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KINDLEBERGER CYCLES:
METHOD IN THE MADNESS OF CROWDS?

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Kindleberger Cycles & Economic Growth: Method in the Madness of Crowds?

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ABSTRACT

Corporate R&D has a social rate of return several times higher than its internal rate of return to innovating firms, and so is chronically underfunded if agents are rational. Kindleberger cycles of stock market manias, panics and crashes, prominent in financial history, also accord poorly with rationality. If episodes of mania inundating “hot” new technologies with capital sufficiently counter chronic underinvestment in innovation, economy-level competition may favor institutions and behavioral norms conducive to Kindleberger cycles despite individual agents’ losses in panics and crashes. Evidence from several different corners of economics supports this view.

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1. No Bubbles in the USSR

Kindleberger (1978) discerns an irregular cycle of stock market manias, panics and crashes from the past four centuries of financial history. In 2008, as the latest Kindleberger cycle ended, US Federal Reserve chair Alan Greenspan reflected “There were no bubbles in the Soviet Union” and posited that a cycle of manias, panics and crashes might underlie free market economies’ prosperity.¹ Seemingly unconnected stylized facts from different corners of economics coalesce to back this.

Most economic growth in high-income economies reflects technological progress, not increased inputs (Solow 1957). Innovative firms devise higher productivity (higher output value from lower input costs) production processes, which displace lower productivity ones. Because one firm’s innovation often opens ways for others to devise higher productivity processes, innovation has very large positive externalities. Innovations with positive externalities throughout the economy, called general purpose technologies (GPTs), can generate vastly new wealth (Bresnahan and Trajtenberg 1995; Bekar et al. 2018). Alexander Graham Bell made a decent return on the telephone, but created far more new wealth as firms and people found ever more valuable uses for instantaneous voice communication (Fischer 1994). The social returns from corporate R&D are plausibly estimated to be manifold higher than its return to the innovator firm (Hall et al. 2010; Jones and Summers 2020).

This is an epic market failure: profit-maximizing corporate governance keeps R&D spending to a small fraction of its socially optimal level. Externality economics (Pigou 1920) prescribes R&D subsidies and intellectual property (IP) to boost innovators’ private returns; however, mounting evidence contests the efficacy of such interventions (Jaffe and Lerner 2011).

Another market failure has comparable importance: the irregular cycle of stock market manias, panics and crashes Kindleberger (1978) discerns throughout modern financial history. Each cycle begins with a disequilibrium, usually a big new technology, sometimes a new market, with very high expected private returns. A mania inflates stock prices as uninformed investors pour capital into anything associated

¹ Quoted in Guha, Krishna. 2008. Greenspan urges focus on banks’ capitalization, *Financial Times* May 26, 2008

with the disequilibrium. A panic causes an abrupt crash. Sometimes a major economic downturn follows, but Samuelson correctly notes “the stock market has predicted nine of the past five downturns.”² A large prior credit expansion seems instrumental to a serious subsequent downturn (Sufi and Taylor 2021).

Financial historians document Kindleberger cycles beginning shortly after stock markets arise. Each cycle gives play to behavioral biases conducive to excess investment that defeat whatever tough new regulations the previous crash begat (Dagher 2018). Uninformed investors’ enthusiasm repeatedly triumphs over lessons learned in the previous crash (Reinhart and Rogoff 2009).

Most of humanity lived in poverty until a few centuries ago, when large middle classes arose in country after country in step with the rise of stock markets (Rosenberg and Birdzel 1986). Stock markets are prominent in early industrializations of all large high-income economies (Morek and Stier 2005; Demirgüç-Kunt and Levine 2018), including Germany (Fohlin 2005) and Japan (Morek and Nakamura 2005), which subsequently gave banks prominence. Combining these stylized facts suggests stock markets are the greatest of all GPTs. Institutions that encourage intermittent stock market manias that flood new technologies and markets with capital counter chronic underinvestment in innovation.

Unlike biology, economics has always recognized the reality of multi-level selection – micro-level competition between individuals and firms as well as macro-level competition between national economies (Nelson and Winter 1982). Micro-level selection, such as selfish genes or individuals, predominates unless high-level selection is intense, such as deadly warfare between Paleolithic tribes (Wilson and Wilson 2008; Wilson 2012). If manias, by countering suboptimal innovation, strengthen economies despite disruptive panics and crashes and enrich people despite occasional losses in crashes, economy-level selection favors institutions conducive to Kindleberger cycles. Consequently, institutions that exploit behavioral biases to deluge new technologies with capital are likely to persist in economies that prosper long-run.

2. Large Social Returns to Unprofitable Innovation

Solow (1957) shows technological progress underlies most economic growth. Continued innovation thus

² Newsweek, Sept. 9, 1966.

sustains high-income economy's continued prosperity.

2.1 Chronic and Pervasive Underinvestment in Innovation

Typical corporate R&D yields the innovation firm an internal rates of return (*IRR*) in the 10 to 15% range and, by creates productivity increasing opportunities for other firms, yields the economy a social rate of return (*SRR*) in the 40 to 85% range (Bloom et al. 2020).³ The *SRR* minus *IRRs* gap varies across industries and over time. Griliches (1957) estimates *SRRs* of agricultural innovations at 35 to 40% versus a 10% *IRR* benchmark. Subsequent work, reviewed by Hall et al. (2010), affirms innovations have *SRRs* manifold higher than their *IRRs*.⁴ Bloom et al. (2013) identify an *SRR* of R&D of 59% using U.S. states' changes in R&D taxes. Acharya (2008) finds the *SRR* of R&D exceeding its *IRR* by 90 to 101% in pharmaceuticals and by 49 to 62% in computers, but by little if anything in general machinery and equipment. Jones and Summers (2020) calculate that "under conservative assumptions, innovation efforts produce social benefits that are *many multiples of the investment costs*."

Profit-maximizing firms do R&D if its *IRR* exceeds its cost of capital (*COC*). The T-Bond rate, the government's long-term borrowing cost, sets a benchmark *COC* for near riskless undertakings. That plus the implied equity risk premium (Damodaran 2014) gives a benchmark for undertakings of average risk. Adding twice the implied risk premium provides a benchmark for high-risk ventures.

Figure 1 summarizes. Bloom et al (2020) estimate median *SRRs* of listed firms' R&D rising in the early 1990s, as IT innovation gained salience, falling from the mid-1990s on as capital flooded in, and then stabilizing after the 2000 crash. Their lower *SRR* for aggregate R&D highlights the importance of stock market in financing innovation. Both *SRRs* far exceed estimated ranges for the *IRRs* and *COCs* of corporate R&D, which are similar, implying most R&D is only marginally profitable to innovating firms.

³ Some studies refer to the total return all R&D in an industry or country as an industry-level or economy-level *IRR*. Both might better be called *SRRs* because they include positive externalities – the benefits of one firm's R&D to other firms in the industry or economy. For clarity, the firm's return from its own R&D spending is its *IRR* and society's return from that firm's R&D spending is its *SRR*.

⁴ See Griliches (1979, 1992, 1998, 2000); Nadiri (1993); Jones and William (1998); Verspagen (1997ab); Frantzen (2002); Keller (2002a, 2004); Brynjolfsson and Hitt (2003); Fung (2004); Park (2004); Fraumeni and Okubo (2005); Hall, Jaffe and Trajtenberg (2005); Bloom, Sudun, and Van Reenan (2006); Sveikauskas (2007); and Acharya (2008)..

Firms acting for society would do all R&D whose *SRR* exceeds its *COC*, including R&D with *IRRs* below their *COCs*. Scherer (1999) concludes that firms acting for society would do large amounts of R&D with negative *IRRs*. Consequently, the R&D profit maximizing firms do falls chronically and profoundly short of what socially optimal R&D would be.

