DETERMINING GDP

Adjustment Process: total output (Y) will adjust to match total expenditure (AD). So in equilibrium:

$$Y = AD$$

Expenditure: AD = C + I + G + NX. Need to decipher components carefully.

I - SIMPLE VERSION

Consumption (C): two parts

$$C = \underset{\downarrow}{C_0} + \underset{\downarrow}{cY}$$

(autonomous) (induced)

C_0 = autonomous consumption (depends on confidence, wealth, etc.)
c = marginal propensity to consume
Y = income (≡ output).

Total Expenditure:

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

So, since in equilibrium (after adjustment), Y = AD, then:

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

or, rearranging:

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

Total Output = multiplier × [autonomous spending terms]

Example:

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

$$\text{output} = Y = \frac{1}{(1-0.8)} \times [\$50 + \$60 + \$80 + \$10]$$

$$\text{output} = Y = 5 \times [\$200]$$

$$\text{output} = Y = \$1{,}000$$

II - <u>COMPLEX VERSION</u>

Consumption (C): two parts

$$C = C_0 + cY^p$$

where Y^p is personal disposable income (i.e. net of taxes and transfers)

$$Y^p = Y - TX + TR$$

Y = gross income (≡ output).
TR = net transfers (positive or negative, depending on programs, demography, etc.)
TX = total taxes, where:

$$TX = TX_0 + tY$$

↓ ↓
(autonomous) (income taxes)

TX_0 = autonomous taxes (= poll taxes, excise taxes, property taxes, etc.)
t = marginal income tax rate

Combining all this:

$$C = C_0 + c(Y - TX + TR)$$
$$= C_0 + c(Y - (TX_0 + tY) + TR)$$

or simply:

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

Investment (I): depends on interest rates, etc.

Government Spending (G): depends on Congress.

Net Exports = Exports minus Imports (EX - IM)

$$IM = IM_0 + mY$$

↓ ↓
(autonomous) (induced)

IM_0 = autonomous imports (dependent on exchange rates, tariffs, etc.)
m = marginal propensity to import.

$$NX = EX - (IM_0 + mY)$$
$$= EX - IM_0 - mY$$

Total Expenditure:

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

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

Equilibrium after adjustment, Y = AD, so:

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

rearranging:

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

$$(1 - c + ct + m)Y = C_0 - cTX_0 + cTR + I + G + EX - IM_0$$

finally:

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

or, in English:

output = complicated multiplier × [autonomous spending terms]

N.B. = marginal propensity to consume (c) is attached to TX_0 and TR terms in the autonomous spending terms, but not to the other terms. That reflects the fact that taxes and transfers only have an impact on the spending *indirectly* through consumption spending, whereas the other terms (C_0, G, I, EXP, IM_0) impact spending *directly*.

Example: Initial Data:

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

$$\text{output} = Y = \frac{1}{(1 - (0.8) + (0.8)(0.15) + (0.10))} \times [\$50 - (0.8)(\$40) + (0.8)(\$10) + \$60 + \$80 + \$40 - \$30]$$

output = Y = 2.38 × [\$176]

output = Y = **\$418.88**

III - CALCULATING POLICY IMPACT

Fiscal Policy (Congress): any adjustments in government spending (G), autonomous taxes (TX_0), income taxes (t) and transfer programs (TR). Some fiscal measures have direct impact (e.g. G), others affect indirectly by influencing personal disposable income of consumers (e.g. taxes & transfers).

Monetary Policy (Federal Reserve): adjustment in interest rates to affect investment spending (I). Adjustment in Fed policies on reserve requirements, discount rates, TARP, etc. also affect lending rates and thus investment spending.

External Policy (Treasury): adjustments in exchange rates affect exports (EX) and imports (IM). Adjustments in tariffs/quotas are usually done by Congress, and also impact exports & imports.

Example 1 (**Monetary policy**): Federal Reserve reduces interest rates thereby raising investment spending from \$60 to \$90 (i.e. I rises by \$30)

Calculating the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.15)+(0.10))} \times [\$50 - (0.8)(\$40) + (0.8)(\$10) + \mathbf{\$90} + \$80 + \$40 - \$30]$$

output = Y = 2.38 × [\$206]

output = Y = \$490.28 (output increased by \$71.4)

Calculating the short way:

change in output = multiplier × [change in autonomous terms]

change in output = 2.38 × [\$30]

= \$71.4.

