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## **The Excess Supply of Knowledge**

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The headline shocked and dismayed: "Businesses raise alarm: Governments reel in disarray as worldwide glut reaches unprecedented levels! No relief in sight!"

OK, I made that one up. Such headlines don't resonate in a world where drama rests instead on how as a planet we're rapidly running out of fuel, rainforest, raw materials, and global cool [we lose that when we global warm]. Humanity is too quickly eating up too much of too many goods costly to produce.

But while that headline is fictitious its content is not. The commodity on which the world is running excess supply? Knowledge.

Today, just as the world's knowledge stock is climbing ever higher peaks, the fraction of knowledge being used productively is plumbing ever lower depths. Since knowledge can't be added up the same way that, say, apples and bananas can, we can only tell if knowledge is under-used by comparing its social benefits with its social costs. If, at the margin, benefits exceed costs then productive usage is too low - life would be sweeter on net were society to deploy more of that particular item of knowledge; we would say knowledge is under-used.

To use knowledge is to create - invisibly, inadvertently - a copy of it. Mathematical equations, engineering blueprints, computational algorithms, and chemical formulas all work this way. The nature of knowledge is that creating copies costs little - unlike, again, apples and bananas, where making another apple or banana involves purposefully applying fertilizer, clearing land, and then picking, cleaning, shipping, and packing (all the things that suppliers typically have to do).

The more applications of an item of knowledge or the more users of it there are, the greater will be the net social benefits from its deployment and dissemination. Thus, the more pronounced its excess supply when the market is left unsaturated.

Today, in economic and social value, items of knowledge comprise not only scientific formulas and engineering blueprints - resources used in production. For, just as formulas and

blueprints, many consumer items now also expand in quantity through copy-making, and therefore succumb to characterisation as knowledge. When value and output are digital or conceptual, copy-making no longer means knocking off cheap imitations. Instead, in hard-nosed economic value, an original is no longer distinct from a copy. Digital entertainment - movies, music, video games - forms the quintessential example. Less obvious but perhaps more significant are pharmaceuticals: Creating more quantity of a drug is copying its chemical formula, with insignificant physical wrapping. What is a copy and what is an original when both contain the same chemicals and identically improve the human condition?

We live in a knowledge economy today not just because of the growing significance of high-tech science and engineering, but in how other digital and conceptual goods - for our enjoyment and our health - have assumed higher economic valuation and take up greater fraction of our spending. The coalface of the knowledge economy is not just R&D laboratories, where its seams are mined by researchers in white laboratory coats. The knowledge economy appears in every bitstream (pornographic or otherwise) coursing its way through the Internet. Its icons are Google, Amazon, ebay, Yahoo - suppliers of consumer-intensive goods and services.

In this account the knowledge economy matters worldwide. Sure the knowledge economy is important in advanced nations forging the latest scientific breakthroughs. But it also manifests in the poorest parts of Africa, Brazil, China, India, and elsewhere seeking to provide, amidst extreme poverty, affordable HIV/AIDS antiretroviral medication. Its presence is palpable when an anthrax attack or flu pandemic rips, and governments seek emergency medication, or when ailments affecting over 90% of the world's population remain untreated. The knowledge economy appears in China, Papua New Guinea, Palestine, Vanuatu, and Vietnam where software and digital entertainment reproduction is raising the fraction of knowledge products deployed worldwide. It shows up in the hundreds of thousands of Open Source software projects, created to be shared as widely as possible.

As humanity becomes more educated, and ideas, tastes, and beliefs integrate more closely, the greater become the potential social benefits from deploying all the different kinds of knowledge - those that increase our productivity, improve our health, and raise our quality of life. With modern globalisation and the Internet, we are now in the midst of arguably the largest expansion ever in the demand of and absorptive capacity for knowledge. In this situation the fewer copies of knowledge being made, the greater the loss to humanity.

Economic historians call what I've just described dissemination, in contrast to invention. Invention creates new knowledge at the frontiers of understanding - that's what white labcoats do. Dissemination, on the other hand, carries that knowledge out into the world in its billions of copies. Invention is about improving best-practice; dissemination is about raising average-practice. Invention is costly and getting costlier; dissemination is cheap and getting cheaper.

New drugs now cost over US\$1bn to develop. Over the 20th century the average age at which inventors do their best work has risen by six years; the average size of innovation teams has grown five-fold. R&D workers and R&D dollars now produce an ever smaller number of patents on average. Computer software now involves so many lines of code that even using the best available tools no one individual can imagine writing it all alone.

But this distinction between invention and dissemination, useful in some respects, misleads in others. Obviously, dissemination takes place only with prior invention. But dissemination also drives invention. Tensions in one surface in the other.

Technology in 14th-century China was more advanced than in the West. But that technical expertise was tightly controlled by the state and never disseminated to the population at large. China's failure to cultivate and satisfy a broad-based demand for knowledge led to its technological edge withering away and then being decisively overtaken over the course of the West's Industrial Revolution and indeed the next five centuries. By contrast the steam-mad public and commercial interests in 18th-century England helped drive James Watts's engine to ever greater technical improvement.

The history of successful societies shows commercial success flows from supplying what consumers demand. Successful businesses are ones that smooth out points of friction. Unprecedentedly the output of business is now, in the words of Alan Greenspan, conceptual and weightless. The friction today rests in such output being taken up insufficiently. Putting up barriers to the free flow of all these varied forms of knowledge, paradoxically, worsens their excess supply. And, the bottom line, restricting the flow of knowledge in the knowledge economy diminishes human welfare and is a sure way to economic extinction.

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