2.2 Increasingly Problematic State Intervention

Stronger and longer patent and copyright protection raise a firm's *IRRs* from any given innovation, but may not accelerate aggregate innovation (Brown et al. 2017). First, larger or longer streams of profits from one innovation makes finding the next less urgent, limit its spread, and makes gaming IP law more profitable. Many innovations have valuable externalities within a few years (Caballero and Jaffe 1993). *Patent trolls* game IP by buying up unused patents and setting *patent thickets*, minefields of patents on processes someone might someday use and thereby become vulnerable to a lucrative lawsuit. For example, Blackberry never recovered from paying a US patent troll \$612.5 million for violating its patent on wireless e-mail (Sweeny 2009).

With economists unsure what constitutes socially optimal IP law (Heller and Eisenberg 1998), Saperstein (1997) describes how lobbyists took charge

“The legislative history demonstrates that industry specific interest groups were instrumental in driving the shift from copyright law based on misdemeanor penalties to one based on felony sanctions.”

IP law attracts intensive lobbying (Draho 2003), suggesting the *IRR* of lobbying to game IT law exceeds the *IRR* of innovation (Murphy et al. 1993). Accumulating evidence (Wu 2010; Jaffe and Lerner 2011) suggests IT law impedes, rather than encourages, innovation.⁵

Alternative state interventions, subsidizing corporate R&D with tax deductions, tax credits, and direct subsidies (Lach 2002; Fazio et al. 2019) and directly funding R&D at universities and research labs, also may have scant traction. First, corporations, universities and research labs routinely patent state-

⁵ Other work includes Heller (1998, 2008); Heller and Eisenberg (1998); Buchanan and Yoon (2000); Maurer and Scotchmer (2002); Menell and Scotchmer (2007), Menell (2011); Wu (2010) and Maurer (2012, 2017).

subsidized R&D, so dysfunctional IP law remains a problem (Lach and Schankermann 2004). Second, cash-strapped university administrators selling, rather than developing, patents may help patent trolls erect patent thickets (Watkins 2014). Third, government bureaucrats are poor at “picking winners” to subsidize. Bureaucrats understandably find more bureaucratic applicants’ timely and perfectly filled-out proposals more convincing (Jaffe 1989) and influential lobbyists’ applications more worthy (Lerner 2009). Both effects plausibly divert subsidies away from actual innovators. Yet other solutions – governments offering prizes for important new technologies (Wright 1983) or buying patents and making technologies free (Kremer 1998) – are complicated by perverse incentive problems (e.g. Ales et al. 2017).

State-financed R&D has lower *IRRs* and *SRRs* than private-sector R&D (Hall et al. 2010). Governments deliberately do socially valuable things the private sector cannot, so lower *IRRs* are unsurprising. However, lower *SRRs* reinforce the above concern and studies reporting resource misallocation in research at universities (Goulsbee 1998; Sokal and Bricmont 1999; Strevens 2013; Ioannidis et al. 2014), including in economics (Kwak 2017).

2.4 Innovation Drives Prosperity

All of this coalesces into a major market failure. Solow (1957) shows increased inputs (resources, capital and labor) explain only a small fraction of economic growth in high-income countries. The unexplained greater part of economic growth, called the Solow Residual, arises from successions of new technologies displacing older ones, each permitting the production of higher-valued output from familiar inputs or familiar outputs from lower-cost inputs or some mix of the two. Economic prosperity depends on ongoing technological progress, and can continue as long as valuable new ideas keep arising. Subsequent work affirming, formalizing and expanding Solow’s insight built the subdiscipline endogenous growth theory (Akcigit and Nicholas 2019). This is good news, in that ongoing prosperity depends on the potentially unlimited flow of new ideas, not on limited natural resources, but underscores the cost of socially insufficient spending on innovation.

Figure 2 shows Solow residuals, approximated by cumulative multifactor productivity growth, rising in lockstep with private-sector R&D in high-income economies. No such relationship is evident for

state-funded R&D (OECD 2003). One possible explanation is that “Science owes more to steam engines than steam engines owe science”⁶ – academic research explains, rather than inspires, economically important innovations (Edgerton 2004; Ridley 2020).

Mokyr (2018) argues that the pace of innovation rises and falls, but remains the primary engine of growth in the long-run. Although, Gordon (2016) concludes the pace of innovation is slowing markedly, Trajtenberg (2018) and (Choi 2018) see AI and 3D printing as nascent GPTs. .

3. Ideas about Ideas

Neal (1996, 155) sees recurrent financial manias as “less a tale about the perpetual folly of mankind and more one about financial markets’ difficulties in adjusting to an array of innovations.” This is an economically important insight.

3.1 Procedurally transcomputational problems

Living up to economists’ expectations of rationality is difficult. Financial economics deems a prospective investment project viable if its IRR exceeds its cost of capital; and provides exact equations for both. A project’s internal rate of return is the value of i that solves

$$-K + \sum_{s=1}^S \sum_{t=1}^T \pi_{s,t} e^{-i \times t} \left(\sum_{m=1}^M p_{m,s,t} q_{m,s,t} - \sum_{n=1}^N p_{n,s,t} q_{n,s,t} - \tau_{s,t} \right) = 0$$

Into this equation, one plugs in the project’s setup cost K and, for each future time t in each possible state of the world s , the prices $p_{m,s,t}$ and quantities $q_{m,s,t}$ of each of the project’s M outputs, the prices $p_{n,s,t}$ and quantities $q_{n,s,t}$ of each of the project’s N inputs (raw materials, intermediate goods, and categories of employees, for example), the taxes τ the project would incur, and the probabilities $\pi_{s,t}$ of the world being in each state s at each time t . Relating each output to its required inputs also requires knowing all the parameters of the M time and state-dependent production functions, $q_{m,s,t} = f_{m,s,t}(q_{1,s,t} \dots q_{n,s,t} \dots q_{N,s,t})$. A project’s cost of capital comes from solving

⁶ Attributed to the chemist Lawrence Henderson (Gillispie 1960, 357).

$$k = r_{f,t} + \sum_{s=1}^S \pi_{s,t} \sum_{j=1}^J \beta_{j,s,t} (r_{j,s,t} - r_{f,t})$$

Into this equation one plugs the same set of probabilities $\pi_{s,t}$ of each possible state of the world s prevailing at each future time t , a set of $\beta_{j,s,t}$, each the theoretical linear regression coefficient of the project's IRR on the returns of J different portfolios of securities, subtracting the risk-free interest rate $r_{f,t}$ for time horizon t from each, whose return captures of J risk-factors. The project is then viable if $i > k$.

A few are unreliably guestimatable; most are fundamentally unknowable. After history unfolds, most of the numbers one plugs into these equations are known to a degree. But when the investment is made, solving them requires either knowledge of or abstract assumptions about hundreds of numbers: the prices and quantities of all inputs and outputs, taxes, and benchmark risk-factor returns; all for every future time period in every possible state of the world., and the probabilities of every state of the world in every time period. Statistical assumptions about the probabilities such time invariant distributions, ergodicity, normality, and even that statistical distributions are sufficiently well behaved to have meaningful means and variances, are often implausible simplifications.

Told to evaluate an investment project, students are given almost all these numbers and As for solving the equations. Graduates have almost none of this information, yet must evaluate real corporate investment decisions. Experience fills in numbers and justify assumptions for familiar repeated investments. But innovations are, by definition, new; their prospects are largely unknowable. Keynes' (1936) conclusion *"human decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist"* surely applies to innovations. The more profound the innovation, the more distant the time horizon and the deeper our current ignorance and, the more outrageous the conceit that mathematical expectations provide insight. Keynes' critique is frequently elaborated and acknowledged (e.g. Simon 1957; Nelson and Winter 1982; King and Kay 2020), but students memorize ever more intricate equations of mathematical expectations.

