The Academic-Industry Research Network

The New Economy Business Model and the Tension Between Innovation and Financialization in Research-Intensive Corporations

AIR Report #24-07/22

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Cambridge, Massachusetts
July 22, 2024

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1. The U.S. Prescription Drug Problem: Corporate Financialization

Society has made great advances in scientific knowledge that can be translated into the development, manufacture, and delivery of safe and effective medicines. Yet these medicines are not always accessible and affordable to the people who need them, even as there remain vast numbers of deadly or debilitating diseases for which curative, therapeutic, or preventative remedies remain to be developed. Our research seeks to advance our knowledge of how, for the sake of medicine innovation, reforms in governing the *relation between value creation and value extraction* can support the development, manufacture, and delivery of safe, effective, accessible, and affordable medicines. Our primary empirical focus is on the institutions and organizations involved in medicine development in the United States, which still leads the world in this field. At the same time, our research places U.S.-based pharmaceutical innovation in its global context of cooperation and competition.

In the context of the U.S. pharmaceutical industry, research on the relation between value creation and value extraction requires an analysis of the evolving of the stock market in influencing the tension between innovation and financialization in pharmaceutical companies. As an historical process that unfolds over time, the very success of innovation in the U.S. pharmaceutical industry since the mid-20th century has set the stage for its financialization. Innovation creates value by generating products that are higher-quality (safer and more effective) and lower-cost (more accessible and affordable) than those previously available. *Corporate financialization* represents the power of certain financial interests to extract far more value from the gains of innovation than is warranted by the value that these parties have contributed to the innovation process—which in some cases can even be negative because of the value-destroying actions that are taken to engage in value extraction.[1]

Research by the Academic-Industry Research Network (AIRnet)[2] and the Bentley University Center for the Integration of Science and Industry (Sci-Industry), [3] reveals imbalances, often extreme, in the relation between value creation and value extraction in the U.S. pharmaceutical industry. Moreover, the prevalence of value extraction that is not warranted by value creation appears to have increased over time. AIRnet's research has focused on excessive value extraction within pharmaceutical firms, ranging from venture-backed startups to century-old companies, while Sci-Industry's research has highlighted the imbalance in value extraction by pharmaceutical companies in their profitable use of value-creating investments in knowledge made by U.S. federal government agencies, especially the National Institutes of Health (NIH). Our findings to date point toward reform of the governance of both government agencies and business enterprises that can result in superior medical innovation and a more equitable distribution of its gains.

AIRnet's working hypothesis is that excessive value extraction within pharmaceutical firms and through government-business relations interact to undermine medicine innovation and result in inequities in access to and affordability of medicines that have been approved for use. Corporate financialization in pharmaceuticals also contributes to the highly inequitable distribution of income and wealth in the U.S. economy as a whole. For the sake of social justice, extreme

economic inequality creates its own need for institutional and organizational reform. But it also creates powerful financial interests who seek to rationalize their own gain as a necessary condition for achieving the common good. They deploy that ideology to block reform and exacerbate this profound social problem.

Given that pharmaceutical products can be a matter of life or death, an understanding of the tension between innovation and financialization in this particular industry is especially important. Indeed, the extent to which corporate financialization was often in plain sight during the SARS-CoV-2 pandemic emphasizes the urgency of a reform agenda to create a balance between value creation and value extraction in the pharmaceutical industry.

Our ongoing research seeks to understand a) the extent to which an imbalance in the relation between value creation and value extraction exists in the U.S. pharmaceutical industry; b) when, how, and why this imbalance evolved over time; c) what types of industry participants are the major beneficiaries of excessive value extraction; d) how excessive value extraction affects medicine innovation, along the dimensions of safety, efficacy, accessibility, and affordability; and e) the types of institutional and organizational reforms that can rectify the deleterious impacts of corporate financialization on medicine innovation. Our approach to these questions enables us to research the tension between innovation and financialization in the companies that populate both the "new venture" and "going concerns" segments of the U.S. pharmaceutical industry.

2. The Conceptual and Analytical Framework

Our analysis of corporate financialization applies the "social conditions of innovative enterprise" (SCIE) conceptual framework, developed by William Lazonick and colleagues through the comparative-historical study of the institutions that characterize the leading national economies.[4] Central to the framework is the innovative business enterprise, which depends on a) the interaction of "strategic control" over corporate resource-allocation decisions in the face of uncertainty; b) "organizational integration" of people in a hierarchical and functional division of labor—that often extends beyond the business enterprise to include people in government agencies, academic institutes, and various types of civil-society organizations—into the collective and cumulative learning processes that are the essence of innovation; and c) "financial commitment" of money to sustain the innovation process until, through the generation of a higher-quality, lower-cost product, it can generate product revenues that can provide various stakeholders with financial returns. Taken together, strategic control, organizational integration, and financial commitment are core concepts of "the theory of innovative enterprise" (TIE). Key to understanding the transformation of a business corporation from innovation to financialization is the role of an imbalance of value extraction over value creation in subverting these three social conditions of innovative enterprise.

The evolving functions of the stock market in the operation and performance of U.S. business corporation are central to this analysis. Contrary to the popular belief that the stock market supports value creation by supplying publicly listed corporations with investment finance, U.S.

stock markets have operated primarily as value-extracting institutions over the past century.[5] We summarize the changing functions of the stock market in the operation of the business corporation as "creation," "control," "combination," "compensation," and "cash."

- The stock market can induce the *creation* of highly uncertain technology startups, often in a precommercial stage of a firm's development, by offering venture capitalists a relatively rapid exit from their private-equity investments through an initial public offering (IPO) on the stock market or the acquisition of the startup by an established company that is already traded on the stock market.
- The stock market can separate corporate share ownership from managerial *control* of corporate resource allocation, giving professional managers the power to allocate the firm's resources.
- The stock market can provide the corporation with its own *combination* currency to substitute for cash in gaining strategic control over other companies through merger-and-acquisition deals.
- The stock market can provide the corporation with its own *compensation* currency in the form of stock options and stock awards to attract, retain, motivate, and/or reward employees, including senior executives.
- The stock market can provide the corporations that list on a stock exchange, with cash raised through initial and secondary stock issues, to invest in the firm's productive capabilities, to pay down previously incurred debt, or to add liquidity to the corporate treasury to weather an uncertain future without fear of bankruptcy.

Most observers of the economy assume that the primary role of the stock market is its cash function, with funds raised on the stock market financing the firm's capital formation. That was not, however, the case under the "Old Economy business model" (OEBM) that prevailed in the United States in the post-World War II decades, with major business corporations listing on the New York Stock Exchange.[6] For reasons which we explain later in this essay, the main function of the stock market under OEBM was to separate shareholding from managerial control, making it possible for professional salaried managers to rise to positions of strategic control over companies that came to dominate the U.S. economy.

The creation function of the stock market played virtually no role under OEBM, and the combination, compensation, and cash functions were of limited importance. Central organizational characteristics of major industrial corporations under OEBM were the vertical integration of supply chains, manufacturing, and distribution as expectations on the part of both blue-collar and white-collar employees of a career with one company (CWOC). Earnings retained out of profits—and not cash raised on the stock market—provided the financial foundation for corporate investment in not only plant & equipment and research & development but also training & retaining a productive labor force in the range of functions in which a business was engaged.

As we also discuss in this essay, with the rise of the "New Economy business model" (NEBM) from the 1970s, the functions of the stock market changed dramatically, with the importance of the

creation function manifested by the emergence of an identifiable venture-capital industry, a precondition for which was the creation of the National Association of Security Dealers Automated Quotation (NASDAQ) system in April 1971. Organized venture capital originated in the microelectronics section of the ICT industry but quickly went on to support the creation and growth of biopharma startups as well. Given the existence of NASDAQ, from the beginning of the 1980s, stock issues have played an important role in funding biotech firms through IPOs and secondary stock issues. Stock-market funding of "product-less initial public offerings" (PLIPOs) with highly uncertain product-development strategies is, however, only possible because of the existence of the highly speculative and liquid NASDAQ stock exchange.[7]

Created in 1971 as an electronic stock-price quotation system for corporate stocks traded "over the counter" by securities dealers across the United States, the National Association of Securities Dealers Automated Quotation (NASDAQ) system greatly increased the liquidity of unlisted companies that did not have the assets, profits, and/or the number of shareholders required to list on the New York Stock Exchange (NYSE). By the late 1980s, NASDAQ had evolved into a stock exchange—centralizing and digitizing the activities of over-the-counter securities' dealers—as well as its original function as a quotation system, and by the 1990s the innovative success of a number of companies listed on NASDAQ, including Intel, Microsoft, Oracle, Apple, and Cisco in information-and-communication technology (ICT) and Genentech, Amgen, Genzyme, and Biogen in biopharmaceuticals, had created NEBM as a viable, and in many ways more dynamic, alternative to OEBM.

As we discuss later in this essay, under NEBM, the stock market could still perform the control function, but it also played important creation, combination, compensation, and cash functions. This extended and enhanced role of the stock market in the industrial corporation could, and in many cases did, support innovation under NEBM. But it also rendered NEBM much more susceptible to financialization than OEBM, while adding to growing pressure to financialize on OEBM companies such as, in ICT, Hewlett-Packard, IBM, and Motorola, and, in pharmaceuticals, Johnson & Johnson, Merck, and Pfizer.

Given the liquidity of the stock exchange—that is, the ease with which shareholders of a listed company can sell shares that they have bought—stock traders who absorb these stock issues do not have to hold the shares until the issuing pharmaceutical company generates product revenues, much less profits. Rather, the liquid market enables them to try to time the buying and selling of shares to realize financial gains. It is ever-present *speculation, not innovation*, which has yet to occur, that is driving stock-price movements. The speculation may be based on positive or negative expectations of whether the startup will in fact generate a product innovation. But a liquid stock market, rendered volatile by both the uncertainty of the innovation process and the presence of stock-market speculators, means that any given stock trader does not necessarily have to wait for product innovation to occur to realize financial gains.

Indeed, the possibility of reaping substantial financial gain from the pharmaceutical industry even in the absence of innovative products is a prime reason why the "startup" segment of the industry has become so financialized, especially in the United States. At the same time, however, the

ability of unproven and uncertain young companies to raise substantial funds on the highly speculative stock market has often been critical for sustaining investments in medicine innovation. The key question for our research agenda on this segment is whether and under what conditions innovation can dominate financialization, while the key policy question is how institutional reforms that mitigate financialization can potentially strengthen pharmaceutical innovation.

Realization of gains from the stock market is not confined to innovation and speculation. Stock-market gains can be made through manipulative practices such as trading on inside information related to, among other things, sales, M&A deals, lawsuits, and changes in senior management, before the information becomes available to the public. In the biopharma industry, insider trading can occur on the basis of non-public information about clinical trials as benchmarks of the progress of drug development. For example, some hedge funds focused on biotech have made regular use of Freedom of Information Act (FOIA) requests to obtain, legally, non-public information on biopharma companies from government agencies such as the Food and Drug Administration (FDA) and the Securities and Exchange Commission (SEC).[8] The purpose of this hedge-fund activity is to gain an "edge" in timing the buying and selling of shares.[9]

The liquidity and volatility of the stock market may provide very young, highly uncertain pharmaceutical companies with cash for investment in innovation through a financialized process that can enable stock traders to engage in value extraction—the financial gains on the shares that they buy and sell—even in the absence of value creation—the development, manufacture, and delivery of an innovative medical product. These stock traders include not only outsiders to the biotech firm, such as hedge-fund managers, but also founders and employees of the firm who, once it is listed on the stock market, can seek personal financial gain by trading their company's shares on their own account. Founders acquire their shares through the creation function of the stock market, while executives acquire their shares through the compensation function. For both parties, the combination function of the stock market creates opportunities for personal financial gain if the startup firm is acquired by an established publicly listed company.

Biotech startups are exceptional in U.S. stock-market history in the systematic use of public stock issues as a source of cash to fund investments in innovation. More generally, since the emergence of a market in industrial securities in the Great Merger Movement of the 1890s and early 1900s, the function of the stock market in the U.S. business corporation has been the separation of share ownership from managerial control, thus enabling professional salaried managers to exercise strategic control over corporate resource allocation. As a result of the "managerial revolution" in American business, documented by the business historian Alfred Chandler in his 1977 book *The Visible Hand*, dominant corporations emerged in a range of "high fixed cost" industries by the 1920s. A century later, it remains a fundamental principle of innovative enterprise that a firm should be run by professional managers who, through career employment in the industry, have deep knowledge of the technologies that the firm over which they exercise strategic control must transform, the markets that it must access, and the rival businesses with which it must compete.

During the 1920s, for the first time, the New York Stock Exchange (NYSE) became highly liquid because, largely as the result of the managerial revolution, many business corporations that possessed the capitalization, profitability, and widespread distribution of shareholding required to list on it had dominant positions in their industries. The household savings of a growing upper-middle class flowed into NYSE as these retail traders bought and held common shares for expected dividend income, with rising stock prices offering opportunities to realize gains from stock sales. Even then, without dividends on common stock guaranteed and with stock prices potentially volatile, the yield from holding shares in any one company was risky; the most financially solid companies such as General Motors, General Electric, and DuPont listed on NYSE were known as "blue chip" stocks, so named after the color of the most valuable counter in a poker game.

In the speculative stock-market boom of the late 1920s, however, many of these corporations lent their excess cash reserves on the New York call market, funding stock-market traders, buying on five-percent margin with loans at 10 to 15 percent interest, to speculate in corporate shares.[10] At the same time, many of the same corporations issued new shares on the stock market at the high speculative prices, not for internal investment, but rather to pay off debt or bolster the corporate treasury. As a result, this financial engineering made these corporations less vulnerable to the economic downturn when boom turned to bust, beginning with the Great Crash of October 1929.

Whether a century ago or today, for publicly listed firms, earnings retained from profits, rather than the funds raised from financial markets, form the foundation for reinvestment in the company's productive capabilities (i.e., so-called "capital formation")—with the significant exception, as mentioned, of biopharma, startups. Using the profits from previously successful investments in innovation, companies grow through a resource-allocation regime that we call "retain-and-reinvest": a company retains profits to reinvest in productive capabilities. First and foremost among the productive capabilities in which an innovating firm must invest are those of a stable labor force, which, through organizational learning, can become more productive over time. For reasons that we summarize later in this chapter, however, from the 1980s there was a growing trend among large established U.S. corporations, including those known as Big Pharma, to transform from a resource-allocation regime of retain-and-reinvest to one of "downsize-and-distribute": they downsized their labor forces and distributed corporate cash to public shareholders in the form of not only cash dividends but also stock buybacks.

As an intermediate stage, some of these companies have engaged in "dominate-and-distribute" as they have used the cash flows from *prior innovation*, often boosted by their exercise of power vis-à-vis suppliers, employees, and buyers, to expand investment in their existing dominant product lines while distributing cash to shareholders as dividends and buybacks in amounts that may be even greater than their corporate profits over extended periods of time. Eventually, however, in the absence of new innovative products that can result in new profit streams, corporate resource allocation tends to transition from dominate-and-distribute to downsize-and-distribute. As a result, these business corporations become sources of employment instability, income inequity, and sagging productivity in the economy.[11]

3. Financialization of the U.S. Pharmaceutical Industry

The 478 corporations in the S&P 500 Index in September 2023 that were publicly traded from 2013 through 2022 distributed *$6.4 trillion* as stock buybacks during their 2013-2022 fiscal years, representing 57 percent of net income, and *$4.5 trillion* as cash dividends, an additional 40 percent of net income (see Table 1). We estimate that 95 percent of these stock buybacks were done as open-market repurchases (OMRs) of common shares, the purpose of which is to manipulate the company's stock price.

Table 1. Financial data, 2013-2022, and 2022 employment, for 478 corporations, of which 14 are pharmaceutical companies, in the S&P 500 Index publicly listed for fiscal years 2013-2022

COMPANY (year founded; IPO)	2013-2022 TOTALS, $b						% of NI			R&D, % of REV	2022 EMP. (thous.)
	REV	NI	BB	DV	DV+BB	R&D	BB	DV	BB+DV		
BMS (1858; 1928)	273	24	27	31	57	82	110	127	236	30	34
ABBVIE (1888; 1929)	342	64	32	55	87	62	50	87	137	18	50
AMGEN (1980; 1983)	231	63	50	31	81	43	79	49	129	19	25
MERCK (1891; 1941)	451	78	42	57	98	99	54	73	127	22	69
J&J (1886; 1944)	799	147	57	93	150	114	38	63	102	14	156
ELI LILLY (1870; 1952)	235	42	16	25	41	63	38	59	98	27	39
BAXTER (1931; 1978)	125	14	7	6	13	7	52	44	96	6	60
PFIZER (1849; 1941)	584	157	61	77	138	93	39	49	88	16	83
BIOGEN (1978; 1983)	114	34	28	0	28	24	84	0	84	21	9
GILEAD SCI. (1987; 1992)	249	73	36	24	60	56	49	33	82	22	17
VIATRIS (1971; 1978)	116	4	2	1	3	7	53	24	77	6	37
REGENERON (1988; 1991)	71	24	13	0	13	23	53	0	53	32	12
VERTEX (1989; 1999)	37	10	3	0	3	16	30	0	30	43	5
INCYTE (1991; 1993)	17	1	0	0	0	11	5	0	5	61	2
TOTAL 14 PHARMA	**3,643**	**734**	**373**	**400**	**773**	**701**	**51**	**54**	**105**	**19**	**598**
TOTAL 478 in S&P500	**115,333**	**11,103**	**6,368**	**4,491**	**10,860**	**3,269**	**57**	**40**	**98**	**3**	**28,329**
14 PHARMA AS % OF 478 in S&P 500 = 2.9%	***3.2%***	***6.6%***	***5.8%***	***8.9%***	***7.1%***	***21.4%***					**2.1%**

Notes: IPO=initial public offering, REV=revenues, NI=net income, BB=stock buybacks, DV=dividends, R&D=research & development expenditures, EE=end-of-fiscal-year employment (in thousands); J&J is Johnson & Johnson; BMS is Bristol Myers Squibb; Baxter is Baxter International. The founding and IPO years listed for Abbvie are those of its predecessor company Abbott Laboratories; for BMS, the founding of Squibb and the IPO of Bristol-Myers; and for Viatris, its predecessor company Mylan.

