Macroeconomics I:
Economic Growth in the Long-Run

John Bluedorn
Nuffield College

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you can download the .PDF files from:

http://www.economics.ox.ac.uk
/members/john.bluedorn/teaching.htm

prelims macroeconomics

- Economic Growth in the Long-Run
- The Circular Flow of Income
- Consumption & Investment
- The National Budget Constraint
- Aggregate Demand
- The Labour Market
- Aggregate Supply
- Equilibrium of Aggregate Supply and Demand
- The Money Supply and Banking
- The Money Supply
- The Macro Model with Money: IS-LM I & II
- Inflation
- Macroeconomics in the Open Economy I, II & III

introduction

- "Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's? If so, *what*, exactly? If not, what is it about the "nature of India" that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else", Robert Lucas, 1988.

important elements of long-run growth

- Technical Change (q.v. Smith's pin factory)
  - Over time, technology becomes more advanced, and hence output per worker rises;
- Factor Accumulation (q.v. Ramsey on investment)
  - Over time, with sensible property rights, people accumulate capital assets (physical, human and environmental), even though factors are typically subject to diminishing returns;
- Factor Substitution (cf. Ricardo on land)
  - Over time, factors cannot earn economic rents unless their supply is restricted, even then, other factors can be used as substitutes;
- Product Substitution (q.v. Schumpeter on creative destruction)
  - Over time, new products are invented which replace older versions and types.

Kaldor's stylised facts

- Output per worker grows over time and its growth rate does not tend to diminish; the same is true of real wages;
- Physical capital per worker grows over time;
- The rate of return to capital is nearly constant;
- The ratio of physical capital to output is nearly constant;
- The shares of labour and physical capital in national income are nearly constant;
- The growth rate of output per worker differs substantially across countries.

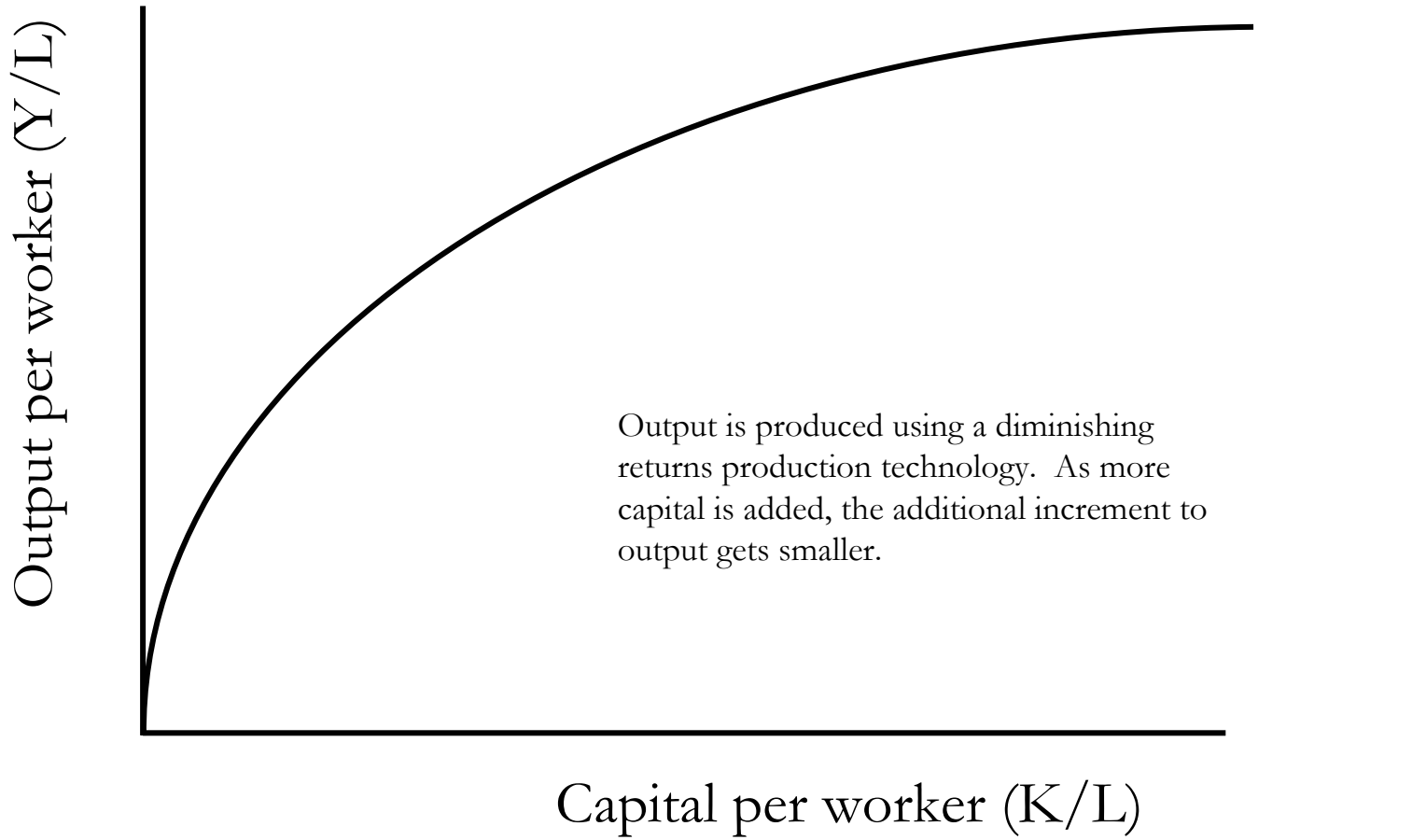
international labour productivity

	1820	1870	1890	1913	1929	1938	1950	1960	1973	1987	1998
	UK=100			USA=100							
USA	83	96	99	100	100	100	100	100	100	100	100
Japan	31	18	20	18	22	23	15	20	45	60	68
Germany	62	48	53	50	42	46	34	52	73	91	106
France	80	54	53	48	48	54	42	51	74	99	102
Italy	58	39	35	37	35	40	38	46	78	96	100
UK	100	100	100	78	67	64	58	57	68	81	82
Canada	..	62	63	75	66	58	68	72	75	83	80