Mathematical problems whose solution must exist, but that cannot be solved, are called

transcomputational (Bremermann 1962). Grossman and Stiglitz (1980) distinguish *substantive rationality*, the optimization of standard economic theory, from *procedural rationality*, optimization of the decision-making procedure itself. Extending this distinction, a problem is *procedurally transcomputational* if an equation provides its solution, but no feasible procedure for ascertaining numbers to plug into that equation exists. Evaluating the financial viability of new technologies easily qualifies.

3.3 Behavioral finance, beauty contests and capital inundations

Facing procedurally transcomputational problems, people make decisions using Simon's (1957) *bounded rationality*. New problems stimulate memories of similar problems and of experienced or observed responses. Stimulus-response pairings, called *heuristics*, that work out well are remembered and imitated (Bordalo et al. 2021). Successful heuristics spread and displace less successful ones (Nelson and Winter 1982; Kahneman 2011). Behavioral economics models heuristics as *biases*, a term King and Kay (2020) reject because rational solutions are typically procedurally transcomputational.⁷ Surviving heuristics, like evolutionary algorithms in machine learning (Lo 2019; Lo and Remorov 2021), can actually “defeat the dark forces of time and ignorance which envelop our future” – Keynes' (1936) definition of investment success.

The heuristic “imitate someone who likely knows what to do” has such survival power. Behavioral finance research shows this heuristic readily elicited in laboratories, evident in many settings, and resonant with a human propensity to conform (Hirshleifer 2015, Bikhchandani et al. 2021). It persists because it often seems successful, but it can also cause overreactions in ways that plausibly drive Kindleberger cycles.

Early highly publicized successes investing in big new technologies, whose valuations are procedurally transcomputational, can evoke expanding rounds of imitation. Early success stimulates more investment, which lift stocks, reinforcing perceptions of success, and stimulating yet more investment. Called *information cascades*, such feedback patterns can inflate securities prices in bubbles that ultimately burst. Bikhchandani et al. (2021) review this literature.

⁷ Kahneman (2011) and Hirshleifer (2015) review this literature.

Any investors who grasp that such a bubble is expanding find themselves caught up in what Keynes (1936) characterized as an investment beauty contest.

“It is not a case of choosing those [faces or investments] that, to the best of one’s judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees.”

Such rational investors as exist vie to buy stocks they expect heuristic-driven investors will soon deem more beautiful. Owning what others deem beautiful can also convey social status, further strengthening the positive feedback (Veblen 1899). Information cascades, turbo-charged by these effects, can escalate stock prices and inundate firms in sectors associated with high-profile innovations.

3.4 The social value of capital inundations

Kindleberger cycle manias flood capital across innovations profit maximizing firms would shun. After the flood abates, the crash harms investors, including corporate acquirers (Moeller et al. 2005), venture capitalists (Kerr et al. 2014), and others deemed “sophisticated.”

However, corporate innovation has massive positive externalities that enrich people beyond the innovating firm. Positive externalities from innovation outlive innovative firms because important tangible and intangible assets remain (Angeletos et al. 2010). The Crash of 1929 destroyed the wealth of investors in electric power grids, but the power grids remained. The 2000 crash erased the wealth of dot.com investors, but the internet remained. Positive externalities of innovation, especially of GPTs, also often have network externalities (Katz and Shapiro 1985; Liebowitz and Margolis 1994). A telephone is a poor investment if yours is the only one, but grows increasingly valuable in an expanding telephone network. Investing in an innovation whose value depends on network externalities requires a leap of faith as to what others will do. Information cascades and Keynesian beauty contests recast such leaps of faith as entirely plausible heuristic responses.

This contrasts starkly with the scolding for greed and folly typically directed at bubble investors

(MacKay 1841; Cole 1720; Chancellor 1999; Reinhart and Rogoff 2009; Goldfarb and Kirsch 2019). Financial manias have social benefits that might counterbalance the social costs of panics and crashes. Financial history helps reveal this trade-off.

4. Bubbles for Needham

Until recent centuries, almost everyone everywhere lived in indistinguishably abysmal poverty (Bolt and Van Zanden 2020). Then, beginning in the early 1600s, one Western country after another developed a broadening middle class and escaped (Deaton 2013). Science historian Joseph Needham (2004) documents China’s technological superiority over the prior millennium and asks “why wasn’t China first?”

Incomplete answers include natural resources or their absence (Sachs and Warner 2001; Morck and Nakamura 2018), and imperialism-plus-slavery (e.g. Baptist 2014). But abundant (or absent) natural resources are not unique to Western countries in these critical centuries; nor are imperialism and slavery. Answering Needham requires finding more unique factors.

Baumol (1990) describes major Chinese innovations sitting unused until rediscovered in the West and argues initially unique Western institutions made innovations fuel prosperity. Rosenberg and Birdzel (1986) describe countries escaping poverty in lock-step with institutions business corporations and stock markets. Corporations could pool vast amounts of capital raised by selling stock.⁸ But corporations plus stock markets also allowed Kindleberger cycles. From the early 1600s on, investment manias intermittently flooded hot new technologies with capital in the West, but not in China or other sophisticated civilizations.

4.1 The first stock market and the first mania

In the early 1600s, new mathematics were revolutionizing oceanic navigation (Davids 2015, Levy-Eichel 2015). Amsterdam schools taught navigators Mercator projections, trigonometry, logarithms and slide rules. Their students were the era’s high tech stars. Amsterdam also organized the modern world’s first stock market in to trade shares in the Dutch East Indies Company, whose spice trade made the city an

⁸ Landes (1998) also highlights patents, invented in Venice, encouraging the development of innovation in the West; however, scarce knowledge not patent law, appears critical to early disequilibrium profits in many cases.

entrepôt to other parts of Europe (Frentrop 2002). The stock market soon capitalized other companies that, using the new mathematics, moved high value added goods (including slaves) across oceans.

The modern world's first bubble also formed and popped in Amsterdam. By 1637, Dutch East Indies stock was up over 250% (Petram 2011, p. 297), oceanic trade investors were rich, and speculative investors sought high returns elsewhere. The bubble arose in tulips, a status luxury good, not stocks. In the 1630s, tulip bulb prices soared and derivative securities priced notional tulips in quantities far outstripping their physical numbers. Tulips crashed in 1637, ruining speculators (scolded by moralists of all subsequent ages), but leaving the economy largely undamaged (Goldgar 2008). Stocks recovered and kept rising (Petram, 2011, p. 98). Stock financed trading companies and broad bourgeois prosperity made the miniscule Netherlands a world power.

4.2 The first international mania

The 1688 *Glorious Revolution*, a Dutch intervention to oust Britain's Catholic king, brought "Dutch Finance" to London (Frentrop 2002; Barone 2007) and enriched a politically disruptive class of Whigs who "raised themselves from poverty to great wealth, despise the advantages of birth" (Davenant 1701).

Late 17th and early 18th century British shareholders avidly bought tech stocks in oceanic trading, steam engine pumps, gas lighting, among others. Edmund Halley's actuarial tables formalized a risk-reward trade-off and revolutionized insurance. As stocks rose, a wave of IPOs floated trading, mining, manufacturing, mortgage, real estate and pseudo-high-tech firms, including possibly apocryphal "element transmutation" and "wheel of perpetual motion" firms (Mackay 1841). Stocks rose in London, Amsterdam (Frehen et al. 2013) and Paris, where the Scottish escaped murderer John Law organized a stock market for his Mississippi Company (Murphy 1997).

The fraudulent nature of Law's company, and of John Blunt's South Seas Co. in London (Balen 2002), brought on the Crash of 1720, ruining small investors in all three markets. But afterwards, England had oceanic trading, insurance, mining, steam pumps and other new technologies (Carswell 1993). Previously an unimportant island, Britain rapidly became a major world power.

