

Part I:

1) False: The original production function is $Y = \bar{A} K^{0.4} L^{0.6}$, so $y = \bar{A} \left(\frac{K}{L}\right)^{0.4} = \bar{A} k^{0.4}$

2) False: the preponderance of difference \rightarrow due to differences in \bar{A}

3) False: TFP plays a larger difference in the production model due to its effects on ability to bring capital into production.

4) True: $y = \bar{A} (1-\ell) (1 + \bar{\ell} \bar{L})^t \rightarrow \Delta \bar{\ell}$ changes coefficient and growth rate

5) False: nonrivalry of ideas explains long run growth

Part II:

1) a) $NGDP_{2016} = 160$

$$NGDP_{2017} = 183.7$$

b) $RGDGDP_{2016, 2016} = 160$

$$RGDP_{2017, 2016} = 171$$

c) $RGDP_{2016, 2017} = 172$

$$RGDP_{2017, 2017} = 183.7$$

d) $\% \Delta \text{NGDP} = 14.8\%$

$\% \Delta \text{RGDP}_{2016} = 6.88\%$

$\% \Delta \text{RGDP}_{2017} = 6.70\%$

c) $\Delta \% \text{NGDP} = 6.84\%$

2) a) + \$1M

b) + \$6000

c) Ø

d) Ø

e) + \$80M

f) + \$5000

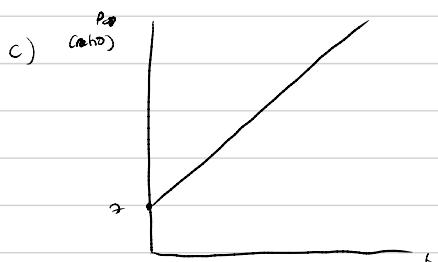
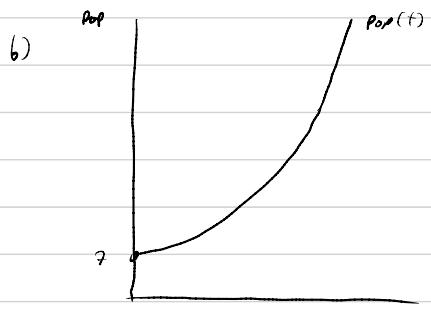
g) Ø

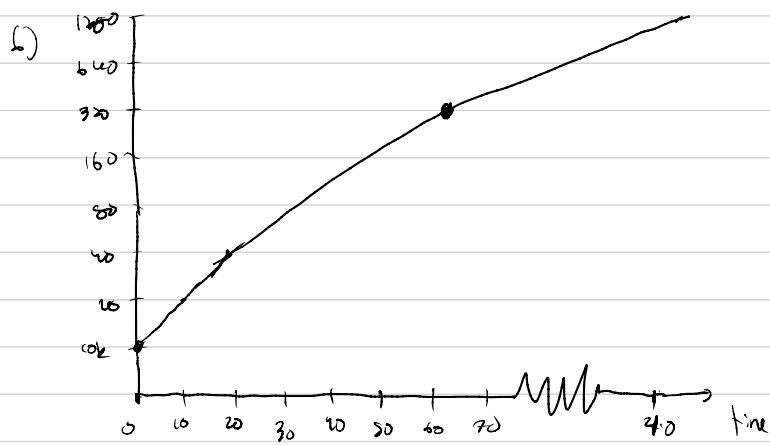
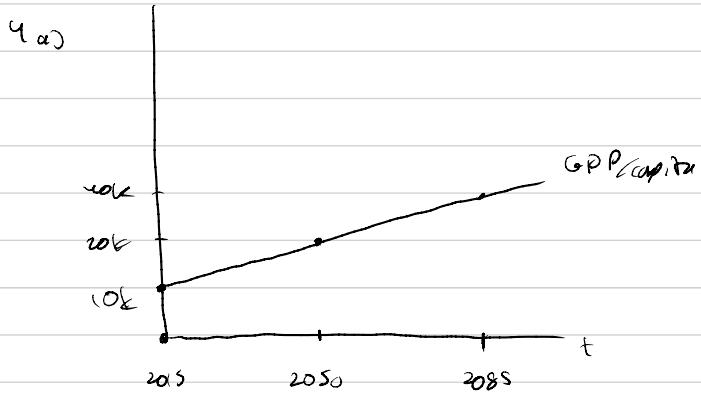
h) + \$100M

