The Academic-Industry Research Network

Innovation and Financialization in the U.S. Pharmaceutical Industry: A Perspective on the Integration of History and Theory in Support of a Prospectus on Collaborative Research*

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Innovation and Financialization in the U.S. Pharmaceutical Industry: A Perspective on the Integration of History and Theory in Support of a Prospectus on Collaborative Research*

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* This perspective/prospectus essay, written for the Institute for New Economic Thinking, summarizes a body of knowledge growing out of an ongoing research collaboration between the Academic-Industry Research Network (AIRnet) and the Bentley University Center for the Integration of Science and Industry (Sci-Industry). We thank Fred Ledley for his extensive comments on this essay as well as insights providing by participants in the AIR-SciIndustry seminar run during 2020 and 2021 on innovation and financialization in pharmaceuticals.

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The 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.

Research on the relation between value creation and value extraction in the U.S. pharmaceutical industry requires an analysis of the evolving functions of the stock market in influencing the tension between innovation and financialization within 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 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] summarized in this perspective/prospectus essay, 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 corporations that can result in superior medical innovation and a more equitable distribution of its gains.

Our 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 matters 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 has often been 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.

It is from this perspective that AIRnet and Sci-Industry are engaged in an ongoing collaborative project 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.

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 corporations 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 company'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, first and foremost, senior executives but also often a broad base of employees.
- 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 corporation'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), 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 rise 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 microelectronic section of the ICT industry but quickly went on to support the emergence 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.

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 of OEBM companies such as, in ICT, Hewlett-Packard, IBM, and Motorola, and, in pharmaceuticals, Johnson & Johnson, Merck, and Pfizer, to focus on their stock-market performance.

Given the liquidity of the stock exchange—that is, the ease with which shareholders of a traded 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 the different phases of 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).[7] The purpose of this hedge-fund activity is to gain an "edge" in timing the buying and selling of stocks.[8]

As result of the liquidity and volatility of the stock market, it 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 biopharma 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 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 and when the startup firm does an IPO or is acquired by an established publicly listed company. As a general proposition, we argue that the key to understanding the PLIPO phenomenon is the extent to which the governance, employment, and investment institutions that prevail in this segment of the U.S. pharmaceutical industry enable value extraction even in the absence of value creation.

Biopharma 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 company over which they exercise strategic control must transform, the markets 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 of 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 gambling casino.

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.[9] 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 in IPOs and secondary offerings. 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 essay, 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.

Financialization of the U.S. Pharmaceutical Industry

Data from the S&P Compustat database for 474 corporations that were included in the S&P 500 in January 2022 and were publicly traded from 2012 through 2021 reveal that they distributed $5.7 trillion as share repurchases during the 2012-2021 fiscal years, representing 55 percent of net income and $4.2 trillion as dividends, an additional 41 percent of net income (see Table 1). The vast majority (we estimate 90-95 percent of the total) of the share repurchases were done as common-share open-market repurchases (OMRs), the purpose of which was to manipulate the company's stock price.

Table 1. Financial data, 2012-2021, and 2021 employment for 474 corporations, including 14 pharmaceutical companies, in the S&P 500 Index in January 2022 that were publicly listed 2012-2021

COMPANY	$b					%				EE
	REV	NI	BB	DV	R&D	BB/NI	DV/NI	(BB+DV) /NI	R&D /REV	FY2021 (000s)
JOHNSON & JOHNSON	771	140	63	88	108	45	63	108	14	144.3
PFIZER INC	543	140	67	75	90	48	53	101	17	79.0
MERCK & CO	445	71	44	55	96	63	78	140	22	77.0
ABBVIE INC	302	57	31	45	58	53	79	132	19	50.0
BRISTOL-MYERS SQUIBB	244	20	21	28	76	106	143	248	31	32.2
GILEAD SCIENCES INC	232	71	35	20	49	50	29	78	21	14.4
LILLY (ELI) & CO	229	39	15	23	61	38	59	98	26	35.0
AMGEN INC	222	61	48	28	42	78	46	125	19	24.2
BAXTER INT.	124	18	9	6	8	47	34	80	6	60.0
BIOGEN INC	109	32	28	-	23	89	-	89	21	9.6
VIATRIS INC	107	3	3	0	7	118	15	133	7	37.0
REGENERON PHARMA.	60	20	10	-	19	50	-	50	32	10.4
VERTEX PHARMA.	30	7	3	-	14	43	-	43	47	3.9
INCYTE CORP	14	1	0	-	9	4	-	4	65	2.1
BP14 Total	3,432	681	377	370	660	55	54	110	19	579.1
Total, 474 S&P500 companies, 2012-2021	**109,089**	**10,376**	**5,735**	**4,225**	**2,951**	**55**	**41**	**96**	**3**	**28,491**
14 Pharma as % of 474 S&P 500 = 3.0%	***3.1%***	***6.6%***	***6.6%***	***8.8%***	***22.4%***					***2.0%***

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

As shown in Table 1, for the decade 2012-2021, distributions to shareholders by the 14 pharmaceutical companies that were included in the S&P 500 Index in January 2022 were, at 55 percent, the same as for all 474 companies in the database, but the pharma dividends as a

proportion of net income was far higher (54 percent versus 41 percent). These 14 pharmaceutical companies accounted for 3.1 percent of the revenues of all 474 companies but 6.6 percent of the net income, 6.6 percent of the buybacks, and 8.8 percent of the dividends. The $747 billion that the pharma companies distributed to shareholders was 13 percent greater than the $660 billion that they expended on research & development.

Significant beneficiaries of this stock-price manipulation have been the senior executives of these companies. From 2010 through 2021 the total average compensation of the 500 highest-paid executives of U.S-based corporations ranged from, with the stock market depressed, a low of $15.9 million in 2009, of which 60 percent were realized gains from stock-based pay, to, with the stock market booming, a high of $47.4 million in 2021, of which 88 percent were realized gains from stock-based pay (see Table 2).

Table 2. 500 highest-paid executives in each year, U.S. corporations, with proportions of mean total direct compensation from stock options and stock awards, and representation of pharmaceutical executives among the top 500, 2006-2021

	All 500 Highest-Paid Executives				Pharmaceutical Corporations				
	TDC, $m	SO/ TDC%	SA/ TDC%	(SO+SA)/ TDC%	TDC, $m	SO/ TDC%	SA/ TDC%	(SO+SA)/ TDC%	No. of pharma execs
2006	25.6	56	17	73	25.7	47	30	77	23
2007	**31.3**	**57**	**19**	**76**	23.1	65	7	72	12
2008	20.6	48	23	71	22.4	65	12	77	20
2009	**15.9**	**37**	**23**	**60**	22.9	39	19	58	27
2010	19.7	39	26	65	20.7	47	25	73	23
2011	**21.4**	**40**	**30**	**69**	20.8	54	16	70	23
2012	32.4	41	38	79	35.9	59	25	84	22
2013	**27.3**	**46**	**33**	**79**	35.8	67	24	91	33
2014	32.6	46	34	80	43.3	69	19	88	40
2015	**34.6**	**48**	**35**	**83**	45.1	56	31	88	33
2016	27.1	37	41	78	32.2	48	23	71	25
2017	**33.5**	**46**	**35**	**82**	41.9	49	39	88	22
2018	33.2	42	43	85	33.2	67	22	88	23
2019	**32.8**	**39**	**43**	**82**	**35.4**	**60**	**25**	**85**	**21**
2020	42.7	51	35	86	49.3	64	27	91	31
2021	**47.4**	**44**	**44**	**88**	61.6	81	12	93	27

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

Distributions to shareholders in the form of dividends and buybacks help to inflate executives' realized gains on stock-based pay.[10] In the case of stock buybacks, not even the Securities and Exchange Commission (SEC), which purportedly regulates America's financial markets, knows the precise days on which buybacks as OMRs are executed. 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.

Table 2 displays data on the compensation of the 500 highest-paid executives in the United States for each year from 2006 through 2021 and the subset of pharmaceutical executives among these 500 highest paid. In most years, the average total direct compensation (TDC) of the pharma executives was higher than for all 500 executives. As we discuss in more detail below, the pharma executives' extraordinarily high TDC and percentage of it that was stock based in 2014 and 2015 were largely the result of the bonanza reaped by a number of executives at Gilead Sciences through the impacts on company's stock price of its sales of the high-priced Sovaldi/Harvoni hepatitis-C on profits and its use of those profits to do stock buybacks.[11] Also, when the average pay of the top 500 executives exploded to new heights in 2020 and 2021, the pay of the subset of pharma executives soared even more. As the pandemic raged, the average pay of 27 pharmaceutical executives among the top 500 rose to an unprecedented $61.6 million, with the 93 percent of it coming from realized gains on stock-based pay, the highest proportion since data on realized gains on stock awards as well as stock options became available in 2006.[12]

Tables 3a and 3b show distributions to shareholders by Merck and Pfizer, two U.S.-based Big Pharma companies that have been among the most financialized of all U.S. corporations. Merck began doing large-scale buybacks in the second half of the 1980s, and Pfizer in the first half of the 1990s. Merck greatly increased its buybacks in the second half of the 1990s and Pfizer even more so in the first half of the 2000s. Over the 25-year period 1995-2019, Merck distributed an amount equal to 118 percent of net income to shareholders, with 54 percent as buybacks, while Pfizer paid out 114 percent of net income, with 58 percent as buybacks. As discussed below, Pfizer ceased doing buybacks from September 2019 through December 2021, while 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 32 percent in 2017-2021, while Merck's was 52 percent.

Table 3a. Merck's distributions to shareholders as stock buybacks and cash dividends, in billions of current dollars and as percent of net income, 1972-2021

MERCK	REV	NI	BB	DV	R&D	BB/NI	DV/NI	BB+DV	R&D	BB	Employment	
	($b)					(%)			% of REV	/R&D	EE, 000s	% change
1972-1976	**6.6**	**1.0**	**0.0**	**0.5**	**0.5**	**1**	**49**	**50**	**8**	**0.03**	**27.5**	**3.5**
1977-1981	11.8	1.8	0.2	0.8	1.0	9	43	53	9	0.17	32.4	4.9
1982-1986	**17.5**	**2.6**	**0.9**	**1.2**	**2.0**	**36**	**45**	**81**	**11**	**0.47**	**30.7**	**-1.7**
1987-1991	33.8	7.5	2.1	3.1	3.8	28	42	70	11	0.56	37.7	7.0
1992-1996	**71.6**	**14.4**	**6.0**	**6.9**	**6.3**	**42**	**48**	**90**	**9**	**0.95**	**49.1**	**11.4**
1997-2001	171.3	29.9	17.2	12.8	11.5	58	43	101	7	1.50	78.1	29.0
2002-2006	**142.4**	**28.9**	**7.1**	**16.4**	**18.6**	**25**	**57**	**82**	**13**	**0.38**	**60.0**	**-18.1**
2007-2011	169.5	31.1	7.7	19.7	35.0	25	63	88	21	0.22	86.0	26.0
2012-2016	**212.8**	**30.9**	**24.4**	**26.0**	**39.7**	**79**	**84**	**163**	**19**	**0.62**	**68.0**	**-18.0**
2017-2021	226.0	38.6	20.0	28.9	55.6	52	75	127	25	0.36	68.0	0.0

Notes: REV=revenues, NI=net income, BB=stock buybacks, DV=dividends, R&D=research & development expenditures, EE=end-of-fiscal-year employment for last year in cell, %change=change in employment over the five-year period.
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 dollars and as percent of net income, 1972-2021

PFIZER	REV	NI	BB	DV	R&D	BB/NI	DV/NI	BB+DV	R&D	BB	Employment	
	($b)					(%)			% of REV	/R&D	EE, 000s	% change
1972-1976	**7.5**	**0.7**	**0.0**	**0.3**	**0.3**	**0**	**40**	**40**	**5**	**0.00**	**40.1**	**3.5**
1977-1981	13.4	1.1	0.0	0.5	0.7	0	46	46	5	0.00	41.5	1.4
1982-1986	**19.6**	**2.5**	**0.1**	**1.0**	**1.3**	**5**	**41**	**46**	**7**	**0.10**	**40.0**	**-1.5**
1987-1991	29.3	3.7	0.9	1.8	2.8	24	50	73	10	0.32	44.1	4.1
1992-1996	**44.3**	**6.3**	**2.3**	**3.0**	**6.1**	**37**	**49**	**86**	**14**	**0.38**	**47.0**	**2.9**
1997-2001	103.9	20.3	9.7	7.9	16.3	48	39	87	16	0.59	90.0	43.0
2002-2006	**229.6**	**51.8**	**35.5**	**25.1**	**43.6**	**68**	**48**	**117**	**19**	**0.81**	**98.0**	**8.0**
2007-2011	281.7	43.1	20.5	34.4	43.5	47	80	127	15	0.47	103.7	5.7
2012-2016	**261.9**	**59.9**	**40.7**	**34.0**	**39.1**	**68**	**57**	**125**	**15**	**1.04**	**96.5**	**-7.2**
2017-2021	281.1	80.3	26.1	40.8	51.0	32	51	83	18	0.51	79.0	-17.5

Notes: REV=revenues, NI=net income, BB=stock buybacks, DV=dividends, R&D=research & development expenditures, EE=end-of-fiscal-year employment for last year in cell, %change=change in employment over the five-year period.
Source: Calculations from data in the S&P Compustat database and company 10-K reports.

Table 4 shows the total direct compensation (TDC) for 2007-2021 of Kenneth Frazier, who was CEO of Merck from January 1, 2011, to June 30, 2021. Over the years of his CEO tenure, Frazier averaged $27.4 million per year in TDC, of which 72 percent was stock based (that is, a combination of realized gains from stock options and stock awards). 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. Total direct compensation and percentage stock-based, 2007-2021, Kenneth Frazier (Merck CEO, 2011-2021) and Ian Read (Pfizer CEO, 2011-2018; Chair, 2019)[13]

YEAR	MERCK		PFIZER	
	Kenneth C. Frazier		Ian C. Read	
	TDC, $m	% SB	TDC, $m	%SB
2007	**4.4**	**31**	**3.8**	**41**
2008	5.4	49	4.2	16
2009	**4.8**	**26**	**6.4**	**15**
2010	7.8	33	15.2	9
2011	**8.6**	**15**	**14.9**	**17**
2012	10.1	17	18.3	31
2013	10.3	58	16.7	59
2014	21.2	59	28.0	63
2015	18.8	49	23.0	56
2016	38.6	76	23.7	72
2017	15.5	67	28.2	76
2018	48.8	84	47.0	88
2019	55.6	79	49.7	89
2020	28.6	77	-	-
2021	45.0	90	-	-

Notes: TDC=total direct compensation, %SB=percent of TDC that is realized gains from stock-based pay
Sources: S&P ExecuComp database and company proxy statements

As displayed in Table 5, the top executives of younger "New Economy" companies such as Regeneron and Vertex, and most recently Moderna, achieve these enormous pay packages without the support of large-scale distributions to shareholders. Rather their bonanzas are the results of soaring stock prices, driven mainly by innovation and speculation, and the abundant amounts of stock-based pay that they and their boards lavish on them. In the case of Regeneron, Schleifer and Yancopoulos are founders and board members as well as CEO and CSO, respectively, although their TDC included in the data in Table 5 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. For established "Old Economy" companies, distributions to shareholders in the form of dividends and buybacks help support the companies' stock prices and boost other financial metrics such as earnings per share (EPS) and price/earnings (P/E) ratio that translate into more lucrative compensation packages.

Table 5 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 U.S. executives. In every year, the mean TDC of the New Economy biopharma executives in the top500 is far higher than the mean TDC for all pharmaceutical executives and (except for 2018) even more so than for all top500 executives.