Sources: Calculations from data in the S&P Compustat database and company 10-K reports.

As shown in Table 1, for the decade 2013-2022, the 14 pharmaceutical companies among the 478 companies in the dataset distributed 105 percent of net income to shareholders,[12] a larger proportion than the highly financialized 98 percent for all 478 companies. These 14 pharmaceutical companies accounted for 3.2 percent of the revenues of all 478 companies but 6.6 percent of the net income, 5.8 percent of the buybacks, and 8.9 percent of the dividends. At 51 percent, pharmaceutical stock buybacks were below the proportion of 57 percent of net income for the 478 companies, but, at 54 percent versus 4 percent, pharmaceutical dividends as a proportion of net income far exceeded that of all the companies in the dataset. The $773 billion

that the pharmaceutical companies distributed to shareholders was 10 percent greater than the $701 billion that these corporations expended on research & development over the decade.

Prime beneficiaries of distributions to shareholders have been the very same senior executives who control the pharmaceutical companies' resource-allocation decisions. Table 2 displays data on the compensation of the 500 highest-paid executives in the United States for each year from 2006 through 2022 and the subset of pharmaceutical executives among these 500 highest paid.

Table 2. 500 highest-paid executives annually, US corporations and subset of pharmaceutical executives, with proportions of mean total direct compensation from stock options and stock awards, 2006-2022

YEAR	All 500 Highest-paid executives				Pharma executives				No. of execs
	Mean, $m	% of TDC			Mean, $m	% of TDC			
	TDC	SO	SA	SO+SA	TDC	SO	SA	SO+SA	
2006	25.6	*56*	*17*	*73*	25.7	*47*	*30*	*77*	23
2007	31.5	*57*	*19*	*76*	22.1	*65*	*8*	*73*	14
2008	20.7	*48*	*23*	*71*	22.1	*64*	*13*	*76*	21
2009	15.9	*37*	*23*	*60*	22.0	*40*	*18*	*59*	29
2010	19.8	*38*	*26*	*65*	20.8	*50*	*24*	*74*	25
2011	21.7	*39*	*30*	*69*	20.6	*55*	*15*	*71*	24
2012	32.3	*41*	*37*	*78*	34.9	*61*	*24*	*85*	24
2013	27.4	*46*	*33*	*79*	35.3	*68*	*24*	*91*	34
2014	32.7	*46*	*34*	*80*	43.7	*69*	*19*	*88*	41
2015	35.0	*49*	*35*	*84*	46.2	*58*	*30*	*88*	32
2016	27.5	*37*	*42*	*78*	31.5	*48*	*23*	*71*	26
2017	33.8	*46*	*35*	*82*	43.5	*52*	*37*	*89*	22
2018	33.6	*43*	*42*	*85*	34.5	*67*	*21*	*88*	22
2019	33.6	*40*	*43*	*82*	38.2	*60*	*26*	*86*	19
2020	43.4	*52*	*35*	*87*	49.7	*63*	*27*	*90*	31
2021	49.1	*45*	*43*	*89*	66.9	*83*	*11*	*94*	24
2022	35.9	*30*	*55*	*85*	45.0	*64*	*24*	*88*	28

Note: TDC=total direct compensation, SO=stock options, SA=stock awards
Source: S&P ExecuComp database

From 2006 through 2022, the average total direct compensation (TDC) of the 500 highest-paid executives ranged from, with the stock market depressed, a low of $15.9 million in 2009, of which 60% were realized gains from stock-based pay, to, with the stock market booming, a high of $49.1 million in 2021, of which 89 percent were realized gains from stock-based pay. In 2022, the average TDC of 500 highest-paid executives in 2022 was $35.9 million, of which 85 percent were realized gains from stock-based pay. In 2021, when the average TDC of the two comparison groups peaked, pharmaceutical executives' average TDC of $66.9 million was significantly higher than for the 500 highest-paid executives.

Not even the SEC, which purportedly regulates America's financial markets, knows the precise days on which buybacks as OMRs are executed.[13] But the CEO and CFO of the corporation doing the buybacks possess this material insider information, and, moreover, they exercise control over when buybacks are done. Under any circumstances, OMRs will result in stock-price increases that

augment the stock-based pay of senior executives, while strategic control over and insider information about the timing of these buybacks can further contribute to the gains that senior corporate executives realize in exercising stock options and the vesting of stock awards.[14]

Tables 3a and 3b show distributions to shareholders, 1978-2022, by Merck and Pfizer, two Big Pharma companies that have been among the most financialized of all US corporations.

Table 3a. Merck's distributions to shareholders as stock buybacks and cash dividends, in billions of current US dollars and as percent of net income, 1978-2022

MERCK	REV	NI	DV	BB	R&D	DV/NI	BB/NI	(DV+BB)/ NI	R&D/ REV	BB/R&D	Employment	
	USD billion					%					EE 000s	%change
1978-1982	13.1	1.9	0.9	0.2	1.2	45	9	54	9	0.15	32.0	13.9
1983-1987	19.5	3.1	1.3	1.9	2.2	42	63	104	11	0.86	31.1	-2.8
1988-1992	38.4	8.6	3.9	2.0	4.4	45	23	68	11	0.46	38.4	23.5
1993-1997	85.6	17.0	7.9	7.7	6.9	47	45	92	8	1.12	53.8	40.1
1998-2002	199.5	32.4	14.0	16.7	12.5	43	52	95	6	1.34	77.3	43.7
2003-2007	114.8	25.0	16.5	6.5	20.8	66	26	92	18	0.31	59.8	-22.6
2008-2012	192.6	34.0	21.7	8.8	38.3	64	26	90	20	0.23	83.0	38.8
2013-2017	205.7	27.1	25.9	25.9	41.7	96	95	191	20	0.62	69.0	-16.9
2018-2022	230.9	50.7	30.7	16.0	58.7	61	32	92	25	0.27	69.0	0.0

Note: REV=revenues, NI=net income, BB=stock buybacks, DV=dividends, R&D=research & development expenditures
Source: Calculations from data in the S&P Compustat database and company 10-K reports.

Table 3b. Pfizer's distributions to shareholders as stock buybacks and cash dividends, in billions of current US dollars and as percent of net income, 1978-2022

PFIZER	REV	NI	DV	BB	R&D	DV/NI	BB/NI	(DV+BB)/ NI	R&D/ REV	BB/R&D	Employment	
	USD billion					%					EE 000s	%change
1978-1982	14.8	1.3	0.6	0.0	0.8	46	0	46	5	0.00	40.0	-0.5
1983-1987	21.0	2.9	1.2	0.3	1.5	42	9	50	7	0.17	40.7	1.8
1988-1992	31.6	3.8	2.0	1.4	3.3	53	37	90	10	0.44	40.7	0.0
1993-1997	49.6	7.7	3.4	2.3	7.2	45	29	74	14	0.31	49.2	20.9
1998-2002	123.8	27.2	10.2	14.1	19.5	38	52	89	16	0.72	98.0	99.2
2003-2007	245.4	50.8	29.9	40.5	46.8	59	80	138	19	0.86	86.6	-11.6
2008-2012	292.5	49.6	32.9	18.7	43.0	66	38	104	15	0.44	91.5	5.7
2013-2017	255.4	66.6	35.1	37.5	38.9	53	56	109	15	0.96	90.2	-1.4
2018-2022	328.9	90.4	42.2	23.1	55.6	47	26	72	17	0.42	83.0	-8.0

Note: REV=revenues, NI=net income, BB=stock buybacks, DV=dividends, R&D=research & development expenditures
Source: Calculations from data in the S&P Compustat database and company 10-K reports.

Merck began doing large-scale buybacks in the second half of the 1980s, and Pfizer in the first half of the 1990s. Merck sharply increased its buybacks in the late 1990s and Pfizer even more so in the early 2000s. Over the 25-year period 1995-2019, Merck distributions to shareholders were 118 percent of net income, with 54 percent as buybacks, while Pfizer paid out 114 percent of net income, with 58 percent as buybacks. Pfizer ceased doing buybacks from August 2019 through February 2022, even when its net income soared in 2021 on profits from its Covid-19 medicines. As a result, its buybacks as a proportion of net income fell to 26 percent in 2018-2022.

Kenneth Frazier, CEO of Merck from January 1, 2011, to June 30, 2021, averaged $27.4 million per year in TDC, of which 72 percent was stock-based. He remained as Merck chair to November

30, 2022, taking home $118.4 million in 2022, of which 97 percent was stock-based. Ian Read was Pfizer CEO from December 5, 2010, to January 1, 2019. Over his tenure as CEO from 2011 through 2018, Read averaged $30.2 million per year in TDC, of which 64 percent was stock-based. In addition, Read stayed on as Pfizer executive chairman in 2019, pocketing another $49.7 million (89 percent stock-based) on his way to retirement.

Table 4 shows the data for six New Economy biopharma companies that in one or more years from 2012 through 2021 had one or more executives among the annual lists of 500 highest-paid US executives. In every year, the average TDC of the New Economy biopharma executives in the top500 is far higher than the average TDC for all pharmaceutical executives and (except for 2018) even more so than for all top500 executives.

Table 4. Biopharma and the explosion of executive pay, 2012-2021

Company (year founded; year of IPO)	Number of executives in 500 highest-paid list in each year									
	2012		2013		2014		2015		2016	
	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m
CELGENE (1986; 1987)	0		3	27.5	1	96.3	3	16.8	1	16.0
GILEAD SCIENCES (1987; 1992)	3	42.6	4	74.7	5	82.4	5	97.3	2	78.1
REGENERON (1988; 1991)	5	51.3	4	53.0	4	56.6	3	66.5	2	83.5
VERTEX (1989; 1999)	0		1	36.6	1	28.9	0		0	
ALEXION (1992; 1996)	2	32.0	4	20.8	2	111.3	1	51.6	0	
MODERNA (2010; 2018)	pre-IPO		pre-IPO		pre-IPO		pre-IPO		pre-IPO	
Executives, 6 cos. above top500	**10**	**44.9**	**16**	**47.4**	**13**	**75.9**	**12**	**65.7**	**5**	**67.8**
Executives, pharma in top500	**22**	**35.9**	**33**	**35.8**	**40**	**43.3**	**33**	**45.1**	**25**	**32.2**
Executives, all top500	**500**	**32.4**	**500**	**27.3**	**500**	**32.6**	**500**	**34.6**	**500**	**27.1**

Company (year founded; year of IPO)	Number of executives in 500 highest-paid list in each year									
	2017		2018		2019		2020		2021	
	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m	No.	Mean TDC, $m
CELGENE (1986; 1987)	1	40.5	0		na		na		na	
GILEAD SCIENCES (1987; 1992)	2	34.6	1	21.8	0		0		0	
REGENERON (1988; 1991)	3	128.7	2	104.9	2	103.6	5	117.9	5	140.0
VERTEX (1989; 1999)	3	43.7	1	32.6	2	50.8	2	53.5	0	
ALEXION (1992; 1996)	0		0		0		1	40.2	na	
MODERNA (2010; 2018)	pre-IPO		pre-IPO		0		3	59.8	2	181.8
Executives, 6 cos. above top500	**9**	**69.7**	**4**	**66.1**	**4**	**77.2**	**11**	**83.3**	**7**	**151.9**
Executives, pharma in top500	**22**	**41.9**	**23**	**33.2**	**21**	**35.4**	**31**	**49.3**	**27**	**61.6**
Executives, all top500	**500**	**33.5**	**500**	**33.2**	**500**	**32.8**	**500**	**42.7**	**500**	**47.4**

Notes: Celgene was acquired by Bristol Meyers Squibb in 2019; Alexion was acquired by AstraZeneca in 2021; Moderna did its IPO on December 6, 2018.

Sources: S&P ExecuComp database and company proxy statements

As shown in Table 4, top executives of younger "New Economy" companies such as Regeneron and Vertex, and most recently Moderna, have received these enormous pay packages, partly supported by stock buybacks as OMRs. Their jackpots have resulted mainly from soaring stock prices, driven by a combination of innovation and speculation, and the abundant amounts of stock-based pay that their boards (of which they are often members) have lavished on these executives.[15] In the case of Regeneron, Leonard Schleifer and George Yancopoulos are founders and board members as well as CEO and CSO, respectively, and their enormous TDC included in

the data in Table 4 does not include their sales of founder shares. Nor does it include the fortunes made from founder shares by Moderna chairman Noubar Afeyan and CEO Stéphane Bancel.

Table 5, which selects from all pharmaceutical executives in the S&P ExecuComp database (not just from companies in the S&P 500 Index), identifies the six highest-paid pharmaceutical executives for each year from 2006 through 2022. Note the prominence of executives from three of the New Economy biopharma companies in Table 5: Regeneron (20 of 102 cells, all during 2012-2022), Gilead Sciences (17 of 102 cells), Celgene (8 of 102 cells). Executives of Moderna, which did its IPO in 2018, occupied one-third of the cells in 2020-2022. Also note the extent to which their pay is stock based. Of the 102 cells in Table 5, the pay levels in 94 cells are 60 percent or more stock based, with 67 cells 90 percent or more, 17 between 80 percent and 90 percent, seven between 70 percent and 80 percent, and three between 60 percent and 70 percent.

Of the highest-paid executives, founders of the companies include Leonard Schleifer and George Yancopoulos, Regeneron (founded in 1988; IPO in 1991); Leonard Bell, Alexion (1992; 1996); Martine Rothblatt, United Therapeutics (1996; 1999); Sol Barer, Celgene (1986; 1987); Jonah Shacknai, Medicis Pharmaceutical (1988; 1990); and Stéphane Bancel (2010; 2018). As indicated, all these companies went public within a few years after their founding, a phenomenon encouraged by the creation of the highly speculative NASDAQ stock exchange in 1971 and its subsequent growth. The compensation of these individuals shown in Table 5 is as executive employees of the companies and does not include personal income received by selling founder shares.

A ten-time "medalist" in the highest-paid rankings is Gilead's John C. Martin, who was the company's CEO from 1996 to 2016 and executive chairman from 2016 to 2018. He appears on the top-six list in each of the first 12 years, 2006-2017, including five times in first place, three times in second, and twice in third. His average annual TDC of $197.9 million in 2013-2015 was more than double the $85.5 million he took home in 2012 and the $98.4 million in 2016. Propelling Martin's megapay in 2013-2015 were surges of Gilead's profits and stock price, based on massive revenues from its price-gouged Sovaldi/Harvoni drugs, aided by $15.3 billion in buybacks in 2014-2015 and Gilead's first dividend ($1.9 billion) in 2015. From 2012 to 2015, Gilead's revenues increased by 3.4 times, its profits by 7.0 times, and its stock price by 4.4 times (July 2012 to its all-time peak in July 2015). In 2016, Gilead distributed $11.0 billion in buybacks and $2.5 billion in dividends—a combined 99.7 percent of net income—but its profits declined from $18.1 billion to $13.5 billion, and its stock price declined from $118 (July 2015) to $72 (December 2016). As a result, CEO Martin's 2016 compensation fell to $98.4 million—a sum which nevertheless placed him at the top of the pharma executive-pay podium for that year.

The established "Old Economy" companies known as Big Pharma, including Wyeth (founded 1860; IPO in 1926), Abbott (1888: 1929), Johnson & Johnson (1886: 1944), and Merck (1891: 1941), were better represented among the top six in the earlier years, including four from Merck in 2009. Both 2018 and 2019 were bountiful years for Big Pharma executives, with Merck's Frazier and Pfizer's Read at, respectively, #3 and #4 in 2018 and #4 and #5 in 2019. Frazier was also #2

in 2022 as he took home $118.2 million as Merck executive chairman. Johnson & Johnson CEO Alex Gorsky was #5 in 2018, and Lilly CEO David Ricks #6 in 2019 and #5 in both 2021 and 2022.

