consumer demand falls to \$40, investment falls to \$40 and net exports fall to 0. Then:

$$\begin{aligned} AD &= [40 + 40 + 80 + 0] + 0.8Y \\ &= [160] + 0.8Y \end{aligned}$$

In a Keynesian cross diagram we would draw this as follows:



If we were now create a new graph, plotting the three price levels (P = 100, 110, 120) with their corresponding equilibrium outputs (\$1000, \$900, \$800), we would obtain a downward sloping locus of points that looked like the following:



In our Business Cycle notes, we call this the "Aggregate Demand Curve" (or AD Curve).

It is important to keep this AD Curve distinct from our earlier AD function (on the 45-line). Note that every point along the AD Curve represents not merely the aggregate

demand, but the equilibrium output at that level. That is, $AD = Y$ at every point along the AD Curve.

Shifts in the AD curve are just like normal shifts:

- increases in aggregate demand (e.g. lower interest rates, lower taxes, more government spending) will shift the AD curve to the right.
- decreases in aggregate demand (e.g. higher taxes, higher interest rates, etc.) will shift the AD curve to the left.

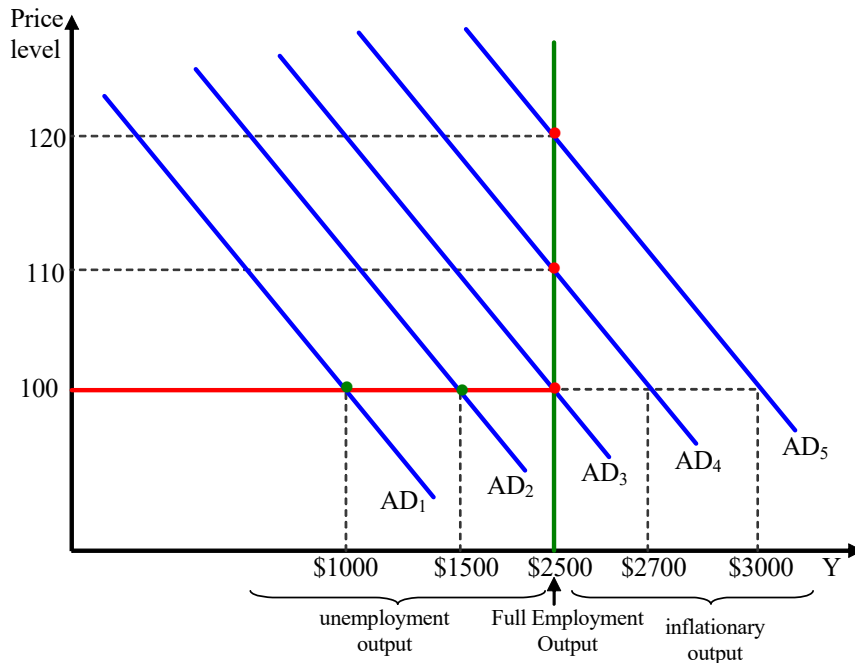
The Labor Market & SRAS

So what is the SRAS? Well, that's not *really* output, but more or a less a locus of points "capturing" the conditions in the factor markets, especially the labor market. This is a little subtle, so bear with me.

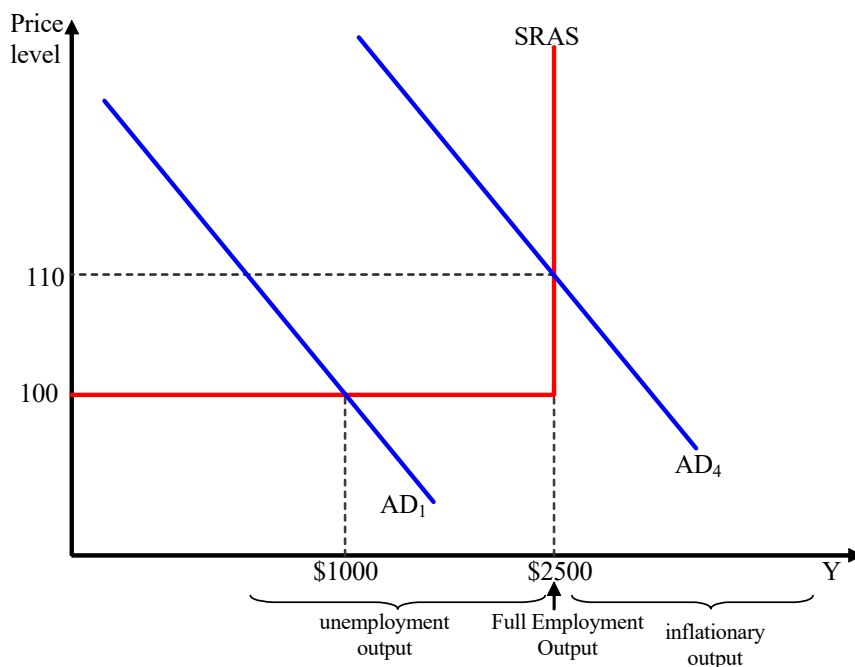
Let us suppose full employment in the labor market is when $Y = \$2500$. Anything less than that is an unemployment equilibrium.