Table 5. Total direct compensation of leading New Economy biopharma companies with one or more executives in one or more annual list of highest-paid U.S. corporate executives, 2012-2021

Company (year founded; year of IPO)	Number of executives in 500 highest-paid list in each year																			
	2012		2013		2014		2015		2016		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	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**	**1**	**40.5**	**0**		**na**		**na**		**na**	
GILEAD SCIENCES (1987; 1990)	3	42.6	4	74.7	5	82.4	5	97.3	2	78.1	2	34.6	1	21.8	0		0		0	
REGENERON (1988; 1999)	**5**	**51.3**	**4**	**53.0**	**4**	**56.6**	**3**	**66.5**	**2**	**83.5**	**3**	**128.7**	**2**	**104.9**	**2**	**113.6**	**5**	**117.9**	**5**	**140.0**
VERTEX (1989; 1991	0		1	36.6	1	28.9	0		0		3	43.7	1	32.6	2	50.8	2	53.5	0	
ALEXION (1992; 1996)	**2**	**32.0**	**4**	**20.8**	**2**	**111.3**	**1**	**51.6**	**0**		**0**		**0**		**0**		**1**	**40.2**	**na**	
MODERNA (2010; 2018)	pre-IPO		pre-IPO		pre-IPO		pre-IPO		pre-IPO		pre-IPO		pre-IPO		0		3	59.8	2	181.8
Executives, 6 cos. above top500	10	44.9	16	47.4	13	75.9	12	65.7	5	67.8	9	69.7	4	66.1	4	77.2	11	83.3	7	151.9
Executives, pharma in top500	**22**	**35.9**	**33**	**35.8**	**40**	**43.3**	**33**	**45.1**	**25**	**32.2**	**22**	**41.9**	**23**	**33.2**	**21**	**35.4**	**31**	**49.3**	**27**	**61.6**
Executives, all top500	500	32.4	500	27.3	500	32.6	500	34.6	500	27.1	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

Table 6, which selects from all pharmaceutical executives in the S&P ExecuComp database (and not just from those companies in the S&P 500 Index), identifies the six highest-paid pharmaceutical executives for each year from 2006 through 2019. Note the prominence, especially in 2013-2016, of executives from three of the biopharma companies in Table 5: Gilead Sciences (17 of the 84 cells), Regeneron (14), and Celgene (8). Also note the extent to which their pay is stock based. Of the 84 cells in Table 6, the pay levels in 75 cells were 60 percent or more stock based, with 49 cells over 90 percent, 16 between 80 and 90 percent, seven between 70 and 80 percent, and three between 60 and 70 percent.

Of the highest paid executives, founders of the companies include Leonard Schleifer and George Yancopoulos of Regeneron (founded in 1988; IPO in 1991), Leonard Bell of Alexion (1992; 1996),

Martine Rothblatt of United Therapeutics (1996; 1999), Sol Barer of Celgene (1986; 1987), Jonah Shacknai of Medicis Pharmaceutical (1988; 1990). As indicated, all these companies went public within a few years after their founding, a phenomenon encouraged by the creation of NASDAQ in 1971 and its subsequent growth—a matter to which we will return. The compensation of these individuals shown in Table 6 is as executive employees of the companies and does not include personal income received by selling founder shares.

Table 6. Six highest-paid pharmaceutical executives, 2006-2021, 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%)

Notes: TDC=Total direct compensation (includes actual realized gains from exercising stock options and vesting of stock awards).

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

Source: S&P ExecuComp database and company proxy statements

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 total compensation 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 because of the surges of Gilead's profits and stock price in 2013-2015, 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 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 companies known as Big Pharma, including Wyeth (founded 1860 and IPO in 1926), Abbott (1888 and 1929), Johnson & Johnson (1886 and 1944), and Merck (1891 and 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 #3 and #4, respectively, 2018, and #4 and #5 in 2019. Johnson & Johnson CEO Alex Gorsky was #5 in 2018, and Lilly CEO David Ricks #6 in 2019.

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 the Covid-19 vaccine, enabled two of its executives to enter the top six in 2020, and then two different executives in 2021. Not in the top six in 2020 or 2021 are Moderna's Afeyan and Bancel, both of whom took home vast fortunes by selling founders' shares at astronomical stock prices.[14]

Social Conditions of Innovative Enterprise as Applied to the U.S. Industrial Economy

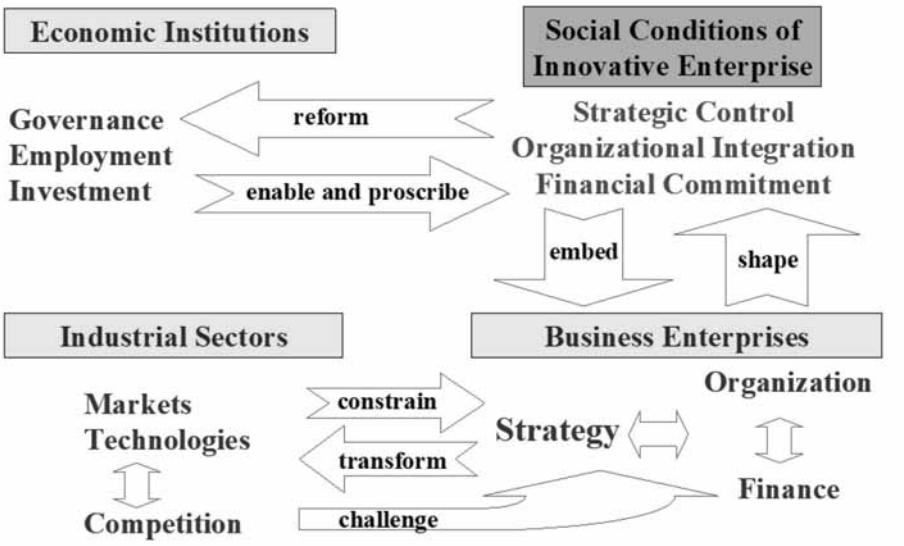
How can one explain these financial outcomes? They would not be possible without innovation occurring somewhere in the larger pharmaceutical ecosystem. For example, the stock-based compensation reaped by Gilead's John Martin and the company's other senior executives were made possible by the profits that Gilead reaped, and the stock-market reaction to those profits, from its 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).[15]

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 that support the innovation process. Once we know what entities contributed to the development of an innovative medicine that is successfully commercialized, we can analyze the

relation between those parties that took the risks in the value-creation process and those parties that positioned themselves to extract the rewards.[16]

This section outlines the "social conditions of innovative enterprise" (SCIE) conceptual framework on the basis of which AIRnet carries out its research on the relation between innovation and financialization (see Figure 1). We focus on the 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. 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.

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



Source: Schematic created by William Lazonick

Armed with the SCIE framework for analyzing the relation between the stock market and a firm's investment in innovation, our ongoing project engages 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 use of life-sciences intellectual property rights, and g) the distribution of income in the U.S. pharmaceutical industry.

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.

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 2019 data (the most recent available), in the United States, 2,230 firms with 5,000 or more US-based employees (and an average of 21,223) were just 0.04 percent of all firms but employed 35.6 percent of the business-sector labor force and accounted for 40.7 percent of business-sector payrolls.[17] 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 the following schematic diagram, firm-level innovation requires strategy, organization, and finance.[18] 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 commit*ment 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. 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 manufacturing, purchasing, and marketing. In 2018, of the 500 very large companies included in the S&P 500 Index, 38 firms accounted for 75 percent of all R&D expenditures, and 100 firms for 93 percent, while 282 firms recorded no R&D expenses at all.[19] 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 on 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 sufficiently high quality in views of these risks. FDA approval for OxyContin has never been withdrawn.[20] 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.[21] In this case, views on "quality" depends 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 them 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.

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, therefore, 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 even more 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.

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—or organizational—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. In U.S. corporations, the particular people who exercise strategic control are chosen by the board of directors. 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 what William Lazonick and Jang-Sup Shin call "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.[22]

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 if and when they decide to sell some or all of their shares.

In the United States, since the mid-1930s, the Securities and Exchange Commission (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 Quotation (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. In aggregate for the decade 2010-2019, companies in the S&P 500 Index did $5.3 trillion in that the S&P Compustat database classifies as stock repurchases, equivalent to 54 percent of combined net income, and another $3.8 trillion in dividends, another 39 percent of net income.[23] We estimate that at least 90 percent of the repurchases measured by the Compustat "repurchases" variable were executed on the open market for the sole purpose of manipulating the issuing company's stock price. (Henceforth in this essay, 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.[24] 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.[25] 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.[26]

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.

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). If and 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 the AIRnet's 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. For 2012-2021, the 474 companies in the S&P 500 Index that were publicly listed throughout the decades executed $5.7 trillion in share repurchases, a sum equal to 55 percent of their combined net income. We estimate that at least 90 percent of these repurchases were done on the open market.[27] In addition, these 474 companies paid out $4.2 trillion in cash dividends, absorbing another 41 percent of net income.

As indicated above, 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.

Research by the AIRnet (supported by the Institute for New Economic Thinking) has analyzed the damage wrought by stock buybacks done by many of the corporations that have been the largest repurchasers.[28] Focusing on the decade between the financial crisis of 2008-2009 and the pandemic of 2020-2021, the top 20 purchasers among industrial (or non-financial) corporations for 2010-2019 are listed in Table 7.[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, 12 companies on the list—Apple, Oracle, Microsoft, Cisco, Walmart, Intel, Home Depot, Johnson & Johnson, Amgen, Qualcomm, Disney, and Gilead—were in what I call "dominate-and-distribute" mode, using the profits from their still-dominant market positions primarily to support their stock price; while the other eight—Exxon Mobil, IBM, Pfizer, 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.

The ranking of the largest repurchasers among U.S. industrial corporations in Table 7 is based on buyback activity in 2010-2019, prior to the Covid-19 pandemic. Table 7 also shows the buybacks done by these 20 companies since the beginning of fiscal 2020, covering the period of the pandemic to the date of each company's financial report through December 2021. Apple, Oracle, Microsoft, Walmart, Intel, Home Depot, Procter & Gamble, Qualcomm, and Amgen have spent

42 percent or more of net income on buybacks during this period. These nine companies have benefited from very strong demand for their products and high profits during the pandemic.

Table 7. Twenty largest stock repurchasers, 2010-2019, among U.S. industrial corporations, their repurchases since fiscal 2020 through December 2021, and their SEC Rule 10b-18 safe-harbor average daily trading volume (ADTV) amounts for repurchases on October 19, 2019, and June 23, 2021

	2010-2019				Since the end of fiscal 2019				ADTV amount	
COMPANY	$BB RANK	BB, $b.	BB/NI%	(BB+DV)/ NI%	BB, $b.	last quarter for data	BB/NI%	(DV+BB)/ NI%	October 21, 2019, $m.	June 23, 2021, $m.
APPLE	1	305.0	73	94	158.3	2021Q4	104	123	1,597	2,526
ORACLE	2	113.7	121	145	35.9	2021Q2	240	272	183	261
MICROSOFT	3	101.1	48	92	48.8	2022Q1	46	76	754	1,522
EXXON MOBIL	4	92.4	35	80	0.4	2021Q3	-5	-322	166	410
IBM	5	88.2	71	107	0.3	2021Q3	3	117	125	144
CISCO SYSTEMS	6	81.5	100	144	5.8	2022Q1	23	78	226	254
PFIZER	7	76.7	60	116	0.0	2021Q3	0	53	146	235
WALMART	8	70.2	50	91	10.0	2021Q3	42	88	141	259
INTEL	9	66.8	51	87	16.6	2021Q3	46	73	219	318
HOME DEPOT	10	64.4	93	137	11.2	2021Q3	43	88	188	299
JOHNSON & JOHNSON	11	62.1	49	110	5.7	2021Q3	18	79	267	280
PROCTER & GAMBLE	12	54.9	52	117	21.2	2022Q1	67	125	186	319
AMGEN	**13**	**51.2**	**92**	**129**	**7.0**	**2021Q3**	**62**	**123**	**97**	**164**
GENERAL ELECTRIC	14	50.3	135	314	0.0	2021Q3	0	38	94	197
QUALCOMM	**15**	**49.4**	**119**	**178**	**5.8**	**2021Q4**	**51**	**102**	**116**	**241**
DISNEY	16	47.8	61	85	0.0	2021Q4	0	-183	231	341
MERCK	**17**	**45.8**	**81**	**172**	**2.1**	**2021Q3**	**13**	**81**	**144**	**265**
MCDONALD'S	18	45.8	87	145	9.5	2021Q3	9	71	159	149
BOEING	**19**	**43.4**	**87**	**137**	**0.0**	**2021Q3**	**0**	**-10**	**292**	**708**
GILEAD SCIENCES	20	39.6	56	75	2.1	2021Q3	35	138	93	122

Notes: BB=stock buybacks; DV=cash dividends; NI=net income; ADTV=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. Table 7 includes the latest quarterly data available for each company as of December 31, 2021.

The last two columns of Table 7 show these generous ADTV "limits" for the 20 largest repurchasers among industrial companies, 2010-2019 at two points in time, one in advance of the pandemic and one in the midst of it. Except for McDonald's, the ADTV limits all rose, in many cases substantially, in June 2021 compared with October 2019, reflecting combinations of higher prices and higher trading volumes. With the exception of a sharp downturn in March 2020, when the World Health Organization (WHO) declared the spread of SARS-CoV-2 to be a pandemic, the U.S. stock markets boomed in 2020 and 2021.

Of the companies that did minimal or no buybacks since the onset of the pandemic, Exxon Mobil, IBM, Pfizer, General Electric, Merck, McDonald's, and Boeing were in downsize-and-distribute mode before SARS-CoV-2 appeared, and the financial condition of all these companies except Pfizer deteriorated further during the pandemic. In the case of Pfizer, its revenues, profits, and employment all fell substantially during 2020 but its results for the first nine months of 2021 look very different, as it reaped high profits by manufacturing and marketing the Covid -19 vaccine (BNT162b2), developed by the German company, BioNTech. Comparing the first nine months of 2021 with the first nine months of 2020, Pfizer's revenues increased to $57.7 billion from $20.2 billion, while net income increased to $18.2 billion, up

from $6.8 billion (it was $8.9 billion in the first nine months of 2019). Its revenues from the BioNTech Covid-19 vaccine were $24.2 billion for the first nine months of 2021, representing 42 percent of Pfizer's total sales for the period and accounting for 80 percent of the increase in the company's revenues compared with the first nine months of 2020.

A highly financialized corporation from the late 1980s, Pfizer had already decided to cease doing buybacks in early 2019. The company's broker executed $2.1 billion in open-market repurchases in the first quarter of 2019 (ending March 31) but none thereafter. In addition, on February 7, Pfizer entered into a $6.8 billion "accelerated share repurchase" (ASR) agreement with Goldman Sachs. An ASR (which Pfizer had also done in February 2017 and March 2018) is a device for stock-price manipulation that enables a company to reduce its shares outstanding by the full number of shares in the agreement on the date on which it signs the ASR contract, while entering into a commitment for share repurchases in the months ahead. This arrangement gives an immediate, i.e., "accelerated," boost to the company's earnings-per-share (EPS), without the company transgressing the ADTV limit under Rule 10b-18. The bank (in this case Goldman Sachs) borrows the shares specified in the ASR agreement from asset funds that are not seeking to sell the shares. Then, during the life of the ASR agreement, the bank purchases the company's shares on the stock market in smaller amounts at its discretion at various points in time and returns the borrowed shares to the asset funds. In the case of Pfizer's 2019 ASR, Goldman Sachs completed it on August 1, 2019.

The $8.9 billion that Pfizer recorded in the first quarter of 2019 was designed to give a big boost to its stock price before turning 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 with years of patent life left from which Pfizer could extract the profits to fund its distributions to shareholders. By 2019, however, with acquisition targets disappearing and the patents on a number of Pfizer's major drugs expiring, its board recognized that Pfizer itself could be gobbled up by another Big Pharma company unless it could develop high-revenue ("blockbuster") drugs internally.

