Introduction: the Innovation Economy

The Innovation Economy begins with discovery and culminates in speculation. Over some 250 years, economic growth has been driven by successive processes of trial and error and error and error: upstream exercises in research and invention, and downstream experiments in exploiting the new economic space opened by innovation. Each of these activities necessarily generates much waste along the way: dead-end research programs, useless inventions and failed commercial ventures. In between, the innovations that have repeatedly transformed the architecture of the market economy, from canals to the internet, have required massive investments to construct networks whose value in use could not be imagined at the outset of deployment. And so at each stage the Innovation Economy depends on sources of funding that are decoupled from concern for economic return.

Upstream, when mechanical tinkering yielded to scientific discovery as the basis for economically meaningful innovation, funding initially was supplied by the great corporations that had been spawned by the second industrial revolution toward the end of the nineteenth century. These corporations, variously supported or at least tolerated by the state, channeled a portion of their profits into central research laboratories. By the time over the past generation that their seemingly unassailable market positions were lost to competition or deregulation, a cadre of American political entrepreneurs had successfully invented national security and human health as legitimizing rationales for direct state investment in science.[1]

The transformational networks of infrastructure that implement the Innovation Economy can be planned, built and funded by the state: the US interstate highway system is an outstanding exemplar. They can also be planned, built and funded by the willing collaboration of

[1] See D. M. Hart, *Forged Consensus: Science, Technology and Economic Policy in the United States, 1921–1953* (Princeton University Press, 1998), pp. 145–234.

promoters and speculators: the original British railway system is the exemplar. In each case, the calculus of expected economic return was a secondary consideration. Hence the endless miles of superhighway crossing the empty wastes and wilderness of the American West and the multiplication of competing routes and the destructive competition that followed hard on the British railway mania of the 1840s.

Downstream, the Innovation Economy is driven by financial speculation. Throughout the history of capitalism, financial bubbles have emerged and exploded wherever liquid markets in assets exist. The objects of speculation have ranged across a spectrum that challenges the imagination: from tulip bulbs, to gold and silver mines, to the debt of newly established countries of unknowable wealth and – again and again – by way of real estate and of the shares that represent ownership of corporations. The central dynamic is that the price of the financial asset is separated from any concern with the underlying cash flows – past, present or possible future – generated by the economic assets it represents. Speculators in the financial asset can and often do profit, even when the project they have financed fails. Inevitably, the speculation collapses: the more it has been fueled by credit and has infected the banking system, the more disastrous the economic consequences and the broader and more urgent the pleas for public relief.

Occasionally, decisively, the object of speculation is the financial representation of one of those fundamental technological innovations – canals, railroads, electrification, automobiles, airplanes, computers, the internet – the deployment of which at scale transforms the market economy, indeed creates a "new economy" from the wreckage of the financial bubble that attended its birth. Both upstream and downstream, absence of market discipline is the essence of the process. For, contrary to the central dogma of neoclassical economics, efficiency is not the virtue of a market economy whose growth is a function of the creative destruction identified by Joseph Schumpeter as the engine of economic development.[2] The prime virtue is the ability to tolerate unavoidable waste in the evolution of the Innovation Economy.[3] So the

[2] J. A. Schumpeter, *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process* (London: McGraw-Hill, 1939), chaps. 1–3 and Schumpeter, *Capitalism, Socialism and Democracy,* 4th edn. (London: Allen & Unwin, 2010 [1943]), part II: "Can Capitalism Survive?"

[3] For a comprehensive analytical review of the literature on technological innovation as an evolutionary process, see G. Dosi and R. R. Nelson, "Technical

state has become central to the Innovation Economy's dynamics, both to fund the upstream research that generates discovery and invention, and to preserve continuity in the market economy when the speculative bubble that has funded its transformation bursts.

I have come to read this history as driven by three sets of continuous, reciprocal, interdependent games played between the state, the market economy and financial capitalism.[4] Through the centuries, the state and the market economy have variously collaborated and competed in the allocation of resources and the distribution of income and wealth. And financial capitalism has emerged to exploit discontinuities in the evolution of market and political processes, while it depends on those same processes for its prosperity and even at times for its survival.

The state, the market economy and financial capitalism are big, abstract concepts. Let me try to give each some substance.

By the state, I mean the political entity that has sufficient coercive authority to establish the rules for the other players. By definition it is able to exploit the other players, but it is also subject to their efforts to capture its authority or at least to bend it to their advantage. The state is the source of monopoly profits and privileges, but it also must have access to economic and financial resources to maintain itself and to pursue its objectives, whether they be wars of conquest or defense, or programs of economic development or social insurance. In principle, a state's authority may derive from the mandate of heaven or from popular sovereignty or from any of a variety of sources in between. Whatever the source of its power, the state is always subject to capture by economic or financial interests; rarely, if ever, is it useful to think of the state as monolithic.

