1.

$$Y(t) = [(1-a_K)K(t)]^{\alpha}[A(t)(1-a_L)L(t)]^{1-\alpha} \qquad \alpha \in (0,1)$$

$$\dot{A}(t) = B[a_K K(t)]^{\beta}[a_L L(t)]^{\gamma}A(t)^{\theta} \qquad B>0 \quad \beta \geq 0 \quad \gamma \geq 0$$

$$\dot{K}(t) = sY(t) \qquad \theta \geq 0$$

$$\dot{L}(t) = nL(t) \qquad n>0$$

$$\boxed{\beta+\theta<1}$$

$(\dot{g}_K = 0)$: $g_K = n + g_A$

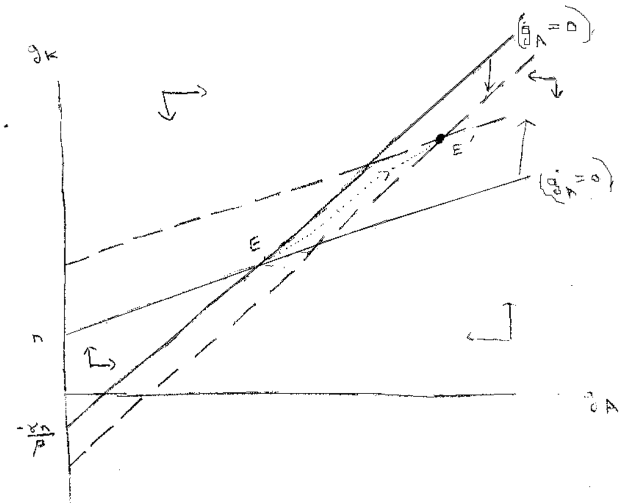
$(\dot{g}_A = 0)$: $g_K = \frac{-\gamma n}{\beta} + \frac{1-\theta}{\beta} g_A$

$$g_K(t) = s(1-a_K)^{\alpha}(1-a_L)^{1-\alpha}\left[\frac{A(t)L(t)}{K(t)}\right]^{1-\alpha}$$

$$g_A(t) = Ba_K^{\beta}a_L^{\gamma}K(t)^{\beta}L(t)^{\gamma}A(t)^{\theta-1}$$

---

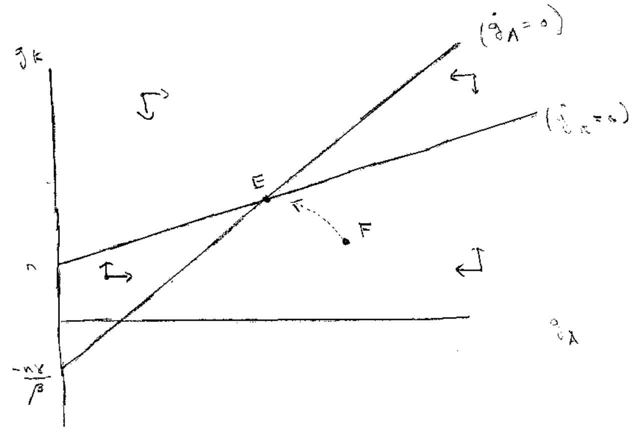
a) an increase in n :



B/c $\frac{\partial g_K(t)}{\partial n} = \frac{\partial g_A(t)}{\partial n} = 0$, there is no initial jump in the values for (g_K, g_A). The economy transitions from E to E'.

b) an increase in a_K:

$$
\begin{cases}
\dfrac{\partial g_K(t)}{\partial a_K} = -\alpha s (1-a_K)^{\alpha-1} (1-a_L)^{1-\alpha} \left[\dfrac{A(t)L(t)}{K(t)}\right]^{1-\alpha} < 0 \\[2ex]
\dfrac{\partial g_A(t)}{\partial a_K} = \beta B a_K^{\beta-1} a_L^{\gamma} K(t)^{\beta} L(t)^{\gamma} A(t)^{\theta-1} > 0
\end{cases}
$$



A change in a_K does not effect the $\dot{g}_K = 0$ or $\dot{g}_A = 0$ locus and thus does not alter the balanced growth combination of (g_A, g_K) at point E. However, an increase in a_K causes $g_K(t)$ to jump down and $g_A(t)$ to jump up immediately upon impact. Thus, the economy jumps to point F but gradually returns to a position of balanced growth at point E.

c) an increase in Θ:

