Topics for Today

1. A Complete Dynamic General Equilibrium Model
   - Intertemporal Substitution in Labor Supply
   - Simultaneous Equilibrium in the Goods & Labor Markets
2. Comparative Statics
   - Changes in Government Spending
   - Changes in Productivity

- So far, we have studied a static model of the labor market (chpt. 4), and a dynamic model of the goods market (chpt. 8).

- Now we are going to put the 2 together, to derive a complete dynamic General Equilibrium model. (chpt. 9)

- We will see that there are potentially complex interactions between the goods + labor markets. We must therefore study them simultaneously.

- In the end, we will have a model that can predict how output, employment, investment, consumption, wages, and interest rates respond to exogenous changes in productivity and fiscal policy.

- The key will be understanding how market-clearing changes in wages and interest rates reconcile the consumption + labor supply decisions of households with the hiring + investment decisions of firms.

Mathematically, the household's problem can be easily extended to incorporate a simultaneous choice of work & saving:

$$\max_{c,c',\ell,\ell'} \; U(c, c', \ell, \ell')$$

subject to:

$$c + s = w(h-\ell) + \pi - T$$

$$c' = w'(h-\ell') + \pi' - T' + (1+r)s$$

} can combine to get

$$c + \frac{c'}{1+r} = w(h-\ell) + \pi - T + \frac{w'(h-\ell') + \pi' - T'}{1+r}$$

Optimality Conditions

1.) $\frac{U_\ell}{U_c} = w$

2.) $\frac{U_{\ell'}}{U_{c'}} = w'$

3.) $\frac{U_c}{U_{c'}} = (1+r)$

} These 3 eqs., along with the budget constraint determine (c, c', ℓ, ℓ') in terms of (w, r, T, π).

Intertemporal Substitution in Labor Supply

- When discussing the labor market, we focused on a static model (i.e., there was just one period).

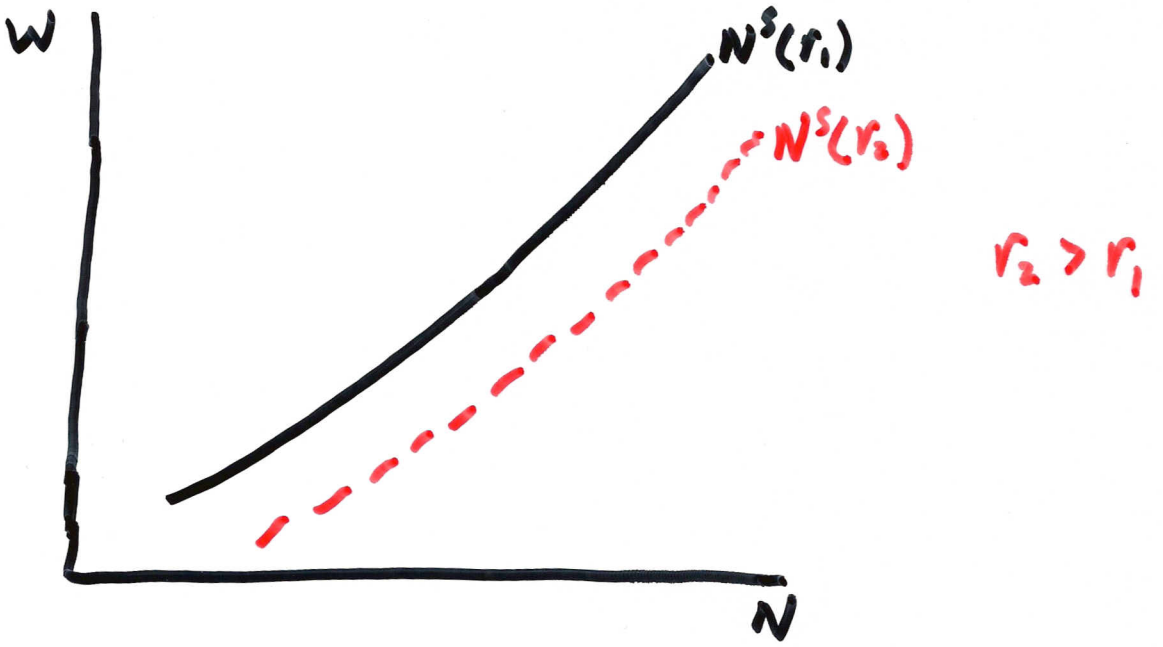
- However, just as there are intertemporal substitution effects on consumption, there are intertemporal substitution effects on leisure + labor supply.

The 2 main effects are:

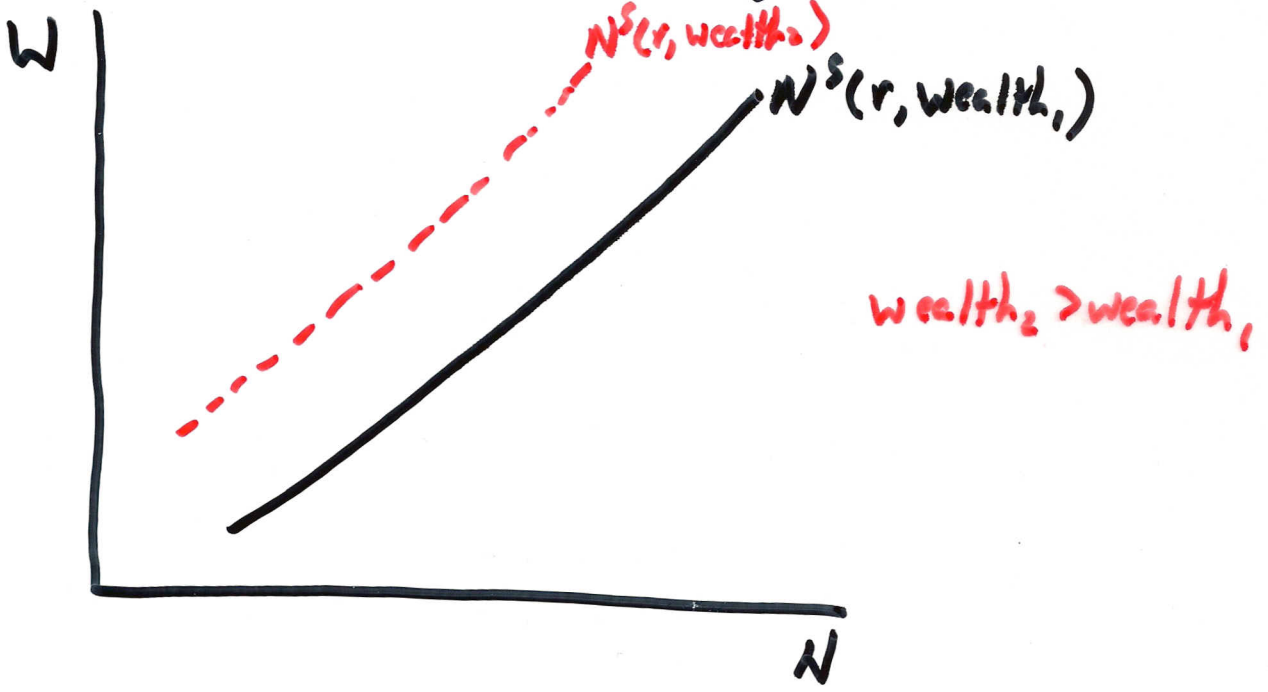
1.) Temporarily high wages increase current labor supply (work now, rest later). Alternatively, a decline in expected future wages increases labor supply.

2.) Higher interest rates raise the price of current leisure (relative to future leisure), just as they increase the price of current consumption
⟹ More current labor supply.

So now, a change in the interest rate shifts the labor supply curve.