By the market economy, I mean the institutions that enable the production and exchange of goods and services. It resides in marketplaces and trade fairs, entrepôts and caravan routes – anywhere the value of commodities is found in exchange, not merely in use. The market economy's virtues are regularity and predictability: ideally, atomistic competitors experience constant or diminishing returns in

Change and Industrial Dynamics as Evolutionary Processes," in B. H. Hall and N. Rosenberg (eds.), *Handbook of the Economics of Innovation*, 2 vols. (Amsterdam: North-Holland, 2010), vol. 1, pp. 51–127.

[4] For a set of relevant case studies that stops short of offering a comprehensive framework, see. R. Sylla, R. Tilly and G. Torella, *The State, the Financial System and Economic Modernization* (Cambridge University Press, 1999).

their own production functions and face well-behaved elasticities of demand from their trading partners, including utility-maximizing end consumers. In this utopian form, the market economy is the world of general-equilibrium theorizing and neoclassical economics. In its messy historical reality, it is the world of the "fair price" and of guild regulations, as it is of state-imposed tariffs and state-sanctioned monopolies. As Adam Smith understood, all who are subject to the rigors of competition seek to escape it. Those who can will innovate their way to market dominance and the enjoyment of economic rents, the profits a company can earn by escaping from competition. The many who fail can be expected to pursue countervailing relief, whether by conspiring to rig the market or by mobilizing intervention from outside the market's conventional confines.

Whereas the market economy is a world of continuity even when it fails to find and hold a state of equilibrium, the world of financial capitalism is one of discontinuous opportunism. The two are intimately related, for the market economy is not only a world of exchange; it is also, always and everywhere, a world of credit. Exchange and the production of goods for exchange must be financed from day to day, from month to month, and across years. Those who first provide credit have the potential to become capitalists as they dispose of liquid financial resources in order to exploit discontinuities in the market economy, and their impact on the market economy is disruptive. Whether invested in the opening of new trading relationships, development of innovative products or deployment of novel transportation and communication networks, financial capital earns its return by subjecting settled markets to new and powerful competition. As Fernand Braudel summarized the orthogonal relationship between capitalism and the market economy: "Capitalism does not invent … the market or production or consumption, it merely uses them."[5]

From this dynamic and unstable configuration of political, economic and financial forces – this "three-player game" – has emerged a world in which state investment in fundamental research induces financial speculation to fund construction of transformational technological infrastructure, whose exploitation, in turn, raises living standards for everyone dependent on the productivity of the market economy. But

[5] F. Braudel, *Afterthoughts on Material Civilization and Capitalism* (Baltimore, MD: Johns Hopkins University Press, 1977), p. 75.

the three-player game is also responsible for a world in which bubbles and crashes in the financial system spill over and liquidate both the employed and their employers, generating appeals to the political process for redress and relief. In yet another version, we find ourselves in a world where "malefactors of great wealth" – to invoke Theodore Roosevelt's epithet – are able to exploit the political process in order to preserve and protect their exploitation of the market economy.

Over the past 250 years, the Innovation Economy has emerged from this intersection of political interests, economic incentives and financial speculation. Here, where the future is supposed to differ from the remembered past and the experienced present, one basic aspect of human existence is paramount: all who are engaged, singly and collectively, in the three-player game are subject to inescapable, irreducible uncertainty with respect to the full consequences of their actions, "the future," as Thomas Hobbes wrote, "being but a fiction of the mind."[6]

We rely to our own future peril on the patterns we imperfectly discern from the past. When, in 1937, John Maynard Keynes sought to convey to his fellow economists the kernel of his new general theory of employment, the theme he emphasized was the uncertainty that is native to the universe in which we exist, not an artifact of our inadequate ability to reason about that universe. This ontological uncertainty infuses economic and financial decision-making all the way down. Keynes wrote:

> By "uncertain" knowledge … I do not mean merely to distinguish what is known from what is merely probable … The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in 1970. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know.[7]

[6] T. Hobbes, *Leviathan,* ed. R. Tuck (Cambridge University Press, 1993 [1664]), p. 14.