Table 5. Six highest-paid pharmaceutical executives, 2006-2022, with total direct compensation (TDC) in millions of dollars (stock-based pay as percent of TDC)

	#1	#2	#3	#4	#5	#6
2006	John W. Jackson **CELGENE** $84.5m (96%)	Kenneth E. Goodman **FOREST LAB.** $78.2m (99%)	Sol J. Barer **CELGENE** $46.1m (94%)	Howard Solomon **FOREST LAB.** $40.9m (96%)	Robert Alan Essner **WYETH** $34.1m (73%)	John C. Martin **GILEAD SCIENCES** $32.5m (92%)
2007	Miles D. White **ABBOTT LAB.** $47.8m (79%)	David E. I. Pyott **ALLERGAN INC** $46.0m (93%)	John C. Martin **GILEAD SCIENCES** $35.6m (93%)	Richard A. Gonzalez **ABBOTT LAB.** $30.7m (88%)	Gregory T. Lucier **LIFE TECHNOLOGIES** $29.4m (90%)	Henri A. Termeer **GENZYME** $24.7m (85%)
2008	Robert J. Hugin **CELGENE** $74.6m (97%)	Sol J. Barer **CELGENE** $59.3m (94%)	John C. Martin **GILEAD SCIENCES** $33.1m (91%)	Miles D. White **ABBOTT LAB.** $30.3m (67%)	William C. Weldon **JOHNSON & JOHNSON** $25.6m (11%)	James C. Mullen **BIOGEN** $24.9m (84%)
2009	Fred Hassan **MERCK & CO** $91.3m (61%)	John C. Martin **GILEAD SCIENCES** $60.4m (94%)	Robert J. Bertolini **MERCK & CO** $58.5m (17%)	Carrie Smith Cox **MERCK & CO** $46.2m (40%)	Thomas Paul Koestler **MERCK & CO** $38.9m (46%)	Sol J. Barer **CELGENE** $31.4m (87%)
2010	John C. Martin **GILEAD SCIENCES** $42.7m (91%)	David E. I. Pyott **ALLERGAN INC** $35.3m (87%)	Gregory T. Lucier **LIFE TECH.** $33.8m (87%)	Martine A. Rothblatt **UNITED THERAPEUTICS** $31.6m (89%)	William C. Weldon **JOHNSON & JOHNSON** $25.5m (17%)	James C. Mullen **BIOGEN** $24.6m (93%)
2011	John C. Martin **GILEAD SCIENCES** $43.2m (90%)	David E. I. Pyott **ALLERGAN INC** $35.8m (86%)	William C. Weldon **JOHNSON & JOHNSON** $27.8m (28%)	Jonah Shacknai **MEDICIS PHARM** $25.3m (38%)	Robert L. Parkinson, Jr. **BAXTER INTERNATIONAL** $22.6m (75%)	John C. Lechleiter **LILLY (ELI) & CO** $22.1m (51%)
2012	George D. Yancopoulos **REGENERON** $129.8m (98%)	John C. Martin **GILEAD SCIENCES** $85.5m (94%)	Robert J. Coury **MYLAN NV** $68.6m (69%)	Leonard S. Schleifer **REGENERON** $52.5m (93%)	Leonard Bell **ALEXION** $41.6m (91%)	David E. I. Pyott **ALLERGAN INC** $41.4m (88%)
2013	John C. Martin **GILEAD SCIENCES** $168.9m (97%)	Paul M. Bisaro **ALLERGAN PLC** $113.2m (95%)	John F. Milligan **GILEAD SCIENCES** $79.7m (97%)	George D. Yancopoulos **REGENERON** $74.5m (96%)	Leonard S. Schleifer **REGENERON** $73.5m (96%)	Robert J. Hugin **CELGENE** $46.4m (81%)
2014	Leonard Bell **ALEXION** $195.8m (98%)	John C. Martin **GILEAD SCIENCES** $192.8m (97%)	Leonard S. Schleifer **REGENERON** $101.8m (97%)	Robert J. Hugin **CELGENE** $96.3m (89%)	John F. Milligan **GILEAD SCIENCES** $89.5m (97%)	Rajat Rai **AKORN** $75.8m (97%)
2015	John C. Martin **GILEAD SCIENCES** $232.0m (98%)	George D. Yancopoulos **REGENERON** $104.5m (97%)	John F. Milligan **GILEAD SCIENCES** $103.4m (97%)	Martine A. Rothblatt **UNITED THERAPEUTICS** $96.7m (98%)	Norbert W. Bischofberger **GILEAD SCIENCES** $95.5m (98%)	Rajat Rai **AKORN** $67.3m (97%)
2016	John C. Martin **GILEAD SCIENCES** $98.4m (96%)	Leonard S. Schleifer **REGENERON** $93.6m (96%)	George D. Yancopoulos **REGENERON** $73.3m (96%)	John F. Milligan **GILEAD SCIENCES** $57.8m (93%)	Robert J. Coury **MYLAN NV** $56.3 million (20%)	Kenneth C. Frazier **MERCK & CO** $38.6m (76%)
2017	George D. Yancopoulos **REGENERON** $267.8m (99%)	Leonard S. Schleifer **REGENERON** $95.3m (95%)	Jeffrey Marc Leiden **VERTEX** $78.5m (94%)	John C. Martin **GILEAD SCIENCES** $48.4m (94%)	Richard A. Gonzalez **ABBVIE** $41.6m (75%)	Robert J. Hugin **CELGENE** $40.5m (90%)
2018	Leonard S. Schleifer **REGENERON** $117.8m (96%)	George D. Yancopoulos **REGENERON** $92.0m (96%)	Kenneth C. Frazier **MERCK & CO** $48.8m (84%)	Ian C. Read **PFIZER** $47.0m (88%)	Alex Gorsky **JOHNSON & JOHNSON** $46.4m (88%)	Jeffrey Marc Leiden **VERTEX** $32.6m (85%)
2019	Leonard S. Schleifer **REGENERON** $116.0m (96%)	George D. Yancopoulos **REGENERON** $91.3m (96%)	Jeffrey Marc Leiden **VERTEX** $82.6m (94%)	Kenneth C. Frazier **MERCK & CO** $55.6m (79%)	Ian C. Read **PFIZER** $49.7m (89%)	David A. Ricks **LILLY (ELI) & CO** $30.8m (71%)
2020	George D. Yancopoulos **REGENERON** $286.0m (98%)	Leonard S. Schleifer **REGENERON** $174.4m (97%)	Daniel P. Van Plew **REGENERON** $91.2m (98%)	Jeffrey Marc Leiden **VERTEX** $90.6m (97%)	Lorence H. Kim **MODERNA** $89.7m (99%)	Tal Zaks **MODERNA** $68.8m (98%)
2021	Leonard S. Schleifer **REGENERON** $452.7m (99%)	Juan Andres **MODERNA** $195.9m (99%)	George D. Yancopoulos **REGENERON** $178.4m (96%)	Stephen Hoge **MODERNA** $167.7m (99%)	David A. Ricks **LILLY (ELI) & CO** $52.2m (87%)	John L. Higgins **LIGAND PHARMA.** $48.2m (97%)
2022	Stéphane Bancel **MODERNA** $397.6m (99%)	Kenneth C. Frazier **MERCK & CO** $118.4m (97%)	Stephen Hoge **MODERNA** $63.5m (96%)	Martine A. Rothblatt **UNITED THERAPEUTICS** $61.5m (91%)	David A. Ricks **LILLY (ELI) & CO** $53.3m (92%)	Daniel P. Van Plew **REGENERON** $48.0m (96%)

Notes: Abbvie is a 2013 spinoff from Abbott Laboratories; Life Technologies was created by the merger of Invitrogen and Applied Biosystems in 2008, with Gregory T. Lucier as the CEO of Invitrogen and, then, Life Technologies,

Source: S&P ExecuComp database and company proxy statements

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In 2020 and 2021, Regeneron's Yancopoulos and Schleifer took turns at #1, with three Regeneron executives holding the top three positions in 2020. Looking back a decade to 2012, Yancopoulos was #1 and #2 three times each, #3 twice, and #4 once, while Schleifer was also #1 and #2 three times each as well as #3, #4 and #5 once each. Moderna's massive stock-price explosion, based on its involvement in the development, manufacture, and delivery of a Covid-19 vaccine, enabled two of its executives to enter the top six in 2020, then two different executives in 2021, and then two more in 2022, with its president, Stephen Hoge, as a repeat. Not in the top six in 2020 or 2021 were Moderna's Afeyan and Bancel, both of whom took home vast fortunes by selling

founders' shares at high stock prices.[16] As Moderna's CEOK, however, Bancel struck gold in 2022, with his take-home pay of $397.8 million (99 percent stock-based) the second highest all-time among pharmaceutical executives.

4. Social Conditions of Innovative Enterprise in the U.S. Industrial Economy

How can one explain these financial outcomes? They would not be possible without innovation occurring somewhere in the larger pharmaceutical ecosystem. For example, the stock-based compensation reaped by Gilead's John Martin and the company's other senior executives were made possible by the profits that Gilead reaped, and the stock market's reaction to those profits, from the company's control over a safe and effective Hepatitis-C drug. But as a 2017 paper by AIRnet argued, and as a pioneering PhD dissertation by Victor Roy has documented in detail, Gilead itself, let alone its most senior executives, played little role in an innovation process that included the NIH, a broader scientific community, Emory University research labs, and the biopharma company Pharmassett in developing sofosbuvir (Sovaldi).[17] The empirical analysis of the relation between value creation and value extraction in the case of a medicine such as sofosbuvir requires a theory of innovative enterprise, focusing on the "social conditions of innovative enterprise" (SCIE). Once we know which entities contributed to the development and commercialization of an innovative medicine, we can analyze the relation between those parties that took the risks in making contributions to. the value-creation process and those parties that positioned themselves to extract the rewards, in some cases making little if any contribution to value creation.[18]

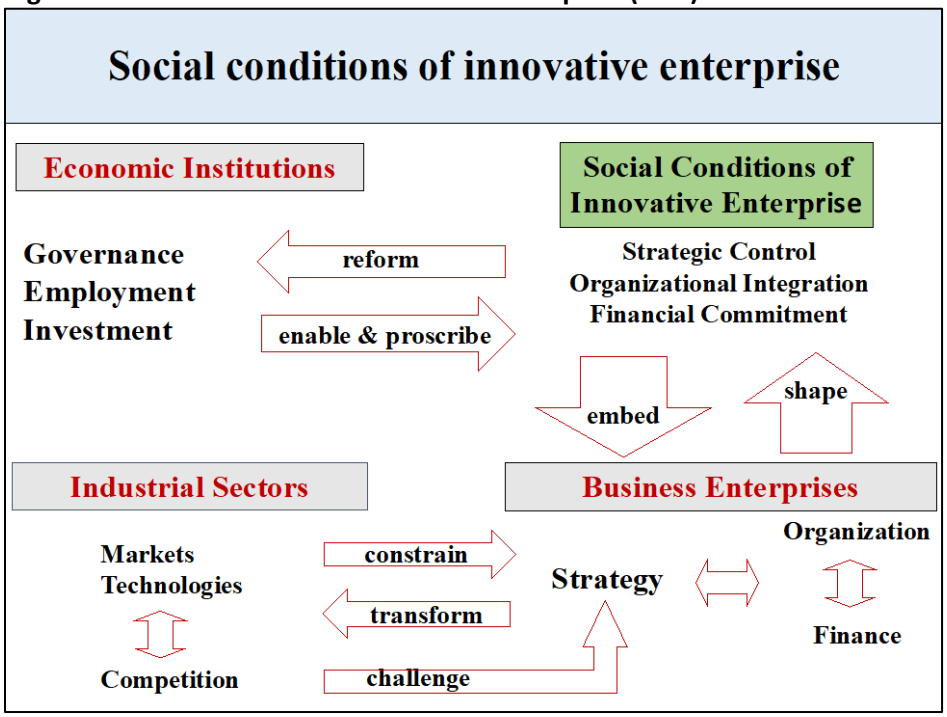
Our analysis focuses on interactions and impacts of three social conditions—strategic control, organizational integration, and financial commitment—as supply-side determinants of the success or failure of a business firm's investment in innovation (see Figure 1). We consider the five functions of the stock market—creation, control, combination, compensation, and cash—as influences on strategic control, organizational integration, and financial commitment, asking whether, given its actual functions, the stock market supports value creation or operates to enable excessive value extraction. Completing our analytical framework, we outline the ways in which three demand-side drivers of a firm's stock price, summarized as innovation, speculation, and manipulation, can both reflect and influence that firm's investment strategy.

Armed with the SCIE framework for analyzing the relation between the stock market and a firm's investment in innovation, we can engage in empirical research on the relation between value creation and value extraction in a) biopharma startups, b) established pharmaceutical firms, c) mergers and acquisitions in the pharmaceutical industry, d) government-business collaborations in pharmaceuticals in general and COVID-19 counter-measures in particular, e) regulation of drug prices, f) possession of life-sciences intellectual property rights, and g) the distribution of income in the U.S. pharmaceutical industry.

We can also analyze how through investment in productive capabilities by governments, businesses and households, a nation can achieve stable and equitable growth. A nation needs productivity growth to have the possibility of raising its population's living standards. It wants

employment to be stable over time so that households that send members into the paid labor force have dependable streams of income over decades of work. A nation should want the revenues that a business corporation generates to be equitably shared among its "stakeholders," reflecting their contributions to creating the value that has enabled its productivity growth. We call this equitable sharing of the gains from innovation "progressive value creation", which we contrast with value extraction by certain parties that is far in excess of their contributions to value creation, or "predatory value extraction".

Figure 1. Social conditions of innovative enterprise (SCIE) framework



Source: Schematic created by William Lazonick

Conventional economic and political analyses that view the operation and performance of the economy in terms of the interaction of "states and markets" are ill-suited to comprehend the determinants of stable and equitable growth. Missing from this perspective is the role of the large-scale business corporation as the economy's central resource allocator. Using 2021 data (the most recent available), in the United States, 2,138 firms with 5,000 or more US-based employees (and an average of 21,859) were just 0.03 percent of all firms but employed 36 percent of the business-sector labor force. Moreover, these firms accounted for 41 percent of business-sector payrolls. The average pay per employee in these 2,138 firms was $72,386 compared with $64,502 in the entire U.S. business sector.[19] The resource-allocation decisions, made by the executives who exercise strategic control over these very large firms, have profound impacts on employment opportunity, income distribution, and productivity growth in the US economy.

A firm can grow to become a large-scale employer by generating one or more products that are higher quality and lower cost than those of its competitors in the markets that it serves. In a

word, "innovation" drives the organic growth of the firm. As displayed in Figure 1, firm-level innovation requires strategy, organization, and finance.[20] Senior executives who exercise *strategic control* over the firm's resource allocation make strategic decisions about the products and processes in which to invest. They may choose to invest in innovation. The implementation of the innovation strategy requires the *organizational integration* of large numbers of people with different hierarchical responsibilities and functional specialties into the firm-level learning processes that are the essence of innovation. The firm must secure *financial commitment* to sustain the innovation process until, through transforming technologies and accessing markets, it can create the higher-quality, lower-cost products that, through market sales, generate financial returns.

Three social conditions of innovative enterprise—strategic control, organizational integration, and financial commitment—must interact to enable a business firm to generate an innovative (i.e., higher-quality, lower-cost) product. Those executives who exercise strategic control must have the abilities and incentives to allocate resources to innovation processes. Organizational integration provides employees with the abilities (through workforce training and work experience) and incentives (through pay increases and career opportunities) to implement the firm's innovation strategy. Financial commitment enables the firm to invest in the productive capabilities, embodied in the skills and efforts of its labor force, required to generate innovative outcomes.

Innovative enterprise, characterized by the dynamic interaction of strategic control, organizational integration, and financial commitment, does not occur in a social vacuum. National institutions related to governance, employment, and investment shape and are shaped by the social conditions of innovative enterprise that prevail in that nation's leading business corporations (see Figure 1 above). Governance institutions define the rights and responsibilities of those who exercise strategic control over resource allocation. Employment institutions determine the education of the labor force and the general terms of management-worker relations. Investment institutions structure the flow of finance for investment in the nation's productive capabilities.

As indicated in the "social conditions" schematic, industrial sectors (or subsectors) in which firms are engaged differ in terms of technologies, markets, and competition. Technologies are combinations of physical capital and human capabilities. High-tech companies seek to measure investment in organizational learning in terms of R&D expenditures, but the enhancement of human capabilities that enable innovation can occur throughout the firm, in functions such as administration, manufacturing, purchasing, and marketing. In 2022, of the 500 very large companies included in the S&P 500 Index, the top 10 firms accounted for 52 percent of R&D expenditures and the top 25 for 72 percent. At the same time, 55 percent of the companies in the Index recorded no R&D expenses at all.[21] Yet many of these "non-R&D" companies have grown large through innovation based on organizational learning.

Markets differ in terms of quality demanded, incomes and numbers of potential buyers, and buyers' price elasticity of demand. For any product, there are many dimensions of quality. In the

passenger-car industry, for example, "high quality" may mean that that a car is safe, fuel-efficient, and environmentally friendly—dimensions of quality that are of public concern and are hence often subject to government regulation. It may also mean that the car is rust-resistant, air-conditioned, roomy, stylish, comfortable, etc.—quality dimensions that are left to consumer choice. It costs money to build quality into cars, and different types of government regulators and car buyers may register very different views about what "high quality" means and how much it should cost to attain.

In the pharmaceutical industry, Americans rely upon the FDA to assess whether, based data from clinical trials, a medicine is sufficiently safe and effective to be authorized for use. Even then, the authorization for approved drugs can be withdrawn if new evidence of risks come to light. In the case of an opioid such as OxyContin, approved by the FDA as high quality as a pain killer in 1995, a rising wave of deaths from the drug by overdose and addiction led to Congressional debate in 2002 about whether it was sufficiently high quality in light of these risks. FDA approval for OxyContin has never been withdrawn.[22] But blame for opioid addiction and deaths has shifted from individuals for abusing the drugs to deliberate deception by Purdue Pharmaceuticals in marketing the drug.[23] In this case, views on "quality" depend on how the medicine is used or abused—and who (regulators, doctors, patients) is doing the assessment.

Firms compete in terms of quality and cost. Indeed, there is a dynamic interaction of quality and cost in the innovation process. In developing a higher-quality product, the innovating firm incurs the fixed cost of investments in not only physical capital (plant & equipment) but also human capabilities (enhanced through organizational learning, a portion of which is measured as research & development). The firm makes these investments in both *transforming technologies* to develop a product that the firm considers to be higher quality and *accessing markets* to inform potential buyers of the new products and, through branding, advertising, regulatory certification, and customer testimony, convince buyers that the product is actually higher quality.

The amount of fixed cost incurred in developing a higher-quality product depends on both the size and the duration of the innovative investment strategy. If the size of investment in physical capital tends to increase the fixed cost of an innovation strategy, so too does the duration of the investment required for the firm to engage in the collective and cumulative—or organizational—learning central to an innovation process that can transform technologies and access markets. Although accounting principles generally do not include investments in organizational learning as a firm's assets, in practice it is these investments in people that create the opportunity for a firm to engage in innovation and determine whether the firm will be successful.

The innovating firm's challenge is to transform the fixed cost of organizational learning into a product that market participants deem to be higher quality than alternative products previously available. If so, the firm can capture a larger share of the market that, by spreading the fixed cost across more units of product sold, transforms the high fixed cost of the innovation strategy into a product that, per unit, is not only higher quality but also lower cost. Indeed, the organizational learning required to scale the production of a product while maintaining quality and to access a larger extent of the market to drive down unit costs places even more pressure on the firm's

capabilities to succeed in innovation by generating a higher-quality, lower-cost product than otherwise available.

An innovation strategy that can eventually develop a higher-quality product may place the innovating firm at a competitive disadvantage when it has only attained low output levels. The high fixed cost of an innovation strategy creates the need for the firm to attain a high level of utilization of the productive capabilities that it has developed and thus reap "economies of scale." Given its existing productive capabilities, the innovating firm may experience increasing cost of variable inputs that it buys as needed on the market to expand production. To overcome this constraint on its innovation strategy, the innovating firm integrates the production of the supply of that input into its internal operations. The development of the productive capability of this newly integrated input, however, adds to the fixed cost of the innovation strategy. The innovating firm is now under increased pressure to expand its sold output to transform the high fixed cost of transforming technologies and accessing markets into low unit cost of sold output.