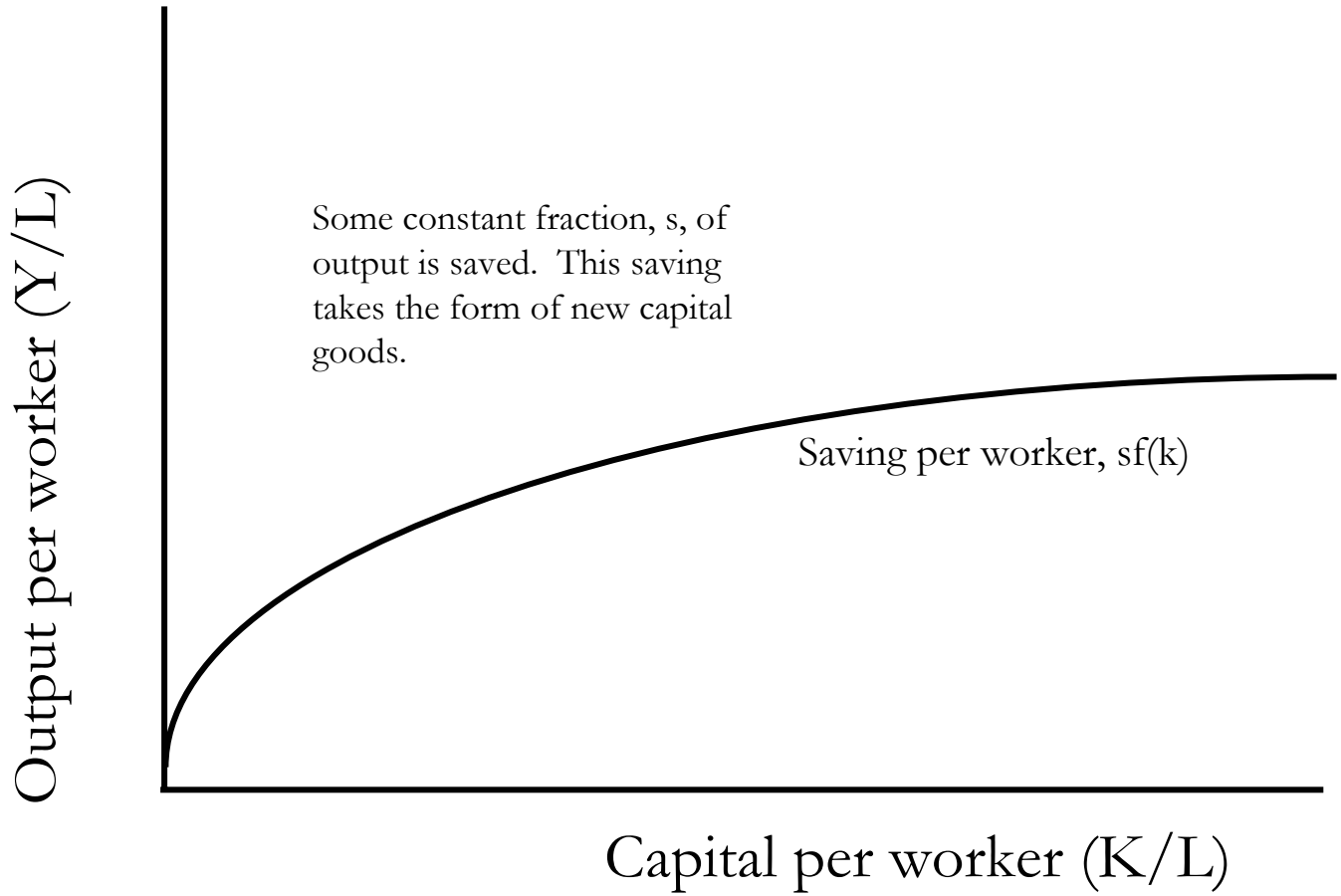
Source: Madison (1991) and OECD

Note: Labour Productivity is defined as GDP per man-hour

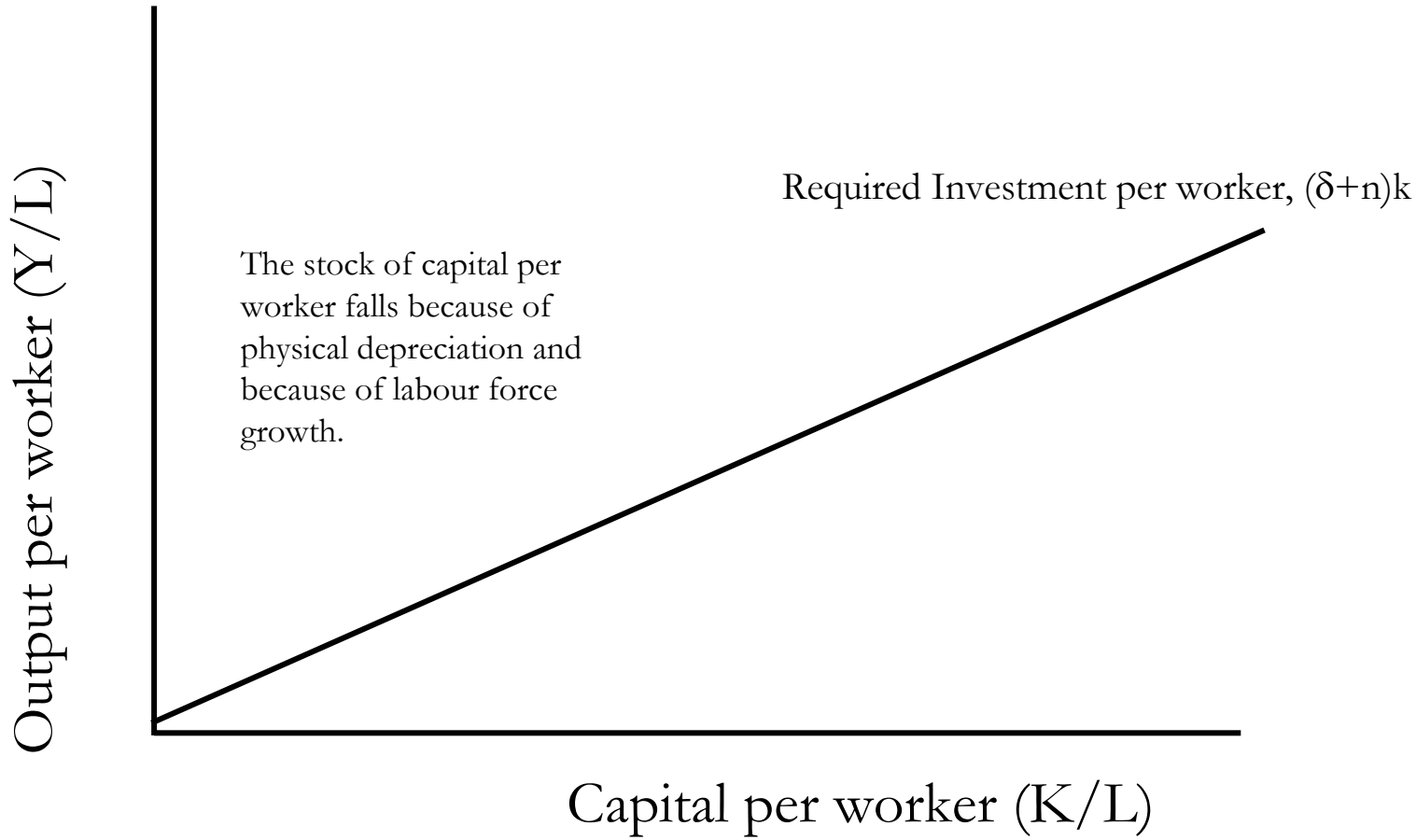
diminishing returns…



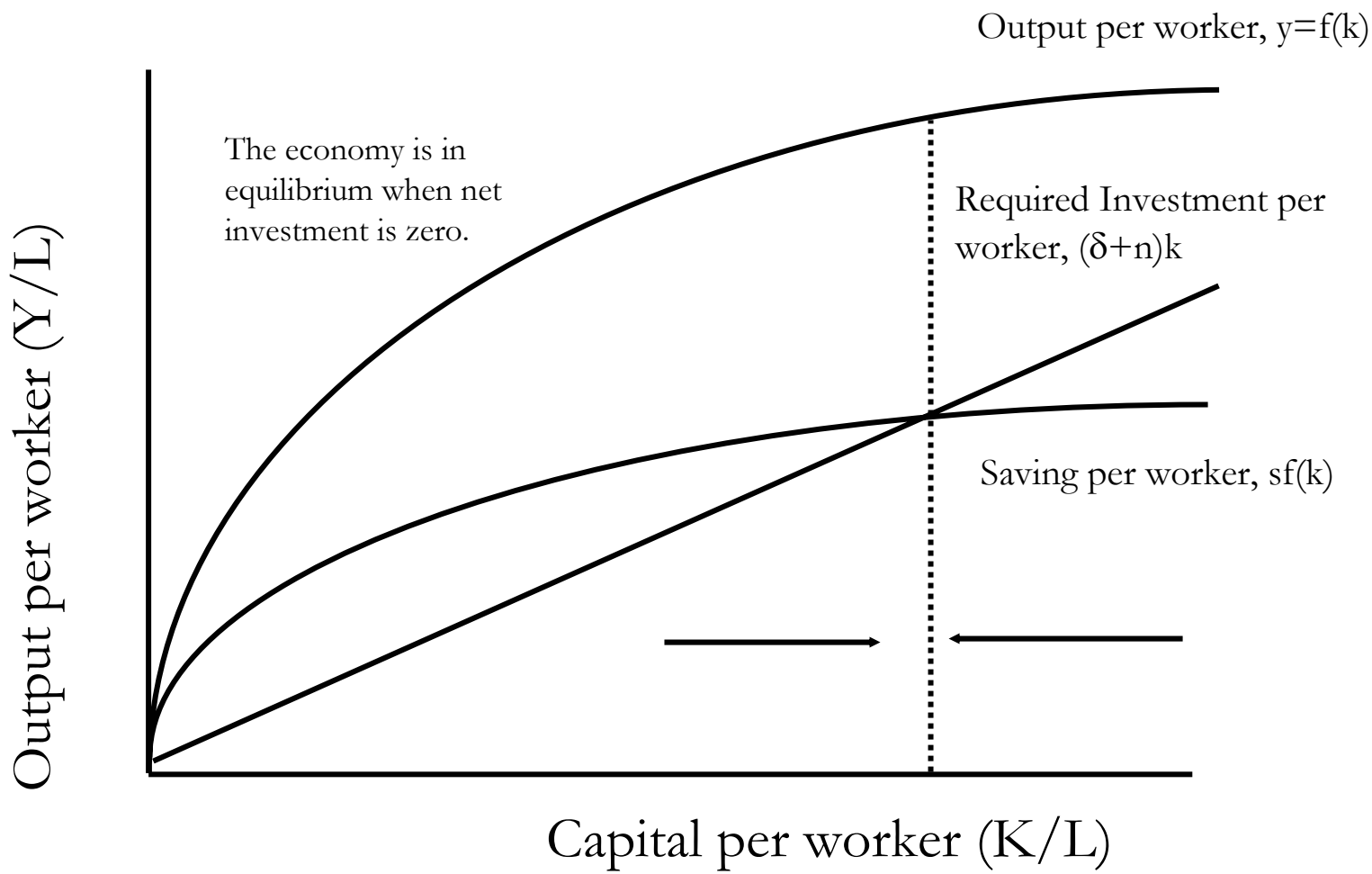
...a constant saving rate…



…and a constant depreciation rate



…the Solow model



the sources of economic growth

- Consider output produced by some production function

$$Y = A.F(L,K)$$

- For example, a Cobb-Douglas production function

$$Y = AK^{\alpha}L^{1-\alpha}$$

- If there is perfect competition, then α will be equal to the share of capital in national income, and $(1-\alpha)$ is the share of wages. We can then show that the growth of output = weighted growth of inputs + growth of total factor productivity

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

- And the growth of labour productivity = weighted growth of capital per worker + growth of total factor productivity

$$\left(\frac{\Delta(Y/L)}{Y/L}\right) = \frac{\Delta A}{A} + \alpha\left(\frac{\Delta(K/L)}{K/L}\right)$$

Solow model analysis

- The economy accumulates capital through saving, but the amount of capital per worker falls when capital depreciates physically or when the number of workers rises.
- Saving per worker (all saving is invested) is

$$S/L = sY/L = sy = sAk^{\alpha}$$

- Required investment per worker to keep k constant is a function of the existing capital stock

$$(n+d)K/L = (n+d)k$$

- In equilibrium, the capital stock will be constant when saving per worker equals required investment per worker

$$\dot{k} = sAk^{\alpha} - (n+d)k$$

steady-state capital and output

- When net investment is zero, we can set the previous equation to zero, which yields