i) Ø

3) a)

time	pop(B)
0	7
1	7.21
2	7.43
10	9.41
25	14.66
50	30.68
100	134.53





$$\Delta t_1 = \left(\frac{3225}{2840} \right)^{1/(59)} - 1 = 1.7\%$$

$$\Delta t_2 = \left(\frac{3225}{2840} \right)^{(1/21)} - 1 \approx 2.4\% \leftarrow \text{from 2013 to 2050 had higher AGR}$$

$$\Delta t_3 = \left(\frac{3225}{3225} \right)^{(1/62)} - 1 = 1.0\%$$

6) a) $\frac{1}{3}\theta_E$

b) $\frac{1}{3}\theta_E + \frac{2}{3}\theta_H$

c) $\theta_M + \frac{1}{3}\theta_E + \frac{2}{3}\theta_H$

d) $\theta_M + \frac{1}{4}\theta_E + \frac{3}{4}\theta_H$

e) $\theta_M + \frac{3}{4}\theta_E + \frac{1}{4}\theta_H$

f) $\frac{1}{2}(\theta_E + \theta_H + \theta_M)$

g) $\frac{1}{4}(\theta_E + \theta_H) - \frac{3}{4}\theta_M$

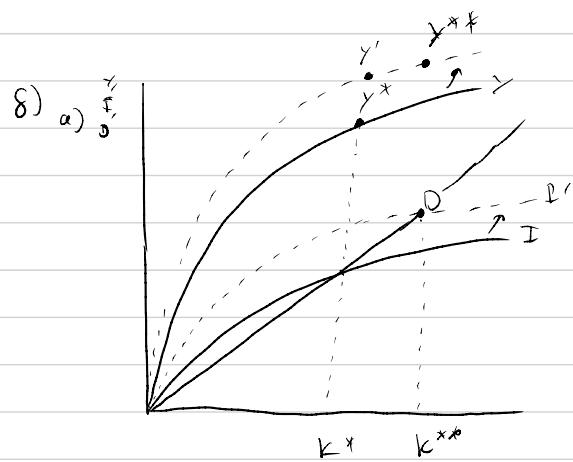
$$7) \text{ a)} Y(2k, 2L) = (2k)^{\alpha} (2L)^{\beta}$$