4.3 New technology manias

Subsequent bubbles financed successive new technologies. Aligning all of these, Kindleberger (1978) discerns a common pattern.

In the early 1790s, British investors took to canal companies. Canal stocks rose and collapsed several times, but left Britain a network that, by the 1810s, connected previously isolated inland regions to ports. In the 1820s, new mining and textiles technologies lifted stock prices. In January 1825 alone, seventy IPOs debuted. Speculation spread to bonds of the newly independent Latin American republics, each touted as the “next” United States. Stocks crashed in December 1825 (Dagher 2018) and a Latin American debt crisis ensued. But the new technologies remained in place in England and the new republics were established. Another canal bubble burst in 1836 in Britain and 1837 elsewhere, but left yet more canals in place in America, Britain and Canada.

A railway stock bubble burst in 1847 in Britain and 1848 elsewhere (Campbell 2012, 2013), but left railways throughout Britain, Europe, Canada and the US. A European stock bubble burst in 1857, but left industrial plant in place. Waves of breakthrough patents in the 1860s and 1880s (Kelly et al. 2021) heralded bull markets that crashed in 1873 and 1893, each leaving new technology in place – improved railroads, telegraph systems among the most important. Rapid settlement in southern Latin America pulled in capital and a second Latin American debt crisis in 1890 nearly destroyed Barings Bank.

Rising stocks from the mid-1890s into the early 20th century financed new technologies in cement, petroleum, steel, telephones, and electric lighting, equipment, and transportation (O’Sullivan 2007). Northern Europe, Australia, Canada, and Japan emerged as new markets and the US emerged as a major economic power. US markets crashed in 1903, recovered, and crashed again in 1907. Canada’s bull market ended in 1911. Shareholders lost, but all these economies were left industrialized.

The roaring 1920s bubble (Nicolas 2007) lifted -tech stocks such as Radio Corporation of America (radio), International Business Machines (adding machines), General Motors (automobiles), PanAm (airfreight), and RKO (motion pictures). Stock-financed power and telephone networks brought network externalities. Stocks crashed in 1929, but left the physical plant of automakers, aviation, business machines,

electric and telephone grids, motion pictures, and other technologies in place. Sometimes under new ownership, tech firms continued making major advances into the 1930s (Field 2003, 2011).

Tech bubbles also arose in the 1960s and 1990s. The 1960s bull market ended with a large real drop in stock prices, partly obscured by the high inflation of the 1970s, but left aerospace, mainframe computers, passenger jets, plastics, solid-state electronics, plastics, and synthetic fabrics. The 1990s dot.com bubble ended with the Crash of 2000, but left cell phones, the internet, microcomputers, and software that increased productivity, including in many established industries.

4.4 Big new markets resemble big new technologies

Big new technologies are a recurring theme across such episodes. However, technologies such as oceanic navigation, canals, railways, automobiles and trucking also opened new markets to rapid development. Real estate bubbles in newly connected areas often ensued.

But some manias arise around promising new market economies, such as new Latin American republics in the 1820s and East Asian tiger economies in the 1990s. Rosenstein-Rodan (1943) explains that economic development itself has huge network externalities. Like a telephone, a factory in a subsistence economy is an iffy investment if yours is the only one. A factory needs competing potential suppliers and customers, which all need their own competing suppliers and customers. Each new firm helps fill out the network and make existing firms more viable. Like patents and subsidies as innovation drivers, industrialization plans and foreign aid are problematic drivers of economic development (Easterly 2006). Here too, bubbles may succeed where bureaucrats and subsidies fail. Hirano and Yanagawa (2016) show country-level bubbles drawing capital into promising middle-income economies, but rarely into low-income economies. Allen (2001) argues a threshold of domestic financial development is necessary for a bubble to form. Like the new technologies left in place after a tech bubble, the physical assets put in place during a country mania remain to offset costs of the panic and crash.

5. Kindleberger Cycles

Parsing centuries of financial history, Kindleberger (1978) discerns an irregular cycle of manias, panics,

and crashes. The outer circle in Figure 3 summarizes, using terminology subsequently associated with individual stages of the cycle.

First, a new technology, such as the internet, or (less often) a new market, such as East Asian Tiger economies, causes a *disequilibrium*, when nimble firms earn large positive economic profits. Grappling with valuing a new technology, investors disagree and the highest bids set prices (Hong and Stein 2007). As the technology's positive externalities spread, so does harmonious investor optimism (Pástor and Veronesi 2009).

Others notice, but find valuing new technology or markets procedurally transcomputational, so information cascades arise (Angeletos et al. 2010). People mimic others who, by insight or luck, got rich; and lobby for deregulation to make this easier. Adapting firms expand and proliferate as capital floods over them. Demand for their shares lifts their share prices, further increasing investor demand. This positive feedback characterizes the cycle's *bubble* stage.

Credit expansion and deregulation can ensue. Credit expands as investors borrow to invest even more. The magnitude of this expansion varies: US banks lent generously to retail shareholders in the 1920s, but had little role in its 1990s bubble. Small investors demand for deregulation also has varying success. Akerlof and Shiller (2009, p. 154) attribute US deregulation prior to 2008 to a "belief that the opportunities to take part in the housing boom were not being shared fairly."

Kindleberger (1978) calls the next stage, the instant of collective insight that stock prices are celestially overvalued, the *Minsky moment*, honoring Minsky's (1986) observation that bubbles burst on days of little or no other major news. Many forces combine to delay Minsky moments. Creative accounting touches up profits to better justify overvaluations, larger frauds obscure earlier rule bending. Bankers lend generously to speculators. Deregulation and monetary expansions that prolong credit expansion. Sometimes, a second Minsky moment is needed. After one market crashes, investors seek high returns elsewhere. Financial engineers help with new ways of disguising high leverage, the conventional way of jacking up returns (Geanakoplos 2010). Spin-off bubbles, often in real estate, expand and, after their own Minsky moments, burst.

A Minsky moment ultimately brings a *panic and crash*. Individual investors fearing others fear others no longer deem stock beautiful, rush to sell first, before prices fall. All investors running to sell first crashes prices. If enough investors who borrowed to buy into the bubble also default, financial institutions are stressed and curtail regular lending. A recession can ensue.

A *clean-up stage* follows. Frauds are exposed. Political calculations press governments and central banks to bail out large banks and firms. Free market economics looks tainted. Angry investors demand tough new regulations.

A *secular stagnation* era of sedate near-equilibrium growth follows, as investors adjust to equilibrium returns (Ramey 2020). Regulators are captured (Stigler 1971); ex-innovators become entrenched monopolists. Pundits solemnly eulogize the end of innovation. Horgan's (1996) *The End of Science* rang in the IT revolution. Gordon's (2016) *Rise and Fall of American Growth* remains for historians to judge.

After an irregular interval, another dislocation initiates a new Kindleberger cycle. Forgetting the misfortune of their elders, or former selves, investors demand deregulation so all can share in the new investment opportunity. Free market economies have been repeating this pattern for four centuries, and most discussions of this cycle despair of human greed and folly.

Despair is unwarranted if each cycle generate vast new wealth from positive externalities to lift productivity, but not stock valuations, to a new permanently higher plateau. If, in the long run, higher economy-wide prosperity more than offsets bubble investors' private wealth destruction and other social costs of the panic and crash, economy-level competition select for institutions that generate Kindleberger cycles.

6. Social costs and benefits

For economy-level selection to favor institutions prone to Kindleberger cycles, the social benefits must exceed the social costs by a wide enough margin to be a net social gain. If investors who lose in bubbles are nonetheless better off by living in such an economy, the case is clinched.