Hence since August 2019, for the sake of internal drug development, Pfizer has done no buybacks, directly or indirectly. Indeed, in a rare move among U.S corporations, in January 2020 Pfizer committed to do no buybacks that year, and it did so again in January 2021. The company did, however, increase its dividend in 2019, 2020, and 2021. The implementation of this change in Pfizer's investment strategy entailed the retirement of Ian Read 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.[30] Bourla's mandate was to shift to a retain-and-reinvest mode of corporate resource allocation. In an earnings call with stock-market analysts in January 2020, Bourla uttered an extraordinary admission of the company's financialized past, while making it clear 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.[31]

Bourla did not explain why the "old" Pfizer—which had been in existence less than 12 months before when it did its $6.8 billion ASR—"had to do what we had to do even if that was financial engineering, purchasing back ourselves." But his rambling statement is a very rare recognition by a CEO of a major U.S. corporation that stock buybacks are the enemy of investment in innovation.

As the case of Pfizer clearly illustrates, even with a business corporation that has become a major repurchaser of its own stock, there is an ongoing tension between innovation and financialization, with the outcomes determined by specific sets of circumstances. Intel, #9 in buybacks in Table 7, provides another explicit attempt to shift corporate strategy from financialization to innovation in an advanced-technology industry. Once the world leader in chip fabrication, a financialized Intel found itself falling behind in the face of innovative global competition. Under its new leadership, Intel is now seeking to invest in advanced nanometer fabrication facilities with the goal of catching up with industry leaders Taiwan Semiconductor Manufacturing Company (TSMC) and South Korea's Samsung Electronics. As documented in a recent INET working paper by Lazonick and Hopkins,[32] 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, who said in an interview that a condition of his taking the top Intel job was assurances from the company's board that Intel would "not be anywhere near as focused on buybacks going forward as we have in the past."[33]

In a subsequent interview with *CNET* in November 2021, Gelsinger was even more emphatic. He recounted how, before taking the CEO job, he had written a strategy paper for Intel's board, with which he got unanimous agreement. "I was concerned," Gelsinger said in the interview, "about how we get the process roadmap back in shape. 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."[34]

Not all companies in Table 7 that have done minimal or no buybacks during the pandemic were in a position to make a strategic reversal from financialization to innovation. Once the largest repurchaser until Apple assumed that position,[35] Exxon Mobil had been paring its buybacks since 2013, and after a loss of $22.4 billion in 2020, did only $155 million in 2021. After $7.4 billon in profits in 2021, however, high oil prices gifted the company with $23.3

billion in the first half of 2022, out of which it distributed $6.0 billion as buybacks along with $7.5 billion in dividends.

As for Boeing, through the first half of 2022, it continued to reel from the crashes of its 737 MAX planes in October 2018 and March 2019, although it cut its losses from $11.9 billion in 2020 (with loss of sales because of the pandemic playing a role) to $4.2 billion in 2021 and to $1.0 billion in the first half of 2022. Boeing cut its 2020 dividend to 25 percent of 2019 and then to zero in 2021 and the first half of 2022. Meanwhile, as of June 2022, the company had done no buybacks since the week before the 737 MAX crash on March 10, 2019. As Lazonick and Sakinç have shown, the 737 MAX catastrophes were integrally related to the company's financialization, manifested by $43 billion in buybacks from January 2013 until just prior to the second MAX crash.

The once iconic computer company, IBM, which epitomized the managerial revolution in U.S. business in the post-World War II decades, has a history of financialization that dates back to the early 1990s.[36] The company has been slashing its labor force since 2014 and cutting back on buybacks since 2015, without any clear path from financialization to innovation. After averaging $14.0 in buybacks annually in 2010-2014 and $3.7 billion in 2015-2019, IBM did zero buybacks in 2020, 2021, and the first half of 2022.

As yet another company that was central to the managerial revolution, General Electric was already a highly financialized company when, in 2016, hedge-fund activist Nelson Peltz (Trian Partners) made use of the corrupt U.S. proxy-voting system to leverage the influence of his shareholding stake of less than one percent to "maximize shareholder value."[37] When, in October 2015, Peltz purchased his GE shares, the company was on its way to posting a loss of $6.1 billion for the fiscal year, while it distributed $9.3 billion in dividends and $2.7 billion in buybacks. In 2016, GE returned to profitability with $8.8 billion in net income but paid out virtually all of it in dividends. In addition, under pressure from Peltz, GE did $22.6 billion in OMRs in 2016. Then in 2017 GE incurred a loss of $5.8 billion but still shelled out $8.7 billion in dividends over the whole year while doing $3.3 billion in buybacks in the first half of the year. Thereafter, the company continued in a downward spiral, which has culminated in its announcement that it will split into three separate corporations in aircraft engines, energy equipment, and medical equipment—businesses that date back to GE's growth as one of the world's most innovative enterprises from the 1890s to the 1940s.[38]

A key point of this overview of the shareholder payouts of the largest repurchasers is that individual companies make decisions concerning their level of buyback activity within the context of their specific product and process strategies. Hence an analysis of the relation between stock buybacks and corporate performance—and more generally the tension between innovation and financialization—must examine particular corporate allocation regimes, including interactive changes in strategic control, organizational integration, and financial commitment. Moreover, even though firms within the same industry often differ in terms of their investment strategies, learning processes and financial sources, there are also similarities across these firms in terms of the technological, market, and competitive characteristics of the industries in which they

compete. TIE provides an analytical framework for conducting firm-level and industry-level research, while recognizing the importance of the broader institutional contexts related to governance, employment, and investment within which firms and industries operate.

The New Economy Business Model and the Financialization of ICT

Of the 20 largest repurchasers in Table 7, 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 since the 1970s. Of the largest repurchasers that were ICT companies, 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.[39] 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—new CEOs, respectively, of a pharmaceutical company ranked #7 and an ICT company ranked #9 in Table 7—indict the MSV-orientation of their predecessors, as manifested by stock 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 7, 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 8, adapted from Lazonick's 2009 book, *Sustainable Prosperity in the New Economy?*, refer specifically to the ICT industry. Of the leading repurchasers, 2010-2019, in Table 7, only IBM has an historical legacy in ICT. Adjusting for industry-specific characteristics related to technologies, markets, and competitors, the transition from OEBM to NEBM is also relevant to the other "Old Economy" firms in Table 7, including Pfizer, J&J, and Merck in pharmaceuticals.

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 company-funded nonportable defined-benefit pensions, based on years of service with the company, in retirement; and c) the funding of the growth of the firm with retained earnings, leveraged, if required, by long-term bond issues.

Table 8. 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

By the early 1990s, six ICT companies in Table 7—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 7, 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 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 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 of the grant date with a ten-year expiration date. Thus, especially if a company could keep its stock 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.[40]

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."[41] Intel's buybacks exploded 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 of 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, as discussed previously, 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 7, 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 Mike 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.[42]

It was in this context that Steve 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 June 2022, Apple executed $529 billion in buybacks (93 percent of net income) and $126 billion in buybacks (another 22 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 the *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.[43] 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.[44] 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.[45]

Succumbing to Icahn's wealth, visibility, hype, and influence,[46] 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 billion in buybacks in 2014 and $36 billion in 2015—unprecedented amounts for any company at the time. 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. As Icahn was selling, however, 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.[47] In May 2018, Buffett enthused 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."[48] 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, and $86.0 billion in 2021. The company maintained the pace with $20.4 billion in buybacks in the first quarter of 2022 (ending December 25, 2021).

Beyond the inaccurate designation of its $484 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."[49] 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.[50] 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 Switzerland-based corporation that, better known simply as Roche, is both the least financialized and, currently, the most innovative of the global "big pharma" companies.[51] 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.[52] 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.[53]

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.[54] 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."[55] 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 7—Oracle, Cisco, and Qualcomm—grew to positions of dominance through retain-and-reinvest resource allocation regimes. In the process of growth, 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 incumbent management's position of strategic control.[56] The so-called Tax Cuts and Jobs Act of 2017 also led U.S. corporations to increase significantly their buyback activity in 2018.[57]

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 42.4 percent in 2021.[58] 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."[59] 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."

In the 1990s, Cisco Systems grew to dominate enterprise networking by using its stock as a compensation and combination currency, and, through a combination of innovation and speculation. in March 2000 sported the highest market capitalization of any company in the world. In September 2001, when its stock price had collapsed to just 14 percent of its peak 18 months earlier, Cisco began doing buybacks to prop it up.[60] From that time through fiscal 2022 (ended July 30), Cisco distributed 130 percent of its net income to shareholders, with 98 percent as buybacks. Over those two decades, as Marie Carpenter and Lazonick document,[61] the company has failed to innovate as a communications-technology company. 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 take-home compensation of $22.17 million from 2016 through 2021, of which 75 percent was stock based.

As for Qualcomm, 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.[62] 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 provided by 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.[63] 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[64] that, in part in response to the Republican tax cuts, companies in the S&P 500 Index devoted to buybacks in 2018.[65]

The rise of NEBM and its subsequent financialization had an impact on the resource-allocation orientation of Old Economy ICT companies such as IBM, #5 in the repurchasers list in Table 7, as well as Hewlett-Packard (HP), which in 2015 was split into Hewlett Packard Enterprise (HPE) and

HP Inc. In historical perspective the main function of the stock market for these Old Economy companies was the separation of share ownership from managerial control, and not the "cash" function as is commonly believed. The following summaries of the historical functions of the stock market at IBM and HP provide insights into the changing role of the stock market as, in recent decades, these companies have sought to make the transition from OEBM to NEBM and, in the process, turned from innovation to financialization.

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.[66] In 1915, with almost no publicity and no funds raised, CTR was able to list on NYSE.[67]

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 who had been 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 employee 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[68]) the explicit objective of ridding itself of the CWOC norm. In the process, IBM made, and legitimized, the transition from OEBM to NEBM.

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 net income. 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 restricting 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.[69] That would double IBM's EPS of $10.01 in 2009, which was up from $3.76 six years earlier.[70] Along with revenue growth and operating leverage, IBM cited stock repurchases as a driver in achieving its EPS objective.[71] One way in which IBM sought to increase "operating leverage," and hence jack up EPS, was through layoffs.[72] 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.[73] 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.[74]

At the end of 2021, IBM employed 282,100 people, after spinning off its managed infrastructure services business, with 90,000 employees, as Kyndryl.[75] With its net income in 2020-2021 at one-third its level in 2012-2013, the company did no buybacks in these two recent years. But its dividend was 50 percent higher in 2020-2021 than in 2012-2013, now absorbing 104 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 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 ICT cases of downsize-and distribute.

Another company, not listed in Table 7, 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.[76] 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."[77] 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, listing on stock markets resulted in a much wider distribution of share ownership while the founders still maintained managerial 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. Thereafter it was salaried managers, not family members, who occupied positions of strategic control, completing the historical process of separating share ownership from managerial control.

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.[78]

HP did not start paying regular dividends until 1965. As shown in Table 9, 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."[79] 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, the 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 the 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 to the present as the world's leading patent holder, using its intellectual property rights to generate licensing revenues and gain leverage in strategic alliances rather than to develop proprietary technologies. 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 2020 was 112,400, after a decade of an intensive downsize-and-distribute regime.

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) have documented 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.[80]

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, which 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.

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.[81] Like Intel, TI is an IDM that, to manufacture the chips that it designs, has ten wafer fabs worldwide, of which six are located in the United States.[82] 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. In 2021, demand for a limited supply of chips led TI to expand employment to 31,000. Even though TI's revenues increased from $14.5 billion in 2020 to $18.3 billion in 2021, and its profits from $5.6 billion to $7.6 billion, it reduced its annual buybacks from $2.6 billion to $527 million. But with revenues and profits continuing to increase in the first half of 2022, TI ramped buybacks up to $1.8 billion for the six months.

Founded in 1906, Xerox 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. Xerox had all-time highs of $22.6 billion revenues in 2011 and 147,600 employees in 2012. Over the decade 2011-2020, however, the company distributed 99 percent of its $6.7 billion in net income as buybacks and another 42 percent as dividends, while its revenues declined in every year, falling to $7.0 billion in 2020, at which point the company

employed only 24,700 people. In 2021, Xerox slashed employment further to 23,300. In 2021 and the first half of 2022, company's sales were stagnant, while it incurred losses of $515 million. Nevertheless, continuing to downsize-and-distribute, the company saw fit to pay out $294 million in dividends and just over $1.0 billion in buybacks.

Institutions Supporting Innovation and Financialization in the U.S. Pharmaceuticals Industry

Among the five pharmaceutical companies in Table 7, 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 7—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.[83]

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 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 could raise funds through both initial and secondary stock issues, without a revenue-generating product—that is, the PLIPO model. In addition, 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 essay, 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 for 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.[84] 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 precondition for such fundraising is a highly liquid NASDAQ stock market, which was not the case in 2008-2010, when virtually biotech IPOs occurred. In the second quarter of 2022, the biotech IPO market was at its weakest in more than five years.[85]

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."[86] After the discovery of DNA cloning by Stanley Cohen at Stanford and Herbert Boyer at the University of California San Francisco in 1973, Cetus shifted into genetic engineering. In March 1981, Cetus raised $119.6 million in its IPO, 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.[87]

Such was also the case with Genentech, which in October 1980 was the first biopharma IPO, raising $35 million.[88] The company's first FDA-approved product, a growth hormone for children, approved for commercial sale in 1985, was, according to a Genentech press release, "the first recombinant biotech drug to be manufactured and marketed by a biotechnology company."[89] By this time, biopharma companies such as Biogen (founded 1978; IPO 1983) and Amgen (1980; 1983) also went public without a product. Genzyme, founded in 1981, was generating revenues and profits from selling specialty chemicals to other biotech companies when it did its IPO in 1986, but its first major biotech medicine, Ceredase for Gaucher's disease, was not approved for sale by the FDA until 1991.

Government funding and procurement played major roles in the microelectronics revolution, from computers to semiconductors to the Internet.[90] 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.[91] In the introductory chapter, entitled "Technology's Vanishing Wellspring," conference organizers and volume editors Richard Rosenbloom and William Spencer argued 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."[92]

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.[93] 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 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 he contributed to the *Engines of Innovation* volume, Moore 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.[94]

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 research at university labs. 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.[95]

Government funding of pharmaceutical research has been of critical importance to the emergence of PLIPOs. As a government-funded entity to fund life-sciences research, the NIH, with its 27 specialized institutes and centers, is by far the world leader. The 2021 NIH budget was $42.9 billion, and from 1938, the year it first recorded expenditures, through 2021, the NIH spent about $1.3 trillion in 2021 dollars in support of life-sciences research.[96] The 2022 NIH budget is $45 billion.[97]

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.[98] 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.

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 >$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 screening.[99]

Patent protection has been fundamental to the U.S. innovation system. The pharmaceutical industry has benefited from general patent laws, including 17 years of protection against competition from the time of filing a successful patent that prevailed from 1861 through 1994 and 20 years of protection in existence since 1995.[100] In addition, there have been special protections applicable to the medical drug industry. In 1980, in the wake of the recombinant DNA revolution of the 1970s, the U.S. Supreme Court ruled in Diamond v. Chakrabarty 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 provided 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.[101] From 1983 through September 2022, there 6,258 ODA designations and 1,090 approvals.[102] 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 Collington and Lazonick in their paper of a framework for drug-price regulation for this project, 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.