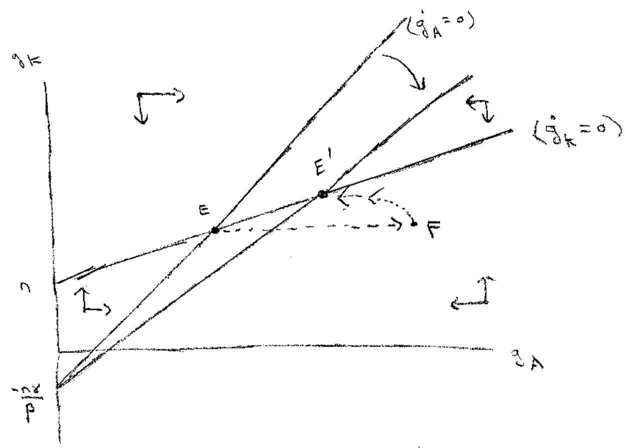
$$\frac{\partial g_K(t)}{\partial \Theta} = 0$$

$$\log g_A(t) = \log \theta a_K^{\beta} a_L^{\gamma} + \beta \log K(t) + \gamma \log L(t) + (\theta - 1) \log A(t)$$

$$\frac{1}{g_A(t)} \frac{\partial g_A(t)}{\partial \Theta} = \log A(t)$$

$$\frac{\partial g_A(t)}{\partial \Theta} = \underbrace{\log A(t)}_{(?)} \cdot \underbrace{g_A(t)}_{(+)}$$

$$\begin{cases} \text{if } A(t) > 1 \implies \dfrac{\partial g_A(t)}{\partial \Theta} > 0 \\ \text{if } A(t) < 1 \implies \dfrac{\partial g_A(t)}{\partial \Theta} < 0 \\ \text{if } A(t) = 1 \implies \dfrac{\partial g_A(t)}{\partial \Theta} = 0 \end{cases}$$

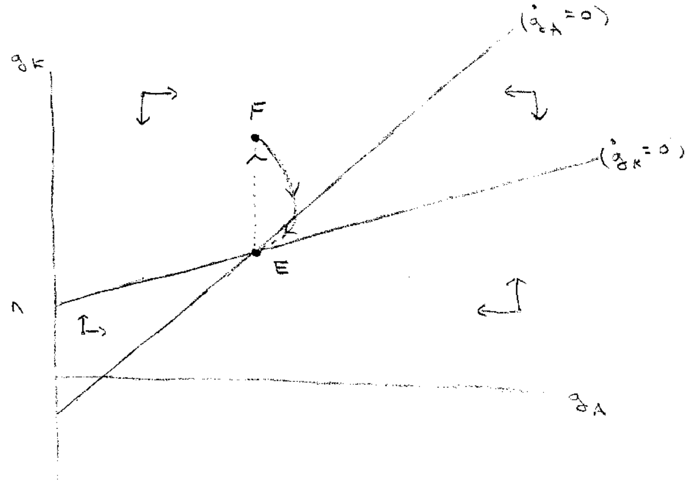


A rise in Θ does not affect the $\dot{g}_K = 0$ locus. It does, however, reduce the slope of the $\dot{g}_A = 0$ locus, giving the economy a new balanced growth point E'.

A rise in Θ has no immediate impact on g_K b/c $\frac{\partial g_K(t)}{\partial \Theta} = 0$. The immediate impact on g_A, however, depends on the value of $A(t)$. Assume $A(t) > 1 \implies$ a rise in Θ causes $g_A(t)$ to jump immediately upon impact to a point F. The economy gradually transitions from point F to a new balanced growth position at point E'.

d) an increase in s:

$$\begin{cases} \dfrac{\partial g_K(t)}{\partial s} = (1-a_K)^{\alpha}(1-a_L)^{1-\alpha}\left[\dfrac{A(t)L(t)}{K(t)}\right]^{1-\alpha} > 0 \\[2ex] \dfrac{\partial g_A(t)}{\partial s} = 0 \end{cases}$$



An increase in s does not effect the $\dot{g}_K = 0$ or $\dot{g}_A = 0$ locus and thus does not alter the balanced growth combination (g_A, g_K) at point E. However, an increase in s causes $g_K(t)$ to jump up immediately but has no immediate impact on $g_A(t)$. Thus, the economy jumps to point F but gradually returns to a position of balanced growth at point E.