6.1 Positive externalities suspend Cardwell's Law

Economics long viewed bubbles as welfare reducing deviations from optimality⁹. However, in the presence of various growth impeding frictions, imperfections such as credit constraints or underwriting fees, bubbles can become growth promoting lubricant.¹⁰ Stock market bubbles coincide with sharply elevated corporate investment (Martin and Ventura 2018), especially where large positive spillovers arise.¹¹

During bubbles, shareholders attach higher valuations to firms with important patents and firms likely to benefit from externalities (Haddad et al. 2020), which further encourages firms to invest in innovation (Dang and Xu 2018). Option value effects from skewed and fat-tailed payoff distributions of technology experimentation can also elevate stocks (Kerr et al. 2014). CEOs, enraptured by novel technologies, skew investment towards those technology (Xu and Dang 2018). Equity financing is especially large during bubble-like episodes (Loughran and Ritter 1995), but is not obviously allocated to firms with the highest profit opportunities. (Lamont and Stein 2006; Dittmar et al. 2020).

Innovations financed in 1920s (Field 2003, 2011; Nicholas 2008) and 1990s (Xu and Dang 2018) bubbles are atypically important, implying larger positive externalities (Kogan et al. 2017; Shin and Subramanian 2019). Martin and Ventura (2010), Tanaka (2011), Lansing (2012), and Takao (2017) also model growth enhancing bubbles. Xu and Dang (2018) report stock market bubbles ease capital constraints on R&D. Eatwell (2004) reports bubbles allocating capital to profitable

⁹ Growth-retarding bubbles forming if economic growth exceeds the full-information steady-state interest rate (Tirole 1985; Saint Paul 1992; Grossman, and Yanagawa 1993; Caballero et al. 2006).

¹⁰ Mainstream macroeconomics (Martin and Ventura. 2018; Simsek 2021) and finance (Jarrow 2015) are rethinking bubbles after long considering them troublesome distortions. Specifically, if underwriting fees, information costs or other frictions reduce corporate investment, bubbles that increase investment can have ambiguous or even positive growth implications (Caballero and Krishnamurthy 2006; Caballero et al. 2006; Farhi and Tirole 2012; Martin and Ventura 2012, 2016; Kikuchi and Thepmongkol 2020; Ventura 2012; Miao and Wang 2014, 2018; Miao et al. 2015; Kunieda and Shibata 2016; Hirano and Yanagawa 2016; Hillebrand et al. 2018). Such constraints are often binding (Fazzari et al. 1988; Baker et al. 2003). Polk and Sapienza (2009) model a rational manager's optimal investment rising with the size and duration of a stock price bubble and present supportive evidence. Such revisionism is not universally accepted. For example, Bosi and Pham (2016) propose taxing bubbles to subsidize innovation.

¹¹ Bubbles or episodes interpretable as bubbles see accelerated, not slowed, investment and growth (Loughran and Ritter 1995; Chirinko and Schaller 2001; Baker, Stein, and Wurgler 2003; Sapienza 2004; Gilchrist, Himmelberg and Huberman 2005; and others).

investments left unfunded by capital rationing or managerial myopia and to unprofitable investments with large positive externalities.

During bubbles, R&D rises more than capital investment (Xu and Dang 2018). R&D-intense firms, often young and without earnings histories or collateral, cannot borrow directly and therefore rely on stock markets (Brown et al. 2012; Hsu et al. 2014; Acharya and Xu 2017). Such firms are exceptionally likely to list and issue seasoned equity during bubbles (Brown et al. 2009; Aghion et al. 2012) to fund current and future R&D (Brown et al. 2009, 2012; Brown and Petersen 2011). As the bubble expands, takeovers of high tech firms proliferate (Phillips and Zhdanov 2013). Early 20th century inventors (Nicholas 2010) and late 20th century venture capitalists and IT entrepreneurs (Gompers and Lerner 2004) often listed and sold to acquirers, locking in high returns for themselves and the crash to others.

Much evidence also reveals social costs. Flooding capital across whole sectors or even whole economies allocates capital indiscriminately. Still, Ashton (1948, p. 83-4) concludes that although the British canal mania of the late 1770s “undoubtedly led to some waste of national resources,” its benefits were greater because “agricultural regions which had been remote from the centre were brought within the widening circle of exchange; the fear of local famine, of both food and fuel, was removed; and the closer contact with others, which the new means of communication afforded, had a civilising influence.”

Pastor and Veronesi (2009) model risk from innovation as initially firm-specific, as winners and losers become evident, but growing more systematic as the technology spreads higher net productivity across the economy; with rising market-wide co-movement resembling a bubble. DeLong et al. (1990) model rising stock price comovement magnifying the importance of noise traders and bubbles. Chun et al. (2008, 2011, 2016) report elevated firm-specific risk as the 1990s IT bubble developed, then elevated systematic risk as it approached its peak and bust

Rapid innovation also redistributes wealth. Individuals, firms and communities with skills or assets associated with obsolescing technologies lose. Vested interest lobbying, from 18th century Luddites to 21st

century anti-GMO activists (Mazur 1975; Jones 2013; Juma 2016), often succeeds in slowing or halting innovation (Mokyr 2000; Wu 2010; Jaffe and Lerner 2011). This traction perhaps reflects behavioral finance findings (Kahneman and Tversky 2013) that prospective losses outweigh equal prospective gains; and resonates with Edmund Burke's (1790) *precautionary principle*: human survival is precarious and change with even a miniscule risk of unforeseen disaster is unwise. This principle explains movements from political conservatism to environmental conservationism; Schumpeter's (1911) warning innovators of ostracism, condemnation, and even violence; and Cardwell's Law (1972, p. 210): the historical regularity that societies are technologically innovative only briefly.

Kindleberger cycles may defeat Caldwell's Law by eliciting other offsetting heuristics: fascination with novelty, success emulation, and comfort in following the herd. Novelty activates the brain's dopamine system: intermittent success, repeated or observed, elicits more repetition, optimism, and thus bubbles (Hirshleifer 2015; Bikhchandani et al. 2021). Thus, early movers' highly visible disequilibrium profits cue investors and CEOs into financing cascades of additional investment in similar things.

Group-level natural selection might favor novelty-seeking if lives saved by an expanded food supply exceeded deaths from tasting unfamiliar plants (Williams and Taylor 2006) and explain investor excitement with new technologies (Galor and Michalopoulos 2012). A "disposition to admire, and consequently to imitate, the rich and the great" (Smith 1759) that copes with procedurally transcomputational problems successfully on average also has plausible survival value (Gibson and Hoglund 1992; Blackmore 1999, pp. 74 – 81; Bikhchandani et al 2005) and explain investors rushing to investments like those that enriched earlier investors (Hirschleifer et al. 2006). A well-documented "fear of missing out" may reinforce this (Janeway 2012; McGinnis 2020). Success begets optimism; emotion is contagious in groups (Barsade 2002); and Keynes' (1936) describes contagious optimism, or positive *animal spirits*, inflating stock market bubbles.

Economies with institutions that enlist these behavioral regularities to power Kindleberger cycles may, despite suffering panics and crashes too, outcompete other economies by defying Carswell's law.

6.2 Creditors and regulators

Financial crises precede increased health problems, mistrust of institutions, and political polarization as well as GDP trend line drops of two to ten percent across studies survey by Sufi and Taylor (2021).¹² Greater credit expansion and deregulation as a mania crescendos exacerbates those costs (Reinhart and Rogoff 2009; Greenwood et al. 2021; Sufi and Taylor 2021). Mania lifts stocks over several years; panics crashes are fast and precipitous *market runs* (Bolton et al. 2011). Each investor, fearing others no longer value stocks highly, runs to sell before prices drop. Everyone simultaneously running to sell first crashes stock prices. If this ends the story, investors are poorer but the economy moves on.