$$= 2(k^{\alpha} L^{\beta})$$

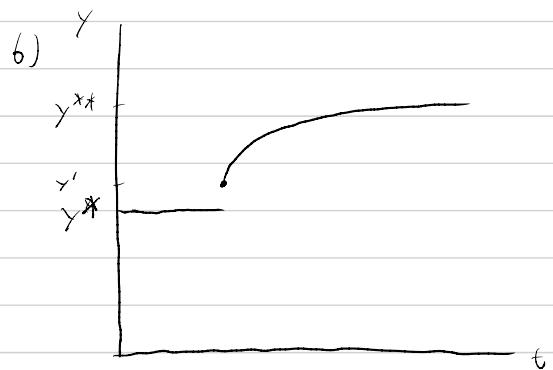
$$= 2Y(k, L); \text{ CRS}$$

$$b) Y(2k, 2L) = 2k + 2L = 2(k + L) = 2Y; \text{ CRS}$$

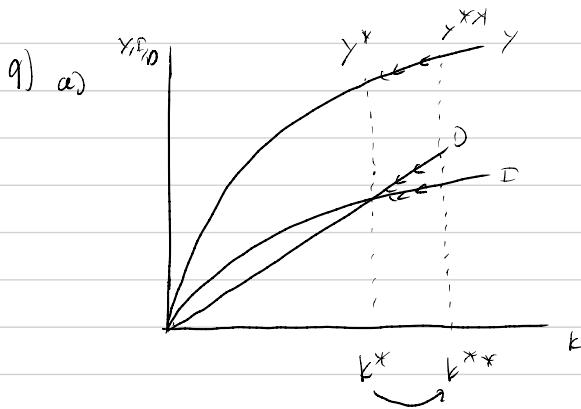
$$c) Y(2k, 2L) = (2k)^{\alpha} (2L)^{\beta} + \bar{A} < 2(k^{\alpha} L^{\beta} + \bar{A}); \text{ DRS}$$



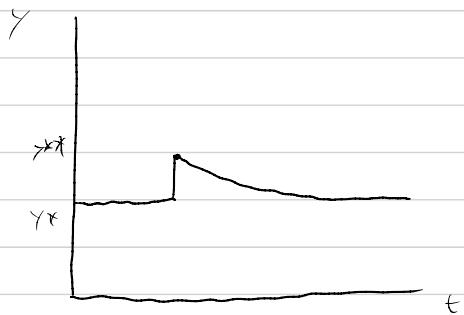
The economy grows to a new steady state at higher k and Y
than previously



- c) The increase in technology allows for higher levels of capital per person and increases output towards a new, higher steady state.



Output goes up then returns back to steady state as depreciation removes excess capital



- b) Foreign aid has no long term effect because it does not change underlying conditions of \bar{A} or δ .

- c) Our findings indicate that aid can have an effect on \bar{A} , because overall effects were somewhat lasting.

$$10) \text{ a) } Y_t = \bar{A} k_t^{2/3} l_t^{1/3}$$

$$\Delta k_t = \bar{I} - \bar{d} k_t$$

$$l_t = \bar{l}$$

$$C_t + I_t = Y_t$$

$$b) Y_t = \bar{A} k_t^{2/3}$$

$$\Delta k_t = i_t - \bar{d} k_t$$

$$C_t + i_t = y_t$$

$$\bar{A}^{3/2} \left(\frac{\bar{s}}{\bar{d}}\right)^{1/2}$$

$$c) \bar{s} y_t = \bar{d} k_t$$

$$\bar{s} \bar{A} k_t^{2/3} = \bar{d} k_t$$

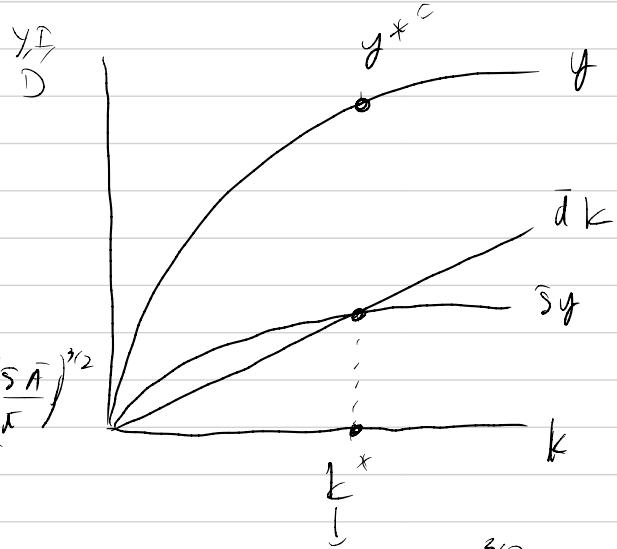
$$\frac{\bar{s} \bar{A} k_t^{2/3}}{\bar{d} k_t^{2/3}} = \frac{\bar{d} k_t}{\bar{d} k_t^{2/3}}$$