3.1 $Y(t) = A(t)(1-a_L)L(t)$

$$\dot{A}(t) = B[a_L L(t)]^{\gamma} A(t)^{\theta} \qquad \theta < 1$$

$$\dot{L}(t) = n L(t)$$

$$g_A(t) \equiv \frac{\dot{A}(t)}{A(t)} = B a_L^{\gamma} L(t)^{\gamma} A(t)^{\theta - 1}$$

$$\dot{g}_A(t) = \gamma n g_A(t) + (\theta - 1) g_A(t)^2$$

$$\dot{g}_A(t) \equiv 0 \Rightarrow \boxed{g_A^* = \frac{\gamma}{1-\theta} n}$$

a) on the balanced growth path: $\dot{A}(t) = g_A^* A(t)$

$$\Rightarrow B a_L^{\gamma} L(t)^{\gamma} A(t)^{\theta} = g_A^* A(t)$$

$$A(t)^{1-\theta} = \frac{B a_L^{\gamma}}{g_A^*} L(t)^{\gamma}$$

$$A(t) = \left(\frac{B a_L^{\gamma}}{g_A^*}\right)^{\frac{1}{1-\theta}} L(t)^{\frac{\gamma}{1-\theta}} = \left[\frac{(1-\theta) B a_L^{\gamma}}{\gamma n}\right]^{\frac{1}{1-\theta}} L(t)^{\frac{\gamma}{1-\theta}}$$

b) on the balanced growth path:

$$Y(t) = A(t)(1-a_L)L(t) = \left[\frac{(1-\theta) B a_L^{\gamma}}{\gamma n}\right]^{\frac{1}{1-\theta}} (1-a_L) L(t)^{\frac{\gamma}{1-\theta}+1}$$

$$= \left[\frac{(1-\theta)B}{\gamma n}\right]^{\frac{1}{1-\theta}} a_L^{\frac{\gamma}{1-\theta}} (1-a_L) L(t)^{\frac{\gamma}{1-\theta}+1}$$

$$\max_{a_L} Y(t) \qquad a_L: \left\{\left(\frac{\gamma}{1-\theta}\right) a_L^{\frac{\gamma}{1-\theta}-1}(1-a_L) - a_L^{\frac{\gamma}{1-\theta}}\right\}\left[\frac{(1-\theta)B}{\gamma n}\right]^{\frac{1}{1-\theta}} L(t)^{\frac{\gamma}{1-\theta}+1} = 0$$

$$\left(\frac{\gamma}{1-\theta}\right) a_L^{-1}(1-a_L) = 1$$

$$\frac{1-a_L}{a_L} = \frac{1-\theta}{\gamma}$$

$$a_L^{-1} - 1 = \frac{1-\Theta}{\gamma}$$

$$a_L^{-1} = \frac{1-\Theta+\gamma}{\gamma}$$

$$\boxed{a_L^{*} = \frac{\gamma}{1-\Theta+\gamma}} < 1$$

3. $$Y(t) = K(t)^{\alpha}\left[A(t)L(t)\right]^{1-\alpha}$$

$$\dot{K}(t) = sY(t) \qquad \text{let } L(t)=1 \ \forall t \implies n=0$$

$$\dot{A}(t) = BY(t) \qquad B>0$$

a) $$g_K(t) \equiv \frac{\dot{K}(t)}{K(t)} = \frac{sY(t)}{K(t)} = s\,K(t)^{\alpha-1}\left[A(t)\,\underbrace{\cancel{L(t)}}_{1}\right]^{1-\alpha} = s\,K(t)^{\alpha-1}A(t)^{1-\alpha}$$

$$g_A(t) \equiv \frac{\dot{A}(t)}{A(t)} = \frac{BY(t)}{A(t)} = B\,K(t)^{\alpha}A(t)^{-\alpha}\,\underbrace{\cancel{L(t)}}_{1}{}^{1-\alpha} = B\,K(t)^{\alpha}A(t)^{-\alpha}$$

