Role of Infrastructure Finance in Solow growth model

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India Finance Conference 2018

20 December 2018

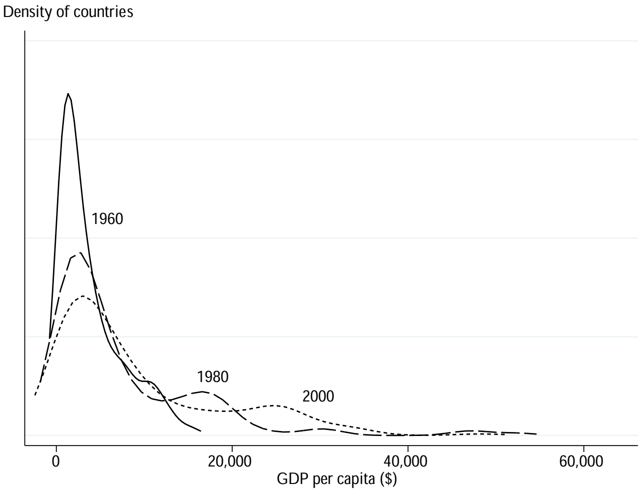


FIGURE 1.1 Estimates of the distribution of countries according to PPP-adjusted GDP per capita in 1960, 1980, and 2000.

Questions for Solow Growth Model

Infrastructure	Why do developing countries lack adequate infrastructure?
	Why does infrastructure wither away over time in developing countries?
Reforms	What kind of reforms turn a low-income country into a middle income country
Fiscal Policy	Does fiscal policy matter for long-run growth?
Capital Flows	*Lucas (1990):* Developing countries have a lower capital labour ratio. So, why doesn't capital flow to developing countries?

What is capital in growth models?

Physical capital very varied and impossible to aggregate

Financial capital easy to aggregate

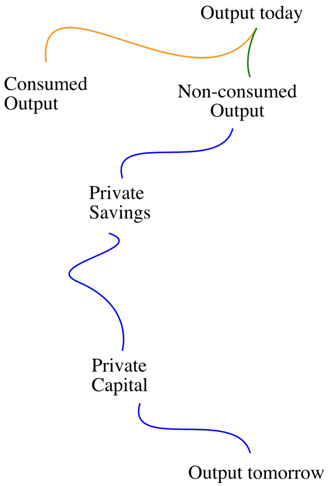
Question What is *capital* in a growth model?

How many *types of capital does a growth model require* to capture the essence of reality?

Answer …depends on how many *distinct channels* there are to transform output into capital

Solow Model

Output gets transformed into *private capital* through the *saving channel*



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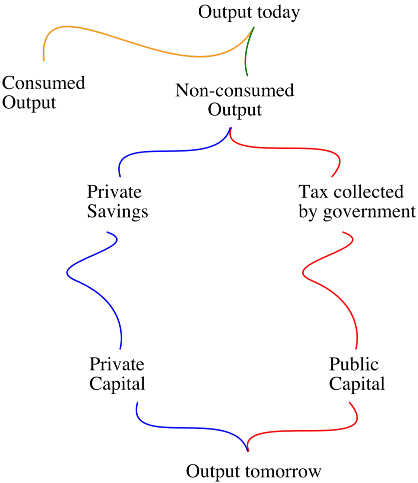
Output also gets transformed into *infrastructure* through the *fiscal channel*



Variables

$Y = F(\bar{K}, K, AL)$	production function
A	labour augmenting technology
K	private capital
δ	private capital's depreciation rate
$\bar{K}$	public capital (infrastructure)
$\bar{\delta}$	public capital (infrastructure)'s depreciation rate
s	private saving rate
τ	tax rate
ς	public goods investment rate
$1 - \varsigma$	leakage due to inefficiency and corruption

Output decomposed

Y	output
$\varsigma\tau \cdot Y$	output invested in public goods public capital (infrastructure)
$s(1-\varsigma\tau) \cdot Y$	output channeled to private savings and invested in private capital
$(1-s)(1-\varsigma\tau) \cdot Y$	output consumed

Production function

$$Y = \bar{K}^{\beta} K^{\alpha} (AL)^{1-(\alpha+\beta)}$$

Cobb-Douglas production function

β *elasticity* of output with respect to *public capital*

α *elasticity* of output with respect to *private capital*

$$y = \bar{k}^{\beta} k^{\alpha}$$

Cobb-Douglas production function (per-effective worker)

$\bar{k} = \frac{\bar{K}}{AL}$ private capital per-effective worker

$k = \frac{K}{AL}$ public capital per-effective worker

System of difference equations

$$k_{t+1} = s(1 - \varsigma\tau) \cdot \bar{k}^{\beta} k^{\alpha} + (1 - \delta - n - g) k_t$$
$$\bar{k}_{t+1} = \varsigma\tau \cdot \bar{k}^{\beta} k^{\alpha} + (1 - \bar{\delta} - n - g) \bar{k}_t$$

