

Macroeconomics | Activity 3, Lecture 4

Saving, Diminishing Returns and the Power of Ideas

Worked solutions

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Lesson of the day. Saving more raises the *level* of income, but capital runs into diminishing returns, so a higher saving rate lifts income once and then stalls. Sustained growth comes from ideas: new technology, which is nonrival and so escapes the diminishing returns that stop capital.

Phase 1 – Concept checks

ANSWERS

ConceptTest 1. Answer. (b). A higher saving rate raises the steady-state stock of capital and so the level of output per worker, but only up to a point. Once the economy reaches its new steady state, growth per worker is back to zero. Saving buys a higher level, not a faster long-run growth rate.

ConceptTest 2. Answer. (c), zero. With A fixed, capital runs into diminishing returns. Investment eventually only replaces what depreciates, so k and y stop rising. Without technological progress the model has no long-run growth in income per worker.

ConceptTest 3. Answer. (b), nonrival. Many people can use the same idea at the same time without using it up. This is the defining property of ideas, and it is why ideas bring increasing returns and can raise output across a whole economy at once.

ConceptTest 4. Answer. (b). A machine added to a fixed number of workers adds less and less output, so capital alone hits a ceiling. A nonrival idea raises the productivity term A itself, can be used everywhere at once, and can be built upon without limit, so it does not run into the same diminishing returns.

Phase 2 – The desk problem

FULL WORKING

(a) The steady state (worked for you). Setting $sAk^{1/3} = dk$ gives $k^{2/3} = sA/d$, so $k^* = (sA/d)^{3/2}$ and $y^* = (sA/d)^{1/2}$. With $A = 1$, $s = 0.20$, $d = 0.10$: $k^* = 2^{3/2} \approx 2.83$ and $y^* = 2^{1/2} \approx 1.41$.

(b) A thriftier neighbour. With $s = 0.40$, $d = 0.10$, $A = 1$:

$$y^* = \left(\frac{0.40}{0.10}\right)^{1/2} = 4^{1/2} = 2.$$

(c) How much richer. The ratio of steady-state output is $2/1.41 = \sqrt{2} \approx 1.41$, so the high-saving country is about **41 per cent** richer per worker. It saves twice as much, but it is far from twice as rich: because $y^* \propto (s/d)^{1/2}$, doubling s multiplies output by only $\sqrt{2}$. Diminishing returns again.

(d) The growth rate. In each country, once at the steady state, the long-run growth rate of income per worker is **zero**. Doubling the saving rate bought a one-time rise in the *level* of income

(about 41 per cent), not a faster growth rate. To keep income per worker growing you need a rising A , that is new ideas, which is the subject of the case.

Double the saving and you get about 41 per cent more income, once, then nothing. Saving sets the level; only ideas set the long-run growth rate.

Phase 3 – The case

WORKED ANSWERS

1. The seed, the *idea*, is nonrival. A tractor helps one farm; the recipe for dwarf wheat helps every farm that plants it, at the same time, without being used up. A nonrival idea can raise output across the whole economy at once, which is why ideas can drive sustained growth where capital alone cannot.
2. Adding a machine to a fixed number of workers adds less and less output, so investment alone eventually stalls. A better idea instead raises the productivity term A : it makes every unit of capital and labour more productive, and it can be improved on again and again, so it does not run into the same ceiling.
3. Mexico became self-sufficient in wheat by 1956, and by 1963 almost all its wheat was the new dwarf variety. The same research, adapted locally, spread to India and Pakistan, where wheat harvests rose by about 60 per cent within a few years. Borlaug's work is widely credited with saving on the order of a billion people from famine, and he received the Nobel Peace Prize in 1970. World grain output rose more than 150 per cent between 1950 and 1992.
4. Long-run prosperity rests on productivity, that is on ideas and technology, not on the stock of machines alone. Capital has diminishing returns, so saving and investing lifts income to a higher level and then slows. Only a steady flow of new, nonrival ideas keeps output per person rising. A poor country can grow fast for a while by borrowing ideas from the frontier, which is one reason catch-up can be rapid, but staying at the frontier means producing new ideas of its own.

One agronomist's recipe, nonrival and almost free to copy, helped feed a subcontinent. Machines wear out and crowd each other; ideas do neither. That is why the lecture puts productivity, not the saving rate, at the centre of long-run growth.

End of solutions. Sources: Jones, *Macroeconomics* 6e, Ch. 5–6; Nobel Peace Prize 1970; The World Food Prize. All figures verified.