With the help of neoclassical economics, the pharmaceutical industry argues that the market mechanism can kick in to set a "competitive" price when a drug goes off patent, with generic producers entering the commercial fray to compete for market share. This market-directed "regulatory" approach was put into force by the Drug Price Competition and Patent Term Restoration Act of 1984, often referred to as the Hatch-Waxman Act. Generic competition works in some cases and to some extent to lower drug prices, although even then it takes 20 years from the filing of a patent before open generic competition can take place. Although the market entry of generic makers induces some downward pressure on drug prices at first, the patented drug producers often use some of their monopoly profits to bribe generic producers not to enter the market when a drug goes off-patent. Additionally, with the growing merger and acquisition activity in the generic drug business consolidating the sector into fewer major players, price competition among generic manufacturers has declined.

When threats of drug-price regulation arose in the 1990s, the established pharmaceutical companies, known as "Big Pharma," and the rapidly growing New Economy biopharma companies joined forces to defeat this interference with so-called "market forces." In 1994, the Pharmaceutical Manufacturers Association changed its name to the Pharmaceutical Research and Manufacturers of America, or PhRMA, to emphasize in its lobbying efforts that its members were engaged in research activities for the benefit of the U.S. public.

One year after this name change, PhRMA helped to persuade U.S. lawmakers to extend patent protection from 17 to 20 years. Focused on securing every possible advantage of government support for the industry while avoiding price regulation, PhRMA has become one of the most powerful lobbies in Washington D.C. A major policy coup of PhRMA was the Food and Drug Administration (FDA) Act of 1997, which removed any regulatory restriction on television broadcasting of drug information; permitted the drug companies to provide medical professionals with some information in peer-reviewed academic journals on the off-label use of any prescription drug; and granted drug companies an additional six months of data exclusivity on pharmaceutical products developed for children. With the passing of this legislation, direct-to-consumer pharmaceutical advertising went from $360 million in 1995 to $1.3 billion in 1998 and $5.0 billion in 2006.

PhRMA is one of more than 500 members of Research!America, formed in 1989 for the purpose of advocating public support for biomedical research. R!A quickly became the umbrella organization for all the stakeholders of NIH funding, including major research universities and academic institutes, Big Pharma and other drug companies, disease advocacy groups, and professional societies. In 1992, R!A was in the forefront in lobbying for the Prescription Drug User Fee Act, under which the FDA could charge drug companies fees for reviewing drugs for accelerated approval. Along with R!A, PhRMA played a key role in the successful lobbying efforts to double NIH funding in the late 1990s and early 2000s. This expansion of the NIH along with the growing support for life-sciences research from non-governmental sources resulted in the rapid expansion of physical infrastructure to support research to develop innovative medicines. The 21st Century Cures Act of 2016 was the first major legislative effort to increase funding for the NIH and included $1.8 billion in new funding over seven years to the National Cancer Institute for the Cancer Moonshot, sponsored by then-Vice President Joe Biden.

Within the Department of Health and Human Services (HHS), the Biomedical Research and Development Authority (BARDA) had an annual budget of $1.6 billion in 2020 to fund the development of countermeasures against a bioterrorist attack or a pandemic.[103] Immediately after the terrorist strikes on the World Trade Center and the Pentagon on September 11, 2001, there was alarm about the possibility of a bioterrorist attack on the U.S. population, utilizing highly contagious and lethal pathogens. Indeed, just one week after 9/11, one or more bioterrorists (by all accounts domestic) mailed envelopes with anthrax spores to 22 people, including prominent politicians, resulting in five fatalities.[104] In his 2002 State of the Union Address, President George W. Bush signaled a focus on Iraq as a potential terrorist enemy, arguing that "the Iraqi regime has plotted to develop anthrax and nerve gas and nuclear weapons for over a decade."[105]

In November 2002, Congress created the Department of Homeland Security (DHS), which consolidated 22 agencies into one. Included in DHS were a number of agencies that could enable the United States to respond to a bioterrorist attack, the most important of which were the newly created Federal Emergency Management Agency (FEMA), the Strategic National Stockpile (SNS) as part of FEMA, the National Biodefense Analysis and Countermeasures Center (NBACC), and the National Disaster Medical System (NDMS).[106] Previously the SNS had been the National Pharmaceutical Stockpile, launched in 1999 as part of the Center for Disease Control and Prevention (CDC) within HHS.

In his 2003 State of the Union address, delivered on January 28, President Bush engaged in fear mongering about Iraqi capacity to launch a bioterrorist or nuclear attack. Bush's speech created a pretext for the U.S. invasion of Iraq less than two months later.[107] In May 2004, the Senate voted 99-0 to authorize funding for Project BioShield for research on and production of vaccines to counter bioterrorist agents such as anthrax, botulinum toxin, and smallpox. The Project BioShield Act, with an appropriation to DHS of $5.6 billion over ten years to contract with business for "next generation countermeasures," was signed by President Bush on July 21, 2004.[108]

In November 2005, President Bush's Homeland Security Council issued a report, *National Strategy for Pandemic Influenza*, in view of "an unprecedented outbreak of avian influenza in Asia and Europe, caused by the H5N1 strain of the Influenza A virus,"[109] followed by, in May 2006, the Council's *Implementation Plan*.[110] In November 2005, HHS Secretary Michael Leavitt, sworn in the previous January, issued the *HHS Pandemic Influenza Plan* "as a blueprint for all HHS pandemic influenza and preparedness planning and response activities."[111] Governors and state health officials followed with their own pandemic influenza preparedness plans.[112]

In December 2006, Congress passed the Pandemic and All Hazards Preparation Act (PAHPA) "to improve the Nation's public health and medical preparedness and response capabilities for emergencies, whether deliberate, accidental, or natural."[113] In charge of PAHPA, within HHS, was the newly created position of Assistant Secretary for Preparedness and Response (ASPR). Under PAHPA, Project BioShield became part of BARDA and responsibility for the SNS moved from DHS to HHS. BARDA had a budget of $5.9 billion over ten years to develop vaccines and other countermeasures for the SNS.

AIRnet research on BARDA's contracts for ventilators for the SNS illustrates both the potential of BARDA to support innovation in pandemic countermeasures and the undermining of these efforts when, through acquisition, financialized corporations secure strategic control over the companies with which the contracts were originally made.[114] In September 2010, under the Obama administration, as part of its planning for "a severe influenza pandemic or other public health emergency," BARDA awarded California-based Newport Medical Instruments a three-year contract, initiated with a $6.7 million government grant, to "help fill the need for domestically manufactured, low-cost, user-friendly and flexible next-generation ventilators."[115] The goal was for BARDA to procure 10,000 such ventilators from Newport at $3,000 per unit, which would yield $30 million in sales for the company. If Newport had succeeded in developing the device

according to the targets set by BARDA, it would have been a significant achievement. BARDA claimed that portable ventilators with all the requisite features would have a market price of $6,000 to $30,000 each.[116] The implied cost savings to the SNS for 10,000 ventilators from Newport under the contract would range from $30 million to $270 million.

In 2012, however, Newport, with 160 employees,[117] was acquired by Covidien, with 43,000 employees, and by late 2013 Covidien had backed out of the project without having delivered a single ventilator to the SNS. A highly financialized company, Covidien (which in retrospect was an ill-chosen name for a medical equipment company) had previously been a division of Tyco, whose former CEO, Dennis Kozlowski was incarcerated for up to 25 years on corporate corruption charges at the time that Covidien acquired Newport.

BARDA had to find a new business collaborator for the project to supply the SNS. In September 2014, it awarded a contract, with a $13.8-million seed grant, to Philips Respironics, a Pennsylvania-based manufacturer, wholly owned by the Dutch company Royal Philips.[118] This contract, which remains in force, included an option for the SNS to purchase 10,000 completely kitted, initial production ventilators for a total of $32.8 million—that is, $3,280 per ventilator.[119]

In September 2019, the FDA approved the ventilator, the Trilogy Evo Universal, that Philips Respironics had agreed to deliver to the SNS.[120] But as of March 2020, Philips had delivered not one of these machines to the SNS because its contract with HHS did not require the initial shipment of ventilators until August 2020, with all 10,000 to be delivered to the SNS by August 2022. Rather, Philips was accused of selling the Trilogy Evo Universal on the open market at multiples of its contract price with BARDA.[121] While, in a press release on March 31, Philips stated that it was "working closely with BARDA to accelerate delivery to the SNS,"[122] a subsequent investigation by the House Oversight Committee found that the Trump administration had renegotiated the contract with Philips, agreeing to pay $15,000 per ventilator, almost five times the price of the original contract.[123] In the context of doing the research for their INET paper on ventilators, Hopkins and Lazonick took a close look at the evolution of Philips, the iconic Dutch technology company that had acquired Pittsburgh-based Respironics in early 2008. By that time, Philips had made a very clear transition from innovation to financialization, which rendered it an unreliable partner in a government-business collaboration designed to deal with a pandemic.[124] In contrast, as in-depth research by Hopkins shows, when it was acquired by Philips in 2008, Respironics was a highly innovative company, based on over four decades of retain-and-reinvest.[125]

In medicines, BARDA's main investment prior to the pandemic had been a manufacturing company, Emergent BioSolutions, which received repeated large-scale contracts for an anthrax vaccine for the SNS, including $894 million from the Trump administration prior to the pandemic, and in March 2020 received a $628 million contract from HHS to manufacture Covid -19 vaccines for Johnson & Johnson and AstraZeneca.[126] The Emergent factory contaminated 75 million doses of J&J vaccines, and the government then turned to Merck to manufacture for J&J. In November 2021, the Biden administration terminated the Covid-19 vaccine manufacturing contract with

Emergent,[127] but not before, In October, BARDA had awarded the company another $400 million to produce its anthrax vaccine for the SNS over the next 18 months.[128]

Within HHS, there was severe conflict between Robert Kadlec, Assistant Secretary for Preparedness and Response (ASPR) and Rick Bright, director of BARDA, over control of BARDA's budget. In April 2020, Kadlec managed to reassign Bright to NIH, which in turn led Bright to file a much-publicized whistleblower complaint against HHS. Kadlec played a central role in the Trump administration's Operation Warp Speed (OWS), which provided an estimated $18 billion to develop, manufacture, and deliver Covid-19 vaccines. Subsequently, under the Biden administration the funding of Covid-19 countermeasures, including antiviral pills and tests of infection has been anything but coherent.

One clear constraint on the rollout of Covid-19 medicines was the availability of scalable manufacturing capacity. As part of a collaboration between AIRnet and INET, Tulum and colleagues published a series of articles on the problems of capacity and scale in the manufacture of the Covid-19 vaccines, especially those using mRNA technology.[129] Recognizing the problems of capacity and scale, in October 2021, the U.S. House of Representatives passed H.R. 4369,[130] authorizing $100 million over four years to establish National Centers of Excellence in Advanced and Continuous Manufacturing at U.S. academic institutions. According to a column by two lawyers who have worked with the FDA, "the new bill builds on existing partnerships between FDA and research institutions, such as Rutgers University's Center for Structured Organic Particulate Systems (C-SOPS), which has been a player in the advancement and integration of continuous manufacturing technologies into commercial production."[131]

From Innovation to Financialization in Pharmaceuticals: A Collaborative Research Agenda

Our research on the pharmaceutical industry confirms that innovation requires coherent and durable government-business relations for the development, manufacture, and delivery of medicines. For innovation to occur, government support for the pharmaceutical industry requires business enterprises that are focused on generating high-quality, low-cost products. As we have begun to document in this essay, corporate financialization undermines corporate innovation, and it can feed back through political lobbying and political appointments to corrupt the ways in which the government provides support for the industry.

The AIRnet/Sci-Industry collaborative research agenda, going forward, combines qualitative business histories of companies in both the Fully Integrated Pharmaceutical Company (FIPCO) and Productless Initial Public Offering (PLIPO) sectors of the industry with statistical analyses of indicators of innovation and financialization. Applying the "social conditions of innovative enterprise" (SCIE) framework, as summarized schematically in Figure 1 above, our studies of the operation and performance of U.S. pharmaceutical companies focus on key issues related to the exercise of strategic control, the processes of organizational integration, and the sources of financial commitment. With a view toward supporting innovation and limiting (if not preventing) financialization among pharmaceutical companies operating in the United States, we focus on government policies that influence the prevailing governance, employment, and investment

institutions. In the research agenda that follows, therefore, we divide our research agenda into business strategies and government policies, while recognizing that we seek a systemic understanding of how the interaction of business strategies and government policies can result in high-quality, low-cost medicines

Research on the pharmaceutical industry conducted by AIRnet and Sci-Industry has focused on the sources of innovation as well as the tension between innovation and financialization in companies, large and small. We place our research on the industry in the United States in the context of changes in technologies, markets, and competition on a global scale. We argue that the United States possesses an unparalleled ecosystem for pharmaceutical innovation, including

- multi-faceted government-funded research through the National Institutes of Health (NIH);
- a system of higher education that attracts faculty, researchers, and students from around the world;
- government legislation that enables and encourages companies that seek to engage in medicine innovation to obtain licenses to the results of federally funded research;
- government protection of corporate control over intellectual-property rights through patent awards, licensing agreements, and Orphan Drug Act market exclusivity;
- startups backed by the world's most advanced venture-capital industry (made up of firms that mobilize finance and management to set up new firms, especially in research-intensive industries) with the possibility of initial public offerings, even without a product;
- the speculative NASDAQ stock market, which, when it is highly liquid, enables venture capital to exit its private-equity investments while creating the possibility for the publicly listed biopharma firms to access large amounts of funds through initial and secondary issues of shares;
- long-established FIPCOs, many with their origins in the 19th century, with substantial R&D budgets as well as, of utmost importance, deep manufacturing and marketing capabilities;
- high (unregulated) drug prices that pharmaceutical companies can charge in the United States on patented drugs that have been commercialized, as a result of which these companies can secure substantial profits that are potentially available for reinvestment in new product development;
- a regulatory environment that, notwithstanding the long legal tradition of antitrust in the United States, places only minimal constraints on corporate growth through mergers and acquisitions;
- by far the largest domestic market for pharmaceutical products with, in 2020, an estimated $530 billion, 46 percent of the world total;[132] and
- a government regulatory agency—the Food and Drug Administration (FDA)—that is trusted (despite occasional missteps) to give approval for use only to medicines that have been scientifically proven to be safe and effective.

This system of innovation is, however, vulnerable to corporate financialization. Indeed, depending on the abilities and incentives of those who exercise strategic control over the resources of a pharmaceutical company, the very characteristics of the industrial ecosystem that

can support innovation may be perverted to enable financialization. Central features of the financialized industry include:

- research scientists who use the results of federally funded research to get rich through their involvement with PLIPOs, which may blunt their incentives to engage in collective and cumulative learning within the scientific community;
- corporate employment of "star" scientific personnel by startups, the value of which may derive more from roadshow hype in attracting investor funds than from the actual contributions these scientists make to organizational learning for the sake of product development;
- corporate entities, posing as biopharma companies, which have little if any ability to transform scientific knowledge into safe and effective medicines , but which can gain exclusive licenses to the results of federally funded research;
- stock market speculation, which may channel large amounts of cash to startups, whose executives possess little if any ability or incentive to invest those funds in the collective and cumulative learning processes required for drug development;
- established pharmaceutical companies which may use their profits, inflated by unregulated drug prices, to distribute corporate cash to shareholders in the form of dividends and buybacks.
- pharmaceutical companies which may engage in M&A activity to gain strategic control over successful drugs—in some cases, blockbusters—for the purpose of extracting value from the patent-life left on them for the sake of higher profits that, through dividends and buybacks, can boost the company's stock yield;
- the enormous U.S. prescription-drug market, in which (exceptionally among nations) direct-to-consumer advertising is permitted, facilitating practices such as price gouging and the promotion of drug dependence by pharmaceutical corporations, all for the sake of higher stock-market valuations;
- financial interests, concerned with profits and stock yields, which may be able to pressure the FDA into approving an unsafe and/or ineffective drug.