When a firm develops productive capabilities to gain competitive advantage in one line of business, it can make use of those capabilities to transform technologies and access markets in related lines of business—and hence grow by becoming a multiproduct firm. The critical decisions concerning which new business lines to enter depend on the abilities and incentives of executives in positions of strategic control. By providing career opportunities within the firm to key employees who the company wants to retain, the growth of the multiproduct firm relies upon, and can strengthen, organizational integration. And the profits from successful innovation can provide the firm with financial commitment in the form of retained earnings that can be used to reward career employees for their contributions to prior innovation and invest in augmenting the productive capabilities required for the next generation of innovative products.

5. From Innovation to Financialization

In short, as outlined in the introduction, the innovative firm grows through a strategy of "retain-and-reinvest": it retains profits and reinvests in productive capabilities, including the collective and cumulative learning of its labor force. By sharing the productivity gains with suppliers, employees, and buyers, innovative enterprise can contribute to stable and equitable growth. But, by generating a substantial profit stream, the firm's innovative success creates the possibility that its strategy can turn from retain-and-reinvest to "downsize-and-distribute"—that is, from innovation to financialization.

A change in the firm's strategy from retain-and-reinvest to downsize-and-distribute depends on the incentives and abilities of those executives who exercise strategic control over corporate resource allocation. Instead of retaining profits and reinvesting in the firm's productive capabilities, corporate executives who have attained positions of strategic control may choose to downsize the firm's labor force and distribute corporate cash to shareholders in the form of cash dividends and stock buybacks. Rather than invest in productive capabilities to enable further innovation, the financialized firm may seek to cut costs by, for example, suppressing wages, and inflate profits by, for example, price gouging, so that it can use its augmented cash flow to

increase yields to shareholders. These modes of predatory value extraction may, however, undermine the firm's innovative capabilities and the profits that can be generated from them over time.

As an intermediate stage between retain-and-reinvest and downsize-and-distribute, the previously innovative firm can reorient its resource allocation to a strategy of "dominate-and-distribute": it can continue to grow in the business lines that it has come to dominate through previous innovation but use its profits to increase yields to shareholders via income streams in the form of dividends and buybacks. If, perhaps as a result of its focus on distributions to shareholders, the firm ceases to remain dominant in its key markets, we can expect that it will transition from dominate-and-distribute to downsize-and-distribute.

The strategic reorientation of the firm from retain-and-reinvest to downsize-and-distribute by way of dominate-and-distribute represents a transformation from innovation to financialization. The macroeconomic results, as evidenced by the increasing financialization of the U.S. economy since the 1980s, are unstable employment opportunity, inequitable income distribution, and sagging productivity growth. Stock buybacks represent the foremost method of "predatory value extraction": the power of certain parties to extract value from a firm that is far greater than their contributions to the firm's value creation. In their book, *Predatory Value Extraction*, Lazonick and Shin analyze how, since the 1980s on a generally increasing scale, senior executives as value-extracting *insiders*, asset-fund managers as value-extracting *enablers*, and corporate raiders as value-extracting *outsiders* have, in combination, engaged in the legalized looting of the U.S. business corporation.[24]

As a form of distribution to shareholders, buybacks done as OMRs are much more volatile than dividends, with buybacks booming when stock prices are high. Since the early 1980s, major U.S. business corporations have been doing buybacks in addition to paying dividends. For 1981-1983, the 216 companies in the S&P 500 Index in January 2020 that were publicly listed 1981-2019 distributed 49.7 percent of net income as dividends but only 4.4 percent as buybacks. For 2017-2019, dividends were 49.6 percent of net income but buybacks for the same 216 companies were 62.2 percent.

Both types of distributions to shareholders drain corporate treasuries, but they differ in terms of how gains from them are realized. Dividends provide *all* shareholders with a yield for *holding* shares. In contrast, buybacks done as OMRs increase the gains of *sharesellers* who, as professional stock traders, are in the business of timing the sale of the shares that they hold, benefiting (as it turns out) from access to nonpublic information on the precise days on which the company is executing buybacks. These privileged sharesellers include senior executives of the company doing the buybacks, Wall Street bankers, and hedge-fund managers.

Stable shareholders who buy corporate stocks for dividend yields should be opposed to buybacks. Instead, they should want corporate management to reinvest in the productive capabilities of the company as a basis for creating the next round of innovative products that can generate the profits out of which a stream of dividends can continue to be paid. If the firm is successful in

making these innovative investments, the shares of the company will rise in value, giving these shareholders a stock-price gain when they decide to sell some or all of their shares.

In the United States, since the mid-1930s, the SEC has been mandated to regulate the stock market (as well as other financial markets) with a view to eliminating manipulation and fraud. Why, then, are companies listed on U.S. stock markets, of which the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ) system are by far the most important, permitted to use open-market repurchases to manipulate their own stock prices? The short answer is Rule 10b-18, adopted by the SEC in November 1982, which provides publicly listed corporations with a "safe harbor" against charges of stock-price manipulation, even when they do hundreds of millions of dollars in buybacks, trading day after trading day.

As shown in Table 1 above, the 478 corporations in the S&P 500 Index in September 2023 that were publicly traded from 2013 through 2022 distributed *$6.4 trillion* as stock buybacks during their 2013-2022 fiscal years, representing 57 percent of net income, and *$4.5 trillion* as cash dividends, an additional 40 percent of net income. We estimate that 95 percent of these stock buybacks were done as open-market repurchases (OMRs) of common shares, the purpose of which is to manipulate the company's stock price. (Henceforth, when we refer to buybacks, we mean open-market repurchases.)

The dramatic change in trajectory from retain-and-reinvest to downsize-and-distribute that has occurred in the United States over the past four decades did not have to happen. Rather, it was imposed upon the U.S. labor force by the dominance of a highly damaging and fallacious ideology of the relation between corporate governance and economic performance. In the name of "maximizing shareholder value" (MSV), U.S. business executives have favored extracting value that workers have already created while also neglecting to invest in productive capabilities that can enable workers to create new sources of value in the future. In doing so, they have shifted, often dramatically, the distribution of income within the firm from workers to shareholders.

Fundamental to this reversal was the capture of the SEC by free-market Chicago economists in 1981 following the election of Ronald Reagan as president of the United States. Reagan's appointment of a Wall Street executive John Shad as chair of the SEC put the agency that was supposed to eliminate fraud and manipulation from the nation's financial markets under the leadership of a Wall Street banker for the first time since Joseph Kennedy was the inaugural holder of that position in 1934–1935.

On November 17, 1982, the SEC promulgated Rule 10b-18, which gives a company a safe harbor against manipulation charges in doing OMRs.[25] Rule 10b-18 states that a company will not be charged with stock-price manipulation if, among other things, its buybacks on any single day are no more than 25 percent of the previous four weeks' average daily trading volume (ADTV). Under Rule 10b-18, moreover, there is no presumption of manipulation if the corporation's repurchases exceed the 25 percent ADTV limit.[26] The adoption of Rule 10b-18 in 1982 was called a "regulatory

about-face" from previous SEC views on the detection and prevention of manipulation of a company's stock price through OMRs.[27]

It has become customary (but not a legal requirement) for companies to announce publicly a share repurchase program, authorized by the board of directors, for a certain value of buybacks (say $10 billion) over a certain period of time (say, three years). Within the authorized value and timeframe of buybacks, this announcement permits the CEO and CFO to decide at any point in time to instruct the company's broker to execute buybacks on a given trading day and, if they wish, for several successive trading days. If the total authorized value of buybacks is reached, the board can simply authorize a new repurchase plan.

The prime—and typically only—purpose of stock buybacks is to boost a company's stock price. Note that most buybacks are done when stock prices are high and rising, as publicly listed companies compete to boost their stock prices. In tech companies, persistent stock-price boosts from buybacks can help attract highly mobile "talent" with the lure of stock-based pay. But at all companies, it is the most senior executives, with their compensation packages heavily laden with stock options and stock awards, who reap by far the greatest realized gains from the company's stock-price increases.

Note that some stock buybacks are carried out as accelerated share repurchases (ASRs), in which an issuer company enters into a contract with a bank under which the bank is to repurchase a certain value of the issuer's shares over a certain period of time. For example, on February 7, 2019, Pfizer entered into a $6.8 billion ASR agreement with Goldman Sachs, to be completed by August 1, 2019. On signing the contract, the bank borrows shares equal to the value of the ASR contract from asset managers who are not interested in selling the shares. Then, over the term of the ASR contract, the bank executes OMRs at its discretion—presumably for amounts that remain with the 25% ADTV safe-harbor limit on any given trading day—and gives the borrowed shares back to the asset managers. But, on the date on which it signs the ASR contract, the issuer company reduces its number of shares outstanding by the entire amount of the ASR (in the case of Pfizer, by $6.8 billion), thus giving an immediate—"accelerated"—boost to its earnings-per-share (EPS) without transgressing the ADTV safe harbor limit under Rule 10b-18.

A company's stock price can increase because of *innovation*, *speculation*, and *manipulation*. Innovation is, by definition, uncertain; when the investments in innovation are made, it cannot be known whether a higher-quality, lower-cost product will result (if it could be known, it would not be innovation). When a company generates profits from innovation, stock-market traders take notice, after the fact of the successful innovation process, and compete to buy shares on the market, bidding up the company' stock price. At some point in this bidding process, innovation gives way to speculation as some traders buy shares at higher prices on the expectation that the firm's profits from innovation will continue in the future. Other traders may view the stock to be overpriced but keep buying shares anyway on the speculation that there exist "greater fools" among traders who will take the shares off their hands at even higher prices.

To sustain and enhance the boom in its stock price, a company might execute stock buybacks to give manipulate boosts to its stock price. Speculation and manipulation may interact to keep the stock price rising. A new round of successful innovation can support the stock price. But our research on buybacks strongly suggests that senior executives who do large-scale buybacks to boost stock prices lack the incentive, and often the ability, to invest in innovation.

Stock buybacks are the most direct and pervasive—and currently legal—mode of corporate resource allocation available to manipulate a company's stock price. Buybacks can result in stock-price increases at four different stages of the "buyback process": a) when the company *announces a program* to do share repurchases; b) when the firm's broker actually *executes the buybacks* on the open market, which may be done trading day after trading day; c) when the *upward momentum* that buybacks give to a company's stock price is reinforced by market speculation that the stock-price increase will continue; and d) when the company releases its *quarterly earnings report*, with buybacks resulting in a higher EPS and P/E Ratio, even if earnings (i.e., net income) have remained the same.

These four events in the buyback process can reinforce one another in lifting a company's stock price. And innovation plays absolutely no role as a driver of the company's enhanced stock-price "performance." As Lazonick puts it in the subtitle of his 2014 *Harvard Business Review* article: "Stock buybacks manipulate market and leave most Americans worse off."[28]

Research undertaken by the Academic-Industry Research Network, supported by the Institute for New Economic Thinking, has analyzed the damage wrought by buybacks done by many of the companies listed in Table 6, which shows the top 20 repurchasers among industrial (or non-financial) corporations for 2010-2019.[29] Of these 20 companies, 13 distributed more than 100 percent of net income to shareholders over the decade while the other seven distributed 75 percent or more.

Coming into the pandemic, 11 companies on the list—Apple, Oracle, Microsoft, Cisco, Walmart, Intel, Home Depot, Johnson & Johnson, Amgen, Qualcomm, and Gilead—were in dominate-and-distribute mode, using the profits from their still-dominant market positions primarily to support their stock prices; while seven—Exxon Mobil, IBM, Procter & Gamble, General Electric, Merck, McDonald's, and Boeing—were in downsize-and-distribute mode, distributing corporate cash to shareholders as they downsized their labor forces. Pfizer had been in downsize-and-distribute mode through 2018, but, as discussed below, in 2019 began to eschew buybacks and augmented its labor force for the sake of investment in innovation. Although Pfizer had long been one of the most financialized companies, it entered the pandemic with a new orientation to retain-and-reinvest—and then reaped bonanzas from its collaboration with Germany-based BioNTech in the development, manufacture and delivery of the mRNA Covid-19 vaccine and its internally developed Paxlovid antiviral pill. As also discussed below, Disney had pivoted to retain-and-reinvest in the years just prior to the pandemic.

Table 6 also shows the buybacks done by these 20 companies from April 2020 through June 2022, representing the core period of the SARS-CoV-2 pandemic. Apple, Oracle, Walmart, Home Depot,

Procter & Gamble, and Amgen spent 54 percent or more of net income on buybacks during this period. For Microsoft, Cisco, Intel, and Qualcomm, this proportion was in the 29-39 percent range. These ten companies benefited from very strong demand for their products and high profits during the pandemic.

Table 6. Twenty largest stock repurchasers, 2010-2019, among U.S. industrial corporations, their buybacks from April 2020 through June 2022, and their SEC Rule 10b-18 safe-harbor average daily trading volume (ADTV) value for repurchases on 10/19/19, 6/23/21, and 3/27/22.

	2010-2019				April 2020 through June 2022			ADTV		
COMPANY	$BB RANK	BB, $b.	BB/NI%	(BB+DV)/ NI%	BB, $b.	BB/NI%	(DV+BB)/ NI%	October 21, 2019, $m.	June 23, 2021, $m.	March 27, 2022, $m.
APPLE	1	305.0	73	94	184.8	93	110	1,597	2,526	4,146
ORACLE	2	113.7	121	145	39.3	153	186	183	261	236
MICROSOFT	3	101.1	48	92	65.8	39	65	754	1,522	2,514
EXXON MOBIL	4	92.4	35	80	6.2	27	171	166	410	815
IBM	5	88.2	71	107	0.0	0	108	125	144	145
CISCO SYSTEMS	6	81.5	100	144	10.5	38	93	226	254	305
PFIZER	7	76.7	60	116	2.0	4	48	146	235	425
WALMART	8	70.2	50	91	16.3	54	100	141	259	299
INTEL	9	66.8	51	87	12.4	29	59	219	318	497
HOME DEPOT	10	64.4	93	137	18.7	53	97	188	299	368
JOHNSON & JOHNSON	11	62.1	49	110	7.5	19	81	267	280	356
PROCTER & GAMBLE	12	54.9	52	117	21.0	66	126	186	319	299
AMGEN	13	51.2	92	129	13.0	92	155	97	164	205
GENERAL ELECTRIC	14	50.3	135	314	0.3	-26	-105	94	197	139
QUALCOMM	15	49.4	119	178	6.1	30	64	116	241	408
DISNEY	16	47.8	61	85	0.0	0	0	231	341	341
MERCK	17	45.8	81	172	0.8	3	62	144	265	217
MCDONALD'S	18	45.8	87	145	3.3	25	90	159	149	260
BOEING	19	43.4	87	137	0.0	0	0	292	708	521
GILEAD SCIENCES	20	39.6	56	75	1.2	21	156	93	122	181

Notes: BB=stock buybacks; DV=cash dividends; NI=net income; ADTV=stock-market value of the average daily trading volume limit to secure the safe harbor against stock-price manipulation charges under SEC Rule 10b-18.

Sources: Company 10-K and 10-Q filings with the SEC; Yahoo Finance daily historical stock prices.

Notwithstanding a sharp downturn in stock prices in March 2020, when the World Health Organization declared the spread of SARS-CoV-2 a pandemic, the U.S. stock markets boomed during this social crisis. The last three columns of Table 4 show the generous ADTV "limits" for the 20 largest repurchasers among industrial companies, 2010-2019, at three points in time: in October 2019, in advance of the pandemic; in June 2021, when the Delta variant of SARS-CoV-2 was dominant in the United States, and in March 2022, when the highly transmissible Omicron variant emerged as widespread, prolonging the pandemic.[30] Except for McDonald's, the ADTV values had all risen, in many cases substantially, by June 2021 compared with October 2019, reflecting combinations of higher stock prices and higher trading volumes. The movement of ADTV from June 2021 to March 2022 was more mixed; most noteworthy was the continued explosion of the value of daily repurchases that Apple and Microsoft could do while availing themselves of Rule 10b-18's safe harbor.

Of the seven companies that entered the pandemic in downside-and-distribute mode, the financial condition of IBM, General Electric (GE), and Boeing deteriorated further during it, constraining their financial capacity to do buybacks and even to pay dividends. IBM was known

through the 1980s for its commitment to "life-long employment," but in the early 1990s, in the name of MSV, the company's resource-allocation regime transformed rapidly and dramatically to downsize-and-distribute.[31] GE's corporate financialization, which originated in the conglomerate movement of the 1960s and continued during the reigns of CEOs Jack Welch (1981-2001) and Jeffrey Immelt (2001-2017), was given a coup de grâce by the predatory attack launched by hedge-fund activist Nelson Peltz (of Trian Partners) from October 2015 (as discussed below), leaving GE with no choice but to dramatically reduce buybacks from 2018 and dividends from 2019.[32] As for Boeing, which became highly financialized after its merger with McDonnell Douglas in 1997, the obsession of the company's senior executives with stock yields bears much of the blame for the crashes of its 737 MAX planes in October 2018 and March 2019. From January 2013 through March 2019—up to the week before the second crash on March 10—Boeing did $43.4 billion in buybacks, equal to 118 percent of net income over this period, on top of 43 percent of net income distributed as dividends.[33]

Exxon Mobil was also financially constrained from doing buybacks in the years prior to the pandemic. Since the mid-1980s, high profits from high oil prices have funded the company's stock buybacks, while its dividends have perpetually increased, whether oil prices are high or low.[34] For the decade, 2005-2014, Exxon Mobil averaged $22.0 billion in buybacks annually—by far the highest of any company over that period (second highest was IBM with a $12.3 billion annual average)—representing 61 percent of Exxon Mobil's exceedingly high profits, reaped from high oil prices. As oil prices declined dramatically from mid-2014 to mid-2020, cash-strapped Exxon Mobil had to rein in its buybacks, which declined yearly from $4.0 billion in 2015 to $155 million in 2021.