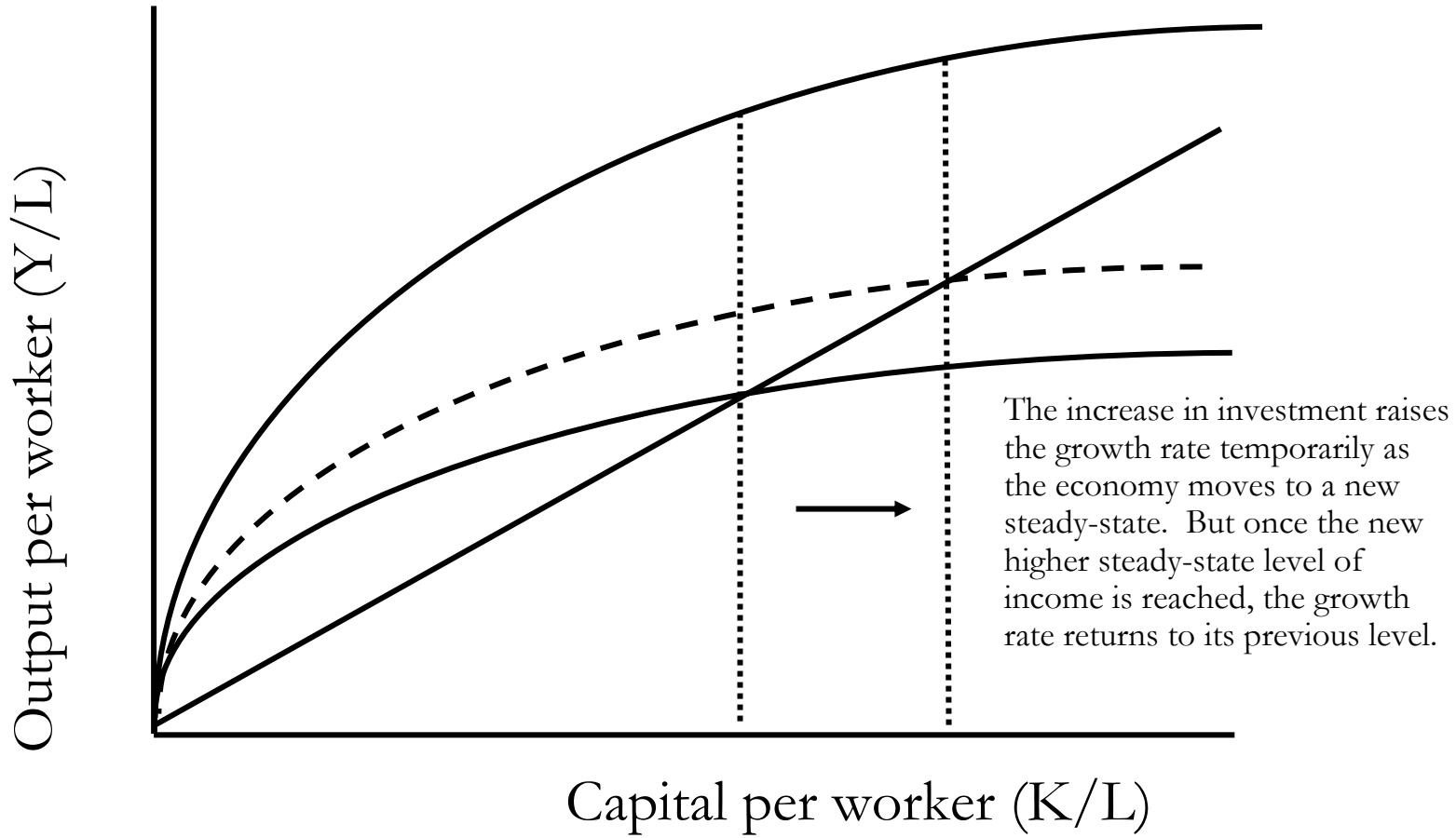
$$k^* = A\left(\frac{s}{n+d}\right)^{1/(1-\alpha)}$$

- Substituting this into the production function reveals the steady-state level of output per worker

