Catch the wave

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The long cycles of industrial innovation are becoming shorter

THINK of innovation as “X” in the economic-growth equation—a factor that clearly matters but no-one is quite sure how much. Annual forecasts of gross domestic product (GDP) are no help. They are just statistical measures, laden with guesswork and opinion. They represent the forecaster’s view about the difference between an economy’s output and its total productive capacity on the one hand, and the state of the country’s consumer confidence, stockbuilding and export prospects in the months ahead on the other hand. If that seems tricky, try forecasting economic growth for a number of years into the future. Nobody has done this successfully, because it requires insight into how productivity can be expected to change in the years ahead—among many other things.

From Adam Smith to Karl Marx, economists have struggled to understand productivity growth. But it was not until after the second world war that the beginnings of an explanation emerged. The theory now generally accepted stems from work done on the so-called “production function” by Robert Solow at the Massachusetts Institute of Technology in 1956. This says, reasonably enough, that the output of an economy depends on its inputs—in short, capital and labour. Double the inputs and you get twice the output. To the basic theory, economists have added a rider to account for embarrassing quirks such as the law of diminishing returns. In the revised version, if you add more and more capital to a given labour force, or an increasing number of workers to a fixed amount of capital, the result will be successively smaller increases in output.

So far, so good. But although the production function, like Newtonian mechanics, may be broadly right, it is nowhere near right enough to make meaningful long-term predictions. The problem is that, as in Isaac Newton’s view of the physical universe, the theory assumes an idealised world—in this case, a heavenly paradise in which perfect competition reigns.

Unfortunately, the real world works rather differently. For instance, if the law of diminishing returns operates as it is supposed to, why have returns on investment in America, Europe and Japan been higher in the second half of the 20th century than in the first half? Why, for that matter, has the gap between the world’s rich and poor countries widened rather than narrowed? The theory says that where the stock of capital is rising faster than the workforce—as has clearly been true in the industrial countries since the second world war—the return on each additional unit of capital should fall over time. Instead, it has risen over the decades rather than fallen, so something is amiss.

For want of a better explanation, that “something” is now reckoned to be technological progress plus other forms of new knowledge—in short, innovation. In this scheme of things, innovation accounts for any growth that cannot be explained by increases in capital and labour. And although the return on investment may decline as more capital is added to the economy, any deceleration in growth is more than offset by the leveraging effects of innovation. This explains why rates of return have stayed high in rich countries, and why poorer countries have not caught up.

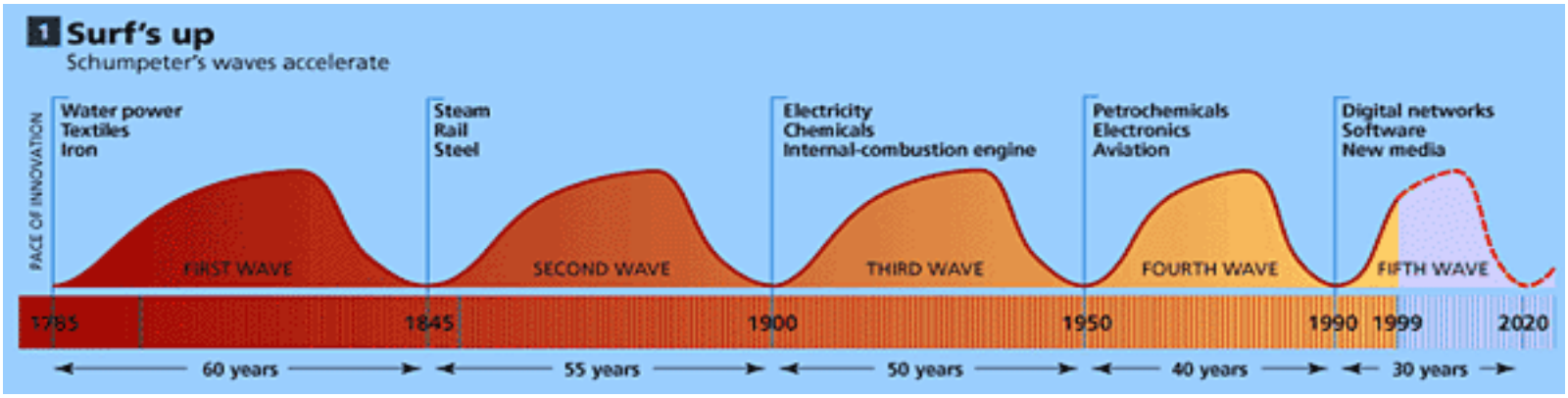
There the economists tend to leave the argument, as if technological progress—along with other new knowledge—were simply to be taken for granted, free as air. However, experience shows that technological know-how, manufacturing experience and market research are not free; they have to be acquired at considerable cost. And once acquired, such proprietary knowledge tends to be hoarded as trade secrets or hedged in by patents and other intellectual-property rights. To ignore such quibbles might be justified if innovation contributed only marginally to economic growth. Yet, maddeningly, this residual, intangible and largely ignored factor seems to account for more than half of all growth. Thus, if this reading is correct, it is innovation—more than the application of capital or labour—that makes the world go round.