b) $$\log g_K(t) = \log s + (\alpha-1)\log K(t) + (1-\alpha)\log A(t)$$

$$\frac{\dot{g}_K(t)}{g_K(t)} = (\alpha-1)\,g_K(t) + (1-\alpha)\,g_A(t)$$

$$= (\alpha-1)\left[g_K(t) - g_A(t)\right]$$

$$\implies (\dot{g}_K = 0):\quad g_K = g_A$$

$$\log g_A(t) = \log B + \alpha\log K(t) - \alpha\log A(t)$$

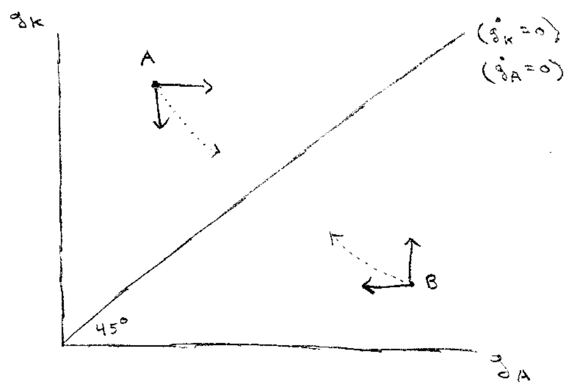
$$\frac{\dot{g}_A(t)}{g_A(t)} = \alpha\,g_K(t) - \alpha\,g_A(t)$$

$$= \alpha\left[g_K - g_A\right]$$

$$\implies (\dot{g}_A = 0):\quad g_K = g_A$$

when $n=0$, $(\dot{g}_K=0)$: $g_K=g_A$

$(\dot{g}_A=0)$: $g_K=g_A$



c) at point A:

1) $g_K > g_A \Rightarrow g_K - g_A > 0 \Rightarrow \dfrac{\dot{g}_K}{g_K} = \underbrace{(\alpha-1)}_{(-)}\underbrace{\left[g_K - g_A\right]}_{(+)} < 0$

$\Rightarrow g_K$ is falling

2) $g_K > g_A \Rightarrow g_K - g_A > 0 \Rightarrow \dfrac{\dot{g}_A}{g_A} = \alpha\left[g_K - g_A\right] > 0$

$\Rightarrow g_A$ is rising

at point B:

3) $g_K < g_A \Rightarrow \dfrac{\dot{g}_K}{g_K} = (\alpha-1)\left[g_K - g_A\right] > 0$

$\Rightarrow g_K$ is rising

4) $g_K < g_A \Rightarrow \dfrac{\dot{g}_A}{g_A} = \alpha\left[g_K - g_A\right] < 0$

$\Rightarrow g_A$ is falling

We can see from the diagram that the economy will eventually arrive at a situation where $g_K = g_A$ and both are constant. Thus, the economy will converge to a balanced stable growth path. However, we still do not have enough information to determine the unique balanced growth path.

$$\begin{cases} g_K(t) = s\,K(t)^{\alpha-1} A(t)^{1-\alpha} L(t)^{1-\alpha} = s\left[\frac{A(t)}{K(t)}\right]^{1-\alpha} \\ g_A(t) = B\,K(t)^{\alpha} A(t)^{-\alpha} L(t)^{1-\alpha} = B\left[\frac{A(t)}{K(t)}\right]^{-\alpha} \end{cases}$$

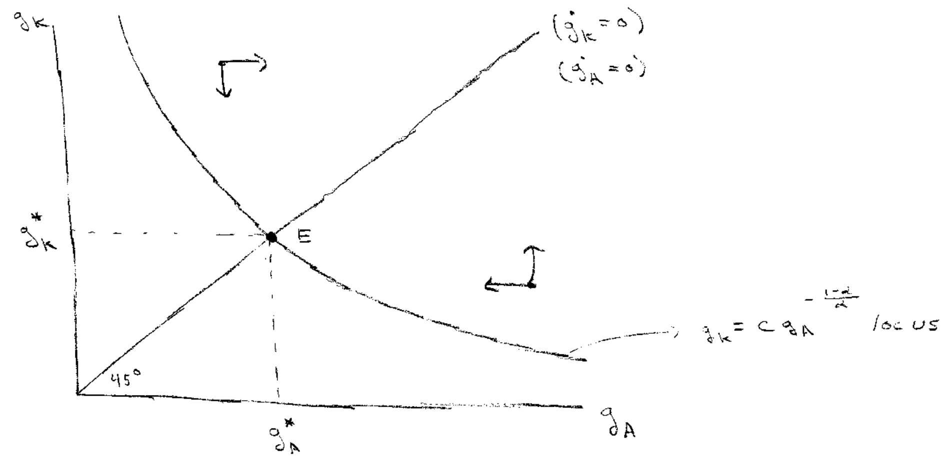
At any point in time, g_K & g_A are linked b/c both depend on $\left(\frac{A}{K}\right)$ at that point in time.