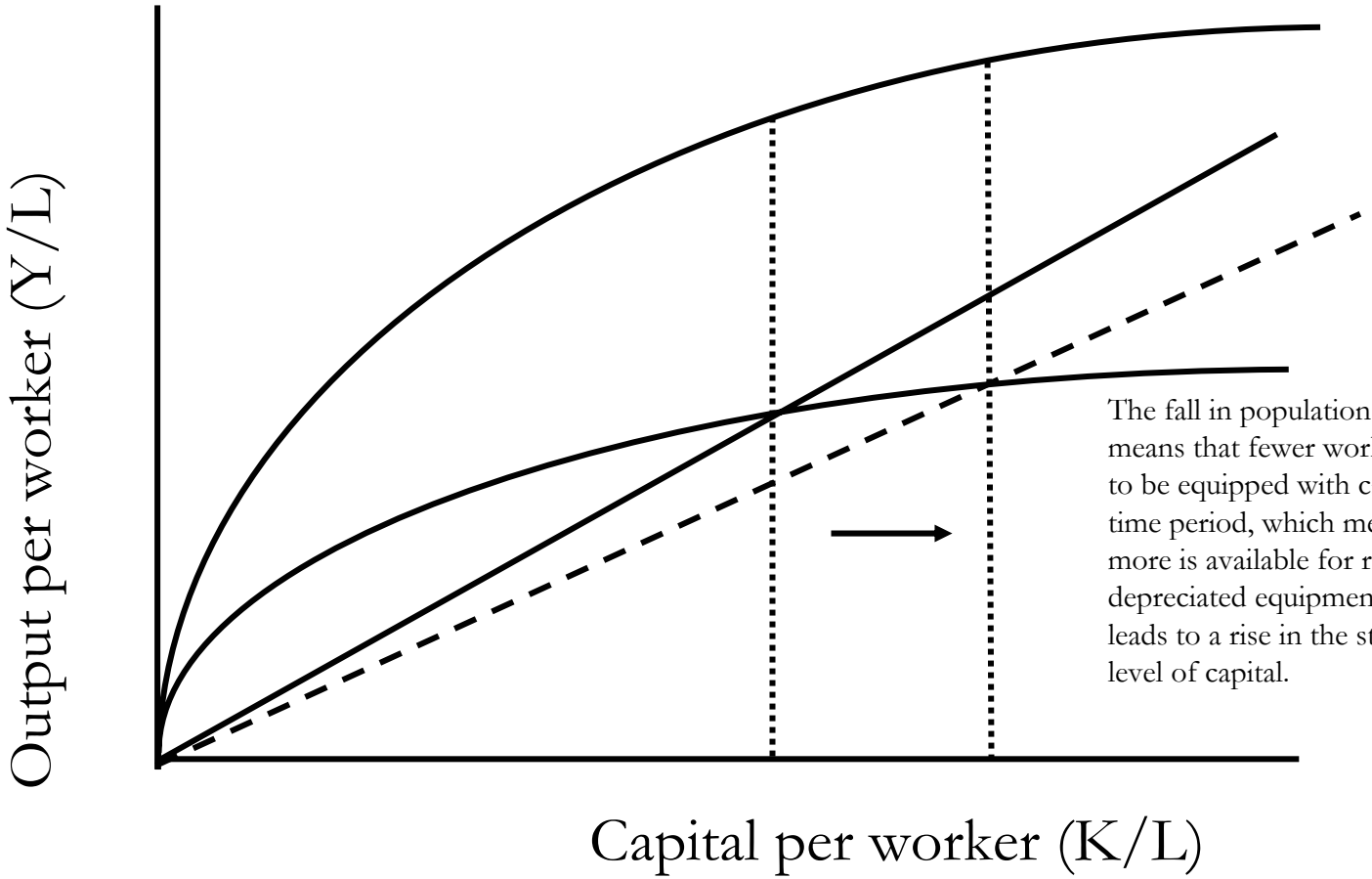
$$y^* = A\left(\frac{s}{n+d}\right)^{\alpha/(1-\alpha)}$$

- Output per worker increases with the level of technology and the saving rate and decreases with population growth and physical depreciation.