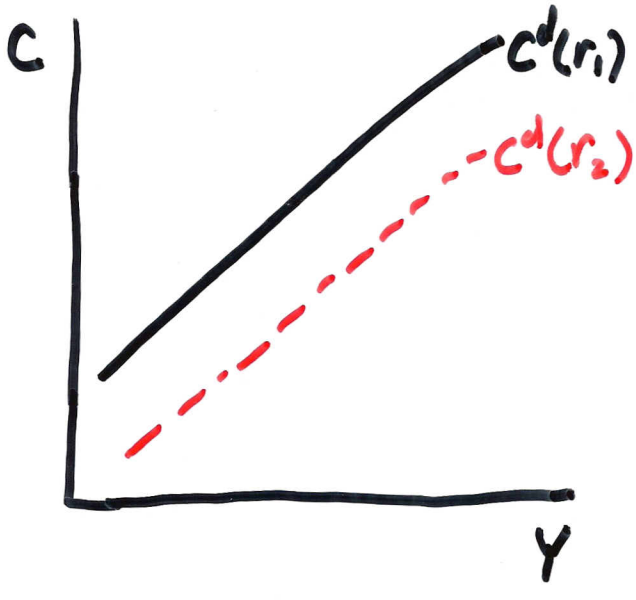
It will also be important to remember that when wealth increases labor supply decreases (because leisure is a "normal" good).



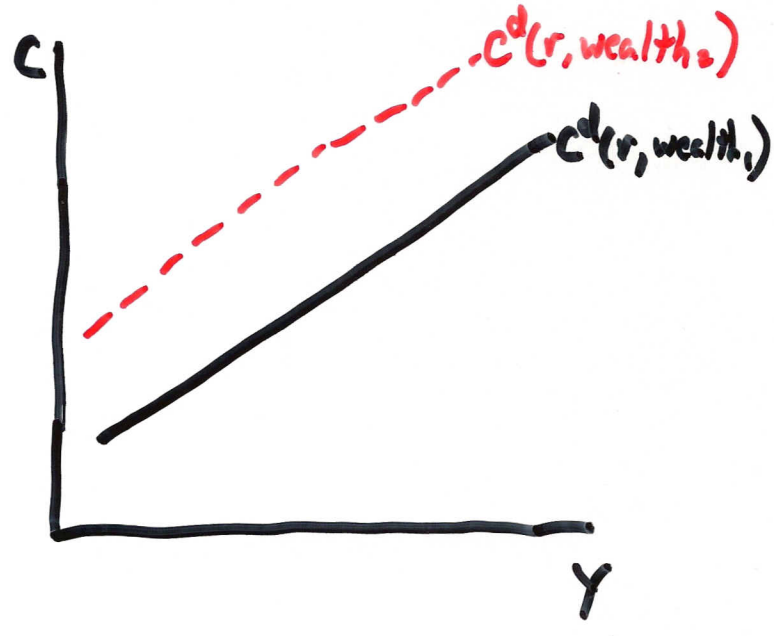
- The household's current consumption decisions can also be depicted with a simple graph.

- Current consumption depends on: (1) Current Income, (2) The Interest Rate, and (3) Future (after-tax) Income, or Wealth.

- If we graph Current consumption against current income, then changes in interest rates or (after-tax) wealth <u>shift</u> the curve.



$r_2 > r_1$

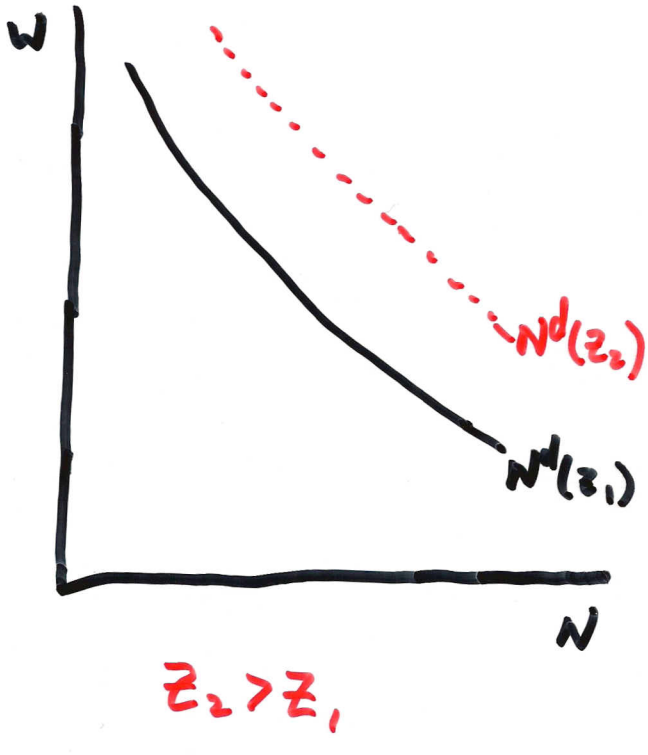


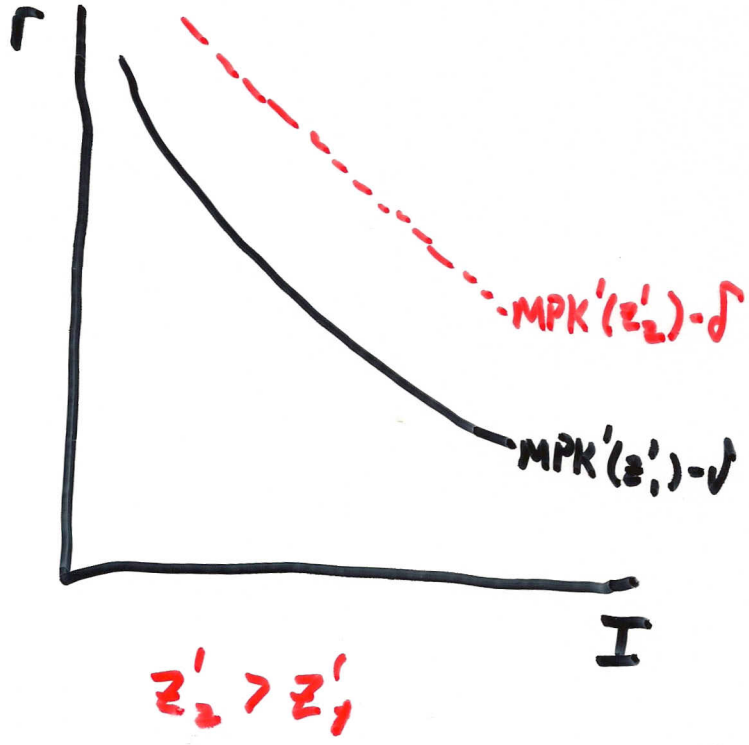
$wealth_2 > wealth_1$

- Now let's turn to the firm's side. They enter the labor market in order to hire workers. Firms also must enter the goods market, since current output must be used to construct the future capital stock. That is, investment represents a demand for current output.