$$\frac{\bar{s} \bar{A}}{\bar{d}} = k_t^{2/3} \Rightarrow k_t^* = \left(\frac{\bar{s} \bar{A}}{\bar{d}}\right)^{3/2}$$

$$\left(\frac{\bar{s} \bar{A}}{\bar{d}}\right)^{2/3} = k_t^{2/3}$$

$$\bar{A} k_t^{2/3} = \bar{A}^{3/2} \left(\frac{\bar{s}}{\bar{d}}\right)^{1/2}$$

$$Y_t = \bar{A}^{3/2} \left(\frac{\bar{s}}{\bar{d}}\right)^{1/2}$$



$$k_t^* = \left(\frac{\bar{s} \bar{A}}{\bar{d}}\right)^{3/2}$$

(1)

Country	GDP, PC	\bar{S}	\bar{A}	(a)	(b)
				Predicted PC_GDP	% gap
US	1.000	0.235	1.000	1	0
SK	0.666	0.369	0.713	0.789	13.2%
MX	0.311	0.196	0.802	0.323	4.80%
AR	0.380	0.159	0.532	0.319	6.3%
IN	0.117	0.247	0.270	0.144	23.1%
BT	0.029	0.187	0.114	0.031	6.9%

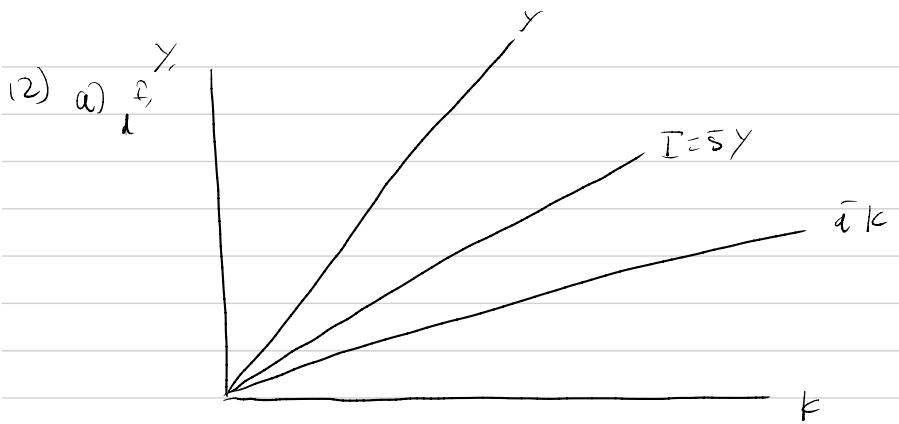
a) we will use the ratio as follows:

$$\text{Predicted}_c = \left(\frac{\bar{A}_c}{\bar{A}_{\text{US}}} \right)^{3/2} \left(\frac{\bar{S}_c}{\bar{S}_{\text{US}}} \right)^{1/2}$$

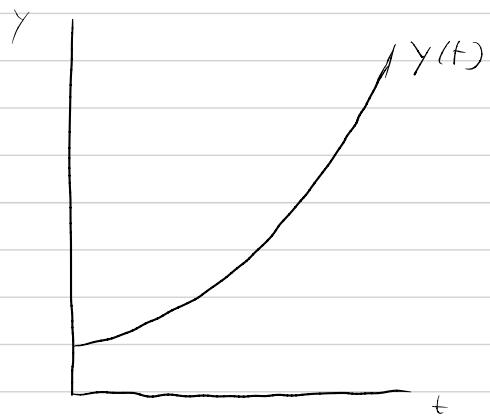
b) we calculate the % gap

c) fastest growth: India

Slowest growth: Mexico



b) The economy continues accumulating capital and growing as a result of investment always being higher than depreciation