a rise in saving

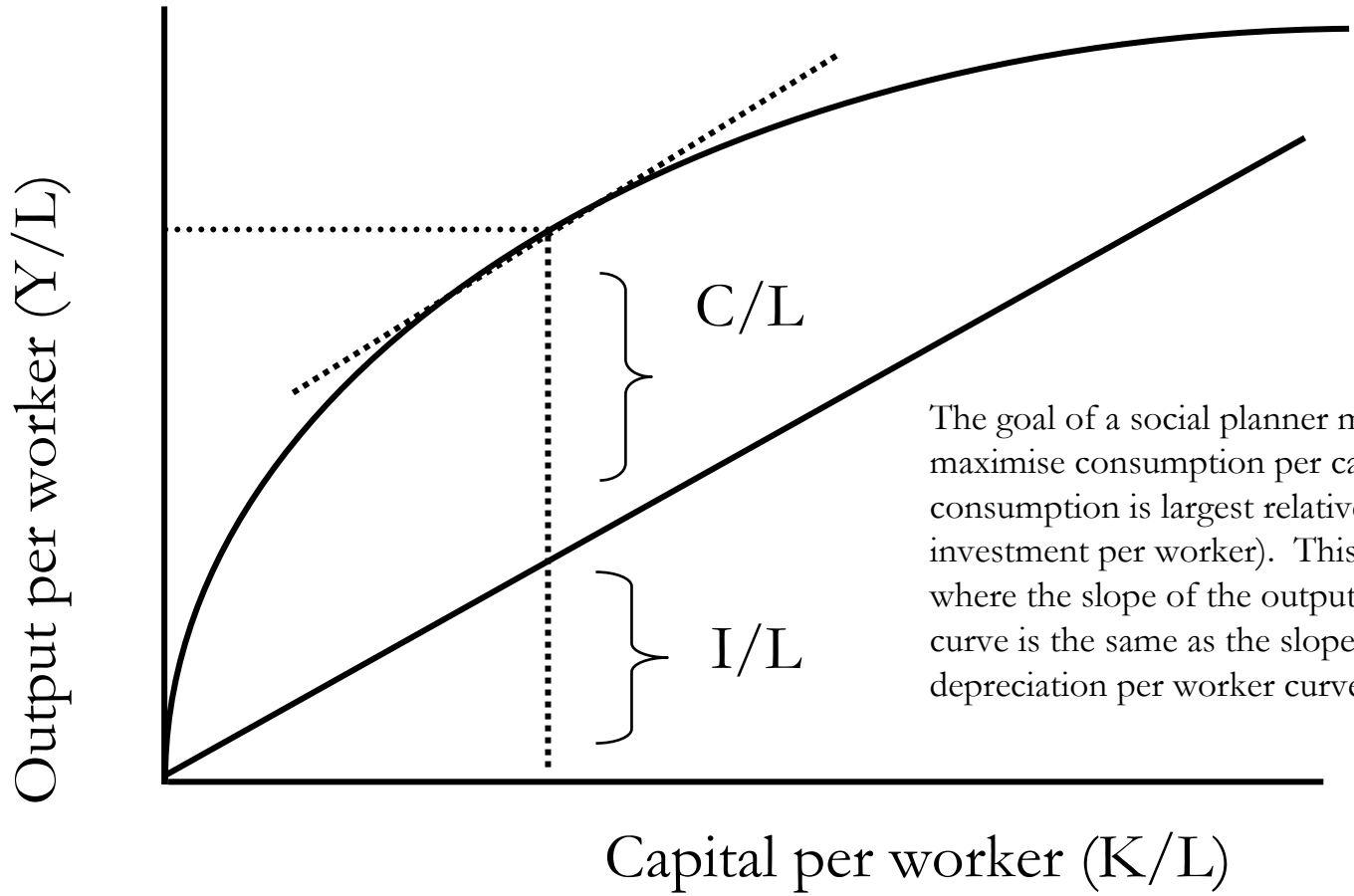


slower population growth



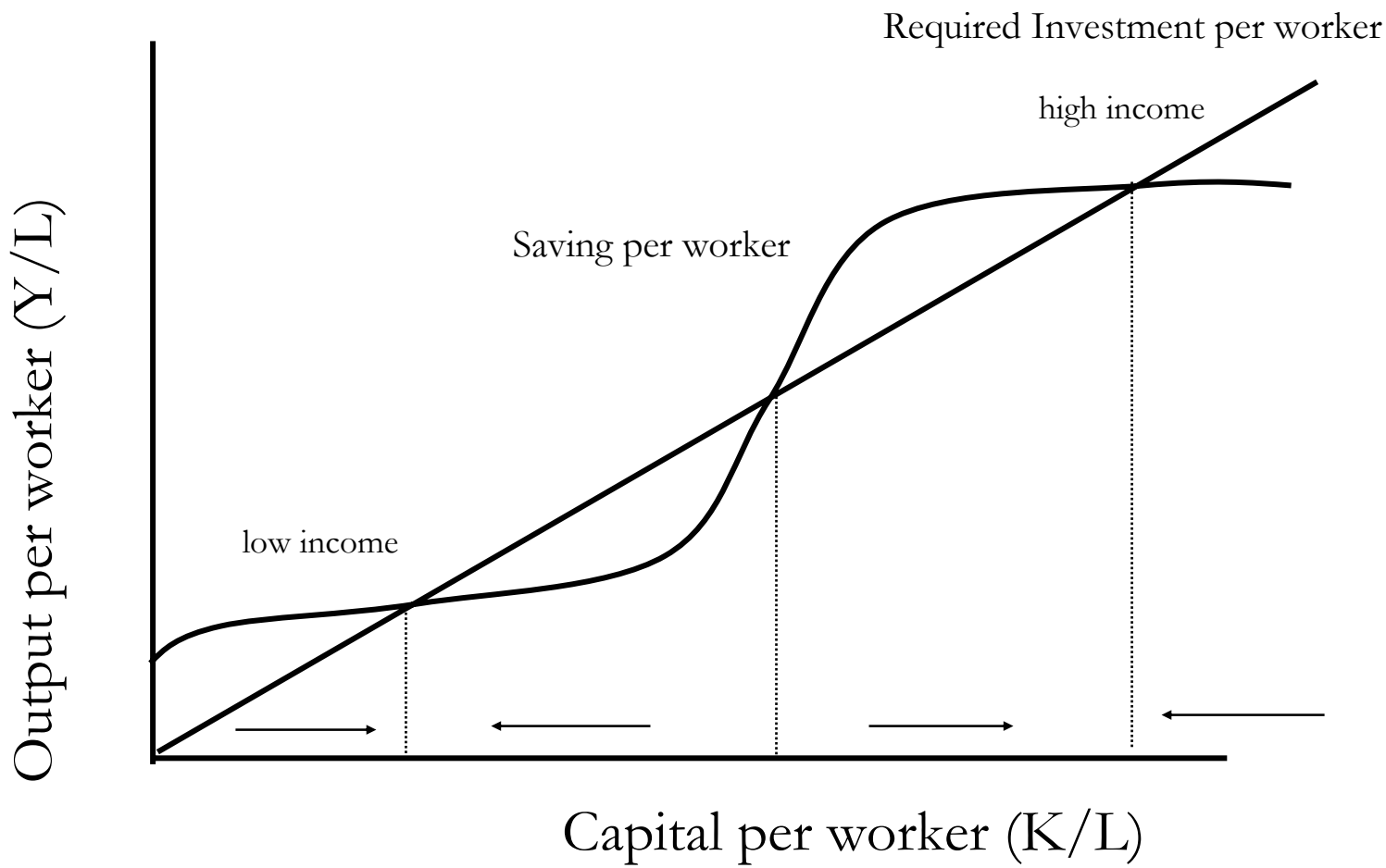
The fall in population growth means that fewer workers need to be equipped with capital each time period, which means that more is available for replacing depreciated equipment. This leads to a rise in the steady-state level of capital.