- Remember, investment adds to the future capital stock ($K' = (1-\delta)K + I$), so it depends on the future marginal product of capital

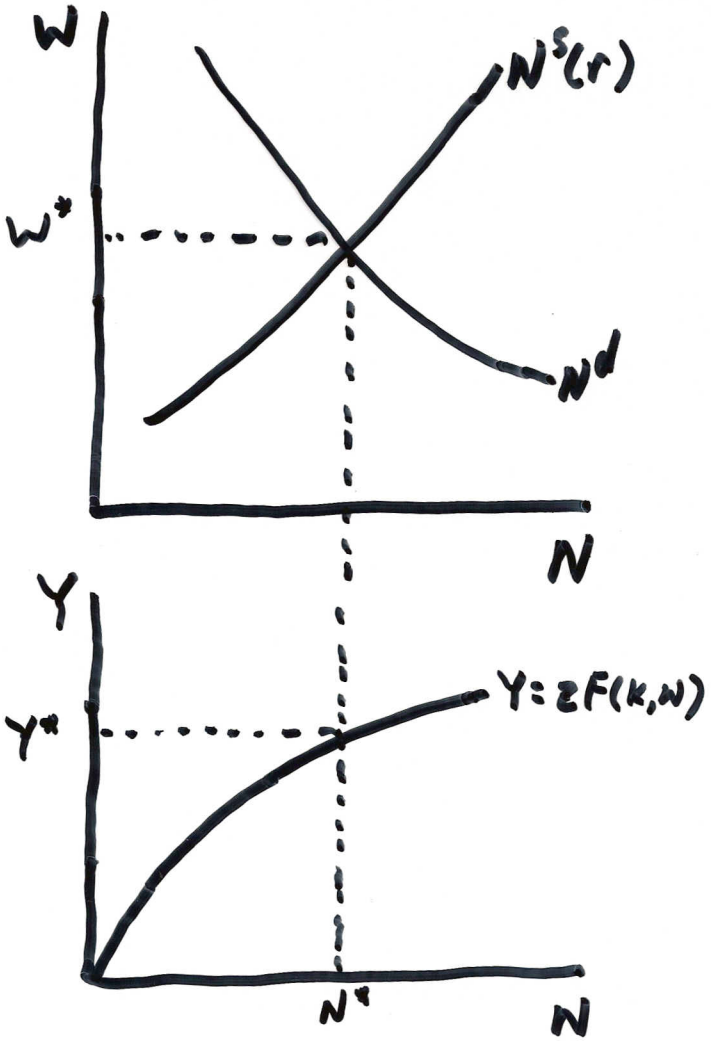
- So the firm's demand for current labor and investment can be described by 2 simple graphs:





- Now let's put it all together and look for equilibrium in both the labor + goods markets.

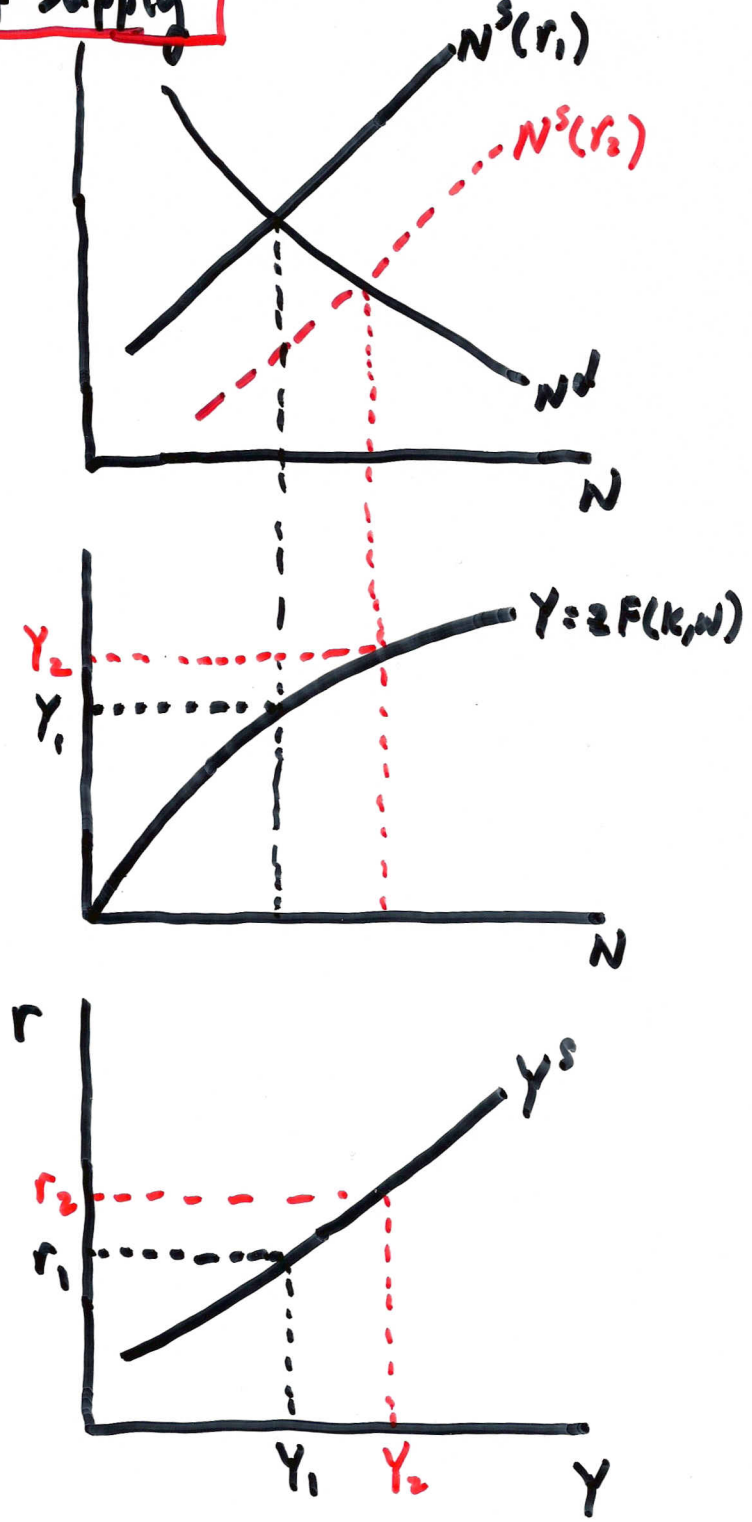
- The labor market is deceptively easy, because it looks just like before:



- The crucial difference is that now labor supply is allowed to depend on the interest rate, which depends on equilibrium in the goods market (which in turn depends on equilibrium in the labor market!)