In this potential for the sources of innovation to mutate into forces for financialization in the U.S. institutional environment, the pharmaceutical industry is by no means unique. Given the dominance of MSV ideology in the governance of corporations in the U.S. economy, U.S. institutions enable almost unconstrained agency for those financial interests who can gain strategic control over resource allocation within U.S. corporations across a range of industrial sectors for the sake of predatory value extraction.[133] As we have shown in this essay, however, the U.S. pharmaceutical industry represents a particularly egregious case of corporate financialization. In pharmaceuticals, corporate financialization undermines not only the wealth but also the health of the nation. Through analyzing the sources of value creation and the forces for value extraction in the industry, the prime purpose of our research is to understand how U.S. institutions for governance, employment, and investment can be reformed to support corporate innovation and prevent corporate financialization.

Out of the body of research that we have summarized in this essay, we can identify three interrelated research projects on which, applying the SCIE framework, AIRnet and Sci-Industry seek to collaborate, going forward:

1. Innovation and financialization: FIPCOs
2. Innovation and financialization: PLIPOs
3. National institutions for medicine innovation

The first two projects require analyses of the tension, and evolving, balance between innovation and financialization in developing, manufacturing, and delivering medicines by, in the first project, FIPCOs, and, in the second project, PLIPOs. Our findings from these two business-sector projects will provide an empirical foundation for evaluating the roles of the governance, employment, and investment institutions that prevail in the United States in supporting innovation or, to the contrary, enabling financialization of pharmaceutical companies, large and small. In concluding this essay, we outline, in turn, the key research tasks that each of these three projects entail.

1. Innovation and financialization: FIPCOs

This project is a key long-term initiative of the AIRnet/SciIndustry collaboration. Applying TIE to the intensive investigation of specific companies, Tulum has been doing a series of studies of the evolution of the tension between innovation and financialization in major FIPCOs, in the United States and abroad, including, thus far, Merck, Pfizer, Roche, AstraZeneca, and GlaxoSmithKline.[134] The last two studies constitute our UK Big Pharma project, done in collaboration with Antonio Andreoni, professor of economics at SOAS University of London (with initial funding by the Gatsby Foundation).[135] Our ambition over time is to carry out similar studies of all the major FIPCOs engaged in global competition. Note that our analyses of the interactions of strategic control, organizational integration, and financial commitment that are the substance of these studies are structured historically, brought up to the present, enabling us to update them as new events unfold.

In his PhD thesis, completed in 2018, Tulum launched this project with a comparison of Swiss-based Roche and U.S.-based Merck. As a company that has resisted financialization, the case of Roche is of particular interest because, with at least majority ownership since 1990, it has exercised strategic control over Genentech, making the pioneering U.S. biopharma company integral to the Swiss company's rise to leadership as a FIPCO innovator. In effect, Roche protected Genentech from the pressures for financialization by public shareholders, a barrier to financialization that was solidified when in 2009 Roche acquired all the outstanding shares of Genentech that it did not already own. Tulum has found that, as a Roche subsidiary, Genentech has become an important training ground for senior executives whose strategic focus is innovation rather than financialization.

One of those executives is Pascal Soriot, who since 2013 has been the CEO of the British-Swedish company, AstraZeneca. Soriot had joined Roche in 2006, was made the CEO of Genentech for a year in 2009, and then returned to the parent company as chief operating officer in 2010. In their

study of AstraZeneca, Tulum, Andreoni, and Lazonick analyze how, under Soriot, the company transitioned from financialization to innovation, ceasing to do stock buybacks in 2013 as part of a strategy of internal investment in the company's drug pipeline. In May 2014, AstraZeneca fought off a takeover bid by Pfizer.[136]

Tulum et al. have done a comparative analysis of GlaxoSmithKline (GSK), the UK's other major FIPCO, documenting its somewhat later, yet decisive, shift from financialization to innovation, when in 2017 the board chose Emma Walmsley, head of GSK's consumer health products division, to replace Andrew Witty as CEO. In July 2022, GSK spun off its consumer products division as part of Haleon, a joint venture with Pfizer. Meanwhile, beginning in April 2021, Paul Singer (Elliott Management), who is widely recognized as the most predatory of the "vulture capitalists" on the global scene, campaigned, unsuccessfully as it turned out, for Walmsley to step down as GSK CEO in a power play intended to enable Elliott to realize gains by boosting the price of GSK shares and then selling its holdings.[137]

Building on his thesis research, Tulum is currently writing a comparative study of Merck and Pfizer. As indicated earlier in this essay, during the last half of the 1980s, with the rise to dominance of MSV as an ideology of corporate governance, Merck began doing large-scale buybacks. Nevertheless, with Roy Vagelos as CEO from 1985 to 1995, Merck maintained a focus on innovation. Educated as an MD, Vagelos had been a scientist at NIH and Washington University before coming to Merck as head of R&D from 1975.[138] With his retirement in 1995 at the age of 65, Merck quickly became highly financialized, seeking to make acquisitions to control revenues from already successful drugs and using the cash flow to pump up the yields on its stock.

Pfizer, which had placed the caption "Building shareholder value through innovation" on the cover of its 1988 annual report, followed a similar financialized business model. Ian C. Read, Pfizer's CEO from 2011 through 2018, was an accountant who pursued downsize-and-distribute, milking profits on lucrative patented drugs over which the company gained control through M&A, until, as we discussed above, this "blockbuster" business model exhausted itself as a mode of predatory value-extracting.[139] In choosing Albert Bourla as Read's successor, Pfizer's board made a deliberate pivot to retain and reinvest. Nevertheless, in 2022, with the bonanza reaped from its sales of the BioNTech-Pfizer Covid-19 vaccine and the Paxlovid antiviral Covid-19 pill, Pfizer reverted back to doing large-scale buybacks ($2 billion in the second quarter of 2022). Our ongoing research on Pfizer seeks to gain more insight into the decision-making processes that led Pfizer to cease doing buybacks in 2019 and to recommence with them in 2022.

In seeking to answer these questions, we focus on the abilities and incentives of those senior corporate executives in positions of strategic control. To implement an innovation strategy, their abilities must enable them to make effective decisions concerning the organizational integration of large numbers of people whom they employ into the collective and cumulative learning processes that innovation requires. Their incentives must be related to their desire to lead an organization that can generate higher-quality, lower-cost products than those previously available.

Even if the CEO and his or her team of senior executives possess *the ability* to implement an innovation strategy (which may not always be the case), the corporation may not give them the incentive to do so. Empirical research, applying TIE, has led AIRnet to develop unique insights into the roles of various components of executive pay in incentivizing the behavior of senior executives, including especially stock awards and stock options.[140] Our research distinguishes between the *realized gains* from the stock-based components of executive compensation, the pursuit of which incentivize executives to do stock buybacks as open-market repurchasers, and the widely used "fair value" estimates of stock options and stock awards which obscure these incentives, yet are sanctioned by that the SEC and the Financial Accounting Standards Board (FASB) in the United States.[141] We have also found that in Europe, corporate boards often include performance criteria for realizing gains from stock-based compensation that are designed to encourage innovation and mitigate financialization.[142]

Organizational learning is the essence of the innovation process. A business corporation can accumulate strategic control over innovative capabilities incrementally through the collective and cumulative interactions of employees within the company or, more rapidly holistically, through the acquisition of other firms (or divisions of other firms) with complementary capabilities. The key to the success of an acquisition in contributing to an innovation strategy is its organizational integration with the capabilities of the acquiring firm. When a merger or acquisition includes products that are already generating substantial revenues and profits, as has often been the case among FIPCOs in the pharmaceutical industry, the acquiring firm may simply seek to use those profits to boost stock yields rather than to invest in innovation. Do mergers and acquisitions contribute to innovation, or do they enable financialization? The only way to find out is through empirical study of the evolution of particular companies that are engaged in these activities. Applying TIE, our company studies enable us to analyze the sources of organizational learning in general and the purposes and performance of M&A activity in particular.

Our approach to studying innovative enterprise enables us to ask why and under what conditions a business corporation can grow through new product development so that it becomes a multiproduct firm. But is the growth of existing firms the most effective unit of strategic control for sustained innovation? Would innovative performance be enhanced by having a proliferation of startup firms develop new products? The question that must be answered is whether an existing firm with innovative capabilities in generating one product has an advantage over a startup in leveraging those capabilities by investing in a new product. The same question can be asked when an established FIPCO acquires a young company based on the PLIPO model. Will the PLIPO eventually generate an innovative product through investment in its own internal capabilities? Or can the acquisition by, or possibly collaboration with, a FIPCO enable faster and better innovation? From the TIE perspective, we can analyze relation between the growth of FIPCOs and the growth of PLIPOs, enabling us to address these questions.

The earnings that a successful company retains out of profits forms the foundation of financial commitment for the growth of the growth of the multiproduct firm over time. Corporate retentions enable the firm to reward its employees for their contributions to current profits and

sustain employment relations as it mobilizes an experienced and committed labor force to invest in new products. Especially under NEBM, characterized by high levels of interfirm labor mobility and broad-based stock options and awards as employee retention mechanisms, a company may do stock buybacks to boost its stock price to reduce labor turnover.

Our research on the evolution of stock buybacks under NEBM since the 1980s suggests that some established technology-intensive firms used them in the 1990s to boost stock prices to make the realized gains from stock options and stock awards attractive to a broad base of professional, technical, and administrative employees, and thus mitigate interfirm labor mobility. Over time, however, this use of buybacks became counterproductive because a) the volatility of the stock market created pay inequities among employees, depending upon when they had been granted their options and awards, that had little if anything to do with productive performance, b) stock-price increases at established company attained by means of manipulation through buybacks could not match the stock-price increases at other rising companies attained by a combination of innovation and speculation, and c) once a company started doing large-scale buybacks for the purpose of increasing the realized gains from stock-based pay by a broad-base of employees, senior executives succumbed to the temptation to do even larger buybacks to enrich themselves as value-extracting insiders and to find off challenges to their strategic control by shareholder (aka hedge fund) activists as value-extracting outsiders.

Hence the initial impacts of large-scale buybacks were to undermine organizational integration and strategic control. Subsequently, the company's innovative capability diminished while buybacks soared, the outflow of corporate cash had a direct negative impact on the funds available for financial commitment. In our ongoing research, we intend to conduct analysis of. whether these types of deleterious impacts of stock buybacks on the social conditions of innovative enterprise occurred at the major FIPCOs operating in the United States.

2. Innovation and financialization: PLIPOs

The innovation rationale for a PLIPO is that, in the presence of a new technology, such as integrated circuits in the 1960s and rDNA in the 1970s, the integration of strategy and learning required to make the new technology functional is more effective in a small, focused firm than in a large, bureaucratic corporation. It is for this reason that, in pharmaceuticals, employees with advanced capabilities bent on new product development often leave a FIPCO to found or join a startup. These employees forego the employment security that the FIPCO can offer, but with the possibility of substantial realized gains from stock options and/or stock awards if and when the startup does an IPO or is acquired by an established publicly listed company. This loss of key personnel by FIPCOs to PLIPOs undermines the FIPCO learning processes, contributing to a low level of R&D productivity, thus reinforcing the exit from the FIPCOs of those scientists who want to be engaged in innovation. The FIPCO then seeks to use stock-based pay to compete for personnel and finds stock buybacks to be a tool to manipulate its stock price to make its compensation more attractive. In the process, the FIPCO's strategic focus on the organization learning required for innovation weakens further.

The challenge for the startup in developing a new product is to integrate the personnel whom it has attracted into effective organizational-learning processes. Addressing that challenge requires sources of committed finance. Hence the importance of venture capital—and more specifically venture capital provided by the limited-partner model that came to dominate in the United States from the 1970s[143]—as a source of financial commitment. The limited-partner model provides the general partner, who makes the actual investments in startups and monitors their progress, ten years of committed finance from institutional investors to make and then exit a start-up investment by going public or doing an acquisition deal. Through an IPO, the firm can raise additional investment funds, but if, as has often been the case in ICT, it does the IPO with a profitable product, the firm can use retained earnings to fund its growth. In addition, as exemplified by Cisco Systems' growth-through-acquisition model in the 1990s, the publicly traded firm can use its own stock as a combination currency.[144]

While the limited-partner model originated in the ICT industry, biopharma startups have also had access to venture capital, but, as we have seen, they generally do an IPO without a product. The paradox of the PLIPO model is that, through listing on NASDAQ, a young biopharma company without a commercial product can raise enormous amounts of cash in initial and secondary offerings. This fundraising is paradoxical because biopharma is an industry in which the uncertainty of whether the firm will ever be able to develop a commercial product—in this case a safe and effective medicine—is greater than in any other industry. Yet, historically, the stock market has not been an important source of funds for U.S. companies, either through IPOs or secondary issues.[145]

Rather, as stressed earlier in this essay, the prime function of the stock market has been to enable the separation of share ownership from managerial control, with venture capitalists viewing a listing on the stock market as an "exit" strategy—that is, a way to monetize their private-equity investments. The PLIPO model enables venture capitalists as well as the firm's entrepreneurs (with their founders' shares) and employees (with their stock-based pay) to cash in after an IPO. But a biopharma firm still needs hundreds of millions, if not billions, of dollars to provide financial commitment to the collective and cumulative learning processes that, like no other industry, are needed in biopharma to develop a commercial product. Some of these funds are raised through R&D collaborations with FIPCOs, which seek to gain by obtaining future licensing and marketing rights if and when a commercial product is available. Public stock offerings, are, however, often more important sources of finance for investment in the biopharma firm's productive capabilities.

Given the uncertainty of biopharma product development, rooted in the need for the collective and cumulative learning, why is biopharma the one industry which can raise huge sums on the stock market for investment in productive capabilities? The solution to the paradox—or what in 2011 Lazonick and Tulum called the "Pisano puzzle"—is the combination of a) government spending on life sciences research, mainly through the National Institutes of Health, the results of which are licensed to startups under Bayh-Dole; and b) the existence of the highly liquid NASDAQ stock exchange, which enables asset managers and hedge funds to sell their shares as quickly as they choose after absorbing a new stock issue. Access to NIH research offers the

potential for successful product development, while the existence of NASDAQ means that any party that buys newly issued shares in a PLIPO can (under normal circumstances) sell the shares whenever they so choose.