Setting $\bar{k}_{t+1} = \bar{k}_t$ and $k_{t+1} = k_t$ gives us

$$\bar{k}(k) = \left[\frac{\varsigma\tau}{\bar{\delta} + n + g} \right]^{\frac{1}{1-\beta}} k^{\frac{\alpha}{1-\beta}}$$
$$k(\bar{k}) = \left[\frac{s(1 - \varsigma\tau)}{\delta + n + g} \right]^{\frac{1}{1-\alpha}} \bar{k}^{\frac{\beta}{1-\alpha}}$$

Proposition

For $\bar{k} \in (0, \infty)$ and $k \in (0, \infty)$, the economy has a unique steady $(\bar{k}^*, k^*)$ state where

$$\begin{aligned} \bar{k}^* &= \left(\frac{s(1-\varsigma\tau)}{\delta+n+g}\right)^{\frac{\alpha}{1-(\alpha+\beta)}} \left(\frac{\varsigma\tau}{\bar{\delta}+n+g}\right)^{\frac{1-\alpha}{1-(\alpha+\beta)}} \\ k^* &= \left(\frac{s(1-\varsigma\tau)}{\delta+n+g}\right)^{\frac{1-\beta}{1-(\alpha+\beta)}} \left(\frac{\varsigma\tau}{\bar{\delta}+n+g}\right)^{\frac{\beta}{1-(\alpha+\beta)}} \end{aligned} \tag{1}$$

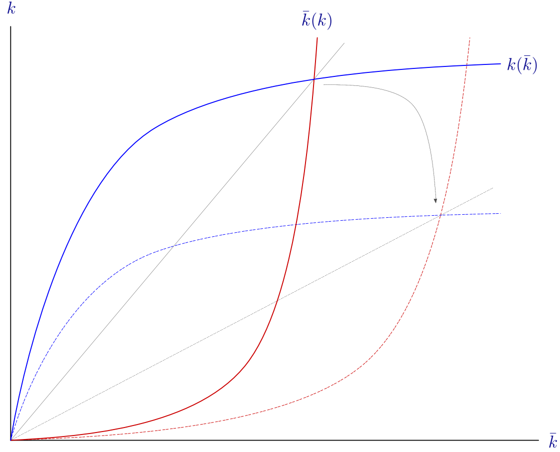
The steady state output and consumption per-effective worker is given by

$$y^* = \left(\frac{s(1-\varsigma\tau)}{\delta+n+g}\right)^{\frac{\alpha}{1-(\alpha+\beta)}} \left(\frac{\varsigma\tau}{\bar{\delta}+n+g}\right)^{\frac{\beta}{1-(\alpha+\beta)}} \tag{2}$$

$$c^* = (1-s)\left(\frac{s^{\alpha}\,(1-\varsigma\tau)^{1-\beta}(\varsigma\tau)^{\beta}}{(\delta+n+g)^{\alpha}(\bar{\delta}+n+g)^{\beta}}\right)^{\frac{1}{1-(\alpha+\beta)}} \tag{3}$$

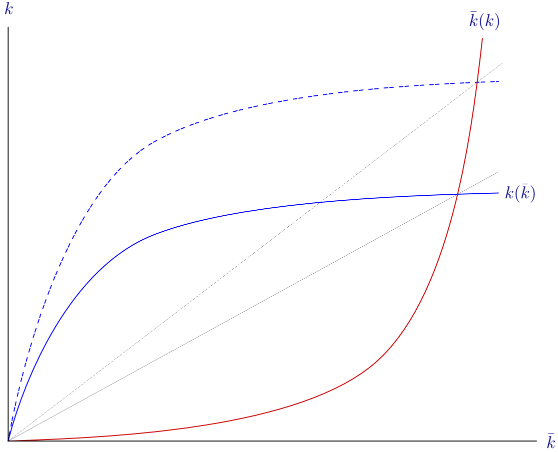
Impact of increase in $\varsigma\tau$

$\bar{k}(k)$ shift right as public good investment increases
$k(\bar{k})$ shift down as disposable income decreases.