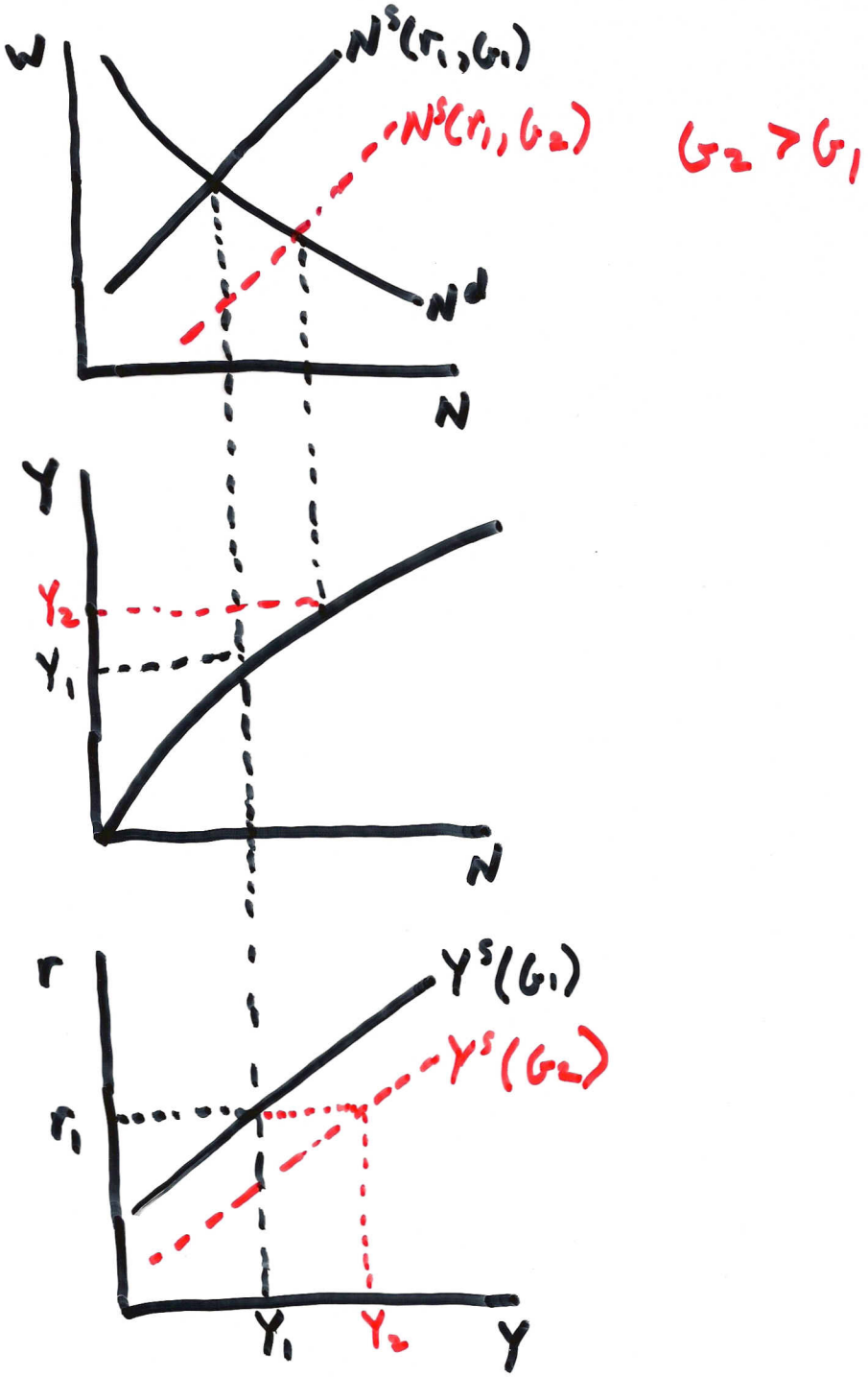
- To determine goods market equilibrium we need to consider the interaction between output supply and output demand

Output Supply

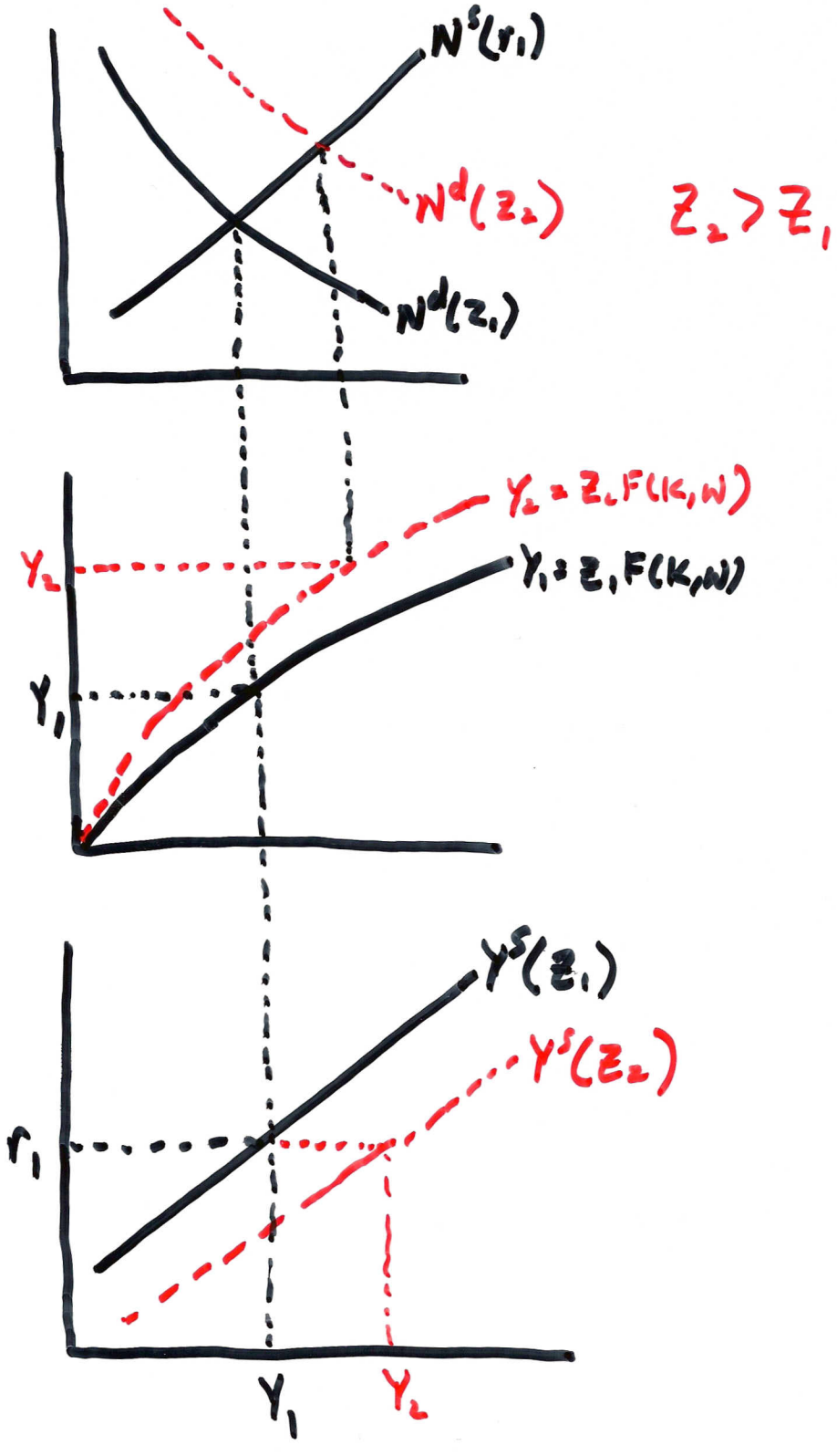


- Anything that causes the supply of output to change for a given interest rate will cause the Y^s curve to shift.