$$\hookrightarrow \quad \frac{A(t)}{K(t)} = \left[\frac{B}{g_A(t)}\right]^{1/\alpha}$$

$$\Rightarrow \quad g_K(t) = s\left[\frac{B}{g_A(t)}\right]^{\frac{1-\alpha}{\alpha}} = s B^{\frac{1-\alpha}{\alpha}} g_A(t)^{-\frac{1-\alpha}{\alpha}}$$

It must be the case that (g_K, g_A) lie on the locus of points satisfying $\boxed{g_K = s B^{\frac{1-\alpha}{\alpha}} g_A^{-\frac{1-\alpha}{\alpha}}}$.

$$g_K = \underbrace{s B^{\frac{1-\alpha}{\alpha}}}_{c} \, g_A^{-\frac{1-\alpha}{\alpha}}$$ recall $\alpha \in (0,1)$



Regardless of the initial value of $\frac{A(0)}{K(0)}$, the economy starts somewhere on this locus and then converges to point E.

Find (g_K^*, g_A^*)?

$g_K^* = g_A^* = g^*$

$\hookrightarrow \quad g^* = s B^{\frac{1-\alpha}{\alpha}} \, {g^*}^{-\frac{1-\alpha}{\alpha}}$

$${g^*}^{1/\alpha} = s B^{\frac{1-\alpha}{\alpha}}$$

$$\boxed{g^* = s^{\alpha} B^{1-\alpha}}$$

$\therefore$

$g_K^* = s^{\alpha} B^{1-\alpha}$

$g_A^* = s^{\alpha} B^{1-\alpha}$

$g_Y^* = s^{\alpha} B^{1-\alpha}$

$Y(t) = K(t)^{\alpha} A(t)^{1-\alpha}$

$\log_e Y(t) = \alpha \log K(t) + (1-\alpha) \log A(t)$

$$\frac{\dot{Y}(t)}{Y(t)} = g_Y(t) = \alpha g_K(t) + (1-\alpha) g_A(t)$$

$$\Rightarrow \quad g_Y^* = \alpha g_K^* + (1-\alpha) g_A^* = g^*$$

d) $g^* = s^{\alpha} B^{1-\alpha}$

$$\frac{\partial g^*}{\partial s} = \alpha s^{\alpha-1} B^{1-\alpha} > 0$$

$\longrightarrow$ so an increase in s has a permanent effect on the growth rate of output ... not just a temporary one.

$(\dot{g}_K = 0)$: $g_K = g_A$

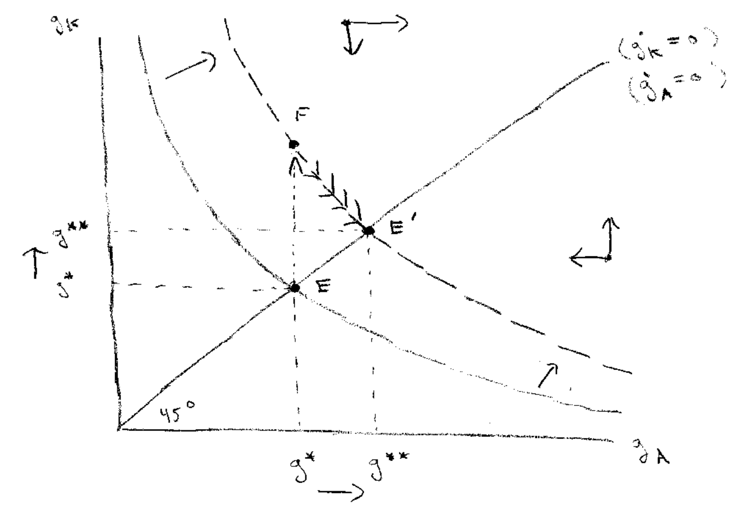
$(\dot{g}_A = 0)$: $g_K = g_A$

$g_K = s B^{\frac{1-\alpha}{\alpha}} g_A^{-\frac{1-\alpha}{\alpha}}$ $\longrightarrow$ locus of points (g_K, g_A) must always be on

An increase in s does not effect the $\dot{g}_K = 0$ locus or the $\dot{g}_A = 0$ locus. It will however shift the 3rd locus up & out.

$$\begin{cases} g_K(t) = s K(t)^{\alpha-1} A(t)^{1-\alpha} \\ g_A(t) = B K(t)^{\alpha} A(t)^{-\alpha} \end{cases}$$

