The Weightless New Economy

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This paper provides one interpretation of the New Economy, against a backdrop of its emergence as an integral, necessary, and continuing evolution in economic growth and technological change.

In this paper I consider three themes. First, while almost all professional economists agree on the importance of technological development in economic growth, controversy surrounds the exact form of that technical progress. Is the New Economy part of the technical progress that matters, or is it an unhealthy, unproductive distraction? Second, is it the nature of the New Economy that it will confine itself to a few leader economies, perhaps just the US? Or, will these developments rapidly disseminate and benefit Europe and all others, including those now-poor developing countries? What institutions and forces will foster and shape that spread, or instead might inadvertently stifle it? Third, what choices will confront businesses, governments, and societies as the New Economy continues to grow?

The framework useful to address these questions recognizes that economic value increasingly residing in intangible objects—software, media, telecommunications, content, intellectual assets—changes production relations, the nature of markets, and economic behavior more generally. Tracing through these developments, we see that key and unprecedented is the growing importance of users and consumers in shaping ongoing technical change. One consequence is that, broadly, the likelihood is good that New Economy developments can benefit all economies greatly, if not right away. But potential obstacles matter as well—possibly in lack of acceptance of these changes through fear or ignorance, possibly in institutional resistance.

1 Background

For the last fifty years, economists and practitioners in the growth and development community have taken the accumulation of physical capital—machines, buildings, bridges, highways—to be central to economic growth. A careful reading of the evidence, however, shows that it has instead been technological advances—and thus the accumulation of knowledge—that is the more important. One arrives at this conclusion by studying calculations such as those that growth accounting relations provided in the 1950s, but also those that so-called endogenous growth reasoning has more recently given. Economic growth and development have always been driven by knowledge and technical progress.

Overlay this on top what's going on out there in the world today—rapid development in information and communications technology (ICT); governments wiring up their countries to ramp onto the world's Internet infrastructure; outsourcing software construction and data entry on a large scale to workers in emerging economies, where the output can then be "shipped" on via telephone lines and satellite; the increasing importance of e-commerce and mobile, wireless transactions. This must be nothing more than continuing the knowledge-driven economic progress that has been with us since the Industrial Revolution of the late 18th century or, going back even further, since ancient Sumerians 5,000 years ago first carved financial records onto clay tablets. If all that is happening now is just this knowledge-driven economy, then our current concerns might well be the same as those when spinning jennies and steam engines first came into mainstream application.

Many policy and social issues, indeed, remain the same. We worry about possibly failing to create new jobs, income inequality potentially rising within and across economies, economies not already rich perhaps being unable to use successfully the best, most advanced technologies.

However, some things differ. Imagine someone having fallen asleep twenty years ago, waking up today, to look at the front pages of any of the world's newspapers: The richest people worldwide have gotten

that way from selling something intangible [just what *is* an Operating System, and why does the world need 600 million of these every two years?]; regulators have spent millions going after companies for giving away products for free—like "Operating System", "Internet Browser" is a phrase that had, for most people, no meaning five years back; mobile wireless text-messaging fewer than 160 characters at a time has generated more revenue than TV network advertising; the judicial system has gotten in bed with heavy-metal rock groups to protect the latter's *intellectual property*, being frittered away by hundreds of millions of people worldwide? Does any doubt linger that the global consumer voraciously feeds on strings of 1s and 0s? The only question is what form the profitable strings will be, what the killer app is on the wireless Internet—not whether that change in consumption patterns will occur eventually.

Social observers ask pointed questions of ICT more generally—computers and the Internet, electronic commerce, and mobile wireless communications—that aren't asked of, say, oil supertankers or steam locomotives or textile spinning machines. How does ICT differ from just any other kind of technology? How does economic development with ICT differ from any other kind of knowledge-driven economic growth? Do e-commerce and mobile, wireless commerce represent simply progressions in degree of improved efficiency in economic transactions?

To address these questions, I find it useful to consider the concept of the *weightless economy*. By this, I mean:

1. Information and communications technology, thus including the Internet and telecommunications;
2. Intellectual assets broadly construed—not just patents, but also copyrights, trademarks, music, video entertainment, advertising, images, industrial trade secrets, financial consulting services, health and medical consulting, education, and so on;
3. Electronic libraries and databases;
4. Biotechnology: Carbon-based libraries and databases.