But a larger expansion of credit to mania investors, precipitously bankrupted by the crash, leaves lenders' balance sheets heavy with nonperforming loans. Fearing *bank runs* (Diamond and Dybvig 1983), individual depositors running to withdraw their savings before their banks fail, can cause banks to accumulate cash by curtailing normal lending – even to sound firms. Firms fail or downsize, their newly unemployed workers default on loans, worsening bank balance sheets, and rerunning the downward spiral. To prevent this, governments insure bank deposits and regulate bank risk. However, these policies often falter. As manias intensify, credit generally expands (Jorda et al. 2013; Fahlenbrach et al. 2016; Krishnamurthy and Muir 2016). Shadow banks that pay depositors higher rates and lend to mania investors readily arise outside the gambit of bank regulators. Bankers, losing business, lobby for deregulation. Like investors, government officials confronting procedurally transcomputational problems align with the seemingly informed (Bošković et al. 2013) and deregulate.

After crashes, governments typically bail out banks and shadow banks to prevent worse damage from a deeper financial crisis (Bernanke 1983). However, bailouts are expensive. Lucas (2019) puts 2008 US bailout costs at 3.5% of GDP. Kaminsky and Reinhart (1999) put mean bailout costs of financial crises

¹² Bartlevy (2004, 2005) reviews estimates ranging from zero to over 20% of GDP, with a grand mean of 2.4%. Barro (2001) estimates the 1997 East Asian Crisis cut GDP growth 3% per year over three years. Hoggarth et al. (2002) and Hutchison and Noy (2005) put the cost of a financial crisis at 10% of GDP. Demirguc-Kunt, Detragiache and Gupta (2006) report banking crises cutting growth by 4% on average. Kroezen et al. (2007) show the negative effects especially concentrated in sectors dependent on external financing. Boyd et al (2005) use alternative calibration assumptions to put the long-run cost of a financial crisis at 63% to 302% of a year's GDP, about 8% of the present value of all future GDP. Ollivaud and Turner (2014) estimate the 2008 global financial crisis reduced GDP 3% in countries that had a domestic banking crisis and 2% in those that did not.

at 5% to 13% of the afflicted economy's GDP.

Overall, financial crises' macroeconomic costs, assessed as pre-crisis trend GDP growth minus actual GDP growth, range from 2.4 to 20% of GDP with most clustering in the lower range.¹³ Such estimates are biased up if, absent Kindleberger cycles, pre-crisis trends would be lower.

Some bubbles appear to arise from others. The Dutch tulip bubble featured neither new technology nor new markets, though concurrent advances in oceanic navigation embodied both. Tulips were status symbols, and booms and busts in status goods (Veblen 1899) often arise and pop alongside technology and new market bubbles. A bubble in beanie babies, a pricy toy, expanded and popped in synch with the US dot.com bubble and crash (Bissonnette 2016). A 1920s US real estate bubble featured Florida second homes, status goods northerners thought easily reachable with their new high-tech new automobiles. Like bubble stocks, status goods are valued in Keynesian beauty contests: tulips convey status because others believe they do. Kapeller and Schütz (2014) argue that high returns in technology bubbles magnify inequality and elicits bubbles in status goods sought by the *nouveaux riches*. Shiller (2020) suggests hot technology goods – telephones, automobiles, or blackberries – confer status, energizes *New Age narratives*, and further lift optimistic investors' valuations of those technologies' Keynesian beauty.

Secondary real estate bubbles also often form proximate to tech bubbles or new market bubbles. Luxury real estate can be a status good, but a more fundamental mechanism may also operate. Chen and Wen (2017) describe initially high network externality returns falling as China's rollout of networks of suppliers and customers neared completion. Seeking continued high returns, investors turned to highly levered real estate plays. Secondary real estate bubbles also accompanied the rollouts of canal, railway, telegraph, and electric power networks. These raised adjacent land values, but real estate valuations overshot and then crashed in each case. The 2008 financial crisis was perhaps also a secondary bubble to the 1990s tech bubble.

6.3 Social summations

¹³ Sufi and Taylor (2021) review this literature, as well as financial crises associations with increased health problems, mistrust in institutions, and political polarization.

Economic comparisons of these social gains and losses is remarkably rare. Lansing (2009) finds the benefits of increased investment exceed the social costs of increased volatility from bubbles. Lansing (2012) models tech bubbles with costly crashes and calculates social benefits outweigh social costs if the technology's *SRR* exceeds 2.5 times its *IRR*. If R&D's *SRR* is five times its *IRR* (Jones and Summers 2021), R&D bubbles increase social welfare. Bloom et al. (2013), conclude R&D has a *net SRR*, that is social benefits minus social costs, double its *IRR*. Historians (Perez 2002; Gross 2007; Janeway 2012) and, with considerable sophistication, marketing researchers (Sorescu et al. 2018) also argue the social benefits of Kindleberger cycles outweigh their social costs.

Larger credit expansions during manias finance larger capital floods, but costlier panics and crashes ensue, so regulations that keep lending institutions above the floodwaters make sense. Olivier (2000) thus models stock market tech bubbles as productivity-enhancing and credit bubbles as productivity-diminishing. Janeway (2012) concurs, but concedes that credit bubbles might also advance innovation by boosting aggregate demand. The social trade-off between more credit magnifying investment in innovation and higher financial systematic risk generally does not inform international banking regulations. Still, despite centuries of manias, panics and crashes, new manias readily expand credit (Reinhart and Rogoff 2009) and erode regulations strengthened after the last crash (Dagher 2018). Often, regulations to ensure “this never happens again” – e.g. America's 848 page post-2008 crisis Dodd Frank Act, widely deemed unworkable (Coffee 2011) – erode easily. Some, such as short-sale restrictions, actually encourage subsequent manias (Hong and Stein 2007).

New technologies undermine old elites and enrich new ones, redistributing and sometimes increasing, inequality (Garleanu et al. 2012; Kogan et al. 2020). This too can have social costs and benefits. Schumpeter (1942) argues an element of socialism to limit such swings might both blunt opposition to innovation and improve its social cost-benefit trade-off

6.4 Multilevel selection

Mokyr (1994) proposes that economic selection stays favors economies that escape Cardwell's Law and

allowed ongoing innovation. This is plausible because economic selection can be multilevel, fast, and discrete (Lo 2019). As intragroup competition becomes more intense and its payoff become larger, group-level selection gains importance relative to individual-level selection (Wilson and Wilson 2008).

Economic selection is multilevel (Nelson and Winter 1982): individuals compete with individuals, firms with firms, and economies with economies. IBM dominated computers until the 1980s, when its top executives, all mainframe computer engineers, opposed microcomputers to safeguard their positions, won the competition between individuals within IBM, but saw IBM marginalized in firm-level competition (Betz 1993).

Economy-level selection can have very high payoffs. Rosenberg and Birdzell (1986, pp. 136-9) describe how economic competition between nations likewise trumps the conservative bias in human nature

“In the West, the individual centers of competing political power had a great deal to gain from introducing technological changes that promised commercial or industrial advantage Once it was clear that one or another of these competing centers would always let the genie out of the bottle, the possibility of aligning political power with the economic status quo and against technological change more or less disappeared from the Western mind”.

For example, the hot new technology of 1840s were railways with telegraph lines alongside (Standage 1998) accelerated trade and information from the speed of horses to the speeds of locomotives and electricity. Western European interstate competition intensified after the 16th century Wars of Religion, and more prosperous economies had larger tax bases to fund stronger militaries. British manias vastly overbuilt canals and railroads, and many Britons lost heavily in crashes but the canals and railroads remained. Soon, telegraph lines connected all parts of Britain. France successfully suppressed stock market speculation after its 1720 Mississippi bubble (Murphy 2005), and still had only 750 miles of state-owned telegraph wire in 1852 (Gross 2007). Economic prosperity gave Britain tax revenues to sustain a Royal Navy that soon ruled the waves. Despite its much smaller population, Britain repeatedly defeated France in wars, seized colonies from France, and lifted its living standards of living increasingly far above those in France during the 18th and 19th centuries.