[7] J. M. Keynes, "The General Theory of Employment," *Quarterly Journal of Economics* (February 1937), in E. Johnson and D. Moggridge (eds.), *The Collected Writings of John Maynard Keynes*, vol. 14 (Cambridge University Press and Macmillan for the Royal Economic Society, 1973 [1937]), pp. 112–113. Following Keynes's insight, the Cambridge economist Tony Lawson has explored in depth the difference between the ontological properties of the world and the theoretical properties of the models we construct in the hope of

The historian John Lewis Gaddis embraces and extends Keynes's assertion when he speaks of our world as compounded of continuities and contingencies:

> The trouble with the future is that it is so much less knowable than the past. Because it lies on the other side of the singularity that is the present, all we can count on is that certain continuities from the past will extend into it, and that they will encounter uncertain contingencies. Some continuities will be sufficiently robust that contingencies will not deflect them: time will continue to pass; gravity will continue to keep us from flying off into space; people will still be born, grow old, and die. When it comes to the actions people themselves choose to take, though – when consciousness itself becomes a contingency – forecasting becomes a far more problematic exercise.[8]

I have lived in the Innovation Economy for forty years. I have learned that the ability of any player in the game to hedge against what cannot be anticipated – to hedge against crisis – is a joint function of assured access to cash and sufficient control of circumstances. Cash buys time to find out what is going on; control permits the player to use that time to shift the parameters of the problem. I learned about Cash and Control painfully through my apprenticeship in entrepreneurial finance. There, a new business's ability to generate positive cash flow from operations by selling goods and services to paying customers confers autonomy from the vagaries of the financial markets and the freedom to invest in future growth. There, too, evidence of effective control of the venture is demonstrated by the ability to fire the chief executive officer or to force a sale if the venture is floundering – or to recapitalize it and redirect it toward alternative opportunities.

As a student of financial crises, I have observed how large and systemically significant players have pursued equivalent strategies – from Jamie Dimon's construction of J. P. Morgan's "fortress balance sheet" in anticipation of the Crisis of 2008 to China's accumulation of $3 trillion of foreign exchange reserves – with consequences that feed back into the unstable dynamics of the global financial economy. In extremis,

understanding how the world works. See, for example, T. Lawson, *Reorienting Economics* (New York: Routledge, 2003) and T. Lawson, "The (Confused) State of Equilibrium Analysis in Modern Economics: An Explanation," *Journal of Post Keynesian Economics*, 27(3) (2005), 423–444.

[8] J. L. Gaddis, *The Landscape of History: How Historians Map the Past* (New York: Oxford University Press, 2004), p. 56.

when those who retain freedom of action find themselves on their own, then the panic-driven scramble for Cash and Control by each threatens the liquidation of all. But in normal times Cash and Control delivers liberation from the narrow constraints imposed by competitive markets and the perceived requirements of economic efficiency.

From the time Britain established the first industrial economy, mercantilism – export-led growth directly sponsored by state policies of protection and subsidy – has repeatedly succeeded in driving economic development.[9] As the prophet of "national economics," Friedrich List wrote in 1841:

> Had the English left everything to itself – laissé faire and laissé aller – the merchants of the Steelyard would be still carrying on their trade in London, the Belgians would be still manufacturing cloth for the English, England would still have been the sheepyard for the Hansards.[10]

With remarkable foresight, List also recognized that strategic competitive advantage already turned on factors that transcend the relative costs of production:

> The present state of the nations is the result of the accumulation of all discoveries, inventions, improvements, perfections, and exertions of all generations which have lived before us; they form the mental capital of the present human race, and every separate nation is productive only in the proportion in which it has known how to appropriate these attainments of former generations and to increase them by its own acquirements.[11]

Thus, List's book, titled *The National System of Political Economy*, "might just as well have been called *The National System of Innovation.*"[12]

[9] For a succinct summary of the success of mercantilist policies, from the Meiji Restoration in Japan through contemporary China, see D. Rodrik, *The Globalization Paradox: Why Global Markets, States, and Democracy Can't Coexist* (New York: Norton, 2011), pp. 143–156.

[10] F. List, *The National System of Political Economy*, trans. Sampson S. Lloyd (New York: Augustus M. Kelly, 1966 [1841]), p. 25. The Hansards, also known as the "merchants of the Steelyard," were representatives of the trading cities of the Hanseatic League, which dominated English commerce prior to the seventeenth century.

[11] *Ibid.*, 140.

[12] L. Soete, B. Verspagen and B. ter Weel, "Systems of Innovation," in Hall and Rosenberg, *Handbook,* vol. 2, p. 1161.

Programs of measured mercantilism do more than enable relatively poor nations to foster industries able to compete in the global market and relatively rich nations to renew their favored position through investment in and sponsorship of discovery and invention. Surplus cash generated from economic activities, at the level of the individual firm as of the nation-state, buys insurance against what cannot be forecast and reduces dependence on the willingness of others to finance the continuity of economic life.