Example 1: Increase in Govt. Spending



Example 2 : Increase in Current Productivity

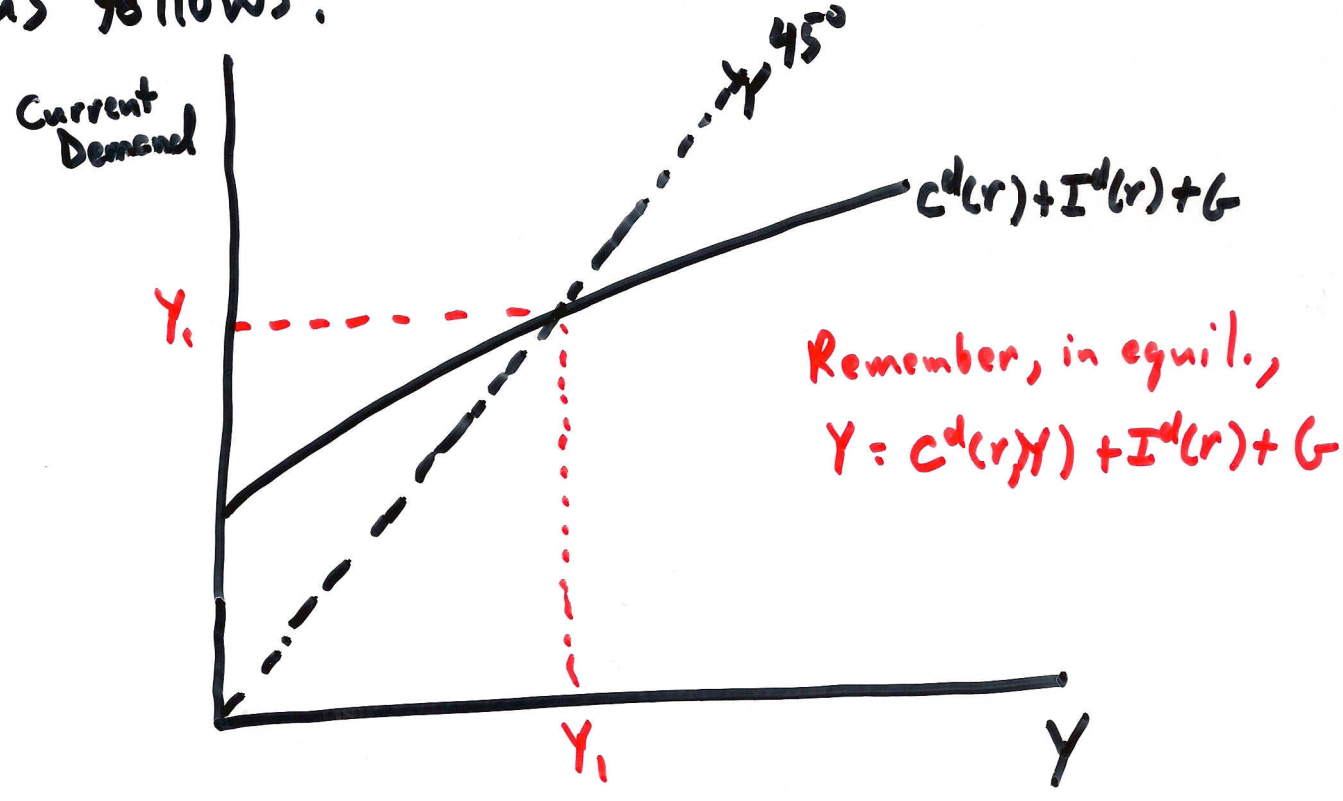


Output Demand

- Demand for current output comes from 3 sources:
  1.) Household consumption
  2.) Firm's investment
  3.) Government purchases

- Govt. purchases are assumed to be exogenous, but both household consumption & firm investment depend negatively on the interest rate.

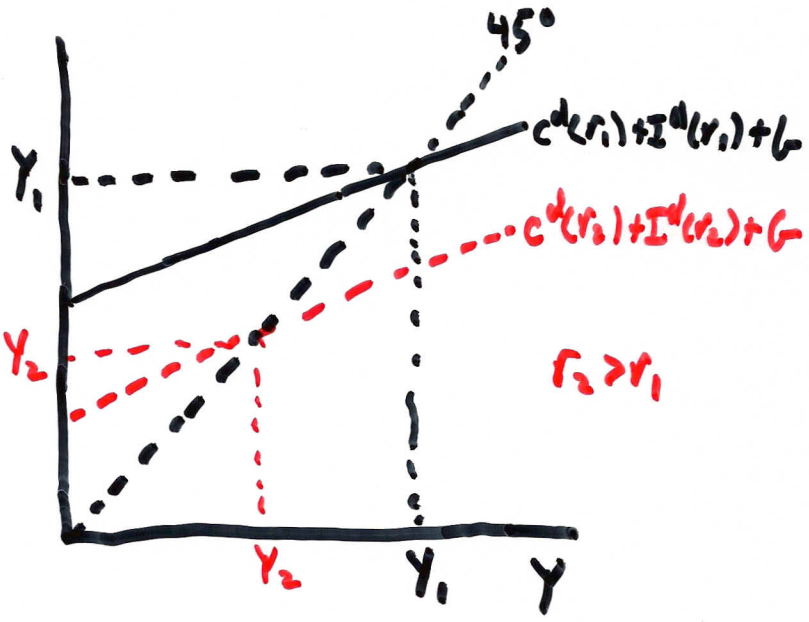
- Household consumption demand is a little tricky, since consumption depends on current income, which in turn depends (in equilibrium) on consumption. We can depict this simultaneity as follows:

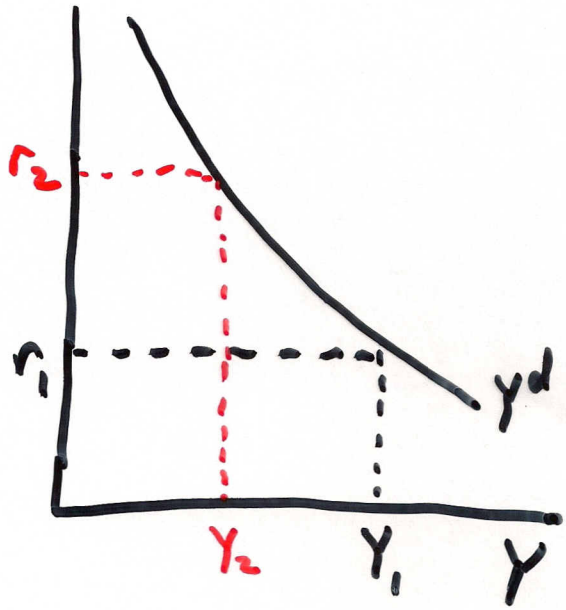


Remember, in equil.,

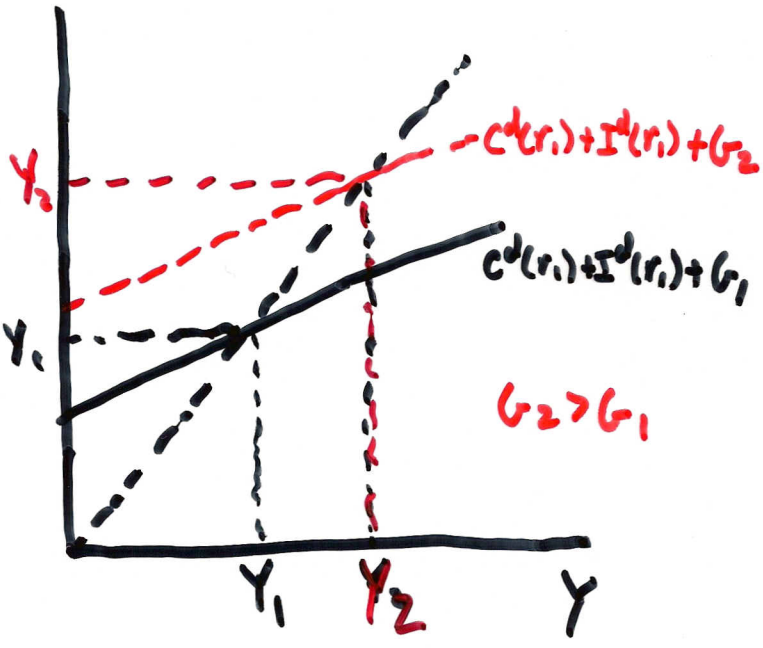
$Y = C^d(r,Y) + I^d(r) + G$

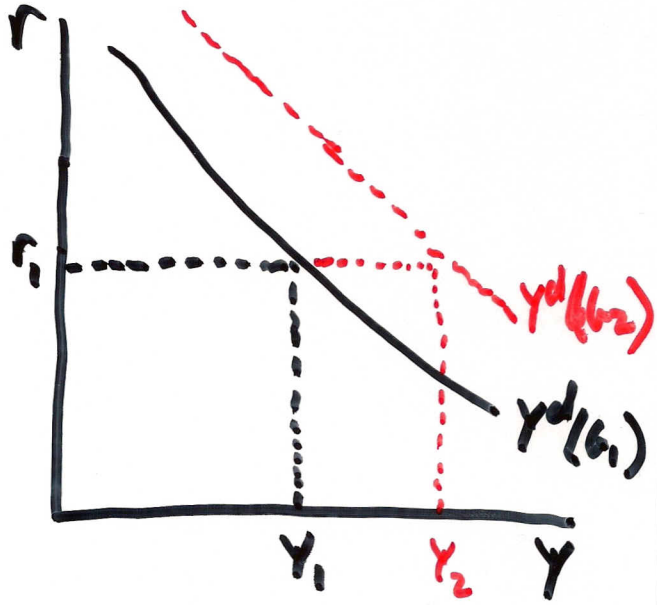
- An increase in r decreases both C^d and I^d, and so output demand declines