Economy-level selection can be fast. Natural selection is Darwinian: the unfit die, the fit survive and procreate; but economic selection is Lamarckian: the unfit imitate the fit. Patterns of economic behavior can spread without individuals, firms or economies dying. Governments actively abetted the imitation (theft) of foreign technologies as the military and soft power advantages of industrialization grew evident. The US industrialized rapidly by pirating European technology (Andreas 2013). Canada nullified foreign patents in its late 19th century industrialization (Bliss 1987). Japan sent students abroad in the 1870s to bring foreign technology home and became Asia's first industrialized economy by the early 20th century (Morck and Nakamura 2005). Other high-income economies followed similar paths. National governments banned technology exports, but actively undermined each other's' bans (Harris 2017).

Economy-level selection can make large jump. Natural selection moves in small increments that find local optima. The vertebrate retina's blood supply is on the wrong side, the cephalopod eye is better designed (Lents 2018). Because no sequence of small improvements leads from one to the other, and humans cope with second-class eyes. In contrast, Kindleberger cycles and capital floods can raise entirely new technologies and wash away old ones. Just as no sequence of small improvements connected horses to automobiles; none connected technologically backward Tokugawa Japan to Asia's first high-income economy. Japan's Meiji Restoration imposed a full reboot of its social, political, and especially its economic and financial institutions along Western lines (Morck and Nakamura 2005). Post-communist transitions in Eastern Europe and liberalizations in many countries were also large discrete jumps.

This reasoning suggests that competition between economies may do far more than eliminate dead-weight losses in standard trade models. Economy-level economic selection favoring institutions conducive to Kindleberger cycles might well undergird the sustained prosperity of the modern world.

7. Capital Hydraulics

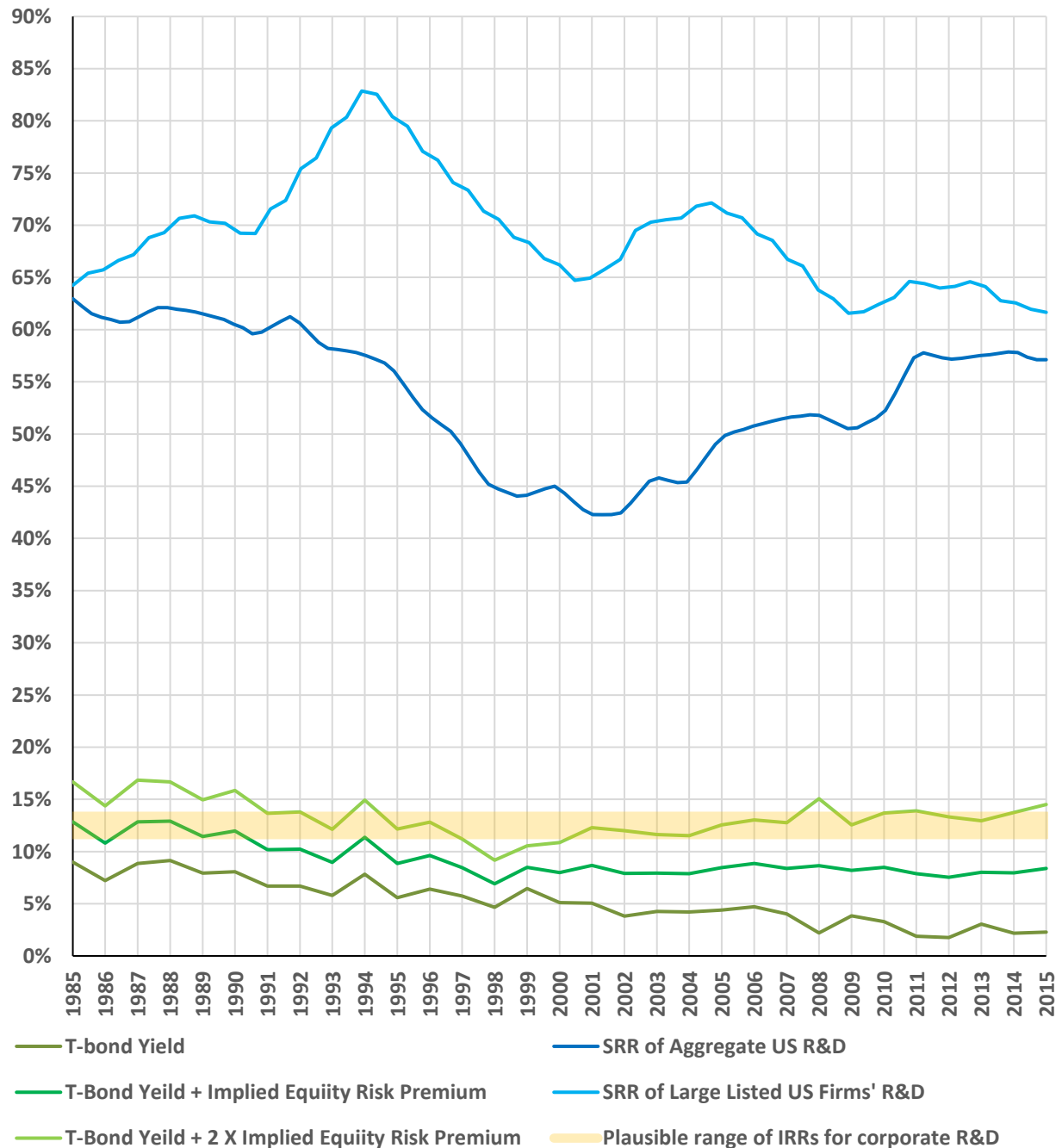
Irving Fisher constructed a model economy of pipes, pumps, valves, floaters and reservoirs of aqueous capital that inspired general equilibrium microeconomics (Brainard and Scarf 2005). Kindleberger cycles induce periodic inundations of capital that reroute the very channels money flows through and the total

capacity of the economy. As Nile floods annually renewed Egypt, floods of capital across new technologies and markets renew the prosperity of the modern world. For four centuries, irregularly repeating Kindleberger cycles suppressed Caldwell's law, permitting ever larger positive externalities from innovation, and sustaining long-run prosperity.

To end annual flood damage, Egypt erected the Aswan dam and adopted chemical fertilizers. Damming capital floods seems risky: intellectual property rights and subsidies to innovators work poorly. Damming capital floods seems ineffective: Kindleberger cycles recur despite mainstream economists' ridicule and politicians' post-crash regulations. Public policy might instead consider capital flood management: Credit expansions deepen capital floods, but worsen clean-up costs. How dry should credit-granting institutions be kept? Frauds sprout anytime, but proliferate in capital floods. Might countercyclical antifraud enforcement help channel capital inundations more effectively?