Godfather of innovation

All attempts to understand the effects of technological progress on economic growth pay homage to Joseph Schumpeter, an Austrian economist best remembered for his views on the “creative destruction” associated with industrial cycles 50-60 years long. Arguably the most radical economist of the 20th century, Schumpeter was the first to challenge classical economics as it sought (and still seeks) to optimise existing resources within a stable environment—treating any disruption as an external force on a par with plagues, politics and the weather. Into this intellectual drawing-room, Schumpeter introduced the raucous entrepreneur and his rumbustious behaviour. As Schumpeter saw it, a normal, healthy economy was not one in equilibrium, but one that was constantly being “disrupted” by technological innovation.

Others had noticed “long waves” of economic activity before him, notably a Russian economist, Nikolai Kondratieff, who drew attention to them in 1925, using data on prices, wages and interest rates as well as industrial production and consumption drawn from France, Britain and the United States. But it was Schumpeter, the economic radical, who studied them in depth.

In his view, each of these long business cycles was unique, driven by entirely different clusters of industries (see chart 1). Typically, a long upswing in a cycle started when a new set of innovations came into general use—as happened with water power, textiles and iron in the late 18th century; steam, rail and steel in the mid-19th century; and electricity, chemicals and the internal-combustion engine at the turn of the 20th century. In turn, each upswing stimulated investment and an expansion of the economy. These long booms eventually petered out as the technologies matured and returns to investors declined with the dwindling number of opportunities. After a period of much slower expansion came the inevitable decline—only to be followed by a wave of fresh innovations which destroyed the old way of doing things and created the conditions for a new upswing. The entrepreneur’s role, as Schumpeter saw it, was to act as a ferment in this process of creative destruction, allowing the economy to renew itself and bound onwards and upwards again.



By the time Schumpeter died in 1950, the third cycle of his “successive industrial revolutions” had already run its course. The fourth, powered by oil, electronics, aviation and mass production, is now rapidly winding down, if it has not gone already. All the evidence suggests that a fifth industrial revolution—based on semiconductors, fibre optics, genetics and software—is not not only well under way but even approaching maturity. This may explain why America shrugged off its lethargy in the early 1990s and started bounding ahead again, leaving behind countries too preoccupied with preserving their fourth-wave industries. If so, then Schumpeter’s long economic waves are shortening, from 50-60 years to around 30-40 years.

There is good reason why they should. It was only during the third wave, in the early part of the 20th century, that governments and companies began to search for new technologies in a systematic manner. One of the oldest, Bell Laboratories at Murray Hill in New Jersey, was founded in 1925. Rather than leave

the emergence of “new-wave” technologies to chance, all the major industrial countries nowadays have armies of skilled R&D workers sifting the data in pursuit of blockbuster technologies capable of carving out wholly new markets. The tools they use—computer analysers, gene sequencers, text parsers, patent searchers, citation mappers—are getting better all the time, speeding up the process. The productivity of industrial laboratories today is twice what it was a couple of decades ago.

So the fifth industrial revolution that started in America in the late 1980s may last no more than 25-30 years. If, as seems likely, we are already a decade into this new industrial cycle, it may now be almost too late for the dilatory to catch up. The rapid-upswing part of the cycle—in which successful participants enjoy fat margins, set standards, kill off weaker rivals and establish themselves as main players—looks as though it has already run two-thirds of its course, with only another five or six years left to go. Catching the wave at this late stage will depend on governments’ willingness to free up their technical and financial resources, invest in the infrastructure required and let their fourth-wave relics go. Failing that, latecomers can expect only crumbs from the table before the party comes to an end—and a new wave of technologies begins, once again, to wash everything aside.