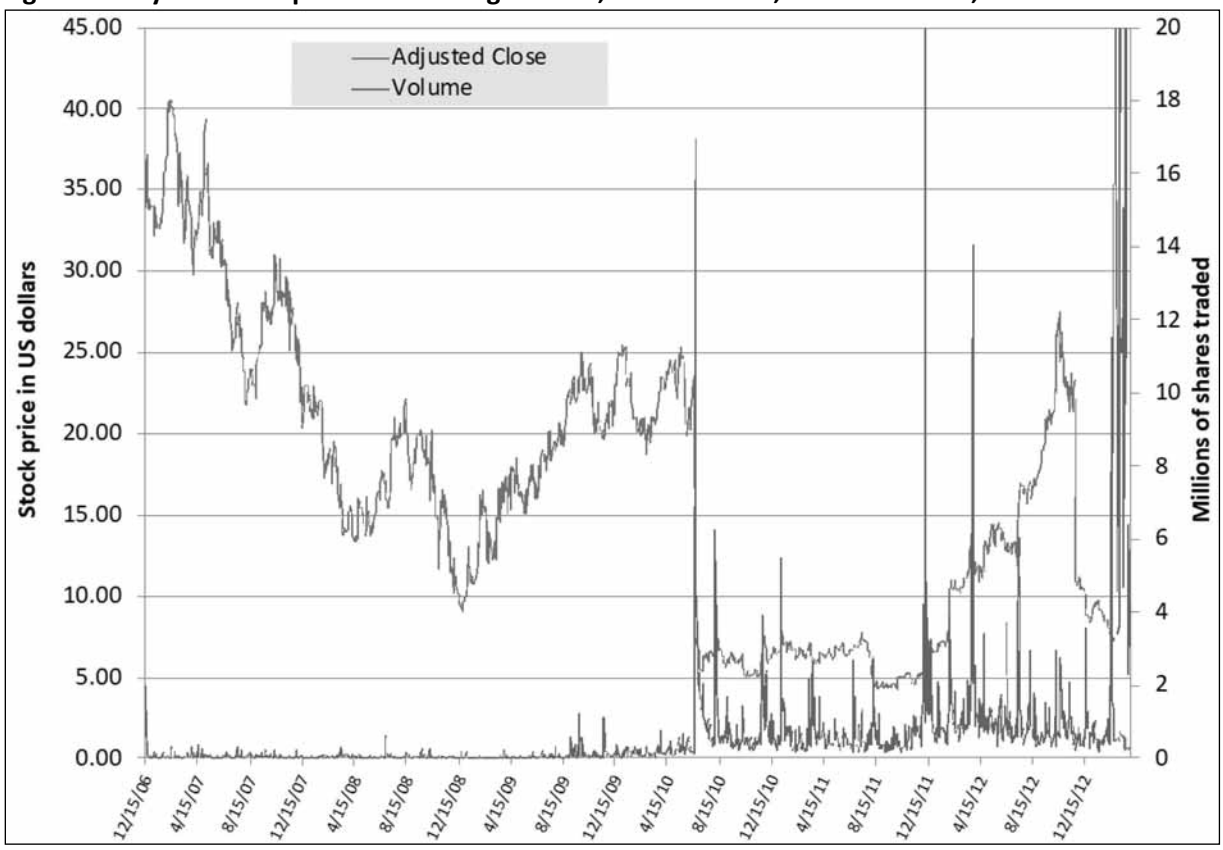
Given a highly liquid stock exchange, moreover, the very process of product development—with its patenting, licensing, pre-clinical testing, three phases of clinical trials, and submissions for FDA approvals—creates opportunities for stock-market traders to speculate on the stock-price effects of upcoming "news" as well as (in some cases) to seek to realize gains through manipulative behavior by trading with "insider" access to nonpublic material information.[146] For a PLIPO that ultimately gains FDA approval for a drug that it has developed over a period of years (or even decades), the company's stock price may be far higher in the earlier speculative phases of the drug-development process than when a product actually is approved by the FDA.

Take, for example, the case of Affymax, which was established in the Netherlands in 1988, with research facilities in Palo Alto, California. In 1995, Glaxo plc acquired Affymax for $533 million in cash and then spun it off to venture capitalists in 2001.[147] Affymax did its IPO in December 2006—18 years after it was founded—with its most advanced product Hematide (later renamed Omontys) under development in late stages of Phase II clinical trials. Its IPO prospectus stated that the company expected the product's Phase III trials to commence in early 2007, and, among risk factors, estimated that "clinical trials and related regulatory review in initial indications…will continue for at least four years, but could take significantly longer to complete."[148] On March 27, 2012, the FDA approved Omontys,[149] a competitor to Amgen's Epogen, and the company started to record product revenues in the second half of the year. Unfortunately, as a result of 12 deaths of users of Omontys subsequent to FDA approval, Affymax and its Japanese collaborator Takeda recalled the drug on February 23, 2013, with Affymax going into liquidation 16 months later.[150]

Figure 2 graphs Affymax's stock price and share trading volume from the time of its 2006 IPO on December 15, 2006, to March 28, 2013, one year after Omontys received FDA approval and just over a month after the product was pulled off the market (the stock price, which was $7.48 on February 22, 2013, fell to $1.10 the next day and was $0.62 on March 28). Note that Affymax's stock price was far higher for about a year after its IPO in December 2012 than it was on March 28, 2012—the day after FDA approval—when it was $13.15. "Adverse events" reports to the FDA began in August 2012, but the stock price rose steadily until mid-October. Even the post-approval peak price of $27.41 on October 16, 2012, was lower than any daily closing price from the IPO on December 15, 2006, through November 12, 2007.

Affymax, which Lazonick chose to scrutinize over a decade ago, in effect randomly, simply because it was the first alphabetically among a list of biopharma IPOs, is one of hundreds of PLIPOs in the history of the biopharmaceutical industry.[151] We have developed a methodology for researching and tracking the cash flows of these publicly listed companies and the extent to which venture capitalists, entrepreneurial founders, and company executives have been able to extract value from their shareholdings in these companies, independently of the productive and net-income performance of these companies.

Figure 2. Affymax stock price and trading volume, December 15, 2006-March 28, 2013



Source: Yahoo Finance, monthly stock-price data

We can then ask to what extent the trillions of dollars that have flowed into biopharma companies via initial and secondary stock issues since 1980 have funded innovation that has resulted in approved products and how much value financial interests in these companies have been able extract from stock-market transactions on shares that they have acquired through their involvement with these companies.

Our research seeks to analyze whether raising money on the highly speculative stock market has a positive or negative effect on medicine innovation. By doing stock issues, the PLIPO accesses significant funds that can be devoted to drug development. At the same time, however, those private-equity financiers, company founders, and senior executives who hold shares in the PLIPO can extract substantial funds—in some cases, hundreds of millions of dollars—for themselves, even when no product is forthcoming. What interest then do those financiers and executives have in investing corporate cash in the collective, cumulative, and uncertain processes required to develop innovative medicines? Indeed, do the senior executives whom the financiers place in positions of strategic control over corporate resource allocation even have ability to make and implement such investments in innovative capabilities?

Besides having a deleterious impact on strategic control as a social condition of innovative enterprise, speculative financing of biopharma companies can undermine organizational integration. As we have seen, a key characteristic of NEBM is interfirm mobility of highly educated

members of the labor force over the course of their careers. The existence of this type of interfirm mobility is critical to the PLIPO model because, in the face of uncertainty, startups can lure personnel who might otherwise find far more secure employment with FIPCOs. At the same, time, however, the hypermobility of biopharma labor tends to undermine collective and cumulative learning.[152]

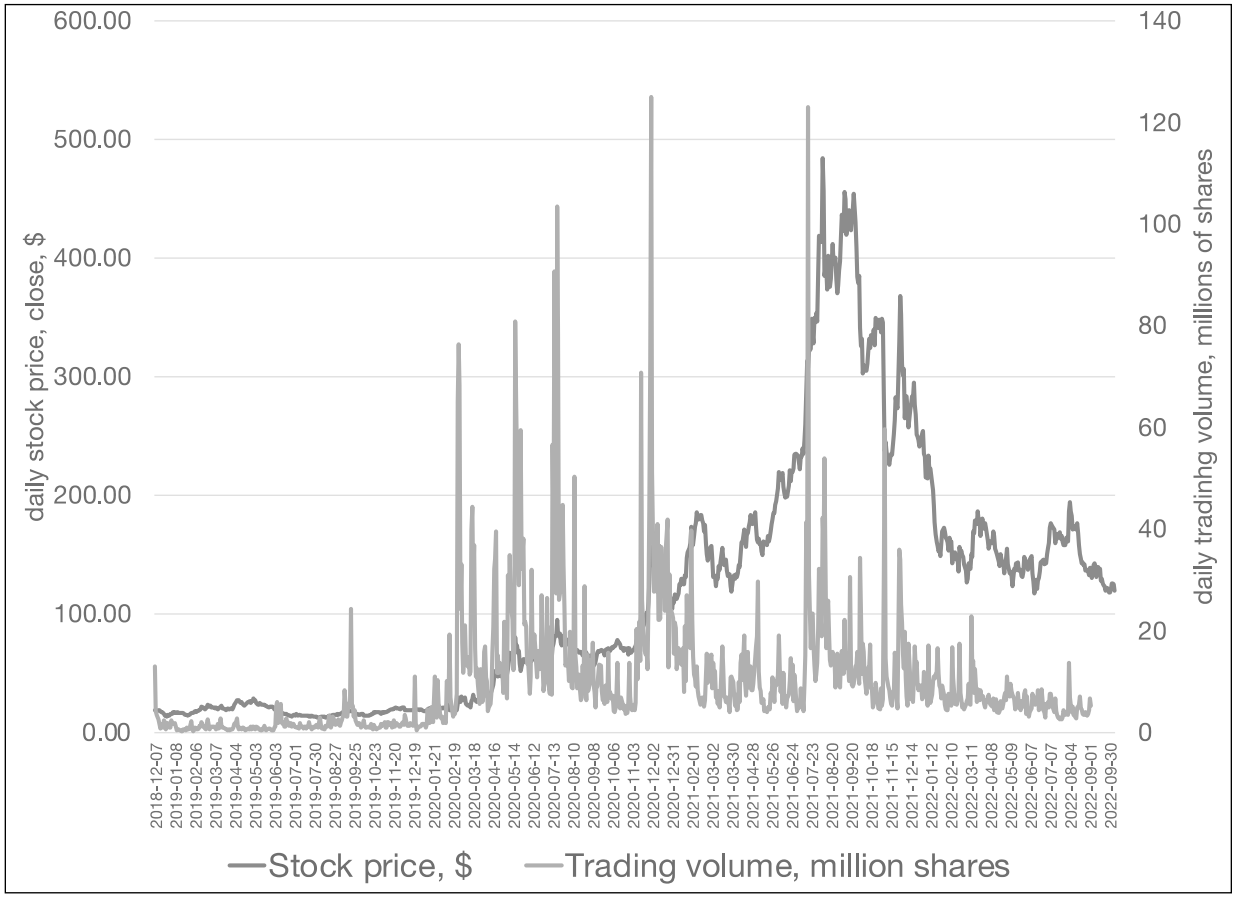
As a recent, and high-profile, example, with funding from INET and CIFAR, we have begun research on Moderna, as part of a project on the development of the Covid-19 mRNA vaccines by U.S.-based Moderna and Germany-based BioNTech and CureVac. Founded in Cambridge MA in 2010, when Moderna went public in December 2018, it was the largest biotech IPO in history.[153] Venture-backed by Flagship Pioneering, its CEO., Noubar Afeyan, hired Stéphane Bancel as Moderna's CEO in 2011. Bancel had obtained a Harvard MBA in 2000 and had most recently been the CEO of French diagnostics firm bioMérieux since 2007. At the 2018 IPO, Moderna had 680 employees and 21 drugs in development, with nine in Phase I and one in Phase II clinical trials. There was no expectation that a commercial product would emerge for several years. As CFO Lorence Kim was quoted as saying at the time of the IPO: "We're saying we can draw a picture that articulates an outsized return over time, and that outsized return comes from not one drug singly advancing by itself to approval, but instead by a technology that is pushed forward over time. The key thing for investors to wrap their arms around is: can we offer that sort of upside? We believe we can."[154]

Bancel was known as a hyper-aggressive fundraiser, with Moderna raising $2 billion in private-equity and another $600 million in the IPO, valuing the company at $7.5 billion.[155] At that time Flagship owned 19.5 percent of Moderna, Bancel 10.0 percent and AstraZeneca 8.4 percent."[156] With Moderna's stock price at $17.94 on June 6, 2019 (180 days after the IPO, when the lockup period for insider sales ended), Flagship's stake was valued at $1.1 billion and Bancel's at $551 million—with no commercial product in sight. Among other insiders, Harvard Medical School professor Timothy Springer, who had invested $5 million in the company at its founding, saw his stake of 5.3 percent after the IPO valued at $311 million; Robert Langer, the star scientist who co-founded Moderna and was on its board, held 3.6 percent of the shares, valued at $210 million; Stephen Hoge, who had been hired by Moderna six years the IPO and had been president three years earlier, held 1.3 percent of the shares with a valuation $73 million; Lorence Kim, CFO, who had joined Moderna in 2015 after 14 years as head of biotech investment banking at Goldman Sachs, held 0.7 percent of the shares with a valuation $41 million.

Figure 3 shows Moderna's stock-price movements and trading volume from December 7, 2018, the day after its IPO, to March 4, 2022. The stock price increased by 2.8 times, from $18.23 to $51.20, from February 21, 2020, to April 22, 2020, as the company became highly visible along with SARS-CoV-2. The price then rose to a new peak of $169.86 on December 8, 2020, on speculation of the pending EUA of the Covid-19 vaccine—the BioNTech/Pfizer vaccine was granted EUA on December 11 and the NIH/Moderna/Lonza vaccine on December 18. By December 31, 2020, the Modern stock price had declined to as low as $104.47, as the United States awaited supplies of the vaccine and then moved up to a new peak of $183.74 on February 12, 2021, as the vaccine became widely available. There was a subsequent decline of the stock

price to as low as $118.49 on March 30, 2021, as the Biden administration made good on its promise to ramp up vaccinations of Americans. But then, with the coming of the Delta variant to the United States from March 2021 and the surge in cases in the summer, the Moderna stock price exploded to an all-time high (thus far) of $484.47 on August 9, 2021. As of October 7, 2022, it was at $119.32, almost 30 percent lower than on December 8, 2020, prior to the NIH/Moderna/Lonza vaccine receiving EUA from the FDA.

Figure 3. Moderna, daily stock prices and trading volume, December 7, 2018, to October 7, 2022



Source: Yahoo Finance, daily historical stock prices

AstraZeneca, which had invested $240 million in Moderna, beginning in 2013, to acquire mRNA knowledge, sold its remaining 7.7 percent stake in the company for $1.2 billion in March 2021.[157] Meanwhile, Flagship Pioneering and Moderna senior executives were cashing in. Moderna's chief medical officer, Tal Zaks, sold stock to the tune of $1 million per week from May 2020.[158] In October 2020, two months before the approval of the Moderna vaccine, Nell Minow, a leading figure in U.S. corporate-governance debates, told *STAT* that "in her 20 years of shareholder advocacy, she could not recall an executive at a public company who had sold stock as frequently as Zaks has in 2020."[159] Moreover, in February 2021, Zaks announced that he would leave the company (riches in hand) in September 2021.[160] By April 2021, the Moderna stock sales of its chairman, Afeyan, were $1.4 billion, CEO Bancel $161 million, CMO Zaks $108 million, president Hoge $66 million, and chief technology officer Juan Andres $27 million.[161] As we have seen in

Table 6, among the highest-paid pharma executives were Zaks and Kim in 2020 and Andres and Hoge in 2021.

As illustrated by these sketches of the cases of Affymax and Moderna, our PLIPO project will create a database of value creation and value extraction at (over time and with sufficient funding) of U.S. biopharma startups that do IPOs to determine to what extent this business model works to deliver innovative medicines and to what extent to make its inside shareholders rich. As in the case of Moderna, a PLIPO can do both, although our research on the Moderna case thus far indicates that the NIH was far more important than Moderna itself for the development of a safe and effective Covid-19 vaccine.[162]

Moreover, our research also strongly suggests that, as an innovative enterprise, the German firm BioNTech was the epitome of organizational integration, with sources of financial commitment to the innovation process that were far smaller, quantitatively, than those funds available to Moderna but far more dedicated, qualitatively, to value creation. BioNTech's power as an innovative enterprise to some extent resided in the strategic control exercised by its scientist founders Uğur Şahin as CEO and Özlem Türeci as CMO.[163] But it also, in our view, reflects differences in the German socioeconomic system, manifested in the ways in which (as studied from the SCIE perspective) the nation's governance, employment, and investment institutions enable value creation and constrain unwarranted value extraction/ The German institutions are markedly different from those that prevail in the United States. The study of how U.S. economic institutions enable and undermine innovative enterprise, placed in historical perspective for the United States and in comparative perspective across competitor nations, is the focus of the third part of our research agenda.