the Golden Rule

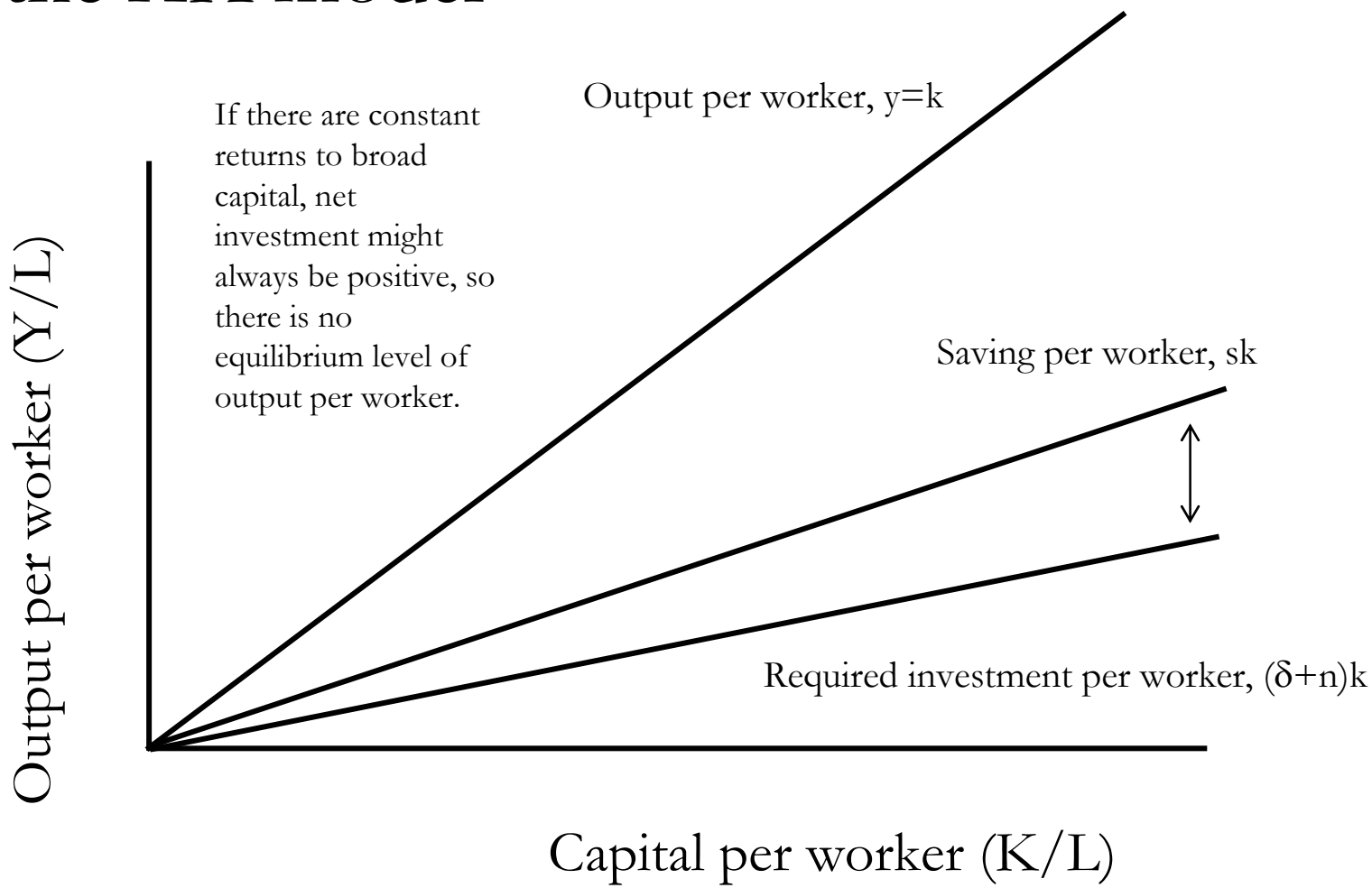


The goal of a social planner might be to maximise consumption per capita (where consumption is largest relative to investment per worker). This occurs where the slope of the output per worker curve is the same as the slope of the depreciation per worker curve.

the poverty trap



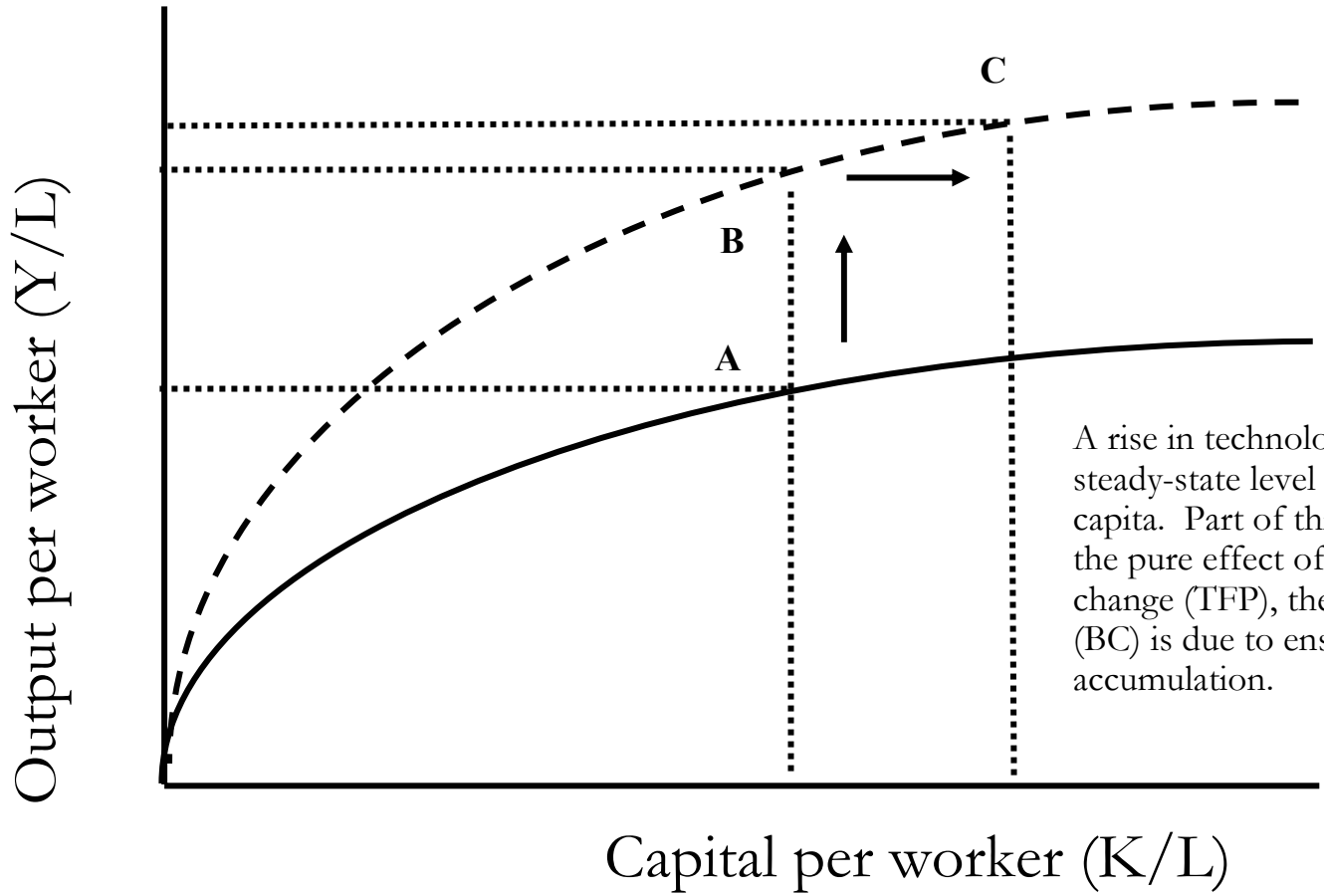
the AK model


Output per worker, y=k
If there are constant returns to broad capital, net investment might always be positive, so there is no equilibrium level of output per worker.
Saving per worker, sk
Required investment per worker, (δ+n)k
Output per worker (Y/L)
Capital per worker (K/L)

Solow vs AK

- The Solow model model has two main predictions:
  - For countries with the same steady-state, poor countries should grow faster than rich ones.
  - An increase in investment raises the growth rate temporarily as the economy moves to a new steady-state. But once the new higher steady-state level of income is reached, the growth rate returns to its previous level – there is a levels effect but not a growth effect.
- However, the AK model yields the opposite predictions – there is no convergence, and policy changes can have permanent effects.

growth accounting



A rise in technology raises the steady-state level of output per capita. Part of this rise (AB) is the pure effect of technical change (TFP), the other part (BC) is due to ensuing capital accumulation.