This listing describes what many of us might consider to be simply the most obvious and visible manifestations of a knowledge-driven

economy. They are the natural current frontiers of technology in economic growth, and are simply the latest stage in an ongoing technological transition from the 18th-century Industrial Revolution to e-commerce and the Internet, and beyond.

This gives us something to get our teeth into, on what new technology is. But what *is* different about new technology in general, or ICT in particular?

2 Productivity paradoxes

A first point to clarify concerns the so-called *productivity paradox*. This is where the rapid expansion over the last 30 years in investment and spending on information communications technology apparently failed to improve measured productivity. Versions of this argument have led some to question if new information technology is not just a bill of goods, foisted on the rest of us by a shrewd, marketing machinery.

Three things to say about this. First, the paradox extends from just ICT to almost all other measures of improvement in the state of knowledge—in new or old economies. While measures of scientists and engineers employed, R&D spending, and so on have increased as much as four-fold over the last fifty years, measured productivity has, again, not kept pace. The so-called productivity paradox calls into question not so much the contribution of ICT alone as the entire view of knowledge advances pushing back the technology frontier, improving in turn national productivity.

Second, the most recent US productivity figures now *do* show dramatic improvement, doubling in trend growth rate since the mid 1990s from that experienced in the 20 years before then.

Finally, perhaps productivity measurements are simply irrelevant for understanding the implications of the new technology. One of the themes argued here is that the demand- or consumer side matters, for understanding the development of new technology and the new, weightless economy—in ways that focusing on the supply side, through productivity measurement, fails to capture.

3 What's with the new, weightless economy

Fig. 1 shows a widely-accepted stylization of the process of economic growth. Skills and education, embodied in human capital in the population, see competing uses for their time and energies. On the right of the Figure, those who are skilled can work in the sector—call it manufacturing for short—that provides goods and services to the end consumer. On the left, the skilled are employed as research scientists, engineers, and other similar knowledge workers. The ideas they generate add to the technological base of an economy, and comprise the ultimate engine of growth.

Those ideas are intellectual assets that attract economic and social protection through *intellectual property rights* (IPRs, summarized by the box labelled Patents in Fig. 1). Ideas cannot be freely bought and sold in an open market: after an idea has been displayed, it cannot be taken back from a viewer and potential customer. Nor can a purveyor control the idea's subsequent spread: additional copies of an idea—as many as one can imagine—are cheap to reproduce. In a free market the price of an idea would quickly be driven to its marginal cost of reproduction, namely zero. But if so, then no one could afford to become a knowledge worker. All human capital would flock to applying their skills only in the manufacturing sector. No new ideas would be generated, and growth would eventually no longer occur.

In this stylization knowledge workers need to have their ideas protected through some social and economic mechanism. A system of intellectual property rights is one feasible and traditional such mechanism. Allowing this protection then permits the commercial sale of an idea to entrepreneurs in the manufacturing sector, and thereby incentivizes knowledge workers to continue to generate new ideas. This creates a monopoly in the use of the idea, however, and thus is not an ex post efficient outcome. Nevertheless, it is one that does—to a degree—work.

What is new now because of developments in ICT? What is different in the new economy? The intermediating blocks of Patents and Manufacturing are progressively disappearing; instead, consumers are having to confront directly the knowledge-producing sector (Fig. 2).

In the weightless economy 1.–4., what is economically valuable are strings of information. Where and how those strings are recorded—in silicon or carbon, on a hard disk or an Internet server, in a read-only CD or in MP3 music format uploaded into computer memory, in someone's mind or on a paper blueprint—matters little for their economic performance. Moreover, these strings are no longer just for plugging into some production process anymore. Instead, consumers and end users deal with them directly, whether through their interacting with a piece of computer software, enjoying digital entertainment in video or music, purchasing health consulting or financial information on the Web, or using the wireless telecommunications infrastructure for an economic transaction.

