

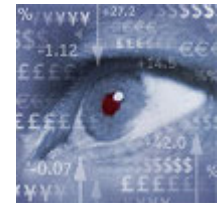
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**The riddle of technology and prosperity is explored in a fine new book**

FIFTY years ago, Robert Solow published the first of two papers on economic growth that eventually won him a Nobel prize. Celebrated and seasoned, he was thus a natural choice to serve on an independent "commission on growth" announced last month by the World Bank. (The commission will weigh and sift what is known about growth, and what might be done to boost it.) Natural, that is, except for anyone who takes his 1956 contribution literally. For, according to the model he laid out in that article, the efforts of policymakers to raise the rate of growth per head are ultimately futile.



A government eager to force the pace of economic advance may be tempted by savings drives, tax cuts, investment subsidies or even population controls. As a result of these measures, each member of the labour force may enjoy more capital to work with. But this process of "capital-deepening", as economists call it, eventually runs into diminishing returns. Giving a worker a second computer does not double his output.

Accumulation alone cannot yield lasting progress, Mr Solow showed. What can? Anything that allows the economy to add to its output without necessarily adding more labour and capital. Mr Solow labelled this font of wealth "technological progress" in 1956, and measured its importance in 1957. But in neither paper did he explain where it came from or how it could be accelerated. Invention, innovation and ingenuity were all "exogenous" influences, lying outside the remit of his theory. To practical men of action, Mr Solow's model was thus an impossible tease: what it illuminated did not ultimately matter; and what really mattered, it did little to illuminate.

The law of diminishing returns holds great sway over the economic imagination. But its writ has not gone unchallenged. A fascinating new book, "Knowledge and the Wealth of Nations" by David Warsh, tells the story of the rebel economics of increasing returns. A veteran observer of dismal scientists at work, first at the *Boston Globe* and now in an online column called *Economic Principals*, Mr Warsh has written the best book of its kind since Peter Bernstein's "Capital Ideas".

Diminishing returns ensure that firms cannot grow too big, preserving competition between them. This, in turn, allows the invisible hand of the market to perform its magic. But, as Mr Warsh makes clear, the fealty economists show to this principle is as much mathematical as philosophical. The topology of diminishing returns is easy for economists to navigate: a landscape of declining gradients and single peaks, free of the treacherous craters and crevasses that might otherwise

entrap them.

The hero of the second half of Mr Warsh's book is Paul Romer, of Stanford University, who took up the challenge ducked by Mr Solow. If technological progress dictates economic growth, what kind of economics governs technological advance? In a series of papers, culminating in an article in the *Journal of Political Economy* in 1990, Mr Romer tried to make technology "endogenous", to explain it within the terms of his model. In doing so, he steered growth theory out of the comfortable cul-de-sac in which Mr Solow had so neatly parked it.

The escape required a three-point turn. First, Mr Romer assumed that ideas were goods—of a particular kind. Ideas, unlike things, are "non-rival": everyone can make use of a single design, recipe or blueprint at the same time. This turn in the argument led to a second: the fabrication of ideas enjoys increasing returns to scale. Expensive to produce, they are cheap, almost costless, to reproduce. Thus the total cost of a design does not change much, whether it is used by one person or by a million.

Blessed with increasing returns, the manufacture of ideas might seem like a good business to go into. Actually, the opposite is true. If the business is free to enter, it is not worth doing so, because competition pares the price of a design down to the negligible cost of reproducing it. Unless idea factories can enjoy some measure of monopoly over their designs—by patenting them, copyrighting them, or just keeping them secret—they will not be able to cover the fixed cost of inventing them. That was the final turn in Mr Romer's new theory of growth.

## As useful as poetry

How much guidance do these theories offer to policymakers, such as those sitting on the World Bank's commission? In Mr Solow's model, according to a common caricature, technology falls like "manna from heaven", leaving the bank's commissioners with little to do but pray. Mr Romer's theory, by contrast, calls for a more worldly response: educate people, subsidise their research, import ideas from abroad, carefully gauge the protection offered to intellectual property.

But did policymakers need Mr Romer's model to reveal the importance of such things? Mr Solow has expressed doubts. Despite the caricature, he did not intend in his 1956 model to deny that innovation is often dearly bought and profit-driven. The question is whether anything useful can be said about that process at the level of the economy as a whole. That question has yet to be answered definitively. In particular, Mr Solow worries that some of the "more powerful conclusions" of the new growth theory are "unearned", flowing as they do from powerful assumptions.

At one point in Mr Warsh's book, Mr Romer is quoted comparing the building of economic models to writing poetry. It is a triumph of form as much as content. This creative economist did not discover anything new about the world with his 1990 paper on growth. Rather, he extended the metre and rhyme-scheme of economics to capture a world—the knowledge economy—expressed until then only in the loosest kind of doggerel. That is how economics makes progress. Sadly, it does not, in and of itself, help economies make progress.