$\longrightarrow$ a rise in s causes $g_K(t)$ to jump up immediately, but the rise in s has no immediate impact on $g_A(t)$



After the rise is s, the economy moves instantly to point F. It then moves down along the new locus until it reestablishes balanced growth at point E'

3.15

$$Y(t) = [(1-a_K)K(t)]^{\alpha}[(1-a_H)H(t)]^{1-\alpha}$$

$$\dot{K}(t) = sY(t) - \delta_K K(t)$$

$$\dot{H}(t) = B[a_K K(t)]^{\gamma}[a_H H(t)]^{\phi}[A(t)L(t)]^{1-\gamma-\phi} - \delta_H H(t)$$

$$\dot{L}(t) = nL(t)$$

$$\dot{A}(t) = gA(t)$$

$$\begin{cases} \alpha \in (0,1) \\ a_K \in (0,1) \\ a_H \in (0,1) \end{cases}$$

$$\begin{cases} \gamma > 0 \\ \phi > 0 \\ \gamma + \phi < 1 \end{cases}$$

a) $k = \frac{K}{AL}$ $h = \frac{H}{AL}$ $y = \frac{Y}{AL}$

$$\Rightarrow \frac{Y(t)}{A(t)L(t)} = \left[(1-a_K)\frac{K(t)}{A(t)L(t)}\right]^{\alpha}\left[(1-a_H)\frac{H(t)}{A(t)L(t)}\right]^{1-\alpha}$$

$$\boxed{y(t) = [(1-a_K)k(t)]^{\alpha}[(1-a_H)h(t)]^{1-\alpha}}$$

$$k(t) = \frac{K(t)}{A(t)L(t)}$$

$$\dot{k}(t) = \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{[A(t)L(t)]^2}\left[\dot{A}(t)L(t) + A(t)\dot{L}(t)\right]$$

$$= \frac{sY(t)}{A(t)L(t)} - \frac{\delta_K K(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\left[\frac{\dot{A}(t)}{A(t)} + \frac{\dot{L}(t)}{L(t)}\right]$$

$$= sy(t) - k(t)[\delta_K + n + g]$$

$$\boxed{\dot{k}(t) = s(1-a_K)^{\alpha}(1-a_H)^{1-\alpha}k(t)^{\alpha}h(t)^{1-\alpha} - k(t)[\delta_K + n + g]}$$

$$h(t) = \frac{H(t)}{A(t)L(t)}$$

$$\dot{h}(t) = \frac{\dot{H}(t)}{A(t)L(t)} - \frac{H(t)}{A(t)L(t)}\left[g+n\right]$$

$$= \frac{1}{A(t)L(t)}\left[B\left(a_K K(t)\right)^{\gamma}\left(a_H H(t)\right)^{\phi}\left(A(t)L(t)\right)^{1-\gamma-\phi} - \delta_H H(t)\right] - h(t)\left[g+n\right]$$

$$= B a_K^{\gamma} a_H^{\phi}\left(\frac{K(t)}{A(t)L(t)}\right)^{\gamma}\left(\frac{H(t)}{A(t)L(t)}\right)^{\phi}\left(\frac{A(t)L(t)}{A(t)L(t)}\right)^{1-\gamma-\phi} - \delta_H\frac{H(t)}{A(t)L(t)} - h(t)\left[g+n\right]$$

$$\boxed{\dot{h}(t) = B a_K^{\gamma} a_H^{\phi}\, k(t)^{\gamma} h(t)^{\phi} - h(t)\left[\delta_H + n + g\right]}$$

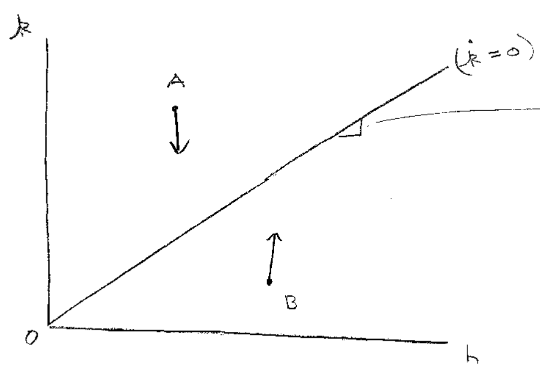
b) $\dot{k}(t) = 0 = c_K k(t)^{\alpha} h(t)^{1-\alpha} - (\delta_K + n + g)k(t)$