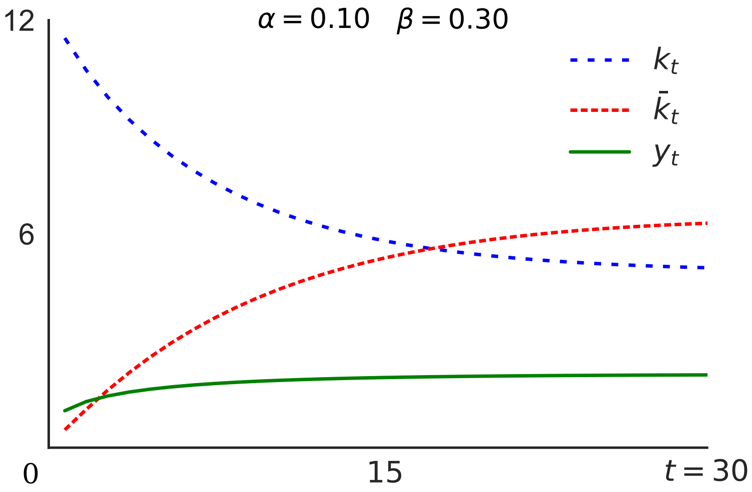


Impact of increase in s

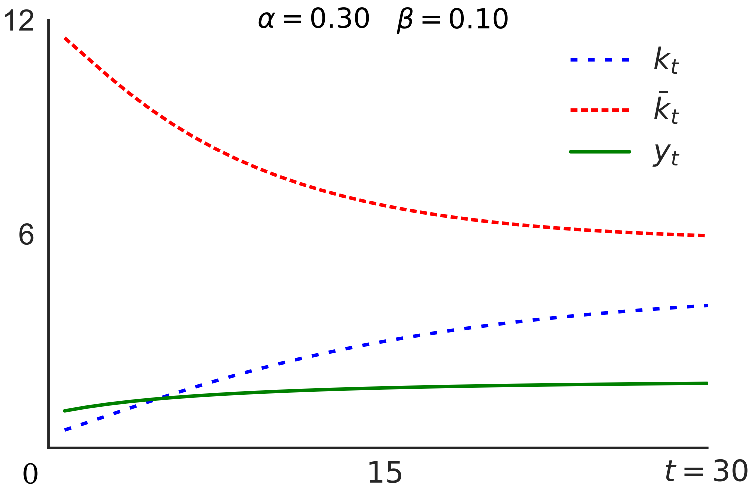
$k(\bar{k})$ shifts up.



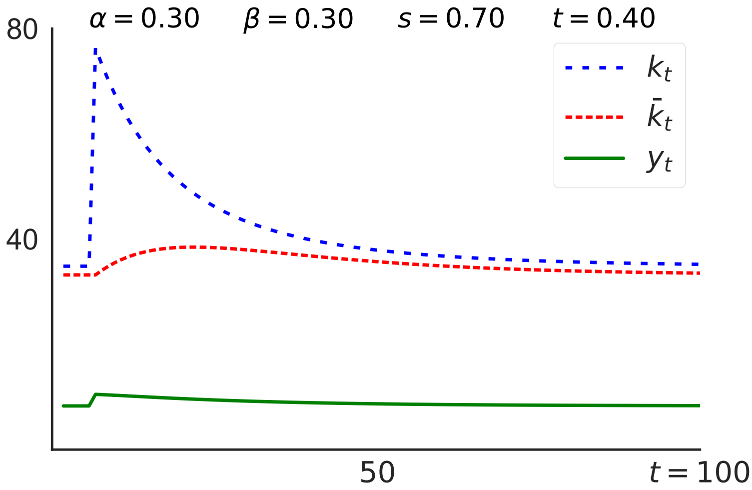
Simulation of output, public & private capital



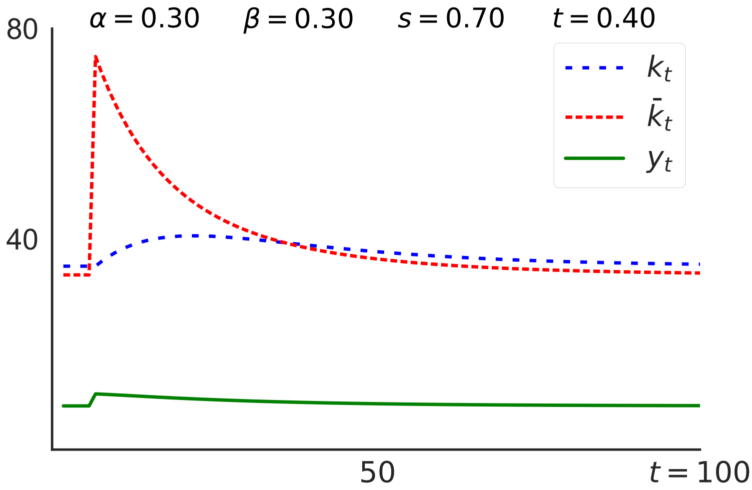
Simulation of output, public & private capital



Effect of shock increase private capital



The effect of shock increase in public



Main message

Saving channel and *fiscal channel* are inextricably linked

Per-capita income is determined by interaction of s and $\varsigma\tau$

Sustained per-capita income growth requires

- *increasing the fiscal capacity* of the state
- increasing the flow of *tax* collected *into productive public goods*
- creating *opportunities for private investment* through *infrastructure investment*
- increasing *efficacy* of the *saving channel through financial reforms* to take advantage of *infrastructure investment*