These strings do not always constitute knowledge, in the conventional sense of a scientist or an engineer producing knowledge in an R&D laboratory or an academic researcher generating a novel insight or establishing a new mathematical theorem. Thus, this new, weightless economy is a knowledge-based economy in a way that differs profoundly from that in a traditional knowledge-based economy. In the traditional, the infusion of knowledge is to improve productivity in some industrial process. To understand the economics of knowledge there, one thinks about the gains from improving productivity versus the costs of creating that item of knowledge. One thinks about the costs of and time in testing and re-engineering the item of knowledge, the patent protection that the knowledge will attract, the price that such a monopoly will earn from using that knowledge.

By contrast, in one extreme vision of the weightless economy, a producer uploads the knowledge-product to a website for immediate dissemination over the telecommunications infrastructure. The knowledge-product is not one that undergoes the same degree of extensive testing and re-engineering; it is not one that attracts patent protection; it gets hawked directly for consumption without getting heavy metal slapped around it.

The weightless economy is knowledge-intensive not only in there being a high concentration of knowledge everywhere, but also in its consumer products behaving as if they were items of knowledge. These products are *infinitely expansible*: their enjoyment by one con-

sumer does not preclude their consumption or use anywhere else on earth by yet someone else. Contrast this with other consumer products such as, say, a chocolate biscuit where one person's eating the biscuit means that biscuit is no more. Knowledge-products are initially *inherently unknowable*: what a knowledge-product does is impossible to reveal without at the same time revealing the knowledge-product itself. Making a knowledge-product, moreover, shows *ranking priority* and *nonadditivity*: Only the first instance of a knowledge-product adds value in production; subsequent re-creations from scratch—regardless of the effort put in—add nothing to society.

Finally, these knowledge-products disrespect natural physical barriers such as geography, as profoundly as they do national boundaries.

4 Problems and policies in the weightless economy

What fresh problems arise from the onset of the weightless economy? What economic policies might repair them?

First, for economic growth, ongoing technological development matters greatly.

Second, when the production and use of knowledge is important, then too are systems for managing intellectual assets. The fundamental dynamic tension laid out above is one between allowing ex-ante incentives and promoting ex-post social efficiency. Ordinary systems of intellectual property rights bias against the latter, permitting monopolistic curtailment on the use of a product, thereby incentivizing those creating the first instance of the knowledge-product. This fundamental tension is present in all areas of the weightless economy, ranging from patents on industrial processes through culling the genetic heritage of entire societies, whether it is in the DNA profile of the Icelandic population or the biodiversity of a tropical rainforest.

Third, modern technological developments hinge on bringing directly to the consumer and user certain goods and services that themselves behave like knowledge. Corollary to this is that *access* is important—the six billion users out there in the world do not automatically have available the means to get at these goods and ser-

vices. Unlike with ordinary goods and services, however, the social cost of weightless-economy products declines dramatically with their quantity supplied. It is not longer the socially efficient outcome to say, Whoever can afford the goods and services has rights to them. In a weightless economy, the socially efficient outcome instead is to flood markets—whoever wants them should have them. It is the right policy for governments or other collective bodies to pay for the fixed costs that would otherwise inhibit global access.

But an equally important corollary is that *participation*, beyond just access, matters as well. Making available technologically advanced goods and services does not guarantee they will be taken up by consumers and users. A simple example of that might be where, as in the US, Internet access costs are so low that 45% of the population is already Internet-enabled. But of that group, less than half use the Internet more than an hour each month. Education in its widest-sense—of cultivating positive attitudes towards knowledge and learning, of using sophisticated knowledge-products—is the surest means of guaranteeing high participation. Both access and participation will be critical for taking forwards.

To explore this last point, I turn now a case study of an economy technologically advanced but ultimately failing to take off in sustained growth.

5 Industrial Revolution, Interrupted

Take 14th-century China.

China then was, of course, *not* a society where computers were rife, Internet and dotcom companies prominent in daily newspaper reporting, and telecommunications mergers a subject of constant speculation. But what is interesting for us is that China at the end of the Sung Dynasty was a technologically advanced economy. China stood on the brink of an Industrial Revolution at least 400 years before that that occurred in Western Europe in the late 18th century. Yet the subsequent 5 centuries of Chinese history have been a period of dismal economic performance. Why?

I will argue that China's failure here was a failure of the demand side in a technologically advanced economy. An imbalance between a technologically-advanced supply side and a demand side that was unable or unwilling to keep up led to a loss of all the technical superiority, and a failure of the economy to continue to develop.