Suppose the Price Level = 100. Let us begin at AD_1 , so $Y = \$1000$. Now, suppose there's an increase aggregate demand from AD_1 to AD_2 that is equilibrium output rises from \$1000 to \$1500. Because there's lot of unemployed labor out there, firms can easily increase production at the current wage. So output will rise, but wages and thus the price level won't.

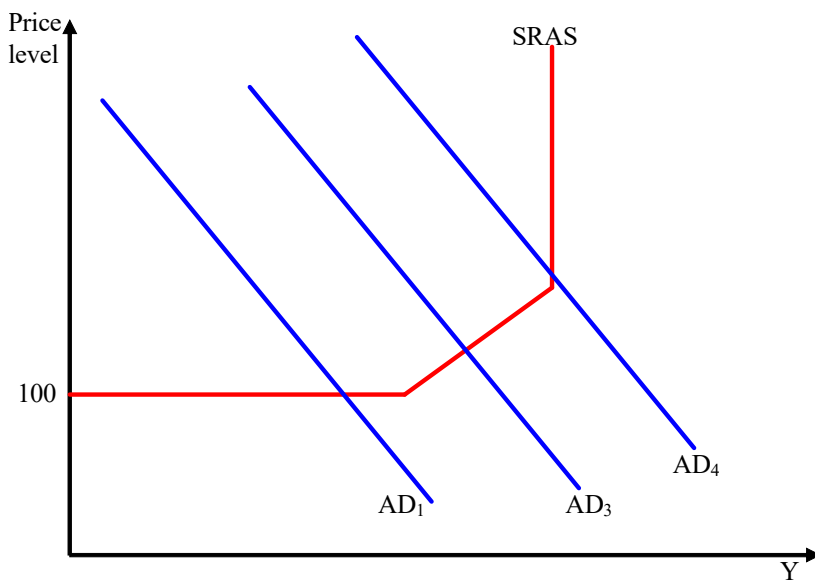
Suppose we continue raising aggregate demand to AD_3 , where we are now at full employment output of \$2500. Great. But now the problem begins. If aggregate demand continues to rise from AD_3 to AD_4 , firms will want to increase their production levels from $Y = \$2500$ to $Y = \$2700$. Unfortunately, *they can't*. Capacity has been reached. There are no unemployed people out there. Firms, of course, will *try* to increase production by poaching each other's workers. But then they have to pay higher wages. And to restore profit margins, have to raise prices accordingly. So total output in the economy doesn't increase, but stays at $Y = \$2500$. Only the price level rises to $P = 110$. If aggregate demand insists on rising further AD_4 to AD_5 , again Y remains at \$2500, but now price rises further from $P = 110$ to $P = 120$.



This movement traces out a sort of "labor market locus", tracing out the relationship between output level and price level (via the wages in the labor market). In sum, the various combinations of achievable equilibrium output and price levels, which we have elected to call a "short-run aggregate supply curve". It would look something like an inverted L-shape. If we start with aggregate demand at AD₁, and proceed to increase it, we will cruise along at first, increasing output and zero inflation, until we hit Y = \$2500, where any further increases to aggregated just creates inflation, but no extra output.



Of course things the actual economy doesn't make such a dramatic sharp and sudden right-angle turn. Rather, the transition in reality is a little more smooth. At first, the SRAS is flat, but as we approach the full employment level of output, we *begin* to see price levels starting to rise, as some industries or areas of the country hit their full employment, while other industries or areas are still slack, and so the price and output will rise together a little for a while, until we really beyond the capacity point and it becomes quite vertical.



Most of the time, unemployment is not so massive that we are in the purely horizontal section of the SRAS curve; it is also quite rare that we have so overreached beyond capacity of labor markets to be in the purely vertical segment. Most of the time we are in the upward-sloping part, where there is some prices rising and some output rising.

It is for this reason that in our Business Cycle section we focus on the purely upward-sloping SRAS curve and ignore the extremes. But the extremes are still there, just a little too far off in either direction for our interest.