(CEP CentrePiece June 1998)

"… and such small portions too"

In returning to his regular column, Danny Tyson Quah addresses the complaint about meals in the holiday retreat being so awful. In parallel, "the weightless economy isn't really a big deal. But even if it were, it's all happened before anyway." Quah describes why technical change has always been important for economic prosperity; why the weightless economy is the natural next stage—already here—in the sequence of technical progress; and why the right response, both demand and supply, matters.

When economists invented growth accounting in the late 1950s, they found that technical change accounted for almost 90% of US economic growth in the first half of the 20th century. Accumulation of physical capital—investment in machines, construction, heavy metal—explained less than one-eighth of the four-fold increase in prosperity of then-recorded history's most dynamic economy.

Two things are remarkable about this. First, that period in the history of economic thought is supposed to be dominated by economic theorists obsessed with Soviet-style accumulation of factor inputs as the route to economic success. Wrong. The academic literature of that time shows a profound interest in understanding the sources and implications of technical change. The literature might not have gotten far, but the supposedly modern concerns were all already there.

Second, the US economy, in real life, was then no playground of rocket science. It was not chock-full of nifty technological whizz-bang gizmos, the way the Western world is today. It was not moved by the learned debate of scientific societies and the ferment of intellectual excitement and engineering discovery—the way that, say, England was during the Industrial Revolution, with James Watt and Matthew Boulton's race against time at the patents office, or the intellectual and political battles between Charles Babbage and George Airy on, not just the content of good science, but how to do science.

For communications, the telegraph and telephone were technologies well in place by the beginning of the 20th century. An earlier time, the 1840s, comprised the period of greatest telegraph expansion, with intense rivalry between competing companies in the US resulting in the 1856 formation of the Western Union Company. By 1866, a permanent telegraph cable linked Britain and the US; by

1872, all the major cities in the world were similarly connected. Alexander Graham Bell's patent for the telephone was filed in 1876. In Britain the telephone exchange appeared in 1879, removing telephony from the deathtrap of dedicated, fixed-line connections. Telegraph and telephony might well be viewed as prime technical drivers for the early 20th century; the truth is, these technologies were already well-established, and no technical change in them was new by the time period studied intensely in early growth accounting. What technical progress between 1900 and 1950?

By the beginning of the 20th century US rail track coverage had already exploded from less than 10,000 miles in 1850 to 20 times that by 1900. No grand technological vision or a deep insight about the world or profound scientific breakthrough propelled the success that would come in the half-century afterwards. By 1900 railroads were a technology well understood: In Britain passenger traffic was providing two-thirds of railway earnings by the 1840s. US railroad superiority over Britain and Europe had to do less with sweeping vision than with details like whether to prefer huge freight cars with double bogies and automatic central couplers over smaller four-wheeled wagons that used screw-couplings and side-buffers: hardly the burning issue to keep awake at nights academics and government policy makers who can be fretting instead over education and the global information infrastructure. Mass production of Henry Ford's Model 'T' went online by 1908; the car would be sold, *unchanged for two decades in design and implementation*, to over 15 million customers. Where was the technical change explaining that 90% of economic growth?

And it isn't just the early part of the 20th century that technology seemed to move at glacial pace. Even in the white heat of the Industrial Revolution, 50 years (two human generations, or the time for a 10 billion-fold increase in modern computing power) after its initial colliery installation, the Newcomen steam engine still operated only at 1% fuel efficiency. It was about that same length of time before James Watt's condenser improvement allowed keeping the cylinder of the steam engine hot all the time, instead of the stressful, inefficient cooling and reheating between each power stroke.

To be sure, not everything points so clearly to the first half of the 20th century being a dull period of technological stagnation. Orville and Wilbur Wright's flying machine only went airborne in 1903, and airplane technology developed from then. But

commercial aircraft, like the space-age technologies coming out of the Second World War—atomic and nuclear energy, mainframe computers, television—really affected ordinary people's lives only later, after 1950.

No, for the technologists among us (say, those who pore over the new electronic devices streaming out of Microsoft, Intel, Netscape, or Sony, and appearing on the World Wide Web every month) for all its frenetic dynamic growth and its global technological leadership, early 20th century US would have been boring beyond belief. But in spite of this, *almost all US economic success then was due to technical change.*

Those familiar with recent research on total factor productivity might challenge my holding firm to Robert Solow's 1957 estimate of 87.5% for technology's contribution to early 20th century US economic growth. That discussion will have to wait for a future column. I turn now to why the weightless economy should be viewed as the logical next stage—if it's not already here—in this economic development, and why society's response to it matters.

One of the most visible manifestations of modern technical progress is information and communications technology (ICT), a large part of the weightless economy. The real price of computing has been falling by 30% per year for the last two decades, a halving every two to three years. Communications too has had its real price declining, although only by a relatively modest (but still spectacular) 8% per year for the last 70 years. Technical progress at this rate is unprecedented. How much more it must now be contributing to long-run economic growth. History records few other instances of similarly large, extended changes in the relative price of goods so intensely used by businesses and consumers.

This last is key: ICT and other elements of the weightless economy are now actually employed and demanded by significant portions of society.

Similarly, the rampaging supply of technology during the Industrial Revolution in the West was matched by a voracious appetite in technology's users, either by other suppliers or by final consumers themselves. Supply alone, no matter how hi-tech and chockfull of good ideas, if unmatched by demand takes society nowhere.

The saddest example of this—one with lessons perhaps for those fearful of technology in the new weightless economy—is the utter failure of the Industrial Revolution to take off in ancient China,

where all technological prerequisites were already present long before the late 18th century. Everything petered out. Why?

In information processing, China had the putative headstart. It introduced paper 1,000 years before the West, and printing about 700AD. Chinese water clocks of 1086AD were more accurate than contemporaneous European mechanical ones. For transforming the material world around them, the Chinese were casting iron in blast furnaces by 200BC, centuries earlier than in Europe; spinning wheels for textiles and water power were developed at about the same time as in the West. The Chinese invented gunpowder: that they made only fireworks from it, not weapons for killing is to their credit, not as Rousseau said and many commonly think, a sign of backwardness.

Yet, in the presence of all these technological prerequisites, China did not experience an Industrial Revolution to set the world afire. It was ahead of the world in 1300; it was far behind by 1900.

Why? The supply side of technology was present; the demand side was not. The Chinese state committed what, with hindsight, we now know to be an egregious sequence of mistakes. In China, most technological development was in the hands of the government bureaucratic elite. New technology was controlled and not permitted to be widely used by the population. Indeed, the state saw a subversion of its power as the most likely outcome should the populace learn of and articulate a demand for the new technology. No diffusion of ideas and tools took place, and the Industrial Revolution that might have been instead died.

What does this have to do with the weightless economy? The easy interpretation is that the weightless economy is the for-now culmination of technological development. Whether society embraces its fruits and, through the usual workings of the marketplace, goes on to encourage further its development matters a great deal.

Europe of the Industrial Revolution? Or 14th-century China?