where $c_K = s(1-a_K)^{\alpha}(1-a_H)^{1-\alpha}$

$\hookrightarrow$ $c_K k(t)^{\alpha-1} h(t)^{1-\alpha} = \delta_K + n + g$

$$k(t) = \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h(t)$$

$$\boxed{k(t) = (1-a_K)^{\frac{\alpha}{1-\alpha}}(1-a_H)\left(\frac{s}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h(t)}$$



$$\left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}}$$

A: $k > \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h$

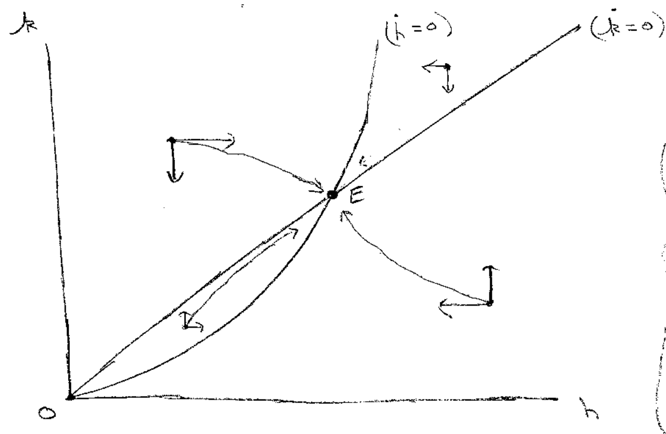
$\Rightarrow$ $k^{1-\alpha}(\delta_K+n+g) > c_K h^{1-\alpha}$

$(\delta_K+n+g) > c_K k^{\alpha-1} h^{1-\alpha}$

$c_K k^{\alpha} h^{1-\alpha} < (\delta_K+n+g)k$

$\Rightarrow$ $\dot{k} < 0$

c)



The stable balanced growth path is unique if we ignore $k=h=0$. Regardless of the initial values $(k(0), h(0))$ the economy will converge to point E

$$k = \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h \qquad k = \left(\frac{c_H}{\delta_H+n+g}\right)^{-1/\gamma} h^{\frac{1-\phi}{\gamma}}$$

$$\Longrightarrow \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h = \left(\frac{c_H}{\delta_H+n+g}\right)^{-1/\gamma} h^{\frac{1-\phi}{\gamma}}$$

$$\left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} \left(\frac{c_H}{\delta_H+n+g}\right)^{1/\gamma} = h^{\frac{1-(\gamma+\phi)}{\gamma}}$$

$$\boxed{h^* = \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{\gamma}{(1-\alpha)(1-\gamma-\phi)}} \left(\frac{c_H}{\delta_H+n+g}\right)^{\frac{1}{1-\gamma-\phi}}}$$

$$\boxed{k^* = \left(\frac{c_K}{\delta_K+n+g}\right)^{\frac{1-\phi}{(1-\alpha)(1-\gamma-\phi)}} \left(\frac{c_H}{\delta_H+n+g}\right)^{\frac{1}{1-\gamma-\phi}}}$$

$$B: k < \left(\frac{c_K}{\delta_K + n + g}\right)^{\frac{1}{1-\alpha}} h$$

$$\Longrightarrow \quad c_K k^{\alpha} h^{1-\alpha} > (\delta_K + n + g) k$$

$$\Longrightarrow \quad \dot{k} > 0$$

$$\dot{h}(t) = 0 = c_H k(t)^{\gamma} h(t)^{\phi} - (\delta_H + n + g)\, h(t)$$

$$\hookrightarrow \quad c_H k(t)^{\gamma} h(t)^{\phi - 1} = \delta_H + n + g \qquad \text{where } c_H = B a_K^{\gamma} a_H^{\phi}$$

$$k(t) = \left(\frac{\delta_H + n + g}{c_H}\right)^{1/\gamma} h(t)^{\frac{1-\phi}{\gamma}}$$

$$= \left(\frac{c_H}{\delta_H + n + g}\right)^{-1/\gamma} h(t)^{\frac{1-\phi}{\gamma}}$$

