The Evolution of Future Wealth

Technologies evolve much as species do, and that underappreciated fact is the key to growth By STUART M. KAUFFMAN

When the world changes unpredictably over the course of centuries, no one is shocked: Who blames the Roman centurions for not foreseeing the invention of rocket launchers? Yet monumental and surprising transformations occur on much shorter time-scales, too. Even in the early 1980s you would have been hard-pressed to find people confidently predicting the rise of the Internet or the fall of the U.S.S.R. Unexpected change bedevils the business community endlessly, despite all best efforts to anticipate and adapt to it—witness the frequent failure of companies' five-year plans.

Economists have so far not been able to offer much help to firms trying to be more adaptive. Although economists have been slow to realize it, the problem is that their attempts to model economic systems focus on those in market equilibrium or moving toward it. They have drawn their inspiration predominantly from the work of physicists in this respect (often with good results, of course). For instance, the Black-Scholes model used since the 1970s to predict the volatility of stock prices was developed by trained physicists and is related to the thermodynamic equation that describes heat.

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As economics attempts to model increasingly complicated phenomena, however, it would do well to shift its attention from physics to biology, because the biosphere and the living things in it represent the most complex systems known in nature. In particular, a deeper understanding of how species adapt and evolve may bring profound—even revolutionary—insights into business adaptability and the engines of economic growth.

One of the key ideas in modern evolutionary theory is that of preadaptation. The term may sound oxymoronic but its significance is perfectly logical: every feature of an organism, in addition to its obvious functional characteristics, has others that could become useful in totally novel ways under the right circumstances. The forerunners of air-breathing lungs, for example, were swim bladders with which fish maintained their equilibrium; as some fish began to move onto the margins of land, those bladders acquired a new utility as reservoirs of oxygen. Biologists say that those bladders were preadapted to become lungs. Evolution can innovate in ways that cannot be pre-stated and is nonalgorithmic by drafting and recombining existing entities for new purposes—shifting them from their existing function to some adjacent novel function—rather than inventing features from scratch.

A species' suite of adaptive features defines its ecological niche through its relations to other species. In the same way, every economic good occupies a niche defined by its relations to complementary and substitute goods. As the number of economic goods increases, the number of ways in which to adaptively combine those goods takes off exponentially, forging possibilities for all-new niches. The autocatalytic creation of niches is thus a main driver of economic growth.

We do not yet know what makes some systems more adaptable than others, but research on complexity has yielded some clues. Some of my own work on physical systems called spin glasses suggests that the level of central control over subsidiary parts of a system is an important consideration. Too much control freezes the system into limited configurations; too little causes it to wander aimlessly. Only systems that hover on the border between order and chaos exhibit the needed general stability and capacity to explore the universe of possible solutions to challenges.

The path to maximum prosperity will depend on finding ways to build economic systems in which new niches will generate spontaneously and abundantly. Such an approach to economics is indeed radical. It is based on the emergent behavior of systems rather than on the reductive study of them. It defies conventional mathematical treatments because it is not pre-statable and is nonalgorithmic. Not surprisingly, most economists have so far resisted these ideas. Yet there can be little doubt that learning to apply these lessons from biology to technology will usher in a remarkable era of innovation and growth. SA

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