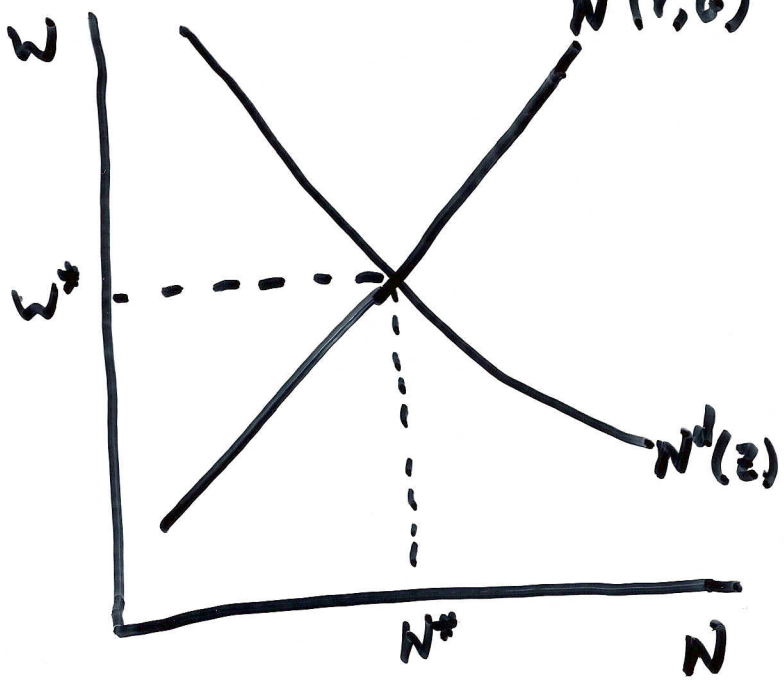


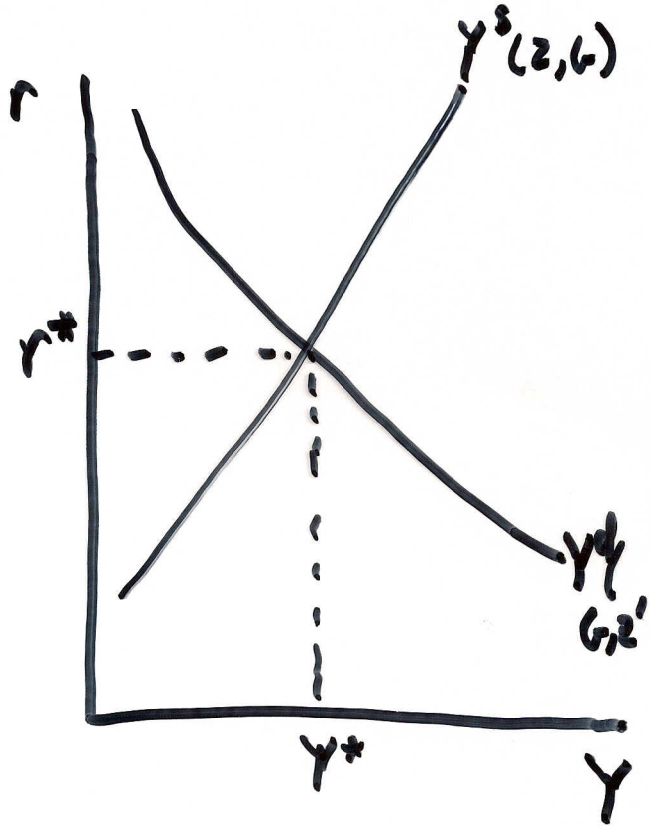
- An increase in current govt. spending shifts out Y^d