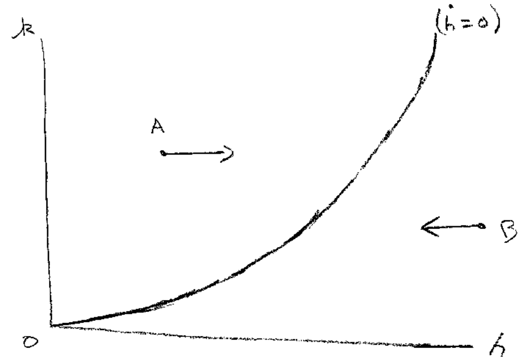
$$\boxed{k(t) = a_K^{-1} a_H^{-\phi/\gamma} \left(\frac{B}{\delta_H + n + g}\right)^{-1/\gamma} h(t)^{\frac{1-\phi}{\gamma}}}$$

$$\hookrightarrow \quad \phi + \gamma < 1$$

$$\frac{\phi}{\gamma} + 1 < \frac{1}{\gamma}$$

$$\frac{1}{\gamma} - \frac{\phi}{\gamma} > 1$$

$$\frac{1-\phi}{\gamma} > 1$$



$$A: k > \left(\frac{\delta_H + n + g}{c_H}\right)^{1/\gamma} h^{\frac{1-\phi}{\gamma}}$$

$$c_H k^{\gamma} > (\delta_H + n + g)\, h^{1-\phi}$$

$$c_H k^{\gamma} h^{\phi - 1} > \delta_H + n + g$$

$$c_H k^{\gamma} h^{\phi} > (\delta_H + n + g)\, h$$

$$\Longrightarrow \quad \dot{h} > 0$$

$$B: k < \left(\frac{\delta_H + n + g}{c_H}\right)^{1/\gamma} h^{\frac{1-\phi}{\gamma}}$$

$$c_H k^{\gamma} h^{\phi} < (\delta_H + n + g)\, h$$

$$\Longrightarrow \quad \dot{h} < 0$$

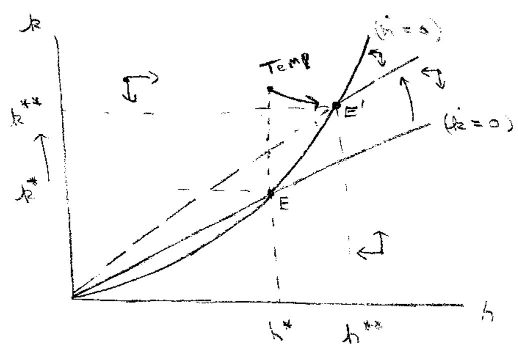
$$\frac{Y(t)}{L(t)} = A(t)\,y(t) \qquad \frac{K(t)}{L(t)} = A(t)\,k(t) \qquad \frac{H(t)}{L(t)} = A(t)\,h(t)$$

$$\left.\frac{\dot{\left(Y(t)/L(t)\right)}}{\left(Y(t)/L(t)\right)}\right|_{SS} = g \qquad \left.\frac{\dot{\left(K(t)/L(t)\right)}}{\left(K(t)/L(t)\right)}\right|_{SS} = g \qquad \left.\frac{\dot{\left(H(t)/L(t)\right)}}{\left(H(t)/L(t)\right)}\right|_{SS} = g$$

d) what happens after a permanent increase in s to the path of Y/L over time?

$$(\dot{k}=0) \Rightarrow k = (1-a_K)^{\frac{\alpha}{1-\alpha}}(1-a_H)\left(\frac{s}{\delta_K+n+g}\right)^{\frac{1}{1-\alpha}} h$$

$$(\dot{h}=0) \Rightarrow k = a_K^{-1} a_H^{-\phi/\gamma}\left(\frac{B}{\delta_H+n+g}\right)^{-1/\gamma} h^{\frac{1-\phi}{\gamma}}$$



Because the slope of the $\dot{k}=0$ locus is positively related to s, an increase in s will rotate the $\dot{k}=0$ locus counterclockwise. It will have no impact on the $\dot{h}=0$ locus.

The economy will converge to a new unique stable steady state (k^{**}, h^{**}). Y/L grows at a rate g until the instant s rises. During the transition from E to E' both k & h are rising $\Rightarrow$ $\frac{K}{L}$ & $\frac{H}{L}$ are both rising at a rate faster than g during the transition. This means that Y/L is growing at a rate faster than g during the transition as well. Once the economy reaches E', k & h are constant again $\Rightarrow$ K/L, H/L, Y/L are all growing at a rate of g again. A permanent rise in s has only a level effect on Y/L, not a permanent growth rate effect.