3. National institutions for medicine innovation

This part of the project will delve into the ways in which governance, employment, and investment institutions in the United States support corporate innovation in the US pharmaceutical industry or, alternatively, enable (and even encourage) corporate financialization. Some of these institutions, such as the SEC, are general to the whole U.S. corporate economy, while others, such as the FDA, are specific to the pharmaceutical industry. In what follows, indicative of our ongoing research agenda, we provide brief overviews of some of the issues raised by AIRnet and SciIndustry research concerning U.S. governance, employment, and investment institutions.

3.1 Governance

Ford and Drug Administration (FDA): Created in 1906, the FDA's responsibility for ensuring the safety of products used on or ingested into the human body was greatly increased with the passage of the Federal Food, Drug, and Cosmetic Act of 1938. By assuring the public that medicines that are commercialized are safe and effective—i.e., high quality—the FDA, as an agency of the Department of Health and Human Services (HHS) supports corporate innovation. Decisions taken by the U.S. FDA provide important guidelines for pharmaceuticals regulators

around the world, thus supporting the access of drugs approved for use in the United States in other national markets. Cleary, the FDA can make mistakes; the approval and then withdrawal of the Affymax drug, mentioned above, is just one case in point. The question for our research agenda is whether FDA decisions concerning the safety and effectiveness of drugs are compromised by pressures from financial interests.

Opportunities for such influence can occur under any circumstances but may be exacerbated when a pharma company has secured FDA "Fast Track" treatment for the decision to approve a drug for use.[164] Considerable controversy occurred in 2016, when the FDA approved Sarepta Therapeutic's Duchenne muscular dystrophy drug, eteplirsen (EXONDIS 51), even though the evidence did not yet exist that it was safe and effective. Sarepta's argument, accepted by the FDA's Center for Drug Evaluation and Research, was that the only way to secure the funds required for clinical trials for this rare and genetic disease was through accelerated FDA approval, which would then enable Sarepta (publicly listed since 1997) to raise new rounds of money on the stock market. FDA scientists who reviewed the decision opposed it, but the FDA commissioner enforced it.[165]

Another case, on which we have done considerable research, is the FDA's emergency use authorization on December 23, 2021, of molnupiravir (Lagevrio), the Covid-19 antiviral pill developed by Emory University and licensed to Ridgeback Biotherapeutics, which in turn licensed the drug to Merck in May 2020.[166] The FDA advisory committee voted 13-10 to give molnupiravir emergency use authorization (EUA), even though clinical trials had shown that it was far less effective than Pfizer's Covid-19 antiviral pill, Paxlovid, that had just been given EUA, without an advisory panel, the day before. In the case of molnupiravir, there are significant concerns that it is mutagenic.[167] Reflecting these safety concerns, the EUA for Lagevrio is only in cases for which "alternative Covid-19 treatment options approved or authorized by FDA are not accessible or clinically appropriate."[168] The alternative treatment is Paxlovid. In July 2022, the FDA gave permission to pharmacists to prescribe Paxlovid, but not Lagevrio.[169] Nevertheless, in the first quarter of 2022, Lagevrio outsold Paxlovid by $3.2 billion to $1.5 billion, partly because in June and November 2021, even before molnupiravir has secured EUA, BARDA had contracted for 3.1 billion courses at $2.2 billion through early 2022 and partly because of the use of the former drug outside the United States.[170]

Intellectual Property Rights (IPRs): The case of Lagevrio is one that raises questions about financialization because Ridgeback Biotherapeutics is a sham biopharma company.[171] Its proprietors, Wendy and Wayne Holman, built their careers as biopharma stock pickers, and the funds used to found Ridgeback Bio came from Wayne Holman's Ridgeback Bio, which in turn made most of its money as a stock trader for Steven Cohen's SAC Capital, at a time when that hedge fund was implicated for insider trading on nonpublic information concerning biopharma clinical trials.[172] Our extensive research on Ridgeback Bio and its IPR over an Ebola drug that it was able to license from the National Institute for Allergy and Infectious Diseases as well as its involvement in bringing Lagevrio to market are red-flag alerts about the credentials and capabilities of supposed biopharma companies that can gain strategic control over critical IPR. It also is an example of the financialization of the process of technology transfer from universities—

in this case, Emory—to a firm such a Ridgeback Bio, which has been granted the license to commercialize the technology[173]

Research on innovation versus financialization in pharmaceuticals is inherently concerned with patents, as the most important form of IPR. In principle, patents are awarded to individuals to enable them to invest in and profit from novel ideas. In practice, however, the innovation process requires the organizational integration of large numbers of people to engage in collective and cumulative learning, enabled by financial commitment over a sustained period of time. For this reason, historically, individual inventors have licensed their patents to business corporations that can engage in organizational integration and financial commitment

The patent system is often abused. Corporations have been known to license patents for the purpose of stifling innovation processes that might render their existing products obsolete. Individuals or organizations, known as patent trolls, engage in the business of patenting and licensing the patents of others for the purpose of extracting fees from corporations which, they charge, are infringing on their patents. More generally, with the transition from OEBM to NEBM, the role of patents transitioned from the protection of a corporation's claim to IPRs required to protect investments in innovation processes to patent markets in which a corporation could strategically use patents as revenue generators or bargaining chips in interfirm deals.

Most germane to our perspective on the relation between innovation and financialization, FIPCOs often acquire other pharmaceutical companies with years of patent life left on drugs that have already proven to be highly lucrative for the purpose of using the profits to increase distributions to shareholders and pump up stock yields. Since the 1990s, the growth of Pfizer and Merck in particular has been dependent on this financialized M&A strategy. As we have seen, in 2019 Pfizer saw the need to suspend its buybacks because the patents on drugs that it had acquired were expiring but has started doing them again with the profits on its Covid-19 bonanza, the result of its strategic alliance with Germany-based BioNTech.

Strategic control over patents has been fundamental to the emergence of the PLIPO model out of the biopharma startup sector. The Bayh-Dole Act of 1980 ratified the right of academic scientists (or the research institutions for which they work) conducting federally funded research to license the results of that research to commercial enterprises. Bayh-Dole enabled the proliferation of biopharma startups subsequent to the product-less IPO of Genentech in 1980. As we have stressed in this essay, however, this governance institution creates opportunities for financial interests to enrich themselves even when no approved drugs are forthcoming. Our ongoing research focuses on the particular role of patents as an institutional mechanism governing the relation between innovation and financialization in the PLIPO segment of the U.S. drug industry.

In our 2011 *Research Policy* article on the sustainability of the U.S. biopharma boom, we demonstrated the importance of the Orphan Drug Act of 1983 in supporting the generation of a number of blockbuster drugs, which in effect bestowed legitimacy on the PLIPO model by demonstrating that it occasionally resulted in commercial products.[174] The key provision on the

Act that renders it a governance institution is the seven-year market exclusivity that it provides to a drug company from the date at which the FDA authorizes commercial use of the drug. This market exclusivity is distinct from any patent rights to the drug that the company holds. Moreover, unlike a patent, which commences at a very early stage of drug research and expires after 20 years, market exclusivity begins at the point at which the product can generate revenues. Given the length of time that can be required to develop a drug, it can happen that market exclusivity is in force after underlying patents have expired. Nevertheless, market exclusivity under the ODA rewards innovation because it only becomes effective when a drug approved by the FDA is actually on the market. The question remains, however, whether the particular parties that developed a successful orphan drug are the ones who control the slae of the drug and hence benefit from ODA market exclusivity.

Unregulated drug prices: While the ODA has incentivized the search by business corporations for medicines that provide solutions to rare and genetic diseases, these drugs have enormous price tags, as is generally the case for prescription drugs in the United States. The recently adopted Inflation Reduction Act gives Medicare the right to enter into drug-price negotiations with the pharmaceutical industry for a small number of medicines. The agency lacks, however, a theoretical perspective that can provide a logical foundation, buttressed by empirical evidence, for taking a position on what the price of any particular drug should be. Collington and Lazonick provide such a framework in their paper, "Pricing for Medicine Innovation." An ongoing objective of our research is to promulgate this framework with a view to having HHS devote resources to train price negotiators and their support teams in how to implement it.

Securities and Exchange Commission (SEC): AIRnet research has documented how, with the adoption of SEC Rule 10b-18 in November 1982, the government agency that was supposed to police manipulation of the nation's stock markets became an enabler of it. As indicated in this essay, our research has documented the extent to which leading Big Pharma companies such as Merck and Pfizer have become among the leading stock repurchasers, going back to the mid-1980s. In 1985 US Representative Henry Waxman (D-CA), chair of the House Subcommittee on Health and the Environment, accused the pharmaceutical industry of "gouging the American public" with "outrageous" price increases, driven by "greed on a massive scale."[175] The US pharmaceutical industry's invariable response to demands for price regulation has been that it will kill innovation. US drug companies claim that they need higher prices than those that prevail elsewhere so that the extra profits can be used to augment R&D spending. The result, they contend, is more drug innovation that benefits the United States and, indeed, the whole world

It is a compelling argument—until one looks at how major US pharmaceutical companies actually use the profits that high drug prices generate. In the name of "maximizing shareholder value," pharmaceutical companies allocate profits generated by high drug prices to massive stock buybacks for the sole purpose of giving manipulative boosts to their stock prices. Yet, in over three decades in which Rep, Waxman made concern over pharmaceutical price gouging the foremost issue of his long Congressional career, he never once questioned Big Pharma on how they were using the profits from high drug prices. Our research on buybacks in the

pharmaceutical has now made this use of Big Pharma's profits a focus on some Congressional efforts to rein drug prices.[176]

Corporate boards: The ideology, pervasive in the United States, is that only shareholders are the only participants in companies who invest in its productive capabilities without guaranteed financial returns. It *might* then be argued that only representatives of shareholders should have directorships on corporate boards, overseeing general corporate affairs. We say "might be argued" because, especially with companies engaged in healthcare, a strong case can be made that a certain proportion of directorships should be reserved for board members acting in the public interest.

More narrowly, however, it is erroneous to assert that only shareholders make investments in productive capabilities without guaranteed returns. Through government investments in human capabilities and physical infrastructure, taxpayers regularly provide productive resources to companies without a guaranteed return. Through their skills and efforts, workers regularly make productive contributions to the companies for which they work that are beyond the levels required to lay claim to their current pay. However, they do so without guaranteed returns. As Lazonick has argued at length, households as taxpayers and workers should have positions on corporate boards to advocate for investments in innovative capabilities and to ensure that just rewards for their productive contributions flow to taxpayers and workers when, through the generation of higher-quality, lower-cost products, those investments yield financial returns.

Proposals have been made in the U.S. Congress for the reform of corporate boards. U.S. Sen. Tammy Baldwin (D-WI) has put forward the Reward Work Act, which would rescind SEC Rule 10b-18 and require that worker representatives constitute at least one-third of the board members of any publicly listed corporation in the United States.[177] In October 2022, U.S. Representatives Jesús García (D-IL), Peter DeFazio (D-OR), and Ro Khanna (D-CA) reintroduced the Reward Work Act in the House, in partnership with 11 other Democratic representatives.[178] U.S. Sen. Elizabeth Warren (D-MA) has introduced the Accountable Capitalism Act, which would create national charters for all publicly listed corporations with $1 billion or more in revenues, with employee representatives constituting 40 percent of board members, with a mandate to advocate for a more equitable distribution of corporate revenues.[179]

Our collaborative research seeks to provide empirical and logical support for such governance reform, with a view to attaining more stable and equitable growth in both the pharmaceutical industry and in the U.S. economy as a whole. Our research on "predatory value extraction" also demonstrates the importance of not only broader stakeholder representation on corporate boards but also the exclusion of hedge-fund activists, whose power to extract value from companies in the form of buybacks and dividends has increased immensely, in part because of the National Securities Markets Improvement Act of 1996 and the SEC 2003 ruling that all fund managers must give proxy votes on the shares in their portfolios.[180]

3.2 Employment:

National Institutes of Health: According to the NIH website, the world's foremost organization for medical research awards 60,000 research and training grants annually, supporting 300,000 researchers at 2,500 universities and other facilities. In 2016, NIH extramural training grants covered 9.500 pre-doctoral researchers and 5,900 post-doctoral fellows, while its intramural programs in NIH labs involved 1,200 principal investigators and 4,000 post-doctoral fellows.[181] This employment provides the knowledge base that makes pharmaceutical innovation possible.

For example, a *Washington Post* article on a meeting in Silicon Valley in 1984, on the occasion of a visit by French president François Mitterrand, reported that venture capitalist Thomas Perkins "extolled the virtues of risk-taking investors who finance the entrepreneurs." Stanford professor Paul Berg, a Nobel laureate for research in genetic engineering, interrupted:

> "Where were you guys in the '50s and '60s when all the funding had to be done in the basic science? Most of the discoveries that have fueled [the industry] were created back then…. I cannot imagine that, had there not been an NIH funding research, there would have been a biotechnology industry."[182]

More recently and more directly, Kizzmekia Corbett and Barney Graham of the NIAID Viral Research Center led the NIH team that developed the Covid-19 vaccine which, given to Moderna with other massive government subsidies, has brought tens of billions of dollars in profits to that PLIPO along with hundreds of millions of dollars in personal income to its top executives. Our collaborative research in this area will build on the pioneering work of SciIndustry in documenting the NIH origins of approved medicines to look more closely at who took the risks compared with who reaped the rewards.

U.S. higher education system: Historically, the foremost achievement of the U.S. developmental state was the building of a system of higher education that served the demands of the U.S. agricultural and industrial economy for highly educated labor.[183] Through the 1970s, public state universities, based on the land-grant college system, kept tuition free or very low cost for the sake of developing a highly qualified U.S. labor force. With this long-term investment in a system of higher education in place, the GI Bill subsidized the college educations of millions of Americans, enabling the emergence of the military-industrial complex in the 1950s and 1960s. College graduates, armed with advanced degrees, entered a wide range of technological and scientific fields, including medical research.

Besides NIH-funded research labs, large numbers these graduates found learning opportunities through employment as scientists and engineers in U.S. industrial corporations engaged in medical research. This type of career employment is exemplified by the experience of Gerald McGinnis, founder and top executive the ventilator company Respironics that has been the subject of Matt Hopkin's recent research.[184] Born in 1935, McGinnis enlisted with the U.S. military for the Korea War so that he would be eligible for the funding of his college education under the GI Bill. The first person in his family to go to college, he received his bachelor's degree

in mechanical engineering from the University of Illinois in 1958. He then took a job in Pittsburgh at Westinghouse, which funded his master's degree in bioengineering while, over the course of 11 years he became an expert in pulmonary engineering. McGinnis left Westinghouse in 1969 when, in line with the conglomerate model that captured U.S. industrial corporations in the 1960s, he had to answer to a new division boss who held the view that "a good manager could manage anything." McGinnis then took a research position at Allegheny General Hospital with a view to gaining the specific expertise and financial backing to start his own company, setting up Lanz Medical, the predecessor to Respironics in 1971. He then oversaw the growth of Respironics to $1.2 billion in revenues and 5,000 employees before selling the company (which had been listed on NASDAQ in 1988) for $5.1 billion to Philips in early 2008.

In the 1980s compared with the 1960s, someone like McGinnis could not have expected to receive either tuition-free (let alone subsidized) higher education or corporation-funded career training of the type that Old Economy company Westinghouse had provided. The cost of tuition at public universities exploded, with high-interest student loans as the new source of government funding,[185] while the "career-with-one-company" employment policy from which McGinnis had benefited at Westinghouse was rapidly eroding.[186] Meanwhile, in the 1980s and 1990s, the demand for scientists and engineers was booming, with the void being filled with college-educated immigrants from abroad, enabled by changes in U.S. immigration policy.