$$c) K_{t+1} = K_t + \bar{s} \bar{A} K_t - \bar{d} K_t$$

$$\Delta K_t = \bar{s} \bar{A} K_t - \bar{d} K_t$$

$$\frac{\Delta K_t}{K_t} = \bar{s} \bar{A} - \bar{d}$$

$$\varphi_k = \bar{s} \bar{A} - \bar{d}$$

$$d) \eta_y = g(\bar{A} K_t)$$

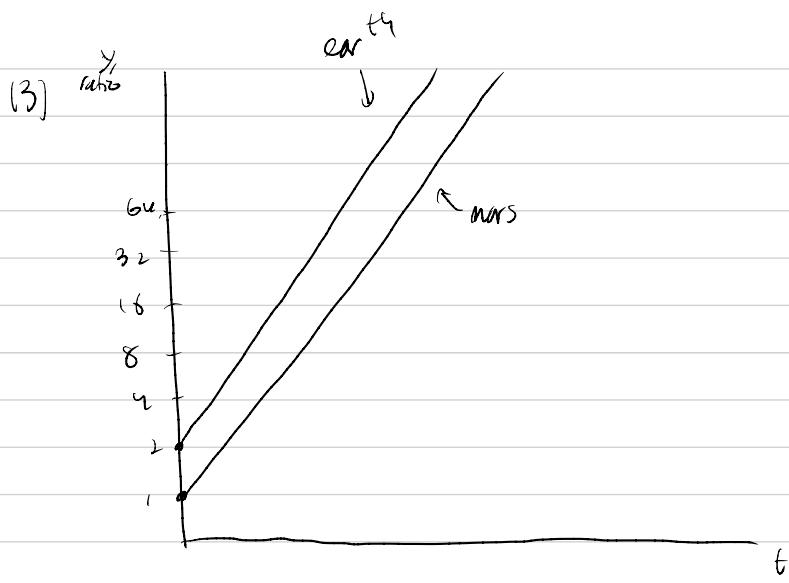
$$= g(\bar{A}) + g(K_t)$$

$$= \bar{s} \bar{A} - \bar{d}$$

$$e) \eta_y = g\left(\frac{Y}{L}\right)$$

$$= g(Y) - g(L)$$

$$= \bar{s} \bar{A} - \bar{d}$$



- The level of output is higher while the growth rates are similar

$$14) a) g = \bar{z} \bar{l} \bar{L} = 0.02$$

$$b) y_0 = (100)(0.94)(1) = 94; y_{100} = (100)(0.94)(1.02)^{100} = 681$$

$$c) g = 0.16$$

$$y_0 = (200)(0.88) = 176$$

$$y_{100} = (200)(0.88)(1.16)^{100} = 491,260,212$$

d) either double \bar{z} or double \bar{L} ; both of these have a positive growth effect without reducing levels.

15) a) - econ's production is a function of workers and ideas, which have diminishing marginal returns

- econ 2: change in ideas is a function of research productivity, current stock of ideas, and researchers

- econ 3: resource constraint people either create output or ideas.

- econ 4: researchers are a fraction \bar{l} of total workers

b) $q_A = \bar{z} \bar{\ell} \bar{L}$, \bar{A} with the original Romer model

$$c) Y = \left(A_0 (1 + \bar{z} \bar{\ell} \bar{L})^t \right)^{1/3} (1 - \bar{\ell})$$

$$= A_0^{1/3} (1 + \bar{z} \bar{\ell} \bar{L})^{t/3} (1 - \bar{\ell})$$

$$g_y = \frac{\bar{z} \bar{\ell} \bar{L}}{3}$$

$$d) y_t = A_0^{1/3} (1 - \bar{\ell}) (1 + \bar{z} \bar{\ell} \bar{L})^{t/3}$$

16) - Fact 1: differences in savings rates and \bar{A} determine eventual income levels

- Fact 2: differences in human capital and institutions, \bar{A} , explain greater differences

- Fact 3: After around 1800, we found some major ideas and institutional changes that started the growth of \bar{A}

- Fact 4: Countries vary in institutions, which helps explain differences in \bar{A} and thus allows some countries to be rich and others lose out