The explosion of crude oil prices during the pandemic, from $23.65 in March 2020 to $116.96 in May 2022,[35] turned Exxon Mobil's loss of $22.4 billion in 2020 into a profit of $23.0 billon in 2021, $55.7 billion in 2022, and $36.0 billion in 2023. Aiding the inflation of Exxon Mobil's bottom line was the slashing of its labor force from 72,000 at the end of 2020 to 61,500 at the end of 2023. With rising oil prices providing Exxon Mobil with soaring profits in 2022, the company reverted to financialized form by gifting shareholders $14.9 billion in dividends and sharesellers $15.2 billion in buybacks. And even though in 2023 oil prices, and Exxon Mobil's profits declined from 2022, the company nevertheless maintained its dividends at $14.9 billion while increasing its buybacks to $17.7 billion.

Among the companies in Table 6. Disney, Intel, and Pfizer explicitly abandoned buybacks before or during the pandemic for the sake of investing in the productive capabilities of their companies. Each of the three cases illustrates that even within a business corporation that has become a leading repurchaser of its own stock, there is an ongoing tension between innovation and financialization, with specific sets of circumstances determining the outcome.[36] It is illuminating to look briefly at the conditions under which each of the three companies, in three vey different industries, eschewed buybacks in recent years.

Disney had decided to cancel its stock-repurchase program in August 2018 in anticipation of the heavy debt load that it would assume when it acquired 21st Century Fox.[37] The company

did no buybacks in the fourth quarter of fiscal 2018 (ended September 29). The acquisition was completed in March 2019, and Disney's revenues rose substantially in the second half of that fiscal year, while its profits declined. Disney's buyback program remained in suspension as the company entered pandemic. With $2.9 billion in losses in 2020, Disney almost halved its previous dividend in fiscal 2020 by paying no dividends in the second half of fiscal year (ended October 3, 2020). Indeed, from April 2020 through December 2023, Disney distributed no corporate cash to shareholders. Its revenues soared in 2022 and 2023, but its profits were modest. Disney had cut employment from 223,000 at the end of fiscal 2019 to 190,000 at the end of fiscal 2021, but then, with its revenues rising from $67.4 billion in 2021 to $88.9 billion in 2023, increased its yearend labor force to 225,000.

Once the world leader in chip fabrication, a financialized Intel found itself falling behind in the face of innovative global competition. Under new leadership, however, Intel is now seeking to invest in advanced nanometer fabrication facilities with the goal of catching up with industry frontrunners TSMC and Samsung Electronics.[38] Intel ceased doing stock buybacks from the second quarter of 2021 after replacing CEO Robert Swan, a finance expert, with Pat Gelsinger, a technology expert.[39] In a *60 Minutes* interview, Gelsinger said that a condition of his taking the top Intel job was assurance from the company's board that Intel would "not be anywhere near as focused on buybacks going forward as we have in the past."[40]

In a subsequent interview with *CNET* in November 2021, Gelsinger was much more expansive and emphatic.[41] He recounted how, before taking the CEO job, he had written a strategy paper for Intel's board, for which he got their unanimous agreement. "I was concerned," Gelsinger said in the interview, "about how we get the process roadmap back in shape." He continued:

> We underinvested in capital. I went to the board and said: "We're done with buybacks. We are investing in factories." And that is going to be the use of our cash as we go forward. And they aggressively supported that perspective; that we needed to just start investing, and those investments would start creating a cycle of momentum that would get our factory teams executing better.

During 2022, Gelsinger was in the forefront of lobbying for the CHIPS and Science Act, signed into law on August 9, 2022. The Act provides $52.7 billion in federal government subsidies to semiconductor companies operating in the United States for research development, manufacturing, and workforce development.[42] During 2022 and 2023, Intel refrained from doing buybacks, and in 2023, with revenues and profits down, the company cut its dividend payments in half.

For its part, the Biden administration has stated that the distribution of the funds under the Act "come with strong guardrails" including "preventing companies from using taxpayer funds for stock buybacks and shareholder dividends."[43] For the time being, Intel has erected its own guardrail by eschewing buybacks. With shrinking revenues and profits, the company cannot afford them, given its investment plans even in the absence of CHIPS and Science Act subsidies. In the implementation of the Act, however, the Department of Commerce, recognizing that it

cannot know whether its grants per se will be used for buybacks, has simply stipulated that companies that, in their grant applications, agree to forgo buybacks for five years will get preferential treatment in the allocation of the Act's funds.[44] In February 2024, Sen. Elizabeth Warren and Rep. Sean Casten deemed it necessary to send a letter to the CEO of BAE Systems, the first recipient of funds under the Act ($35 million), urging him "to hew to the spirit of the law as passed by Congress, as well as guidance issued by Commerce, and refrain from engaging in stock buybacks for the duration of its CHIPS Act grant."[45]

A highly financialized corporation from the late 1980s, Pfizer committed to doing $8.9 billion in buybacks in early 2019, to be completed by August 1 of that year.[46] After this buybacks binge, however, the company ceased doing repurchases as it turned its strategic attention to conserving a portion of its profits to finance investment in its drug pipeline. Previously, Pfizer's strategy had been to acquire other companies with lucrative drugs on the market that had years of patent life left and to extract the profits from these drugs to fund its distributions to shareholders. By the late 2010s, however, with Big Pharma acquisition targets unavailable and the patents on several Pfizer's major drugs expiring, the board recognized that Pfizer itself could be taken over by another Big Pharma company unless it could develop high-revenue drugs internally.

For the sake of internal drug development, Pfizer refrained from doing buybacks from August 2019 through February 2022. Indeed, in an unusual move among U.S. corporations, in January 2020 Pfizer publicly announced its commitment to forego buybacks that year, and it did so again in January 2021. The company did, however, increase its dividend in 2019, 2020, 2021, and the first nine months of 2022, paying out 48 percent of its substantial net income as dividends during the pandemic period, as defined in Table 6 above.

The implementation of this change in Pfizer's investment strategy followed the end of Ian Read's tenure as Pfizer CEO as of January 1, 2019, in favor of current CEO Albert Bourla. As CEO from 2011, Read had engaged in downsize-and-distribute.[47] In an earnings call with stock-market analysts in January 2020, Bourla made an extraordinary admission of the company's financialized past, declaring that Pfizer had stopped doing buybacks so that the company could invest in innovation:

> The reason why in our capital allocation, we are allocating right now money [is] to increase the dividend and also to invest in our business…all the CapEx to modernize our facilities. The reason why we don't do right now share repurchases, it is because we want to make sure that we maintain very strong firepower to invest in the business. The past was a very different Pfizer. The past of the last decade had to deal with declining of revenues, constant declining of revenues. And we had to do what we had to do even if that was financial engineering, purchasing back ourselves. We couldn't invest them and create higher value. Now it's a very different situation. We are a very different company.[48]

Bourla did not explain why the "old" Pfizer—which, less than 12 months before, had done $8.9 billion in buybacks—"had to do what we had to do even if that was financial engineering,

purchasing back ourselves." But his rambling statement to the analysts is a very rare recognition by a CEO of a major U.S. corporation that stock buybacks are the enemy of investment in innovation.

Shortly thereafter, SARS-CoV-2 was declared a pandemic, and Pfizer found itself in what turned out to be a very lucrative partnership with BioNTech to develop, manufacture, and deliver the Covid-19 mRNA vaccine. Even though Pfizer's revenues almost doubled from $41.9 billion in 2020 to $81.3 billion in 2021, with profits soaring from $9.6 billion to $22.0 billion, the company refrained from doing buybacks, while the dividend payout ratio declined from 88 percent to 40 percent. With revenues and profits continuing to explode in the first nine months of 2022, bolstered by sales of Paxlovid (given emergency use authorization by the Food and Drug Administration in December 2021), Pfizer did $2.0 billion in buybacks, all of them in March. We can assume that Pfizer timed these repurchases to give a manipulative boost to its sagging stock price. [49] If so, it apparently worked; on March 1, Pfizer's stock price had sunk to $45.75 but was then pumped up to $55.17 on April 8.

With the release of its results for the second quarter of 2022, however, Pfizer stated that the company "does not anticipate any additional share repurchases in 2022."[50] Pfizer's self-restraint was probably based in its senior executives' recognition that, with the end of the pandemic in sight, Pfizer's windfall profits from its Covid-19 medicines were unlikely to last.[51] Indeed, in 2023, Pfizer's revenues plummeted from $100.3 billion to $58.5 billion, and its profits from $31.4 billion to $2.1 billion. Nevertheless, while still eschewing buybacks, in 2023 Pfizer raised its dividend payments to record $9.2 billion—436 percent of net income—the 14th straight year that its dividends went up.

A key point of this overview of the payouts to shareholders of the largest repurchasers is that individual companies make decisions concerning their level of buyback activity, and hence an analysis of the relation between stock buybacks and corporate performance must examine specific corporate trajectories, including changes in strategic control. The theory of innovative enterprise provides an analytical framework for conducting this company-level research, while recognizing the importance of the institutional and industrial contexts within which a particular corporation operates.

6. The New Economy Business Model and the Financialization of ICT

Of the 20 largest repurchasers in Table 6, seven are in the ICT industry and five are in the pharmaceutical industry. These two R&D-driven industries have been at the core of the U.S. innovation economy. Of the largest repurchasers that were ICT companies, their spending on R&D as a proportion of sales in 2010-19 was Qualcomm 21.9 percent, Intel 19.3 percent, Oracle 14.4 percent, Microsoft 13.5 percent, Cisco 12.8 percent, IBM 6.4 percent, and Apple 4.3 percent. For the pharmaceutical companies in the list, these figures were Merck 20.4 percent, Amgen 18.8 percent, Gilead Sciences 17.9 percent, Pfizer 14.8 percent, and Johnson & Johnson 13.0 percent.[52] These corporations expend substantial funds on R&D, which mainly takes the form of the employment of scientific and technical personnel.

More R&D spending, however, does not automatically result in more innovation. R&D processes must be managed to ensure the collective and cumulative learning required for innovation. A critical research question is whether companies whose senior executives are focused on MSV have the abilities and incentives to direct the organizational learning required to transform R&D activities into innovative goods and services. The recent statements by Pfizer's Bourla and Intel's Gelsinger, quoted above—made when they had become new CEOs of, respectively, a pharmaceutical company ranked #7 and an ICT company ranked #9 in stock buybacks in 2010-2019 (see Table 6 above)—indict the MSV-orientation of their predecessors, as manifested by buybacks, for undermining the social conditions of innovative enterprise.

Together, the growth of ICT and pharmaceuticals since the 1970s has resulted in the transformation of U.S. high-technology industry from the "Old Economy business model" (OEBM) to the "New Economy business model" (NEBM). In Table 6, exemplars of OEBM were, coming into the 1980s, Exxon Mobil. IBM, Pfizer, J&J, Procter & Gamble (P&G), General Electric (GE), Disney, Merck, and Boeing. The differing characteristics of strategy, organization, and finance under the two business models displayed in Table 7, adapted from Lazonick's 2009 book, *Sustainable Prosperity in the New Economy?*, refer specifically to the ICT industry.

Table 7. Strategy, organization, and finance in the transition from the Old Economy business model (OEBM) to the New Economy business model (NEBM) in the U.S. information-and-communication technology (ICT) industry

	OEBM	NEBM
Strategy, product	Growth by building on internal capabilities; business expansion into new product markets based on related technologies; geographic expansion to access national product markets.	New firm entry into specialized markets; sale of branded components to system integrators; accumulation of new capabilities by acquiring young technology firms.
Strategy, process	Corporate R&D labs; development and patenting of proprietary technologies; vertical integration of the value chain, at home and abroad.	Cross-licensing of technology based on open systems; vertical specialization of the value chain; outsourcing and offshoring.
Organization	Secure employment: career with one company; salaried and hourly employees; unions; defined-benefit pensions; employer-funded medical insurance in employment and retirement.	Insecure employment: interfirm mobility of labor; most salaried; broad-based stock options; non-union; defined-contribution pensions; employee bears greater burden of medical insurance.
Finance	Venture finance from personal savings, family, and business associates; NYSE listing; payment of steady dividends; growth finance from retentions leveraged with bond issues.	Organized venture capital; initial public offering on NASDAQ; low or no dividends; growth finance from retentions plus stock as acquisition currency; stock repurchases to support stock price.

Source: Lazonick, *Sustainable Prosperity in the New Economy?,* p. 17

The key characteristics of OEBM were a) a growth strategy based on vertical integration of productive activities to develop proprietary technologies that enabled the firm to invest in new related lines of business over time; b) organizational learning on the basis of the employment norm, both blue-collar and white-collar, of a career-with-one-company (CWOC), manifested by decades-long employment tenures that culminated in retirement in company-funded nonportable defined-benefit pensions, based on years of service with the company,; and c) the funding of the growth of the firm with retained earnings, leveraged, if required, by long-term bond issues. Of the leading repurchasers, 2010-2019, in Table 6, only IBM has an historical OEBM legacy in ICT. In pharmaceuticals, Pfizer, J&J, and Merck also underwent transitions from OEBM to NEBM.

By the early 1990s, six ICT companies in Table 6—Intel (founded in 1968; IPO in 1971), Microsoft (1975; 1986), Apple (1977; 1980), Oracle (1977; 1986), Cisco (1984; 1990). Qualcomm (1985; 1991)—were growing large by implementing the key characteristics of NEBM: a) vertical specialization based on open-systems architectures, relying on distinct firms in distinct industry segments for the supply of inputs and, in some cases, the sale of outputs; b) younger employees with a high degree of interfirm labor mobility; and c) retention of all of their earnings for growth, eschewing even dividend payments until they became dominant in their key lines of business. Among the other companies in Table 6, in biopharma, Amgen and Gilead, adopted modes of operation similar to ICT's NEBM.

Under OEBM, the main function of the stock market was *control*; a listing on NYSE enabled the separation of share ownership from managerial control, with salaried professionals taking the place of former owner-entrepreneurs in positions of strategic control. Within a national institutional environment that supported retain-and-reinvest, the rise of professional management enabled the growth of the vertically integrated, multiproduct firm. With, however, the rise of New Economy companies in ICT and biopharma, the functions of the stock market changed dramatically, with in addition to the control function, the creation, combination, compensation, and cash functions becoming far more important than had been the case under OEBM.

Under OEBM, the main function of the stock market had been to enable owner-entrepreneurs and their financial backers to monetize some or all of their private-equity investments in the company, by selling its shares on a public stock market, thus separating share ownership from managerial control. Under NEBM, the speed at which a company could go public with a quotation on NASDAQ induced venture capital to invest in startups; indeed, for venture capitalists a NASDAQ IPO became known as an "exit strategy."

Founded in Mountain View, California in 1968, Intel did its initial public offering (IPO) "over the counter" in October 1971, with its stock price quoted on NASDAQ, just six months after this electronic system was launched. Intel raised $6.6 million in its IPO, almost doubling the prior private-equity investment in the company. One Intel employee, Mike Markkula, cashed in his Intel options and retired in 1974 at age 32, but three years later he emerged to put up $80,000 in cash and $170,000 as a loan as the first financial backer of Apple.

If Intel lost an employee like Markkula who got rich too quickly—a longstanding problem of using stock as a compensation currency in Silicon Valley—its publicly traded stock also became a tool for attracting new professional, technical, and administrative employees to the young company. Many of these employees were lured away from secure "career-with-one-company" (CWOC) employment at Old Economy companies such as HP, IBM, Motorola, and Texas Instruments. At Intel and other New Economy companies, it became a common practice, even as the most successful of them grew to employ thousands or tens of thousands, to give employees enrolled in a broad-based stock-plan annual option grants which vested over one to four years from the grant date with a ten-year expiration date. Thus, especially if a company could keep its stock price rising over time, the stock-option program functioned as a retention mechanism, with an employee receiving a regular stream of options for staying with the firm but without the OEBM promise of a career with one company.

From 1971 to 1989, as a publicly traded company, Intel was in retain-and-reinvest mode as it increased its revenues from $9.2 million (or $28.1 million in 1989 dollars) to $3.1 billion and its employment from 460 to 21,700. Intel started reaping significant profits in 1983 and 1984 but was threatened with bankruptcy in 1984-1985 when it lost its memory-chip business to the Japanese. Fortunately, Intel was also producing microprocessors for the market-dominant IBM PC and was able to increase its revenues and profit margins as a logic chip company, surpassing Old Economy companies Motorola and Texas Instruments as the world's leading semiconductor company in 1991. From 1971 through 1989, Intel retained and reinvested $1.3 billion in earnings—its total net income less $352 million in 1987 to repurchase its shares from IBM, which had taken a 20-percent ownership stake in Intel in 1982.[53]

Intel's increased use of stock as a compensation currency, however, prompted the company to look to open-market stock repurchases as a way to offset dilution of its outstanding stock. It was for this purpose that in 1990 Intel announced its first stock-repurchase program, under which it bought back shares valued at $102 million in 1990 (16 percent of net income) and $391 billion in 1993 (17 percent). When, in July 1994 Intel's board authorized a new round of buybacks, Intel chairman Gordon Moore, said: "The Intel stock repurchase plan provides us with an opportunity to buy back our shares at attractive prices. We are pleased that our strong cash position enables us to make these share repurchases while continuing to have flexibility in our capital and R&D programs."[54]

Intel's buybacks exploded, however, from $658 million in 1994 (29 percent of net income) to $6.8 billion in 1998 (112 percent). In 1989-1994, the number of shares repurchased as a proportion of shares issued to employees as stock-based compensation was 53 percent; in 1995-2000, it was 167 percent. This proportion rose to 250 percent in 2001-2010 and was 239 percent in 2011-2020.

All these open-market repurchases enabled Intel to manipulate its own stock price. But from the last half of the 1990s the number of shares repurchased was far greater than those that would offset dilution from employee stock-based compensation. In the process, Intel's resource-

allocation strategy transformed from retain-and-reinvest to dominate-and-distribute, and the company fell behind as a global semiconductor company. The historical transitions from retain-and-reinvest to dominate-and-distribute also occurred at the other five New Economy ICT companies—Apple, Microsoft, Oracle, Cisco, and Qualcomm—in Table 6, but with differences in the relative importance of the functions of the stock market, the timeframes of the transitions, and the impacts on their global competitiveness.