So, upstream and downstream, in normal times and in times of crisis, the dynamics of the Innovation Economy challenge inherited principles of mainstream economic theory and the theory of finance. Economists have long recognized, in theory, that market failure legitimizes state intervention.[13] And the market's failure to allocate sufficient resources to scientific discovery and technological invention is often cited as a prime example.[14] Yet as an effective rationale for state intervention, market failure has proved inadequate. Instead, causes that transcend economic calculation – national development, national security, conquest of disease – have been required. At a deeper level, neoclassical economics is irrelevant to understanding how the Innovation Economy evolves through historical time, for its core purpose is to identify the conditions under which a competitive market economy will reach an efficient, timeless equilibrium in the allocation of resources.[15] But excessive devotion to the principles of neoclassical economics has consequences.

Those who hold the state to rigorous criteria of efficiency in the allocation of resources not only inhibit toleration of the "Schumpeterian waste" inherent in the operation of the Innovation Economy. They also encourage toleration of the deadweight loss that is represented by unemployed resources of human labor and physical capital – what,

[13] W. J. Baumol, *Welfare Economics and the Theory of the State*, 2nd edn. (Cambridge, MA: Harvard University Press, 1969) and A. C. Pigou, *The Economics of Welfare*, 2 vols. (New York: Cosimo Classics, 2010 [1920]).

[14] The foundation texts are R. R. Nelson, "The Simple Economics of Basic Scientific Research," *Journal of Political Economy*, 67 (1959), pp. 297–306 and K. J. Arrow, "Economic Welfare and the Allocation of Resources for R&D," in K. J. Arrow (ed.), *Essays in the Theory of Risk-Bearing* (New York: American Elsevier, 1971 [1962]), pp. 144–163.

[15] For a relevant alternative approach that takes both time and uncertainty seriously, as discussed in Chapter 12, see R. R. Nelson and S. G. Winter, *An Evolutionary Theory of Economic Change* (Cambridge, MA: Belknap, 1982).

in recognition of Keynes's valiant assault on the phenomenon, I call "Keynesian waste." During the 1930s, Keynes sought to establish a new macroeconomic rationale for responsive state intervention independent of the specific projects it financed. He began with the recognition that the marginal productivity of unused resources is negative as skills atrophy and machines rust: any vehicle that sponsors incremental consumption by providing employment of whatever sort would be a less bad alternative. Keynes failed in this project. Tellingly, when full employment did return, it was the result of the most economically wasteful of all imaginable state investments, mobilization for total war.

In the postwar era, the Three-Player Game transformed small-state capitalism, whose final crisis was the Great Depression, into big-state capitalism, whose first global crisis seized the world beginning in 2007. Whereas Keynes was the most insightful analyst of the inherent instabilities that destroyed small-state capitalism, his post-Keynesian successor Hyman Minsky was the most prescient analyst of how those instabilities would be conditioned by the rise of big-state capitalism.

Writing twenty-five years ago, Minsky correctly anticipated that an activist central bank would validate the excesses that characterize financial crises in order to protect the market economy from their consequences, even while the big state maintained the cash flows critical to the market economy's continuity and provided the low-risk assets that investors demanded.[16] What he could not anticipate was this: as soon as the big state had saved financial capitalists from their own excesses in the course of limiting the impact of the crash on the market economy, those whom it saved would question the solvency of the very institution that had saved them.

Now, although Keynesian waste is at a markedly lower level than characterized the Great Depression, the rich nations of the world seemed determined to reenact that greatest of historic failures of economic and financial policy. In the United States, and not merely on the fringes of political debate, forces have been at work for a generation to delegitimize the state as an economic actor. To the extent their success persists, we will experience the consequences of the deconstruction of big-state capitalism in both the near and the long terms. In the near

[16] H. P. Minsky, *Stabilizing an Unstable Economy* (New Haven, CT: Yale University Press, 1986), pp. 21, 52.

term we will forgo growth, employment and income; in the long term we will retreat from leadership of the Innovation Economy as well.

This volume is the expression of the double life I have lived as a theorist-practitioner of financial economics, to recall the term that Minsky applied to me twenty-five years ago. The first half of the book is an inside-out narrative of my education in the dynamics of the Innovation Economy. It presents the perspective of a practitioner of venture capitalism operating on the frontier where financial speculation intersects novel technology. The second half offers the outside-in perspective of a theorist concerned with two phenomena that have conditioned the opportunities and rewards for all who are engaged in doing capitalism in the Innovation Economy: financial bubbles and the engagement of the state.

First, financial bubbles have been the vehicle for mobilizing capital at the scale required in the face of fundamental, intractable uncertainty. Second, the post-Second World War American state, extending a diverse history of underwriting economic and financial uncertainty in pursuit of national goals, built the technological platforms on which I and my fellow venture capitalists have danced for a long generation. Beyond the confines of conventional financial economics, this interaction of speculative financiers and the state represented the Three-Player Game at its most productive. Exploring how it arose and how it worked may help reignite the essential engine of the Innovation Economy.