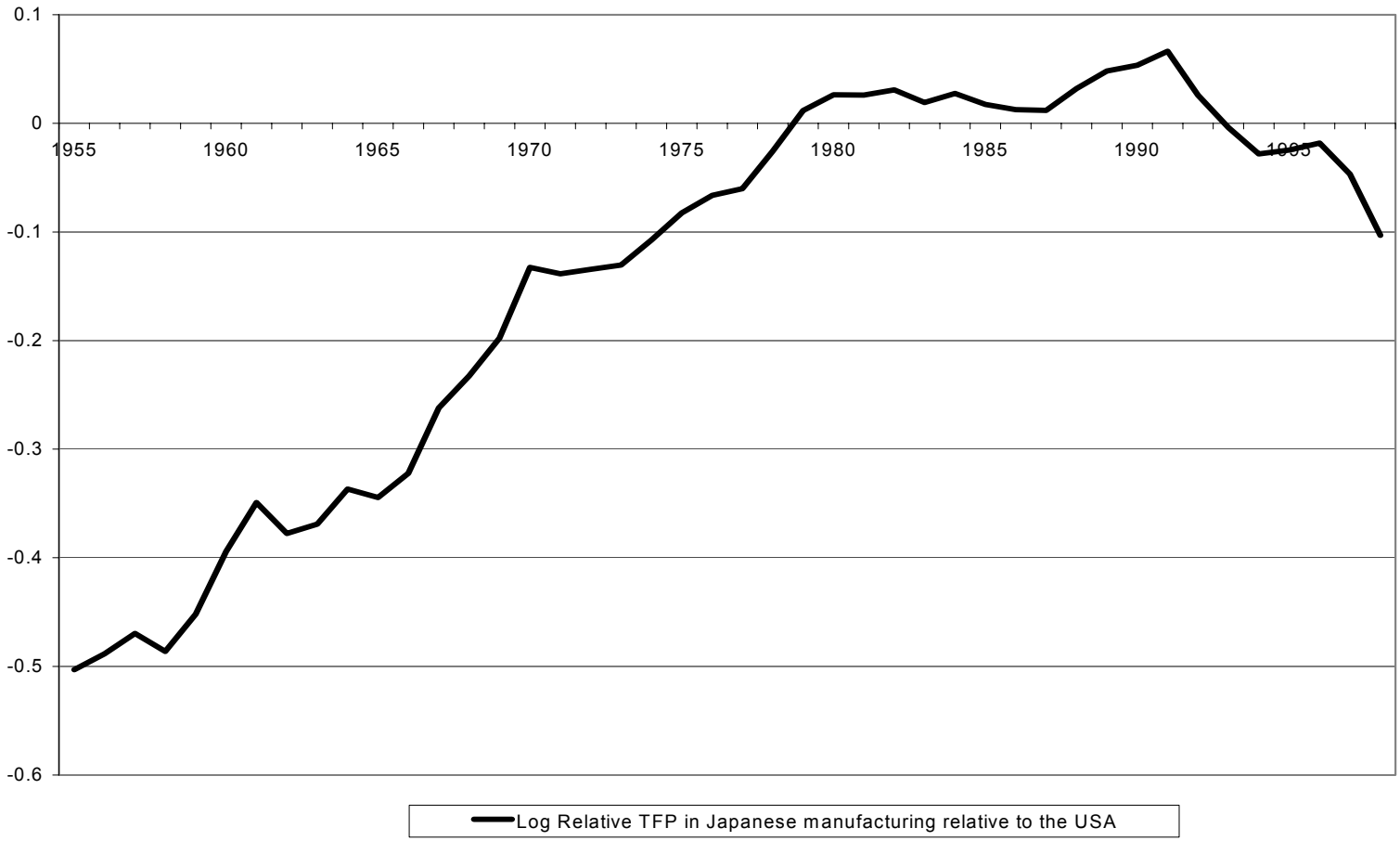
productivity growth in the business sector

	TFP Growth			Labour Productivity Growth		
	1960-73	**1973-79**	**1979-97**	**1960-73**	**1973-79**	**1979-97**
OECD	2.9	0.6	0.9	4.6	1.7	1.7
EU	3.4	1.2	1.1	5.4	2.5	1.8
USA	1.9	0.1	0.7	2.6	0.3	2.2
Japan	4.9	0.7	0.9	8.4	2.8	2.3
Germany	2.6	1.8	1.2	4.5	3.1	2.2
France	3.7	1.6	1.3	5.3	2.9	2.2
Italy	4.4	2.0	1.1	6.4	2.8	2.0
UK	2.6	0.5	1.1	4.1	1.6	2.0

Source: ***Economics of the OECD 2000 exam paper data table 2.***

Note: Growth of total factor productivity= Growth of output minus weighted growth of inputs

the Japanese TFP miracle



total factor productivity

- A typical worker in US or Switzerland is 20 to 30 times more productive than a worker in Haiti or Nigeria.
- Between-country differences much greater than within-country differences.
- Some of this can be explained by natural resources, oil.
- Some can be explained by physical capital, but investment rates surprisingly similar across countries.
- Nor can human capital explain differences, unless investments in intangibles much bigger than we think.
- Therefore, differences in technology must matter.
- What are the barriers to efficient adoption and use of technologies across the world?

high productivity countries

- Institutions that favour production over diversion;
- Low rate of government consumption (i.e. excluding investment or transfers);
- Open to international trade;
- Well-educated workforce;
- Private ownership and good quality institutions;
- International language;
- Temperate latitude far from equator.

scale and growth

- 'As for the Arts of Delight and Ornament, they are best promoted by the greatest number of emulators. And it is more likely that one ingenious curious man may rather be found among 4 million than among 400 persons….', William Petty, 1682.
- does this mean that the larger the world population, the faster the rate of growth (a growth effect of scale)?
- or that the larger the world population, the greater the world income (a levels effect of scale)?

summary

'Productivity Growth isn't everything, but in the long-run, it is almost everything', Paul Krugman, 1990.

- Unemployment and business cycles are important in explaining short and medium run growth, but play almost no role in the long-run: in the long-run, national output is determined by supply.
- In the long-run, the main source of rising living standards is rising output per worker.
- Rising output per worker is due to the accumulation of capital and technological progress.