With $117 million in revenues, $11 million in profits, and just over 1,000 employees, Apple raised $97 million in its 1980 IPO—the only time in the company's history that it has secured funds from the public stock market. In 1985, however, founder Steve Jobs was ousted from the company, and with Markkula as chairman and former Pepsi Cola executive John Scully as CEO, the company sought to drive up its stock price with dividends and buybacks. By 1996 and 1997, after Microsoft had introduced Windows for PCs, Apple was taking huge losses and had to be bailed out by Microsoft in the form of $150 million in preferred shares.[55]

It was in this context that Jobs regained strategic control of Apple and reinstituted a retain-and-reinvest regime that culminated in the launch of the iPhone in 2007 and that remained in place when Jobs passed away in October 2011. The new CEO, Tim Cook, had been an Apple supply-chain executive whose most profound contribution to the company had been outsourcing of its manufacturing to Foxconn in China. In the fourth quarter of fiscal 2012 (ending September 29), Apple began paying dividends, and in the first quarter of fiscal 2013, the buybacks began. From October 2012 through December 2023, Apple executed $651 billion in buybacks (90 percent of net income) and $148 billion in buybacks (another 21 percent).

In October 2014, as hedge-fund predator Carl Icahn, who had purchased $3.6 billion in Apple shares on the market a year earlier, was pressuring CEO Cook to do $100 million in buybacks, Lazonick published two articles online in *Harvard Business Review*. The first article questioned Apple's so-called "Capital Return Program," which at that time included an announcement made in April 2014 that the Apple board had increased its prior authorization to do a total of $90 billion in buybacks and $40 billion in dividends by December 2015.[56] Noting that the only time Apple had ever raised funds from the stock market was in its 1980 IPO, Lazonick asked how Apple could "return" cash to shareholders like Icahn who had never committed any cash to investment in the company's productive capabilities.

The second article was an open letter to CEO Cook, suggesting ways in which he could allocate Apple's cash to innovative investments and an equitable income distribution, including more compensation for tens of thousands of employees in Apple stores (not to mention hundreds of thousands of people working at companies in Apple's global supply chain); more educational support to enhance the career opportunities for Apple employees, especially for those in dead-end jobs in Apple stores and call centers; collaboration with government in social investments in knowledge and infrastructure; and collaboration with government in social innovation to develop the technologies of the future to meet society's needs.[57] And, as Lazonick and Hopkins have subsequently argued, Cook could also have taken up the suggestion made in 2010 by a prominent ICT-industry journalist that Apple could invest in a semiconductor fab to manufacture chips for

its iPhone and other devices.[58] Instead, Apple outsourced the manufacture of its most sophisticated processors, first, to Samsung Electronics and, then, from 2011 to Taiwan Semiconductor Manufacturing Corporation (TSMC), thus supporting these companies as they evolved to dominate global competition in high-end chip fabrication.

Then, as mentioned, from fiscal 2013, Apple began doing massive stock buybacks, responding at first to an attack by hedge-fund activist David Einhorn of Greenlight Capital.[59] Succumbing to Icahn's wealth, visibility, hype, and influence,[60] and possibly fearful of the threat to strategic control that the corporate raider posed, Cook's "reply" to Lazonick's letter was to do $45.0 billion in buybacks in 2014 and $35.3 billion in 2015—the first and third most in a year for any company at the time (the second highest was Exxon Mobil with $35.7 billion in 2008). In the winter of 2016, apparently trading on insider information concerning a drop in Apple's iPhone sales in China, Icahn sold all his Apple shares for a gain of about $2 billion, adding to his hedge-fund "war chest" in his ongoing predatory quest to extract value from other companies. Note that not one cent of the funds that Icahn had used to purchase $3.6 billion of Apple shares flowed to the company for investment in its productive capabilities or any other purpose.

As Icahn was selling his Apple shares in the winter of 2016, Warren Buffett, representing Berkshire Hathaway, the conglomerate which he controls, was buying, accumulating $36.1 billion in Apple shares—5.1 percent of all Apple shares outstanding—by September 2018.[61] In May 2018, Buffett said in an interview: "I'm delighted to see [Apple] repurchasing shares. I love the idea of having our 5 percent, or whatever it is, maybe grow to 6 or 7 percent without our laying out a dime."[62] After having repurchased $32.9 billion in 2017, Apple's buybacks were $72.7 billion in 2018, $66.9 billion in 2019, $72.4 billion in 2020, $86.0 billion in 2021, $89.4 billion in 2022, and $77.8 billion in 2023. The company maintained the pace with $20.1 billion in buybacks in the first quarter of 2024 (ended December 30, 2023).

By January 2022, Buffett's Apple shares were valued at $160 billion, even after he had sold 12 percent of his original stake for $13 billion and had raked in another $3 billion in dividends.[63] He now held almost 5.6 percent of Apple's stock outstanding, a figure that would have been 6.3 percent if Buffett had not sold some of his shares. While Buffett was remarkably candid in saying that he could increase his percentage of Apple's outstanding shares "without our laying out a dime," he might have added that not one cent of the $36.3 billion that he paid to buy Apple's shares on the market flowed into the company for investment in its productive capabilities or any other purpose. As of the winter of 2024, Berkshire Hathaway has an estimated $140 billion in unrealized capital gains from its holdings of Apple shares

With the help of $433 billion in Apple buybacks since the winter of 2016, when Buffett began accumulating the company's stock, through fiscal 2022, Berkshire Hathaway has profited immensely from the greatest treasury robbery in U.S. corporate history. The looting has, as far as we know, been perfectly legal because of SEC Rule 10b-18, adopted without public comment on November 17, 1982—the real birth date, in historical retrospect, of the pernicious and flawed ideology that, for the sake of economic efficiency, a business corporation should be run to "maximize shareholder value."[64]

This is not the first time that Apple's top management has been guided by MSV as its corporate goal. In 1985, after founder Steve Jobs was ousted from the company, Apple CEO John Scully sought to drive up the company's stock yield, and his own pay, with dividends and buybacks. By 1996 and 1997, Apple was taking huge losses and, to avert bankruptcy, had to be bailed out by Microsoft in the form of a $150-million purchase of preferred shares.[65] It was in this context that Jobs regained strategic control of Apple and reinstituted a retain-and-reinvest regime—eschewing distributions to shareholders in order to reinvest profits in Apple's productive capabilities—culminating in the launch of the iPhone in 2007.

Beyond the inaccurate designation of its $651 billion in buybacks since fiscal 2013 as part of its "Capital Return Program," CEO Cook and his board have provided absolutely no rationale for these distributions to shareholders. They apparently do not think any justification is necessary, and U.S corporate governance institutions do not hold them to account. When, in May 2018, Cook was asked what he planned for Apple's $285 billion in cash which the company was repatriating from abroad as a result of tax breaks provided by the Republican Tax Cuts and Jobs Act of 2017, he replied: "We're going to create a new site, a new campus within the United States. We're going to hire 20,000 people. We're going to spend $30 billion in capital expenditure over the next several years. Number one, we're investing, and investing a ton, in this country. We're also going to buy some of our stock, as we view our stock as a good value."[66] Good value for whom?

The Apple director with the longest tenure is Arthur D. Levinson, who has been on the board since 2000 and its chair since late 2011. Levinson is a scientist who spent most of his career with the pioneering biopharmaceutical company Genentech, joining the firm in 1980 and becoming its CEO from 1995 to 2009 and chairman of its board from 1999 to 2014.[67] From 1990, Levinson and other Genentech employees were protected from the pressures of predatory value extractors by the majority ownership of the company by F. Hoffmann-La Roche AG, a Swiss-based corporation that, better known simply as Roche, is the least financialized and among the most innovative of the global Big Pharma companies.[68] Given his employment experience, Dr. Levinson could have advised Apple on how it might have invested a portion of the hundreds of billions of dollars that it has wasted on buybacks in supporting companies engaged in medicine innovation.

The Apple director with the second-longest tenure is Albert Arnold Gore, Jr., who has been on its board since 2003. The former U.S. vice-president and Democratic candidate for U.S. president in 2000 has been one of the world's leading activists for social awareness of the threat of global warming to human existence. In 2006 Gore released his documentary *An Inconvenient Truth*, which went on to win an Oscar.[69] Mr. Gore could have advised Apple on how it might have invested even a portion of the hundreds of billions of dollars that it has wasted on buybacks to combat climate change.[70]

So, too, in the case of Bill Gates, the billionaire who founded Microsoft in 1975 and was its CEO until 2000. At that point, as one of the richest people in the world, he launched the Bill and Melinda Gates Foundation, with a focus on infectious diseases.[71] In 2015, Gates gave a now-

famous TED Talk in which, influenced by the recent Ebola outbreak in West Africa, he warned: "If anything kills over 10 million people in the next few decades, it's most likely to be a highly infectious virus rather than a war. Not missiles, but microbes." Gates concluded the talk with the optimistic advice that "there's no need to panic...if there's one positive thing that can come out of the Ebola epidemic, it's that it can serve as an early warning, a wake-up call to get ready. If we start now, we can be ready for the next epidemic."[72] Yet, as chairman of Microsoft until 2014 and then a director until March 2020, Gates bears could have devoted some or all of the $50.5 billion that the company wasted on buybacks between July 2015 and March 2020 to technology investments to prepare for and respond to a pandemic.

Our point is that even when executives and directors of leading technology companies are aware of, and even outspoken about, society's need to invest in productive capabilities that can confront major social challenges, they succumb to the ideology that the companies over which they exercise strategic control should allocate resources to maximize shareholder value. Along with Intel, Apple, and Microsoft, other New Economy ICT companies among the top 20 industrial repurchasers in Table 6—Oracle, Cisco, and Qualcomm—grew through to positions of dominance through retain-and-reinvest resource allocation regimes. In the process of growth their business models, however, these companies became dependent on stock-price performance to support their use of broad-based stock-option plans to attract, retain, and reward employee, and began to do stock buybacks for that purpose. Then, as these companies became highly profitable, they escalated the use of buybacks to inflate the pay of senior executives and to fend off actual or potential predatory value extractors—aka hedge-find activists—who might challenge the incumbent management's position of strategic control.[73]

Oracle is among the largest repurchasers because its founder and chairman Lawrence Ellison has used buybacks combined with his own stock-based pay to increase his ownership of the company's shares from 22.4 percent in 2011 (the lowest percentage since he founded the company in 1977) to 42.1 percent in 2023.[74] In October 2010, Oracle president Safra Catz and Cisco CEO John Chambers, chairman and CEO of Cisco Systems, published a *Wall Street Journal* opinion piece in which they sought to counter criticism that U.S. corporations were sitting on one trillion dollars in cash abroad instead of investing in jobs in the United States. They recognized that these funds "could be invested in U.S. jobs, capital assets, research and development, and more" if U.S. corporations had an incentive to do so. "But," they continued (with our emphasis), "for U.S. companies such repatriation of earnings carries *a significant penalty: a federal tax of up to 35%*. This means that U.S. companies can, without significant consequence, use their foreign earnings to invest in any country in the world—except here."[75] Having transformed an existing U.S. government tax *concession* to U.S. corporations into a tax *penalty* on U.S. corporations, Chambers and Catz noted that, among other things, repatriated profits could "provide needed stability for the equity markets because companies would expand their activity in mergers and acquisitions, and would pay dividends or buy back stock."

By 2010, when this opinion piece was published, Chambers knew a lot about buying back stock. In the 1990s. Cisco had grown to dominate enterprise networking by using its stock as a compensation and combination currency, and in March 2000 sported the highest market

capitalization in the world through a combination in innovation and speculation. Then, as the Internet boom turned to bust, Cisco turned to manipulation as a driver of its stock price. In September 2001, with its stock price at just 14 percent of its peak 18 months earlier, Cisco began open-market repurchases.[76] Through the second quarter of 2024 (ended January 27, 2024), Cisco distributed 126 percent of its net income to shareholders, with 90 percent as buybacks. In the process, as Carpenter and Lazonick document in detail. the company failed to innovate as a communication-technology company.[77] Meanwhile, as CEO of Cisco from 1995 to 2015, Chambers took home an average annual compensation of $37.4 million, of which 91 percent was in the form of stock-based compensation. Current CEO Charles Robbins, who succeeded Chambers, received an average annual compensation of $22.8 million from 2016 through 2023, of which 75 percent was stock based.

As for Qualcomm, a world leader in chips for the mobility revolution, after doing $4.6 billion in buybacks on 2013 and $4.5 billion, it escalated its repurchases to $11.2 billion in 2015 to fight off Jana Partners. The hedge-fund activist wanted to spin off Qualcomm's lucrative IP licensing division, which was helping to finance the company's innovation in chip design for advanced mobility devices.[78] In 2018, Qualcomm incurred a loss of $4.9 billion as a charge it took when it repatriated foreign profits to benefit from lower corporate tax rates under the Tax Cuts and Jobs Act of 2017 (eliminating the "tax penalty" that Chambers and Catz had bemoaned in their 2010 op-ed). Qualcomm had attempted to make use of its offshore profits without paying any U.S. taxes by doing a $44-billion acquisition of Dutch-based NXP Semiconductors, but that deal was shot down by the Chinese government.[79] Given that 67 percent of Qualcomm's revenues were in China, the company cancelled the NXP acquisition, and instead did $21.2 billion in buybacks in the fourth quarter of 2018 (ended September 30). In doing these massive buybacks, Qualcomm made its contribution to the record-setting $806.4 billion[80] that, in part in response to the Republican tax cuts, companies in the S&O 500 Index devoted to buybacks in 2018.[81]

The rise of NEBM and its subsequent financialization had profound impacts on the resource-allocation orientation of Old Economy ICT companies. In Table 6, IBM, #5 in the repurchasers list, is the only ICT company with its origins in OEBM. IBM was founded in 1911 as Computing-Tabulating-Recording Company (CTR) through a merger of four "information technology" firms launched in the last decades of the 19th century. As part of the merger, the new company floated $2.5 million each in stocks and bonds on the over-the-counter (OTC) market.[82] In 1915, with almost no publicity and no funds raised, CTR was able to list on NYSE.[83]

In 1914, CTR had hired Thomas Watson, a salaried manager, to run the company, a position which he would hold until 1956, renaming the company International Business Machines in 1924. He occupied this position of strategic control as a professional manager, not an owner (he never possessed more than five percent of IBM's outstanding shares). His prestige within the company enabled him to hand over the CEO position to one of his sons, Thomas Watson, Jr., who proved to be an even more competent manager than his father as he led IBM into the era of mainframe computers from the late 1950s.

With its explicit focus on proprietary technology and CWOC, IBM became by far the world's leading computer company by the 1970s. In the 1980s, IBM also pioneered and dominated the

new PC market, based on an open-systems architecture—the key technological characteristic of NEBM—using, in this case, microprocessors supplied by Intel and operating systems supplied by Microsoft, both of which could be licensed to other PC makers seeking to compete with IBM. With the resultant advent of open systems, younger employees with the latest computer-science and engineering skills, often acquired at other companies, became more valuable to IBM, while the systems-integration knowledge and experience of the long-tenured IBM employees needed to develop and utilize the company's proprietary technologies became less valuable.

In the late 1980s, IBM touted the fact that, under its system of "lifelong employment," the company had not laid off any employees involuntarily since 1921. Between the end of 1990 and the end of 1994, however, IBM slashed its worldwide employment from 374,000 to 220,000, with (as Lazonick has shown) the explicit objective of ridding itself of the CWOC norm. In the process, IBM made, and legitimized, the transition from OEBM to NEBM.[84]

From 1986, IBM began doing significant stock buybacks, but its main focus was on dividends as distributions to shareholders. From 1986 to 1990, the company paid out $13.5 billion in dividends, equal to 53 percent of net income, plus another $6.2 billion in buybacks, another 24 percent of NI. IBM refrained from doing buybacks from 1990 through 1994, as it was downsizing its labor force and incurring record losses because of restructuring charges. From 1995, however, the company became one of the largest corporate repurchasers, with $51.4 billion in buybacks (79 percent of net income) in 1995-2004 while keeping dividends to $9.0 billion (14 percent). In 2005-2014, IBM ramped up buybacks to $120 billion (93 percent of net income) along with $29.3 billion in dividends (23 percent). In the process, IBM pursued a strategy of shifting out of hardware in favor higher margin software and services, with ever-increasing proportions of its labor force being employed offshore, especially in India.

In May 2010, IBM CEO Sam Palmisano announced the company's earnings per share (EPS) "road map," the objective of which was to reach at least $20 EPS by the end of 2015.[85] That would double IBM's EPS of $10.01 in 2009, which was up from $3.76 six years earlier.[86] Along with revenue growth and operating leverage, IBM cited stock repurchases as a driver in achieving its EPS objective.[87] One way in which IBM sought to increase "operating leverage," and hence jack up EPS, was through layoffs.[88] At the end of 2011, IBM's headcount was 433,362; at the end of 2015, 377,757.

From 2010 through 2014, IBM did $70 billion in buybacks (92 percent of net income), an average of $14 billion per year. But with revenues and profits in sharp decline in 2014, the reduction of shares outstanding through buybacks was not enough to keep IBM's EPS on track for the $20 2015 target, and in October 2014, IBM CEO Virginia Rometty, who had succeeded Palmisano on January 1, 2012, revealed that IBM was abandoning its EPS road map.[89] At the exact same time, as a definitive last step in the company's two-decades long exit from manufacturing, IBM announced the sale of its semiconductor fabrication plants to GlobalFoundries for $1.5 billion.[90]

At the end of 2022, IBM employed 288,300 people. With its net income in 2020-2021 at less than one-third its level in 2012-2013, the company did only $302 million in buybacks in 2020 and has

done none since (through October 2023). But its dividend was almost 50 percent higher in 2020-2021 than in 2012-2013, now absorbing 115 percent of net income compared with 24 percent when IBM was hellbent on achieving its EPS road map and was shedding employees and, by 2015, its fabs. In 2022 and the first three-quarters of 2023, IBM's dividend was 179 percent of its net income. In the end, IBM's transition from OEBM to NEBM, which had begun when it pioneered in PCs in the first half of the 1980s, was in substance a corporate transformation from an exemplar of retain-and-reinvest to one of the world's most egregious cases in ICT of downsize-and distribute.