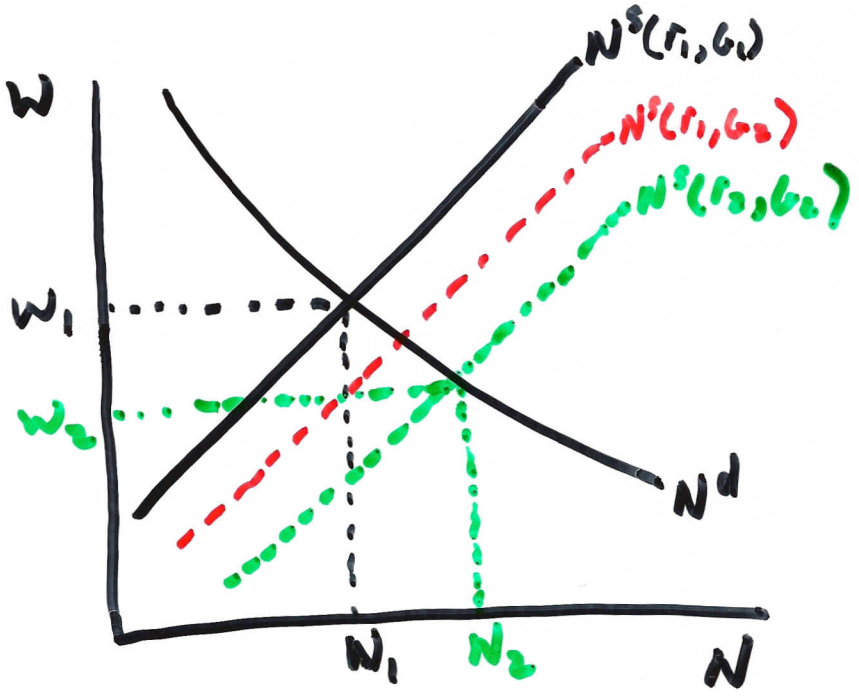
General Equilibrium

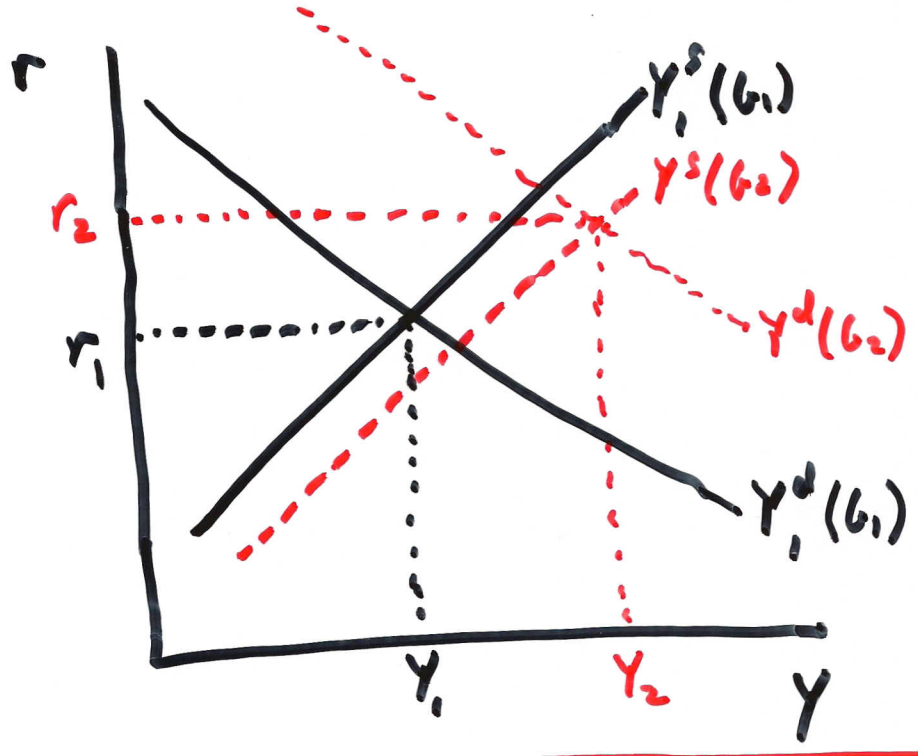




Comparative Statics

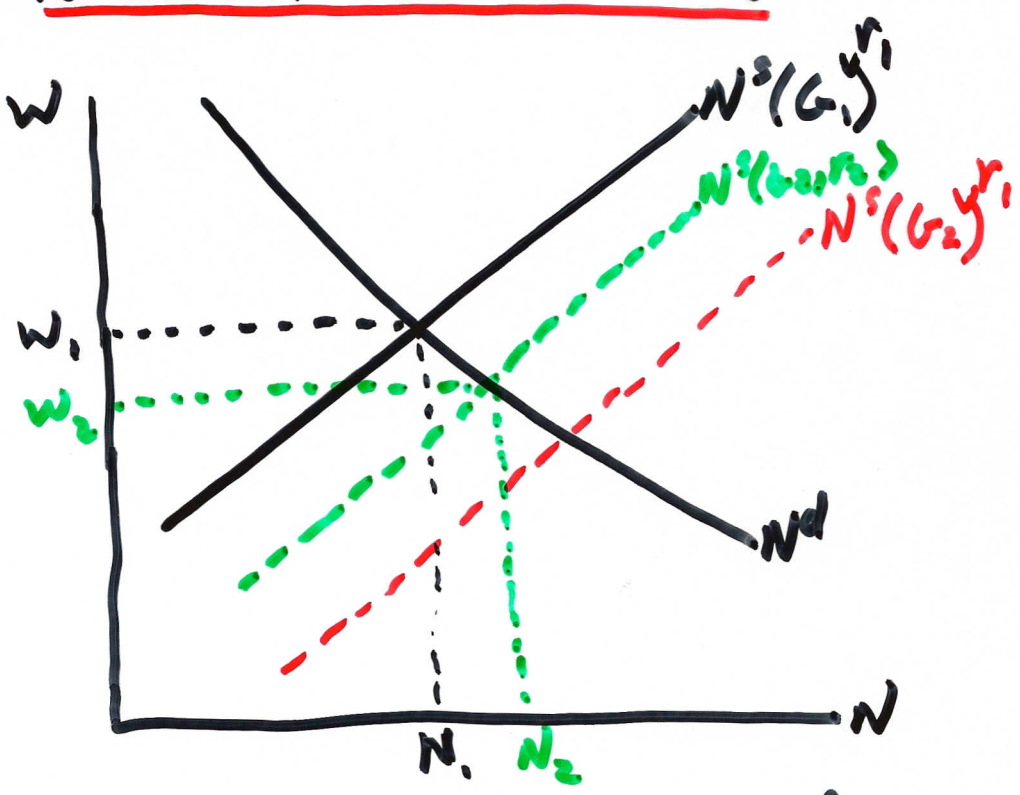
① Temporary Increase in G

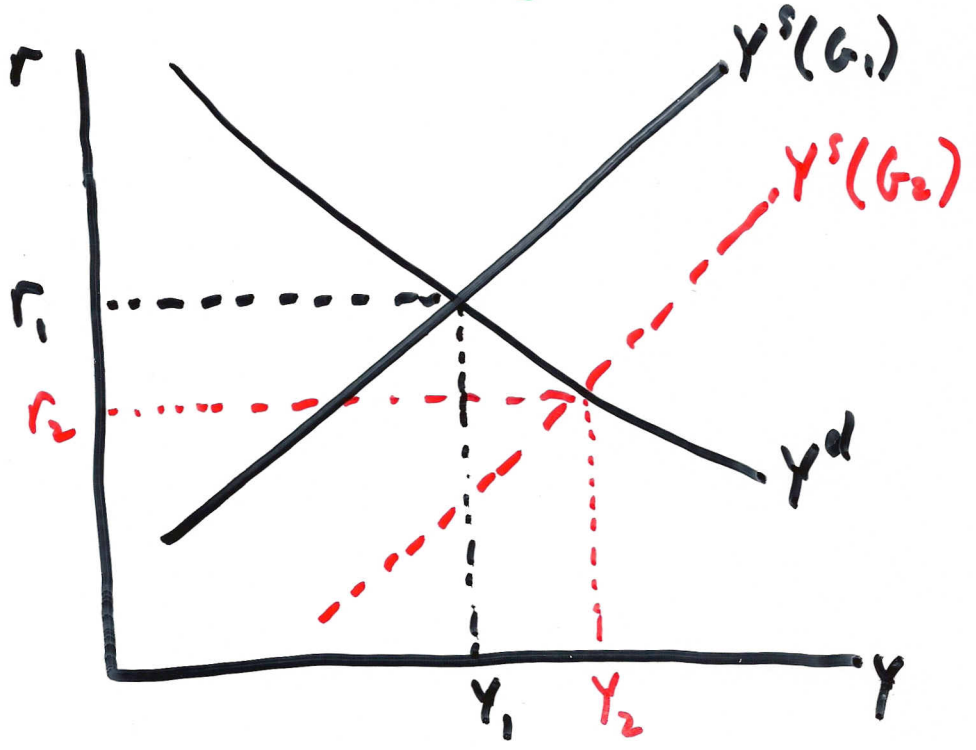




$$G\uparrow \Longrightarrow Y\uparrow, N\uparrow, C\downarrow, I\downarrow, W\downarrow, r\uparrow$$