Economic historians consider four ingredients to be critical for the success of the Industrial Revolution in Western Europe. First, agriculture had to have sufficiently high productivity, so that labor could be released from that sector but food still produced in sufficient quantities to feed the population. Second, manufacturing also had to be highly productive so that that labor did not simply languish in unproductive alternative lines of work, after leaving agriculture. Third, high-quality materials were needed to make the precision equipment and machinery that characterized high-speed, high-productivity manufacturing. Fourth, nonhuman and nonanimal sources of energy were required to power increasingly heavy equipment and machinery.

China had all these by the 14th century, well ahead of similar developments in the West. Blast furnaces for refining pig to wrought iron were employed in China by 200 BCE; Western Europe did not use those until the 14th century. In China, coke was being used in blast furnaces to increase efficiency by the 11th century; similar developments were not observed in the West until 700 years afterwards. These technological advantages resulted in China's iron output per capita by 1078 exceeding that in the West even as late as the 17th century. By the same token, the price of iron relative to grain fell to a third of its starting value in the century between 1000 and 1100, with the West not achieving the same productivity improvement until the 18th century. In China, paper and printing technology were centuries ahead of the West's, with porcelain moveable type available by 1045, four centuries before Gutenberg.

Despite all these technological advantages, China did not experience an Industrial Revolution, and did not undergo a takeoff to rapid growth, but instead languished dismally after the 14th century. The West by contrast developed the same technologies anywhere up to 7 centuries later, but then grew rapidly thereafter. Why?

The answer lies in the differences in the characteristics of the

end-user of technology in China and in the West. In 14th-century China, knowledge about the technology was tightly controlled, with the Emperor "owning" time itself, and scholars and bureaucrats jealously guarding technology's secrets. A large customer base never developed, and technological development languished. The 18th century Western European consumer, by contrast, was eager to use the new goods and services provided by the then-modern steam engine and spinning jenny. Strong consumer demand allowed technological progress to continue, and the West was where the Industrial Revolution took place.

6 Conclusions

Understanding that the weightless economy is the modern, ICT-laden incarnation of a technological, knowledge-based economy makes us aware of the large policy and social issues at stake.

This weightless economy highlights the tension between ex ante incentives and ex post social efficiency. But this tension is old in that it pervades the production of all intellectual assets. Historically, societies developed institutions such as those of intellectual property rights to safeguard ex ante incentives, fully realizing the sacrifice of ex post efficiency in the process. But as ICT, the Internet, and modern technology drive economies to become progressively weightless, such systems become more important but their older versions—designed for different technologies—less reliable and useful.

Education and training—developing those skills and attitudes in society, not just for productive work but for consuming and appreciating sophisticated, complex technologies—matter importantly for continued growth in today's increasingly weightless economies. Because participation matters, not just access, high levels of wide-sense knowledge and openness to new ideas play important roles in the process of technological progess and economic development. The case of 14th-century China is a dramatic case in point. Imbalance and insufficient knowledge in the general population, not in the scientific elite, critically and tragically crippled an entire nation's prospects for

economic growth and development.