Another company, not listed in Table 6, which, like IBM, exemplified OEBM in the 1980s but then made the transition to NEBM in the 1990s, was Hewlett-Packard. In fiscal 2016, HP divided into HP Inc. and Hewlett Packard Enterprise (HPE). For the decade 2010-2019 HP Inc. (ticker HPQ) did $37.5 billion in buybacks, which placed it at #22 of all industrial corporations, just behind Alphabet at $37.8 billion. Taken together, total buybacks for HP Inc. and HPE for 2010-2019 were $48.6 billion, which would have placed the combined company in the #16 position among the largest industrial repurchasers.

Founded in 1939 by Stanford engineering graduates William Hewlett and David Packard in Palo Alto, California—at the heart of what would some three decades later become known Silicon Valley—HP grew to be a world leading electronics company by focusing on retain-and-reinvest. HP did not go public until 1957, at which point the company had $27.9 million in revenues, $2.4 million in profits, and 1,400 employees. HP's IPO was done on the OTC market for the purpose of enabling Hewlett and Packard to cash in 300,000 shares, representing ten percent of their holdings. Another 50,000 shares were available to employees.[91] Funds raised from these stock sales to employees augmented HP's working capital, but it was what was described as "estate planning" for the co-founders rather than a need for cash to finance investment in the company that was the main reason for the IPO.

In 1960, HP did a 3-for-1 stock split, with president Packard stating: "The wider base of ownership would help Hewlett-Packard stock qualify for listing on the New York Stock Exchange."[92] In its *1961 Annual Report*, HP included a brief note on page 7, almost as an afterthought: "Of special interest to shareholders was the listing of Hewlett-Packard common stock on the New York and Pacific Coast Stock Exchanges. The listing occurred March 17, 1961." These listings entailed no new fundraising from the public stock markets.

At HP, the listing on the stock market did not result in the separation of ownership and control. Packard remained president and CEO until 1968 and retired as chairman in 1993. Hewlett was president and CEO from 1968 to 1978 and retired as vice-chairman in 1987. At the end of 1993, the two founders remained HP's largest shareholders, with Packard still owning 14.7 percent of the shares outstanding and Hewlett 8.8 percent.

In its first public annual report, in 1957, HP stressed that reinvested profits were the financial foundation for the growth of the firm. Its financial officers, as the report put it, "administer a financial policy that is dedicated to two objectives" (with emphasis in the original):

> The first is to continually measure the performance of the Company in terms of profit. Hewlett-Packard is highly profit conscious; completely aware of the basic financial law that profit is a means to everything the company does, *and to every contribution the Company is able to make to science, industry and national security.*
>
> The second objective of the financial group is to manage profit so that it can continually be plowed back into the Company to foster continued growth, improve the manufacturing and sales position, anticipate competitive challenges and continue to lead the field. This plan will mean no cash dividends for the next year or so, but will provide a sound foundation for future dividends.[93]

HP did not start paying regular dividends until 1965. As shown in Table 8, which is divided into three 18-year periods from 1962 to 2015 (after which HP split into two companies), HP distributed only 10 percent of net income in dividends from 1962 to 1979 and did no buybacks. In 1984, HP began doing buybacks "for the purpose of acquiring shares of the company's common stock for reissuance to employees under various stock option and purchase plans."[94] As a result, buybacks as a proportion of net income were 35 percent for 1980-1997, reaching as much as $1.6 billion in 1988 and $1.1 billion in 1996. In 1998, however, the HP board also authorized an additional $2 billion in buybacks. Thereafter, HP's stock repurchases became increasingly disconnected from employee compensation plans, with the company doing $83.5 billion in buybacks in 1998-2015, equal to 128 percent of net income. In addition, the dividend payout rate increased to 24 percent.

Table 9. Hewlett-Packard, distributions to shareholders as dividends and buybacks, 1962-2015

	NI, $m	DV, $m	BB, $m	DV/NI%	BB/NI%	(DV+BB)/ NI%
1962-1979	994	99	0	10	0	10
1980-1997	18,312	2,750	6,345	15	35	50
1998-2015	65,388	15,681	83,469	24	128	152

Source: Hewlett-Packard, Annual Reports and 10-K filings.

For HP, which originally developed electronics diagnostic equipment and then from the 1960s built its computer business, its move into computer printers in 1984 marked its entry into open-systems technology, which then became increasingly important to its revenues and profits. As was the case at IBM, the shift from proprietary to open systems rendered career employees, with experience in systems integration, less valuable to the company. In 1995, founder David Packard published his bestselling book, *The HP Way*, in which he extolled the company's CWOC employment policy, which like IBM eschewed involuntary layoffs, as the foundation for sustained innovation. In 1996, however, Packard died, and in 1999 HP divested its original diagnostic business as Agilent, while HP, focusing on computers, printers, and software services, rid itself of CWOC as, again like IBM, the company sought to make a complete transition to NEBM.

As part of the transition, from OEBM to NEBM, during the 1990s, both IBM and HP spun off their manufacturing plants as independent contract manufacturers (IBM Canada, so named since 1917 when the parent company was still called CTR, became Celestica). Both HP and IBM sought to shift from hardware manufacture to higher-margin software and services. Both companies slashed R&D as a percent of sales. At the same time, IBM emerged from the mid-1990s as the world's leading patent holder in the United States, using its intellectual property rights to generate licensing revenues and gain leverage in strategic alliances rather than to develop proprietary technologies. IBM held this top position through 2022 before Samsung Electronics surpassed it to become the leader in 2022 and 2023, with Qualcomm and TSMC also overtaking IBM in the latter year.[95]

Manifesting the demise of CWOC employment at both companies, each of them ceased offering the company-funded, nonportable, defined-benefit pension plans that, as characteristic of OEBM, rewarded seniority with the firm. Instead, the companies supported employee-funded defined-contribution plans—aka 401(k)s—with variable company matches. A key feature of these defined-benefit pensions is their portability from one employer to the next, relevant to the interfirm labor mobility that, in sharp contrast to CWOC, is a signal characteristic of NEBM.

After Carly Fiorina came from Lucent Technologies to be CEO of HP in 1999, the company became known for its "hire-and-fire" labor policies, even as its employment expanded dramatically. In large part because of the acquisition of Compaq Computer with 64,000 employees in 2002 and Electronic Data Systems with 210,000 employees in 2008, HP's worldwide employment exploded from 84,400 in 1999 (after the Agilent divestiture) to a peak of 349,600 in 2011 before being downsized to 287,000 in 2015. The combined employment of HPE and HP Inc. at the end of 2021 was 111,400, after a decade of an intensive downsize-and-distribute regime. With a major reduction in buybacks at HP Inc. in 2023, by the end of that year, their combined employment had recovered somewhat to 120,000.

Other major Old Economy ICT companies sought to make the transition from OEBM to NEBM from the 1990s, reinforcing the dominance of NEBM even as some of these companies became defunct. In 1996, AT&T spun off Lucent, including Bell Labs, as a "127 year-old startup" (it had its origins in 1869 as AT&T's wholly owned subsidiary Western Electric). In a paper, "The Rise and Demise of Lucent Technologies", Lazonick and Edward March (a former R&D executive at AT&T and Lucent) document how, mainly because of poorly executed acquisitions and ill-conceived divestments—driven primarily by the attempt to drive up the company's stock price by giving the appearance of transitioning to NEBM—Lucent undermined its existing capabilities and failed to invest in the new learning required to remain a major communication-equipment company in the age of the Internet and wireless telephony. By 2006, Lucent, including the once-famed Bell Labs, had been taken over by the French company Alcatel, to become Alcatel-Lucent, which was in turn absorbed by Finland's Nokia in 2016.[96]

Other major Old Economy ICT firms also became financialized and entered into downsize-and-distribute mode. In the 1990s, Motorola, founded in 1928, had been a leading designer and

manufacturer of computer chips, with a long legacy of innovation in wireless technology. The company made an ill-fated $5-billion investment in a global satellite system, Iridium, in the late 1990s. Then after emerging as a leader in 3G handsets with its Razr flip phone in 2004 and 2005, Motorola wasted $8 billion on stock buybacks in 2005-2007 and missed the smartphone revolution that occurred after Apple's successful launch of the iPhone in 2007.

Xerox, founded in 1906, which had entered the 1970s with a monopoly in photocopiers and used its profits during that decade to develop what would become known as the personal computer at Xerox Parc in Silicon Valley, had all-time highs of $22.6 billion in revenues in 2011 and 147,600 in employees in 2012. Since then, however, Xerox has been in downsize-and-distribute mode. Over the decade 2014-2023, Xerox distributed 246 percent of its $2.3 billion in net income as buybacks and another 111 percent as dividends. In 2023, its revenues of $6.9 billion were just 30 percent of those in 2011 and lower in *nominal* dollars than any year since 1978. In that year, Xerox had employed 115,700 people; in 2023, employment had plummeted to 20,100.

Texas Instruments (TI), founded in 1930, was once a world leader in semiconductor-manufacturing innovation; Jack Kilby invented the integrated circuit at TI in 1958.[97] Like Intel, TI is an integrated device manufacturer that, to manufacture the chips that it designs, has ten wafer fabs worldwide, of which six are located in the United States.[98] The company is an important supplier of semiconductors to a variety of industries, including automotive. But TI has not been investing in cutting-edge fab technology. In 2011-2020, at $27.5 billion (78 percent of net income), TI's spending on buybacks was four times its spending on plant & equipment. Over the decade TI also paid out $18.1 billion in dividends as it cut its labor force from 34,800 in 2011 to 30,000 in 2020. The company was stagnating, while prioritizing distributions to shareholders over investments in productive capabilities.

Since then, however, chip shortages and government subsidies have helped to restore growth at TI. By the end of 2023, the company had increased its labor force back to 34,000, while in 2021-2023 spending 56 percent of net income on dividends and 19 percent on buybacks. TI did a record $3.6 billion in buybacks in 2022, when it also had record revenues of $20.0 billion and profits of $8.7 billion, but it cut back buybacks to $527 million in 2021 and $293 million in 2023, apparently because of its strategy of vastly increasing its investments in plant & equipment. With chips in high demand in recent years, TI's annual average capital expenditures in 2021-2023 were $3.4 billion, 18.5 percent of revenues, compared with an annual average of $651 million—just 4.7 percent of revenues—in 2011-2010. Aiding TI's investments in a new fab complex in Sherman, Texas have been $2.4 billion in local tax breaks.[99] As of this writing, TI is in line to receive further subsidies under the CHIPS and Science Act,[100] and the company may have gone easy on the buybacks in 2023 to increase its chances of receiving federal government funds.

It should be noted that in ICT "industrial policy" as exemplified by the CHIPS and Science Act is nothing new.[101] Government funding and procurement played major roles in the microelectronics revolution, from computers to semiconductors to the Internet.[102] But Old Economy corporate research labs such as those at AT&T, IBM, General Electric, Motorola, Texas Instruments, and Xerox were the sources of technology breakthroughs that made New Economy

startups possible. In 1993, a conference held at Harvard Business School (HBS) decried the "end of an era" in industrial research, with a volume *Engines of Innovation* appearing in 1996.[103]

In the introductory chapter, entitled "Technology's Vanishing Wellspring," conference organizers and volume editors Richard Rosenbloom and William Spencer argue that industrial research (as distinct from development) of the type that had been carried out by corporate labs in the "golden era" of the post-World War II decades "expands the base of knowledge on which existing industries depend and generates new knowledge that leads to new technologies and the birth of new industries." In the more competitive environment of the 1980s and 1990s, however, in the new industries of "biotechnology, exotic materials, and information products (and services based on them)", Rosenbloom and Spencer observed that it was more difficult for companies "to keep new technologies fully proprietary", and hence "research activities have been downsized, redirected, and restructured in recent years within most of the firms that once were among the largest sponsors of industrial research."[104]

A participant at the 1993 conference was Gordon Moore, one of the eight Shockley Semiconductor Laboratory employees who left that company to found Fairchild Semiconductor in 1957.[105] In 1965 Moore, while head of R&D at Fairchild, enunciated "Moore's Law" (the doubling of the computing power of chips every 18 months), and then in 1968 co-founded Intel with Robert Noyce, who had invented the integrated circuit while at Fairchild. At the time of the HBS conference, Moore, formerly Intel's CEO, was its chairman of the board, a position that he held until 1997. When Intel was founded, its top executives expressly eschewed setting up a corporate research lab, and indeed, as we have seen, Intel was a pioneer in creating NEBM.

In a paper that Moore contributed to the *Engines of Innovation* volume, he clearly stated how product development done in New Economy start-ups was dependent on basic and applied research done in Old Economy corporate labs:

> Running with the ideas that big companies can only lope along with has come to be the acknowledged role of the spin-off, or start-up. Note, however, that it is important to distinguish here between exploitation and creation. It is often said that start-ups are better at creating new things. They are not; they are better at exploiting them. Successful start-ups almost always begin with an idea that has ripened in the research organization of a large company. Lose the large companies, or research organizations of large companies, and start-ups disappear.[106]

As we shall see in the next, and final, section of this essay, in the biopharma revolution that during the 1990s was beginning to yield innovative medicines, the corporate research labs of Old Economy companies did not play important roles in knowledge generation, yet the start-ups did not disappear. The biopharma revolution built on some of the institutions put in place by the microelectronics revolution—especially those related to venture capital and NASDAQ—but also relied much more on research funded by and carried out under the auspices of the U.S. federal government to enable start-ups to appear, with a small portion of them eventually generating safe and effective drugs based on biotechnology platforms.

7. Institutions Supporting Innovation in U.S. Pharmaceuticals and Biopharma

Among the five pharmaceutical companies in Table 6, Big Pharma is represented by Pfizer (founded in 1849; IPO 1941), Johnson & Johnson (J&J, 1886; 1944), and Merck (1891; 1941). Since the 1990s, there has been a consolidation of Big Pharma through mergers, with the surviving companies such as Pfizer, J&J, and Merck adopting the "blockbuster" business model of acquiring other large companies with already highly successful drugs with substantial years of patent life remaining. Under the sway of MSV, the profits from these drugs are then distributed to shareholders in the form of dividends and buybacks. Pfizer's recent strategy of conserving corporate cash to invest in its drug pipeline reflects the limits of the financialized blockbuster model as, through the process of consolidation, the number of potential Big Pharma acquisitions has dwindled and patents on their existing large-revenue products approach expiration.

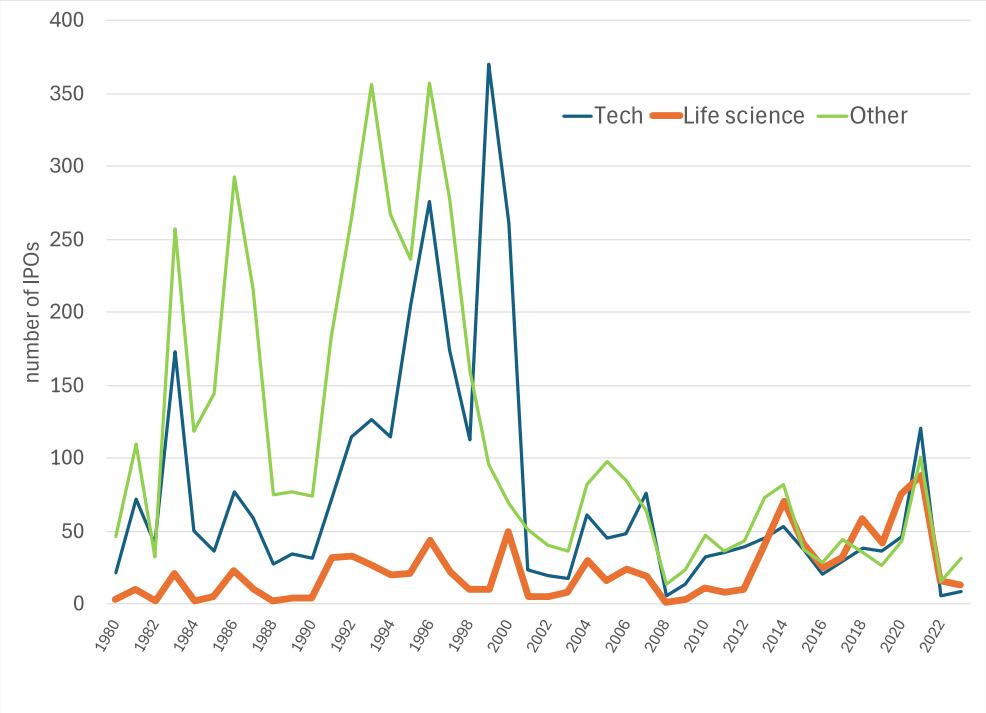
The other two pharma companies in Table 6—Amgen and Gilead Sciences—represent the emergence of a biotech version of ICT's New Economy business model. Called Applied Molecular Genetics when it was founded in 1979, Amgen became its official name when the company did its IPO in 1983. Gilead Sciences was founded in 1987 and went public in 1992. In both cases, these companies did their IPOs without a product. In papers written around 2010, Lazonick, Sakinç, and Tulum dubbed these companies "productless initial public offerings," or PLIPOs.[107]

From 1980 through 2023, there were exactly 1,000 life science IPOs in the United States.[108] Figure 2 shows the annual numbers of tech, life science, and other IPOs over this 44-year span. While tech and other IPOs were vastly more numerous than life-science IPOs in the 1980s and 1990s, since then the numbers of IPOs of all three types have been much closer to one another, with a rising trend in life-science IPOs.

Figure 3 charts the number years from founding to IPO for the 1,000 life to a life-science firms that did initial listing on US stock markets from 1980 to 2023. Dividing the dataset into four 11-yeear periods, the average number of years from founding to IPO was 4.5 in 1980-1990, 5.3 in 1991-2001, 7.2 in 2002-2012, and 6.5 in 2013-2023. For the six years 2018-2023, the average number of years from founding to IPO was only 5.0.