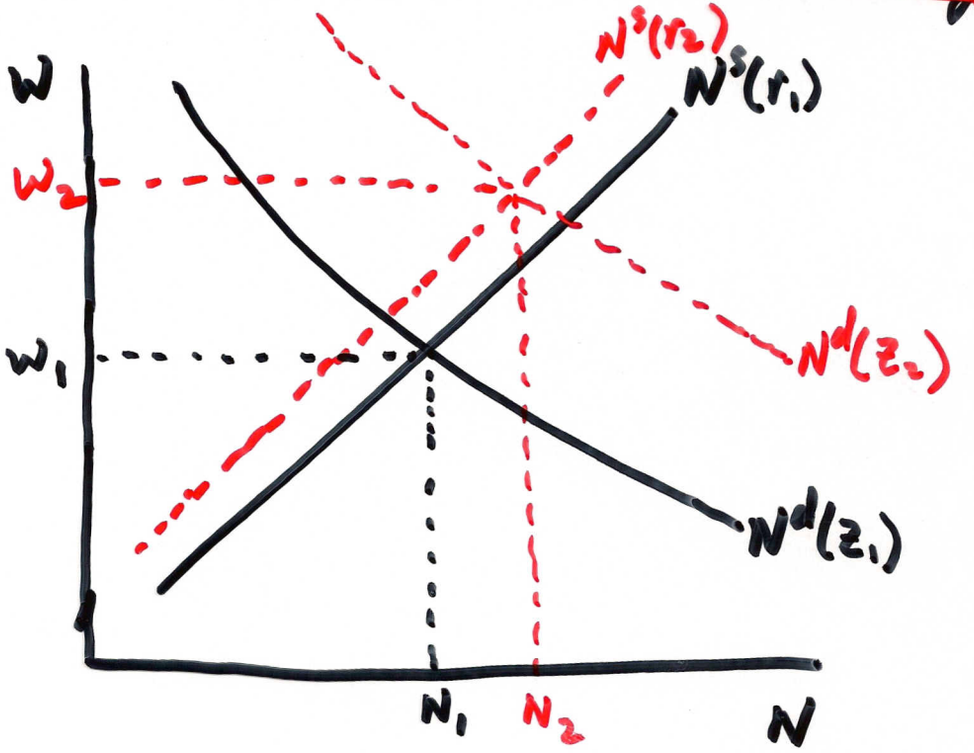
(2.) Permanent Increase in G

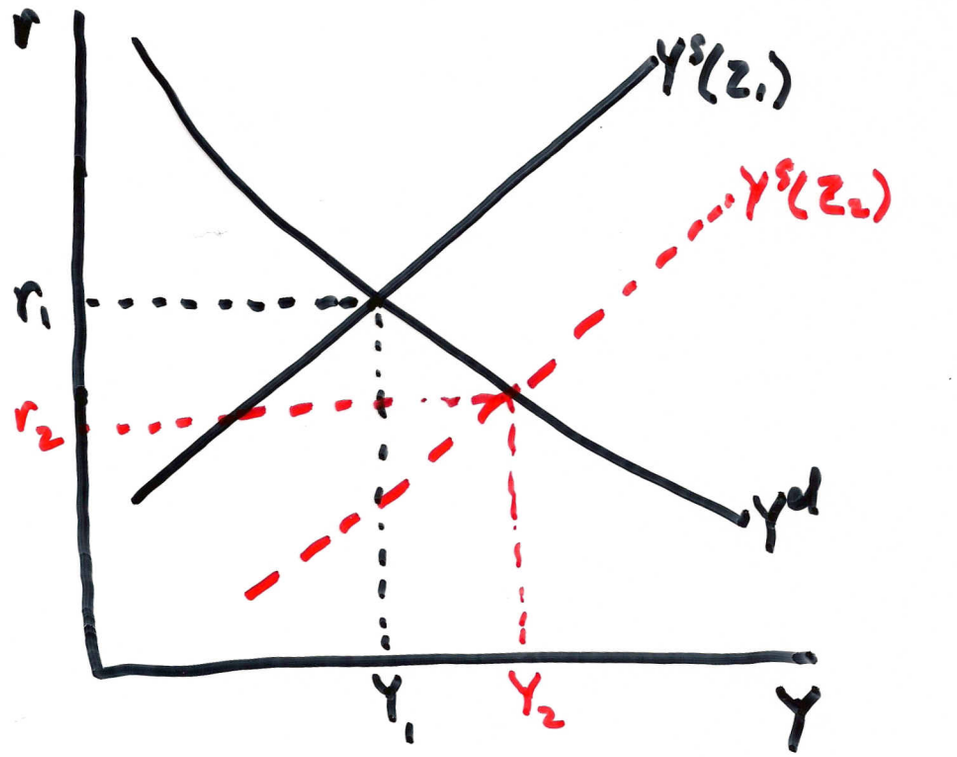




$G\uparrow(\text{permanent}) \Rightarrow Y\uparrow, N\uparrow, C\downarrow(\text{probably}), I\uparrow, w\downarrow, r\downarrow$

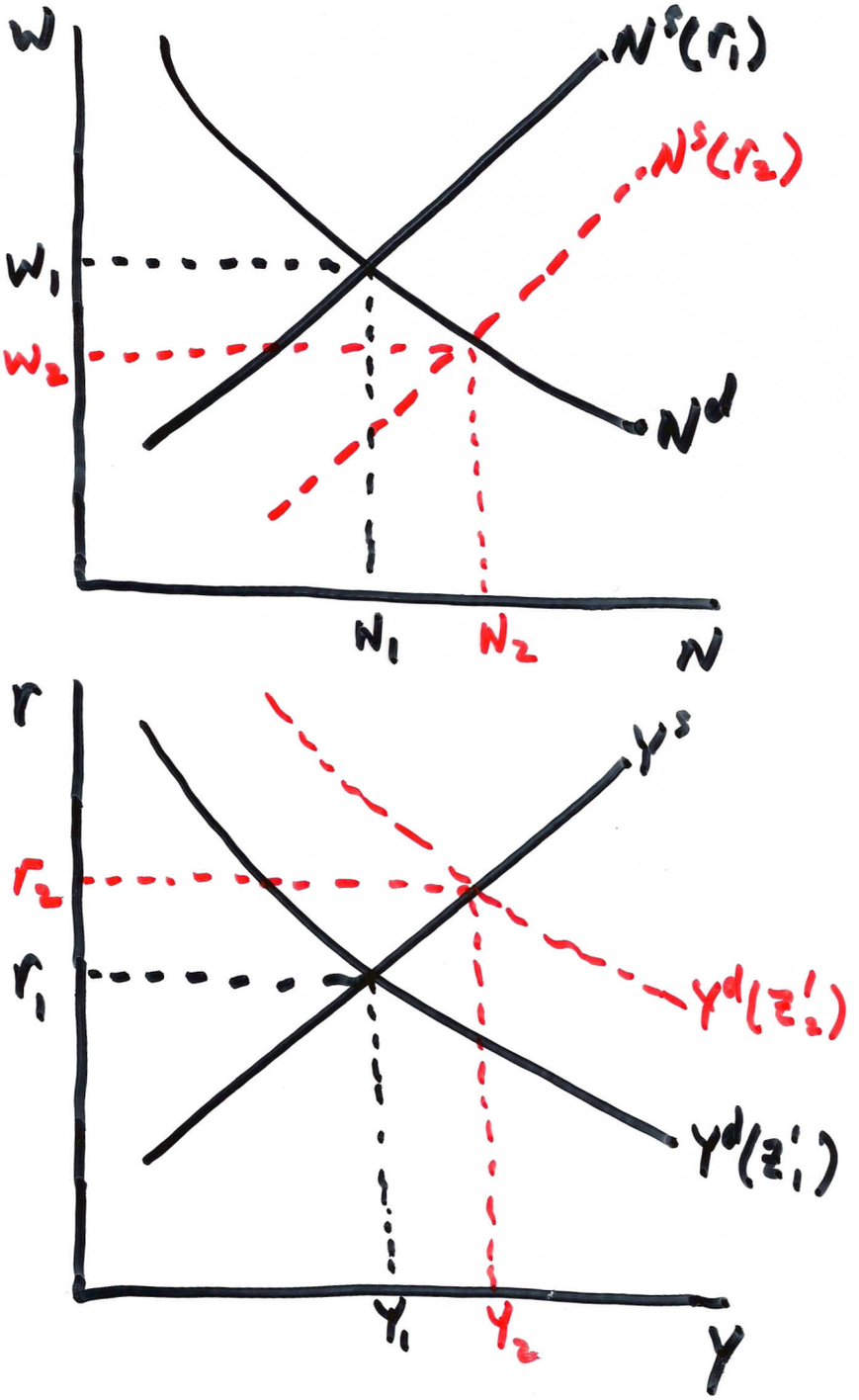
③ Temporary Increase in Productivity, $z\uparrow$





$z\uparrow \Rightarrow Y\uparrow, N\uparrow, C\uparrow, I\uparrow, w\uparrow, r\downarrow$

(4.) Expected Future Productivity Increases, $z' \uparrow$



$z' \uparrow \Rightarrow Y \uparrow, N \uparrow, C \downarrow \text{or} \uparrow, I \uparrow, w \downarrow, r \uparrow$