Example 2 (**Fiscal Policy - tax rebate**): Government gives out stimulus tax rebate checks worth \$15. (So subtract \$15 from TX_0, which falls from \$40 to \$25):

Calculating the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.15)+(0.10))} \times [\$50 - (0.8)(\mathbf{\$25}) + (0.8)(\$10) + \$60 + \$80 + \$40 - \$30]$$

output = Y = 2.38 × [\$188]

output = Y = \$447.44 (output increased by \$28.56)

Calculating the short way:

Note! Autonomous taxes TX_0 falling by \$15 means autonomous spending *increases* by -(0.8)(-\$15) = \$12. There is double negatives and you need to take marginal propensity to consume (c) into account since it is attached to TX_0 term in the equation.

change in output = 2.38 × [- (0.8)(-$15)]

change in output = 2.38 × [$12]

= $28.56

Example 3 (**Fiscal Policy - income taxes**): Government increases the marginal tax rate from 15% to 20%. You now need to adjust t in the multiplier from 0.15 to 0.20:

Calculating the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.20)+(0.10))} \times [\$50 - (0.8)(\$40) + (0.8)(\$10) + \$60 + \$80 + \$40 - \$30]$$

output = Y = 2.17 × [$176] ← note: multiplier changed!

output = Y = $381.92 (output decreased by $36.96)

Unfortunately, there is no short way for this example.

Example 4: (**Combination of policies**): Federal Reserve raises interest rates to reduce investment spending from $60 to $40 (reduction of I by $20), while Congress introduces tariffs to reduce imports from $30 to $22 (reduction of IM_0 by $8). What is net effect?

Calculating the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.15)+(0.10))} \times [\$50 - (0.8)(\$40) + (0.8)(\$10) + \mathbf{\$40} + \$80 + \$40 - \mathbf{\$22}]$$

output = Y = 2.38 × [$164]

output = Y = $390.32 (output decreased by $28.56)

Calculating the short way:

change in output = 2.38 × [-$20 - (-$8)] ← note: both changes included

= 2.38 × [-$12] ← note: net reduction by $12
(careful with double negatives)

= -$28.56.

Example 5 (**"Balanced Budget" Fiscal Policy**): Government increases spending by $30 (G rises from $80 to $110) but to keep balanced budget raises autonomous taxes by exactly the same amount (TX_0 rises by $30, from $40 to $70).

Calculating the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.15)+(0.10))} \times [\$50 - (0.8)(\mathbf{\$70}) + (0.8)(\$10) + \$60 + \mathbf{\$110} + \$40 - \$30]$$

output = Y = 2.38 × [$182]

output = Y = $433.16 (output increased by $14.28)

Calculating the short way:

change in output = 2.38 × [- (0.8)($30) + $30] ← note: both changes included but only change in TX_0 has c attached!

= 2.38 × [-$24 + 30]

= 2.38 × [$6] ← note: net increase by $6!

= $14.28.

So even though we raise taxes to exactly counterbalance spending in the budget, the *net impact* on the economy is actually positive!

Example 6 (**Impact of Inflation**): You can use this tool to also measure the impact of different natural shocks. For instance, suppose there is suddenly a bout of inflation for some reason. There are a couple of channels by which inflation affects expenditure: (1) it reduces the real wealth (*not* income) of consumers, so consumer cut back autonomous spending (e.g. C_0 falls from $50 to $40). (2) by raising the prices of domestic goods, inflation makes imports more attractive to domestic consumers (e.g. and IM_0 increases from $30 to $38) and exports less attractive to foreign consumers (e.g. EX declines from $40 to $35)].

So, the long way:

$$\text{output} = Y = \frac{1}{(1-(0.8)+(0.8)(0.15)+(0.10))} \times [\mathbf{\$40} - (0.8)(\$40) + (0.8)(\$10) + \$60 + \$80 + \mathbf{\$35} - \mathbf{\$38}]$$

output = Y = 2.38 × [$153]

output = Y = $364.14 (output decreased by $54.74 from 418.88)

Calculating the short way:

change in output = 2.38 × [(- $10) + (-$5) - (+ $8)] ← note: three changes included careful with the negative signs

= 2.38 × [-$23]

= -$54.74.

GDP 2010 - GDP = C+ I + G + NX

			Amount	**% of GDP**
Consumers	Consumption Spending	C	$10,349 bn	71%
Firms	Investment spending	I	$1,828 bn	12.5%
Government	Government Spending	G	$3,000 bn	20%
Foreigners	Exports		$1,838 bn	
	Imports		$2,354 bn	
	Net Exports	NX	-$516 bn	-3.5%
	Total Output	GDP	$14,600 billion	100%