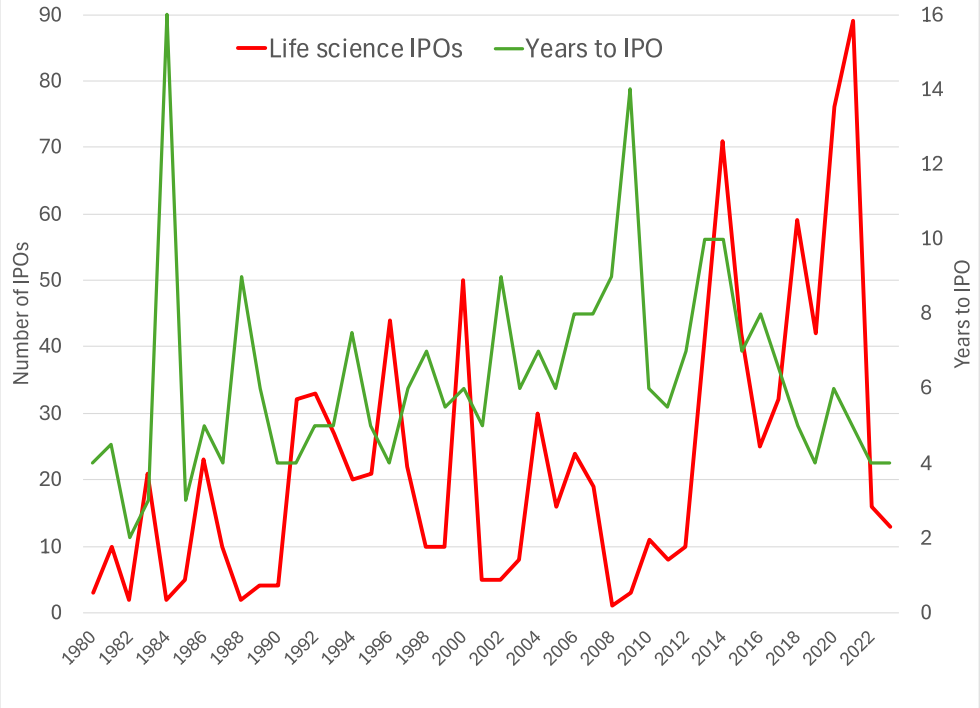
Figure 4 documents the median sales in 2022 dollars of life-science IPOs at the time of going public from 1980 through 2023. These sales include mainly R&D service as distinct from actual medical goods. With the exceptions of 1984 (2 IPOs; median sales $163 million), 2009 (5; $228 million), and 2009 (3; $50 million), median sales (in 2022 dollars) ranged from zero dollars (in 2010, 2014-2015, 2017-2023)—meaning that at least half of the companies doing IPOs did not even have research contracts—to $21 million (in 1980, when there were three IPOs, including Genentech). In 2016, median sales were just $1.1 million, and for the decade 2014-2023, when sales at the IPO were virtually zero, 465 IPOs occurred of the 1,000 IPOs that took place over the whole 44-year period. Hence, our term "PLIPO" has apparently become more applicable over time.

Figure 2. Number of tech, life science, and other initial public offerings in the United States, 1980-2023



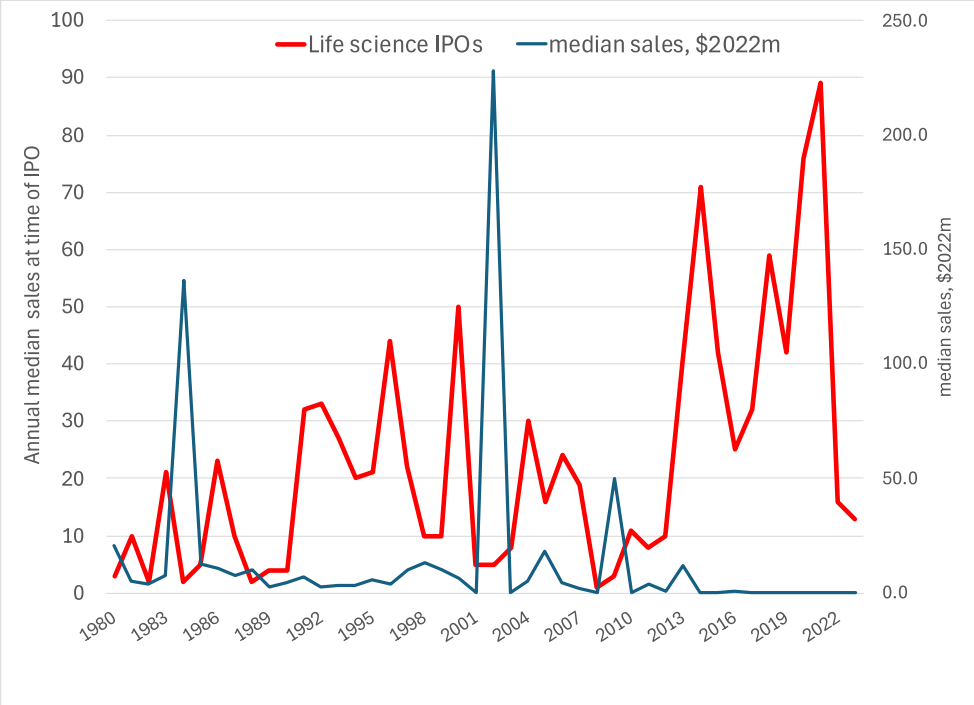
Source: Ritter, "Initial Public Offerings."

Figure 3. Number of years from founding to initial public offering, life-science IPOs, 1980-2023



Source: Ritter, "Initial Public Offerings."

Figure 4. Median sales (primarily R&D service contracts) in 2022 dollars of life-science IPOs, 1980-2023



Source: Ritter, "Initial Public Offerings."

In *Science Business: The Promise, the Reality, and the Future of Biotech*, published in 2006, business academic Gary Pisano documented the expansion of the U.S. biotech industry over the previous four decades, posing the question of how this "startup" sector of the pharmaceutical industry could have not only survived but also grown, given its overall lack of profitability. In an article in the journal *Research Policy*, published in 2011, Lazonick and Tulum's response to what they dubbed the "Pisano puzzle" was the existence of a highly liquid stock market, NASDAQ, on which these companies, even without a revenue-generating product, could raise funds through both initial and secondary stock issues. In addition to the PLIPO model, established pharmaceutical companies in the United States and abroad often acquired the more promising New Economy biotech companies even before an IPO, providing an alternative "exit" strategy for venture-capital firms that invested in biopharma startups. In his book, Pisano does not examine either of these funding sources.

NEBM would have become dominant in the ICT industry even without its emergence in biopharma, but the converse is not the case. The rise of NEBM in ICT, which we have outlined in the previous section of this chapter, preceded the emergence of the PLIPO model in biopharmaceuticals. The limited-partner venture-backed startup model originated in ICT at the end of the 1950s as an integral element of the microelectronics revolution. It was transferred from ICT to biopharma from the mid-1970s. It was far easier for an ICT startup than a biopharma startup to generate a revenue-generating product before doing an IPO; until the dot.com boom of the late 1990s, the notion of an ICT PLIPO did not exist. The recent (but short-lived) popularity

of special purpose acquisition companies (SPACs)—aka "blank check" companies—which are listed on the stock market without any specific business, let alone a commercial product, has taken the PLIPO model to its speculative and manipulative extremes.[109] Nevertheless, in biopharma, the PLIPO remains the norm, with young companies raising funds on the stock market for drug development, despite fundamental uncertainty concerning whether a company's innovative strategy will meet with success.

The first "biopharma" startup was Cetus, a company founded in Emeryville, California (between Berkeley and Oakland) to use microelectronics to "[develop] automated methods of doing ordinary bench top microbiology on a massive scale."[110] After the discovery of DNA cloning by Stanley Cohen at Stanford University and Herbert Boyer at University of California San Francisco in 1973, Cetus shifted into genetic engineering. In March 1981, Cetus raised $119.6 million in its IPO, at the time the largest in U.S. corporate history, surpassing the Apple's $97-million IPO in December 1980. Unlike Apple, which went on the stock market with $117 million in revenues and $12 million in profits from its computer sales, Cetus went public without a product. Indeed, in an interview at the time, Cetus president Peter Farley said that the company did not expect to have any products until the latter half of the 1980s.[111]

Such was also the case with Genentech, which in October 1980 was the first biopharma IPO, raising $35 million. The company had been started in 1976 by Robert Swanson, a 29-year-old MIT graduate, who convinced Herbert Boyer to be a co-founder with a $500 investment. Swanson and Boyer each had 35.7 percent of the shares, with the remainder held by the pioneering venture-capital firm Kleiner Perkins, where Swanson had previously worked after it was founded in Silicon Valley in 1972. Swanson as the first CEO of Genentech, remaining in that position until 1990, when he became chairman of the board, retiring in 1996.[112] Genentech's first FDA-approved product, Protropin, a growth hormone for children, approved for commercial sale in 1985, was, according to a company press release, "the first recombinant biotech drug to be manufactured and marketed by a biotechnology company."[113]

The creation of Genentech as a venture-backed company was integrally dependent on the emergence of an identifiable venture-capital industry, rooted in microelectronics and centered in Silicon Valley, in the immediate aftermath of the 1971 launching of NASDAQ.[114] Eugene Kleiner had been, along with Gordon Moore and Robert Noyce who went on to found Intel in 1968, among the "traitorous eight" scientists and engineers who had left Shockley Labs in 1957 to start Fairchild Semiconductor. In the 1960s, Kleiner became a serial microelectronics entrepreneur. His venture-capital partner, Thomas Perkins, had previously been the head of the computer division at Hewlett-Packard. In 1977, the venture-capital firm was renamed Kleiner Perkins Caufield & Byers, with Brook Byers leading its investments in biotech startups.

The late 1970s and early 1980s saw the founding of many other venture-based biopharma startups, of which Biogen (founded 1978; IPO 1983), Amgen (1980; 1983), and Genzyme (1981; 1986) ultimately had great success. All three were PLIPOs, operation as research entities, raising funds from secondary stock issues and strategic partnerships with established pharmaceutical companies. It was not until 1996 that Biogen manufactured and marketed its first FDA-approved

drug, Avonex, which retarded the onset of multiple sclerosis.[115] Amgen's first commercial drug, Epogen, for managing anemia in end-stage renal disease, was approved by the FDA in 1989.[116] In the 1980s, Genzyme was generating from selling specialty chemicals to other biotech companies but its first major biotech medicine, Ceredase for Gaucher's disease, was not approved for sale by the FDA until 1991.[117]

These three breakthrough medicines from Biogen, Amgen, and Genzyme were all orphan drugs, supported by the Orphan Drug Act of 1983 (see below) and all achieved blockbuster status.[118] Funding for the basic, and in some cases applied, research that made the biopharma revolution came from the National Institutes of Health. In the emergence of NEBM in biopharmaceuticals, Old Economy research labs at companies such as those at Johnson & Johnson, Wyeth, Bristol-Myers Squibb, Merck, and Pfizer provided early-career training for large numbers of scientists who, from the 1980s, left to join New Economy startups. But the breakthrough technologies related to rDNA came mainly from federally funded research at university labs.

Government funding of research has been of critical importance to the emergence of PLIPOs. As a government-funded entity to fund life-sciences research, the National Institutes of Health (NIH), with its 27 specialized institutes and centers, is by far the world leader. Besides its own internal research, NIH funding supports labs in universities and hospitals and makes it possible to attract to the United States talented people from around the world to engage in medical studies and scientific research. The NIH budget request for 2024 budget of $51.1 billion. From 1938 through 2023, the NIH spent $1.6 trillion in 20223 dollars in support of life-sciences research.[119]

Between 1998 and 2004, the NIH budget increased by 2.1 times in nominal dollars (1.8 times in real dollars). Precipitated by the perceived threat of a bioterrorist attack from Saddam Hussein's Iraq, the single year with by far the largest budget increase in NIH history was 2003, with over $3.8 billion ($4.6 billion in 2019 dollars) added to the total budget.[120] Of the 27 institutes and centers that constitute the NIH, the greatest beneficiary of this doubling of the NIH budget was the National Institute of Allergy and Infectious Diseases (NIAID), whose own budget increased from $1.4 billion in 1998 to $4.3 billion in 2004. Of the almost $3-billion boost to NIAID's annual budget between 1998 and 2004, two-thirds occurred in the final two years.

Fred Ledley and his colleagues at Sci-Industry have shown that NIH funding contributed to every one of the new molecular entities (NMEs) approved by the FDA from 2010 to 2016 and was focused primarily on the drug targets rather than on the NMEs themselves. There were 84 first-in-class products approved in this interval, associated with more than $64 billion of NIH-funded projects. The percentage of fiscal years of project funding identified through target searches, but not drug searches, was greater for NMEs discovered through targeted screening than through phenotypic methods (95 percent versus 82 percent). For targeted NMEs, funding related to targets preceded funding related to the NMEs, consistent with the expectation that basic research provides validated targets for targeted screening.[121] A study of 356 drugs approved by the FDA from 2010 to 2019 documents that "the NIH spent $1.44 billion per approval on basic or applied research for products with novel targets or $599 million per approval considering applications of basic research to multiple products."[122] Businesses that make use of NIH-

sponsored research benefit from the public knowledge that it generates. The NIH itself does not receive returns from the pharmaceutical industry for its investments in drug innovation that are commensurate with its contributions to the innovation process.

From 1980, with the passage of the Bayh-Dole (or Patent and Trademark Law Amendments) Act, the U.S. government took steps to ensure that business firms could gain access to knowledge created by federally funded research on highly advantageous terms. Bayh-Dole explicitly permits research institutes, including the nation's leading research universities, to transfer the results of federally funded research to commercial entities. The Stevenson-Wydler Technology Innovation Act of 1980 authorizes the establishment of Cooperative Research Centers (CRCs) to encourage industry-university collaboration and mandates that each federal laboratory establish an Office of Research and Technology Applications to actively engage in technology transfer from the labs to firms. The 1986 Federal Technology Transfer Act (FTTA) created the Cooperative Research and Development Agreement (CRADA) to foster government-business research collaboration, quicken technology transfer to business firms, and make it easier for firms to file patents based on this cooperative research, including military research. The National Technology Transfer and Advancement Act (NTTAA) of 1996 amended the Stevenson-Wydler Act to make it more attractive for drug companies to enter into CRADAs by placing a cap on the amount of royalties that federal researchers could receive on their inventions.[123]

Patent protection has been fundamental to the U.S. innovation system. The pharmaceutical industry has benefited from general patent laws, including the 17 years of protection against competition from the time of filing a successful patent that prevailed from 1861 through 1994 and the 20 years of protection in existence since 1995.[124] In addition, there have been special protections applicable to the medical drug industry. In the wake of the recombinant DNA revolution of the 1970s, in 1980, in Diamond v. Chakrabarty, the U.S. Supreme Court ruled that a genetically modified bacterium could be patented.

Following the Supreme Court ruling in favor of Ananda Chakrabarty, as well as the enactment of the Bayh-Dole Act, patenting activities in drug development increased rapidly. Enabling this increase were radical changes in the judicial process so that any court appeal concerning patent litigation is overseen by a single, nationwide appellate court specialized in patent-related matters. Despite the opposition from some stakeholders, patent attorneys overwhelmingly supported the new judicial reform, which cleared the House and Senate in 1981, President Reagan signed the Court of Appeals for the Federal Circuit (CAFC) Act, which came into effect in 1982. Comprised of judges who were former patent attorneys, the Court's "patent-friendly" attitude strengthened patent-holders in protecting their intellectual property rights (IPRs) while making it difficult for plaintiffs to challenge the patent-holders.

The Orphan Drug Act (ODA) of 1983 provides financial subsidies and market protection for pharmaceutical companies to develop drugs for rare and genetic diseases. Lazonick and Tulum have shown that orphan drugs were the foundation for pharmaceutical revenue growth in the 1990s and 2000s.[125] From January 1, 1983, through July 19, 2024, there 6,946 ODA designations and 1,250 ODA approvals.[126] ODA also offers R&D tax credits as well as FDA assistance in ensuring

the rapid transformation of a promising compound into an approved marketable drug. Most importantly, ODA incentives include seven-year marketing exclusivity for a specific indication. Unlike patent protection, which begins at the outset of the drug discovery process, ODA exclusivity begins once the drug has been approved for sale by the FDA. Moreover, the company that has obtained ODA approval does not necessarily require patent protection to have market exclusivity in selling the drug. Orphan drugs, which have typically come with very high price tags, were central to the growth of the leading companies in the biopharmaceutical drug industry, including Amgen, Genentech, Genzyme, Biogen IDEC, Cephalon, and Allergan. Large pharmaceutical companies have also benefited from orphan drugs, either by acquiring smaller biopharma companies or by entering into co-marketing deals with them that entail both equity investments and research contracts.

With all the government funding and market protection of the pharmaceutical industry, one might assume that the U.S. government would regulate drug prices. With the passage of the Inflation Reduction Act in August 2022 that Medicare has secured the right to negotiate the prices of certain drugs from 2026. But, as shown by AIRnet empirical research on the social foundations for generating safe, effective, accessible, and affordable medicines, conventional economics provides no logical guidelines for engaging in these negotiations. We contend that the SCIE framework, rooted in TIE, offers a set of coherent principles for the regulatory setting of drug prices. The framework also enables us to analyze transitions from innovation to financialization in the U.S. pharmaceutical industry. As indicated in this essay, the Academic-Industry Research Network has done pioneering research on the evolving tension between innovation and financialization in pharmaceuticals and biopharma, as it has occurred in different places and times. As laid out in a forthcoming research agenda to which this essay is a prelude, much more work remains to be done.

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ACKNOWLEDGMENT

The views expressed in this report are solely those of the three co-authors. Funding for the research in this essay was provided by the Institute for New Economic Thinking and the Canadian Institute for Advanced Research Program on Innovation, Equity & the Future of Prosperity. Thomas Ferguson, Matt Hopkins, and Fred Ledley provided comments on a previous draft of this essay.

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The Academic-Industry Research Network – theAIRnet – is a private, 501(c)(3) not-for-profit research organization devoted to the proposition that a sound understanding of the dynamics of industrial development requires collaboration between academic scholars and industry experts. We engage in up-to-date, in-depth, and incisive research and commentary on issues related to industrial innovation and economic development. Our goal is to understand the ways in which, through innovation, businesses and governments can contribute to equitable and stable economic growth – or what we call "sustainable prosperity".

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