Figure 1. Social Rate of Return (SSR) to Research and Development (R&D) over Time

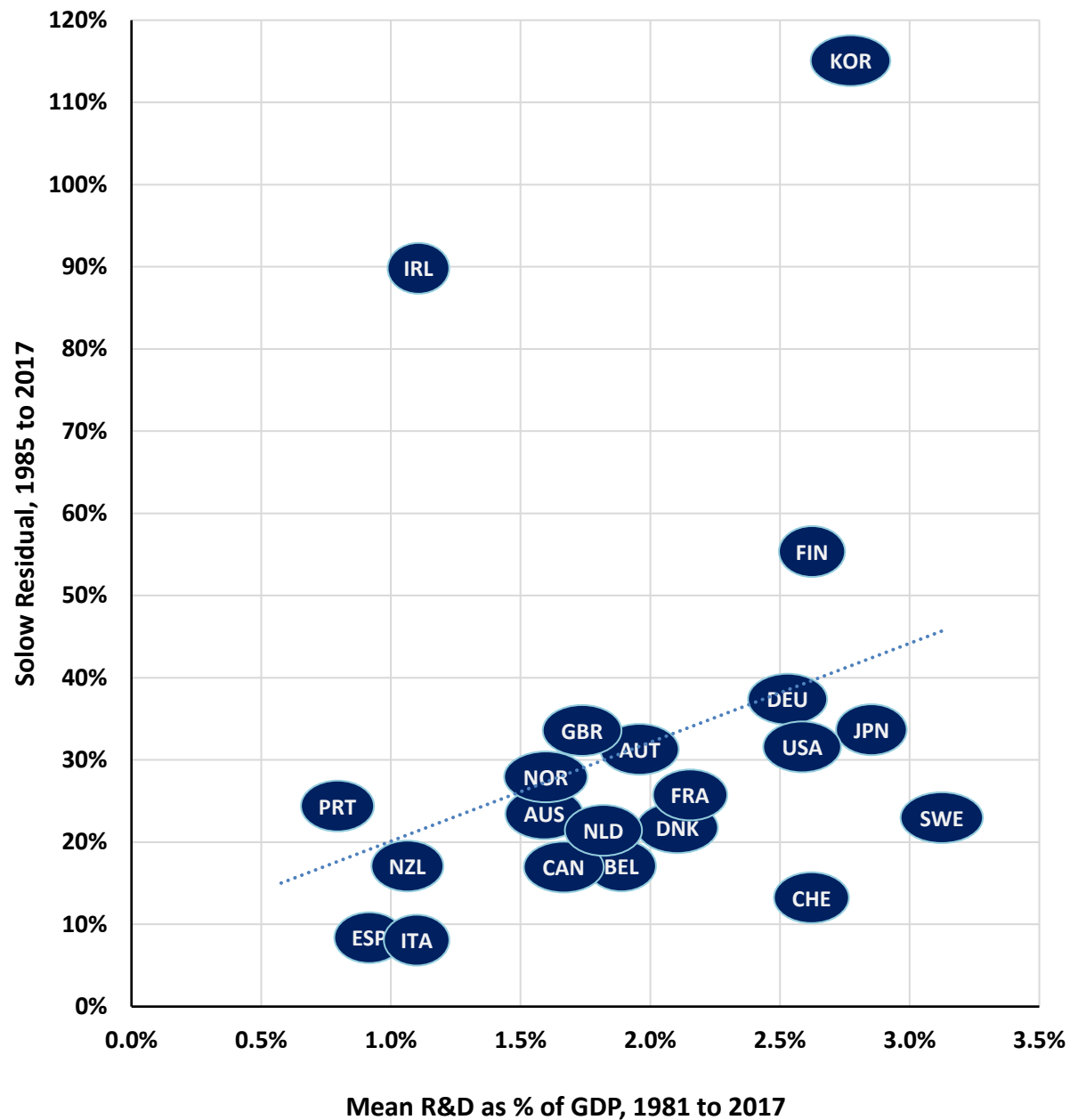
SSR to aggregate US R&D (dark blue) and on US listed (Compustat) firms' R&D (light blue) line) compared to cost of capita benchmarks for low, average, and high risk (successively lighter green) corporate investments and range of *IRRs* for corporate R&D (yellow band)



Source: SSR estimates from Bloom et al. (2020); implied equity risk-premium from [Aswath Damodaran's website](#) at NYU Stern.

Figure 2. Solow residual versus R&D spending

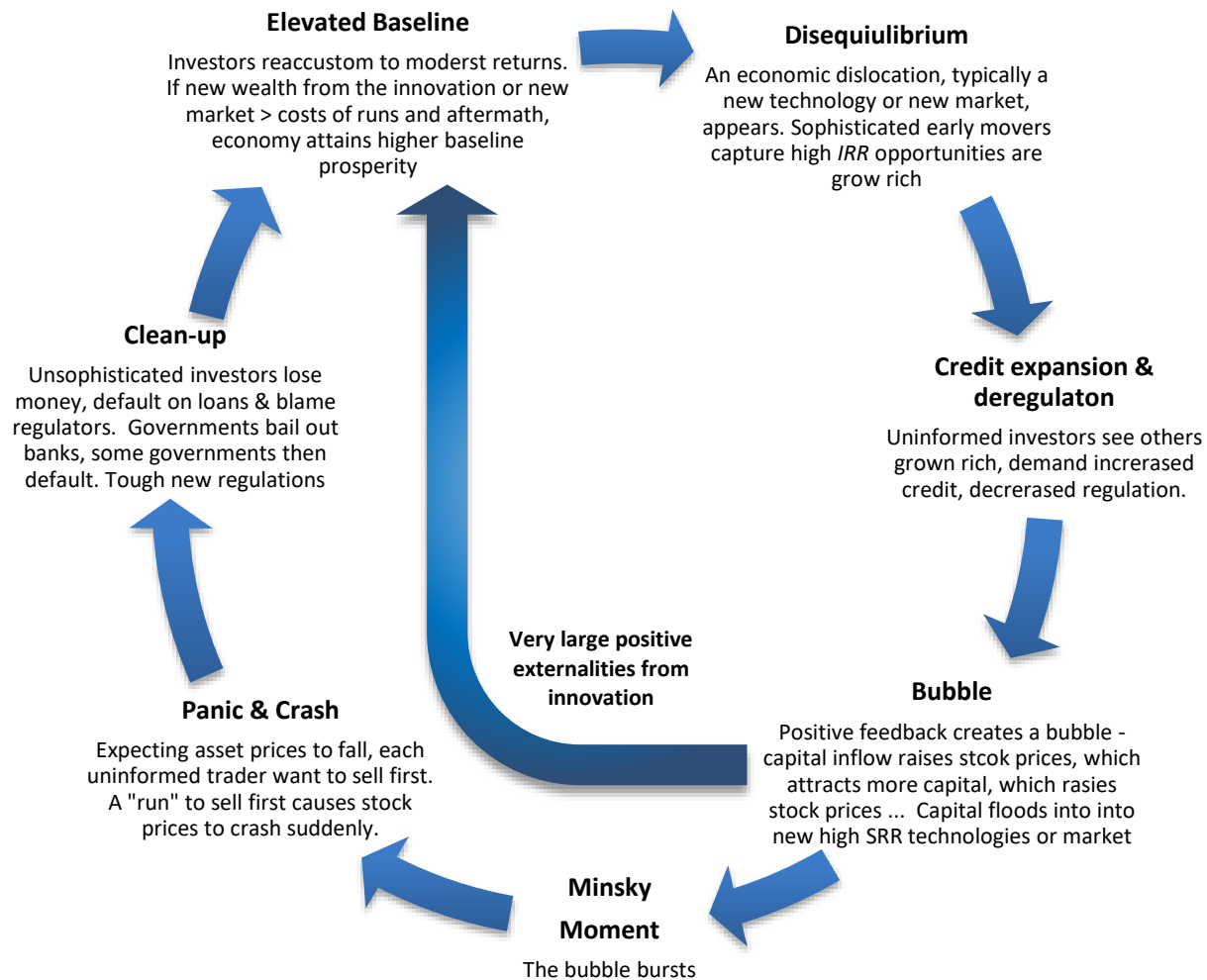
Economies with higher research and development (R&D) spending have faster economic growth primarily because they show evidence of greater cumulative multifactor productivity growth, as estimates of Solow Residuals. Greater productivity growth reflects the faster and more complete adoption of new technologies, which let firms produce ever more valuable outputs from proportionately ever less costly inputs.



Source: [OECD public data website](#).

Figure 3. Kindleberger Cycle Growth Engine

Kindleberger describes a historical cycle of financial manias, panics, and crashes following a common pattern, each preparing the way for the next, and most rolling out major new technologies or markets with large productivity-increasing positive externalities. Each completion of the cycle ratchets productivity up to a higher baseline level after the economy recovers from the panic and crash.



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