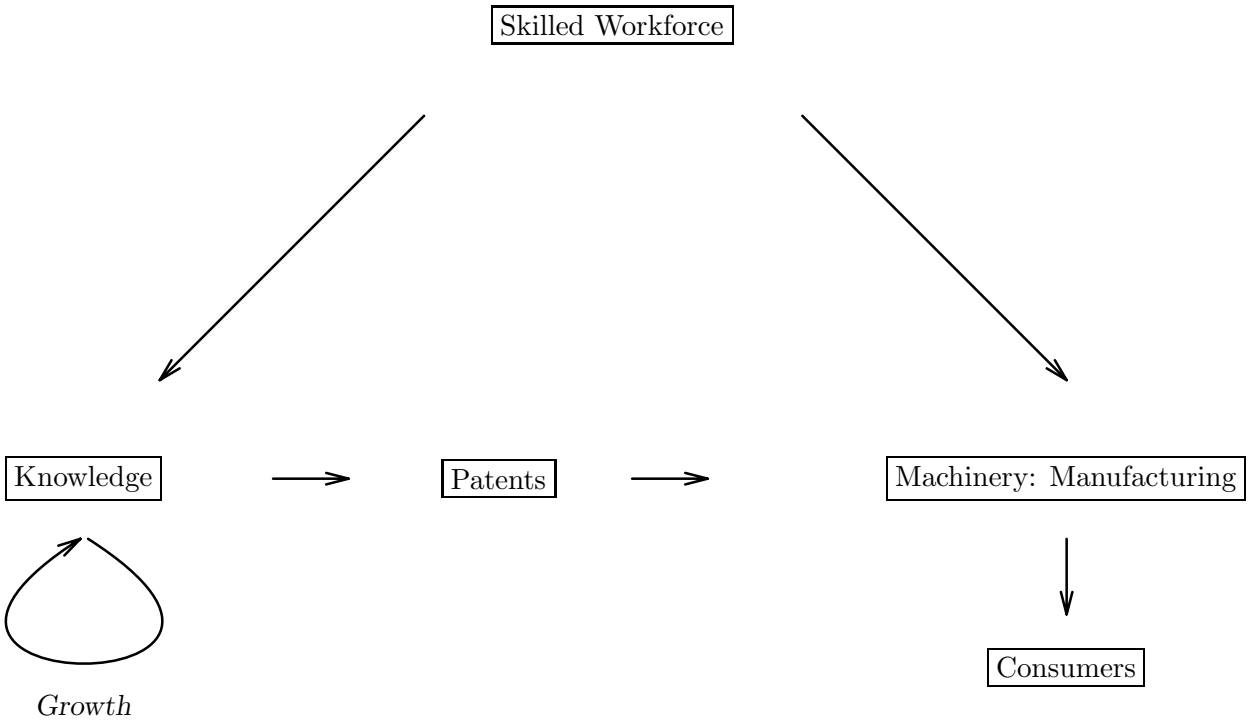

Fig. 1: Traditional models of knowledge and growth Patents and machinery intermediate between knowledge production and consumers

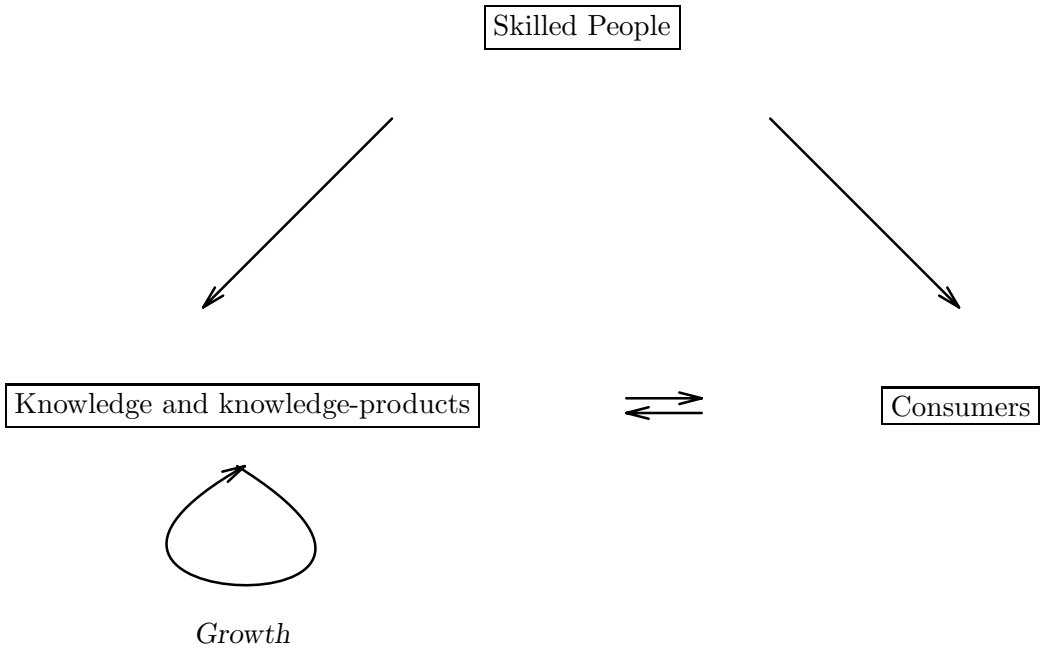

Fig. 2: Weightless economy Reduced distance between knowledge production and consumers