Lazonick, Moss, and Weitz have documented and analyzed these changes for ICT companies, drawing heavily on EEO-1 diversity data, submitted annually by companies to the Equal Employment Opportunity Commission. In our ongoing research, AIRnet and SciIndustry plan to carry out the same analysis for the pharmaceutical industry, focusing on H-1B, J-1, and L-1 temporary visa programs and employment-based preference immigration programs. According to one account, at the end of the 2010s just over half of the 69,000 biomedical researchers in the United States were foreign born.[187]

3.3 Investment

National Institutes of Health: The 2021 budget of the U.S. National Institutes of Health (NIH) was $43 billion, part of a total NIH investment in life-sciences research spanning 1938-2021 that adds up to about $1.3 trillion in 2021 dollars. The funding request for 2022 is $45 billion.[188] Businesses that make use of NIH-sponsored research benefit from the public knowledge that it generates. It is clear that the NIH itself does not receive returns from its investments in drug innovation that are commensurate with its contributions to the process.

Yet, it could be argued that U.S. households as consumers of pharmaceutical drugs reap returns in the form of safe and effective medicines. This claim, which is made by the pharmaceutical industry, is undermined by the high cost of drugs, their inaccessibility to many Americans who need them, and the use of corporate profits from drug sales to boost corporate stock yields. Using the framework presented in Collington and Lazonick's paper on pricing for medical innovation, one can derive a product price based on value-creating logic rather than value-extracting greed.[189] Society can then decide to what extent it should make medicines more accessible and

affordable to those individuals who have the misfortune to need them. As stated previously in this essay, there is considerable work for us to do to demonstrate the validity and promulgate the application of this approach.

The use of the argument for value-based pricing—the notion that the price that a pharmaceutical company should charge for a drug is the value in terms of the beneficial impacts on patients—is in plain view in statements made by Albert Bourla, CEO of Pfizer, on the process of pricing the BioNTech/Pfizer mRNA vaccine, laid out in a book on the company's involvement in the mRNA vaccine. Value-based pricing is Bourla's starting point: "The way we price our medicines is by calculating the value they bring to patients, to the healthcare system, and to society."[190] As for pricing the Covid-19 vaccine that Pfizer was bringing to market, based on BioNTech research, Bourla goes on:

> I asked our pricing team to calculate the usual economics of the global COVID-19 crisis, and they came back with staggering numbers. For an assumed 65 percent efficacy, the reduction of hospitalization costs alone would be hundreds of billions of dollars. We could price the vaccine at $600 per dose, and still the healthcare system would pay less than it saves—not counting the value of human lives saved.[191]

Now, having used value-based pricing to estimate what Pfizer should charge for the vaccine, Bourla can the portray himself as a servant—and savior—of society by coming up with a vaccine price that, at $20, is, as he puts it: *"The cost of a simple meal."* Here is how, in the process of pricing discussions and negotiations, Bourla got from the $600 that Pfizer should have charged to its magnanimous gesture in adopting what we might call a McDonald's price:

> …while these discussions were ongoing, a level of discomfort started gnawing at me. I was thinking that we might be missing an opportunity to gain something more valuable than a fair financial return. We had a chance to gain back our industry's reputation, which had been under fire for the last two decades. In the US, pharmaceuticals ranked near the bottom of all sectors, right next to the government, in terms of reputation. I again asked the pricing team to give me the current prices of the cheapest commodity vaccines. In the US, flu vaccines cost up to $70, but they also offered a low protection rate of around 50 percent. Their low end is around $20 to $30.[192]

A major goal of our research on investment institutions in the U.S. pharmaceutical industry is to make clear that Bourla's starting position on drug pricing is not only immoral but also illogical.

Other sources of government funding of the pharmaceutical industry: Besides the obvious NIH funding of the pharmaceutical industry—which is more than twice as high now in real terms than it was two decades ago, our research on medical innovation identifies subsidies provided by government agencies such as DARPA and BARDA, ongoing programs such as ODA, and emergency programs such as Operation Warp Speed. The willingness of the U.S. government to fund these programs, under both Democratic and Republican administrations and for purposes of both public health and national security, represents a significant investment institution within the SCIE

framework. To support innovation and mitigate financialization, the sources and uses of the various types of government funding need to be fully documented and analyzed.

Securities and Exchange Commission: The mission statement on the SEC website read: "The Investor's Advocate: How the SEC Protects Investors, Maintains Market Integrity, and Facilitates Capital Formation."[193] In our writings on the SEC, including public-comment submissions, AIRnet contended that with Rule 10b-18 in place as "a license to loot" the SEC undermined all three components of this mission.

Under Rule 10b-18, when the SEC permits massive manipulation of the stock market, it fails to protect "investors"—among whom the SEC presumably includes households as savers. Households that allocate a portion of their savings to purchase the shares of publicly listed companies want those shares to yield an income stream from dividends (where available) while they are holding the shares, and they want to realize gains from stock-price increases when they decide to sell the shares. Only by generating innovative products can a company provide these stock yields on a sustainable basis. Payment of dividends to shareholders should be determined after rewards, including wage increases, have been distributed out of profits to the company's employees—the real value creators—and after the company's needs for reinvestment of profits to remain competitive have been met. If the corporation invests in innovation and can generate higher-quality, lower-cost products, we can expect that its stock price will increase. There is no need to do stock buybacks to manipulate the company's stock price.

Stock buybacks done as open-market repurchases do not benefit households as savers, except by accident. Open-market repurchases carried out in accordance with Rule 10b-18 benefit stock market traders—including senior corporate executives, hedge-fund managers, and Wall Street bankers—who are in the business of timing the buying and selling of shares to reap gains from stock-price changes. These traders have access to real-time information on buyback activity that households do not possess.[194] If the SEC wants to protect households that place some or all of their savings and retirement funds in outstanding corporate shares, it should rescind Rule 10b-18 and call for a ban on open-market repurchases.[195]

When the SEC permits massive manipulation of the stock market under the aegis of Rule 10b-18, it fails in its second mission: to ensure "fair, orderly, and efficient" markets. The stock market is not fair when predatory value extractors are granted the right to manipulate stock prices for their own gain, with the corporation often price gouging consumers, shortchanging suppliers, and laying off employees for the sake of increasing profits to be distributed to shareholders. The stock market is not orderly when stock prices are boosted by stock buybacks, often funded by debt as well as by profits that are increased by layoffs of workers and price-gouging of consumers.[196] In a competitive process to keep up with the market in stock-price performance, companies escalate buybacks when stock prices are high, helping to set up the manipulated stock market for a precipitous fall. By enabling manipulation of stock prices and fomenting speculation in a surging stock market, stock buybacks contribute to disorderly markets.

Moreover, there is nothing efficient about a stock market that is manipulated by stock buybacks. For households as savers, the stock market cannot be an efficient way of enhancing the value of their savings when a small number of predatory value extractors benefit from rules of the game that give insiders most of the stock-market gains. If the SEC wants to use its regulatory power to make U.S. stock markets more fair, more orderly, and more efficient, it should rescind Rule 10b-18 and call for a ban on open-market repurchases.

Far from facilitating capital formation, as the SEC claims they do, stock buybacks undermine investment in productive capabilities, including investments in human capabilities as well as expenditures on plant and equipment. Earnings retained out of profits are the foundation of corporate finance for investment in productive capabilities, and stock buybacks, coming on top of ample dividends, have persistently depleted the retained earnings of U.S. business corporations. Significant amounts of those distributions augment the war chests of hedge-fund activists, giving them even more power to engage in predatory value extraction.[197]

For the SEC to be positioned to use its regulatory power for the purpose of encouraging capital formation—that is, investments in productive capabilities that can generate economic growth—the U.S. Congress should rescind Rule 10b-18 and call for a ban on open-market repurchases.[198] A key challenge of our ongoing research is to educate the informed public and policy makers about the centrality of a "retain-and-reinvest" allocation regime as a foundation of capital formation and the need for Congress and the SEC to ban stock buybacks done as open-market repurchases as a social condition for achieving stable and equitable economic growth in the U.S. economy.

Notes:

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[3] E. Galkina Cleary, J.M. Beierlein, N.S. Khanuja L.M. McNamee, F.D. Ledley, "Contribution of NIH Funding to New Drug Approvals 2010-2016," *Proceedings of the National Academy of Sciences*, 115, 10, 2018: 2329-2334; Fred D. Ledley, Sarah Shonka McCoy, Gregory Vaughan, Ekaterina Galkina Cleary, "Profitability of Large Pharmaceutical Companies Compared With Other Large Public Companies," *JAMA*, 323, 9, 2020: 834-843; Ekaterina Galkina Cleary, Laura M. McNamee, Skyler de Boer, Jeremy Holden, Liam Fitzgerald, and Fred D. Ledley, "Comparing Long-Term Value Creation after Biotech and Non-Biotech IPOs, 1997–2016," *PLOS ONE*, January 6, 2021; Anthony E. Kiszewski, Ekaterina Galkina Cleary, Matthew J. Jackson, and Fred D. Ledley, "NIH Funding for Vaccine Readiness before the COVID-19 Pandemic, *Vaccine*, 39, 17, 2021: 2458-2466; Laura M. McNamee, Ekaterina Galkina Cleary, Sunyi Zhang, Usama Salim, and Fred D. Ledley, "Late-stage Product Development and Approvals by Biotechnology Companies After Initial Public Offering, 1997-2016," *Clinical Therapeutics*, 43, 1, 2021: 157-171 and Appendix; Ekaterina Galkina Cleary. Matthew J. Jackson, and Fred D. Ledley, "Government as the First Investor in Pharmaceutical Innovation: Evidence from Drug Approvals 2010-2019, Institute for New Economic Thinking Working Paper No. 133, July 19, 2021; Fred D. Ledley and Gregory Vaughan, "Will Reducing Drug Prices Slow Innovation?," *Science and Industry*, August 2021.

[4] William Lazonick, ""The Theory of Innovative Enterprise: Foundations of Economic Analysis," in Thomas Clarke, Justin O'Brien, and Charles R. T. O'Kelley, eds., *The Oxford Handbook of the Corporation*, Oxford University Press, 2019: 490-514.

[5] William Lazonick, "The Functions of the Stock Market and the Fallacies of Shareholder Value," in Ciaran Driver and Grahame Thompson, eds., *What Next for Corporate Governance?* Oxford University Press, 2018: 117-151.

[6] The distinction between the Old Economy business model (OEBM) and the New Economy business model (NEBM) is central to the analysis in William Lazonick, *Sustainable Prosperity in the New Economy? Business Organization and High-tech Employment in the United States*, W. E. Upjohn Institute for Employment Research, 2009.

[7] Antonio Gargano, Alberto G. Rossi, and Russ Wermers, "The Freedom of Information Act and the Race toward Information Acquisition," *Review of Financial Studies*, 30, 6, 2017: 2179-2228.

[8] As an important example relevant to biopharmaceuticals, see Sheelah Kolhatkar, *Black Edge: Inside Information, Dirty Money, and the Quest to Bring Down the Most Wanted Man on Wall Street*, Random House, 2017.

[9] Gene Smiley and Richard H. Keehn, "Margin Purchases, Brokers' Loams and the Bull Market of the Twenties," *Business and Economic History,* second series, 17, 1988: 129-142.

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The Atlantic, September 15, 2016; William Lazonick and Matt Hopkins, "If the SEC Measured CEO Pay Packages Properly, They Would Look Even More Outrageous," *Harvard Business Review*, December 22, 2016.

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[14] Giacomo Tognini, "VC firm of Moderna chairman sold $1.4 billion of stock in two months," *Forbes,* April , 22, 2021; Spencer Kimball, "Moderna CEO Stephane Bancel has sold more than $400 million of company stock during the pandemic" *CNBC*, March 17, 2022.

[15] Lazonick et al., "U.S. Pharma's Business Model"; Roy, The Financialization of a Cure. Note that the 2017 paper by Lazonick et al. is a revision of two submissions that AIRnet made in March 2016 to the UN Secretary General's High-Level Panel on Access to Medicines.

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[17] United States Census Bureau. "2019 SUSB Annual Data Tables by Establishment Industry," February 2022.

[18] Lazonick, "The Theory of Innovative Enterprise."

[19] Author's calculations based on S&P Compustat database.

[20] "FDA stands by approval of OxyContin," *Judge for Yourselves*,

[21] U.S, Senate Committee on Health, Education, Labor, and Pensions, "OxyContin: Balancing Risks and Benefits," Senate Hearing, February 12, 2002.

[22] William Lazonick and Jang-Sup Shin, *Predatory Value Extraction: How the Looting of the Business Corporation Became the US Norm and How Sustainable Prosperity Can Be Restored*, Oxford University Press, January 2020.

[23] AIRnet calculations based on S&P Compustat database.

[24] Securities and Exchange Commission, "Purchases of Certain Equity Securities by the Issuer and Others; Adoption of Safe Harbor," November 17, 1982, *Federal Register* 47, 228, November 26, 1982: 53333–53341.

[25] "Division of Trading and Markets: Answers to Frequently Asked Questions Concerning Rule 10b-18 ('Safe Harbor' for Issuer Repurchases)," Securities and Exchange Commission, Division of Trading and Markets,. For the safe harbor to be in effect, Rule 10b-18 also requires that the company refrain from doing buybacks at the beginning and end of the trading day, and that it execute all the buybacks through one broker only.

[26] Lloyd H. Feller and Mary Chamberlin, "Issuer Repurchases," *Review of Securities Regulation,* 17, 1, 1984: 993–998. See William Lazonick and Ken Jacobson, "Letter to SEC: How Stock Buybacks Undermine Investment in Innovation for the Sake of Stock-Price Manipulation," Institute for New Economic Thinking, April 1, 2022 (submitted to the U.S. Securities and Exchange Commission as a public comment on Share Repurchase Disclosure Modernization, File No. S7-21-21).

[27] See "Data Appendix on Open Market Repurchases," in Lenore Palladino and William Lazonick, "Regulating Stock Buybacks: The $6.3 Trillion Question," *International Review of Applied Economics*, online, September 2022, pp. 24-25.

[28] See William Lazonick, "Investing in Innovation: A policy Framework for Attaining Sustainable Prosperity in the United States," Institute for New Economic Thinking Working Paper No. 182, March 30, 2022.

[29] During this decade, the largest repurchasers among financial corporations were JPMorgan Chase, $97.2 billion; Wells Fargo $93.1 billion; Bank of America $73.4 billion; Citigroup, $63.4 billion; Goldman Sachs, $56.2 billion; American International Group (AIG), $48.7 billion; and Visa, $46.6. For the role of stock buybacks in contributing to the vulnerability of Wall Street banks and AIG, among other financial corporations, to the financial crisis of 2008-2009, wee William Lazonick, "Everyone is paying the price for share buy-backs," *Financial Times*, September 25, 2008.

[30] See, for example, William Lazonick, Matt. Hopkins, and Öner Tulum (2015), "Tax dodging just one part of Pfizer's corrupt business model," *Huffington Post*, December 4, 2015.

[31] "Event Brief of Q4 2019 Pfizer Inc Earnings Call – Final," *CQ FD Disclosure*, January 28, 2020,

[32] William Lazonick and Matt Hopkins, "Why the Chips are Down: Stock Buybacks and Subsidies in the U.S. Semiconductor Industry," Institute for New Economic Thinking Working Paper No. 165, October 2021.

[33] Lesley Stahl, "Chip shortage highlights U.S. dependence on fragile supply chain," *60 Minutes*, May 2, 2021,

[34] CNET Highlights, "Intel CEO Pat Gelsinger! (CNET's FULL Interview)," *YouTube,* November 19, 2021 (minutes 2:03-2:30 of the interview).

[35] William Lazonick and Matt Hopkins, "How 'Maximizing Shareholder Value' Minimized the Strategic National Stockpile," Institute for New Economic Thinking Working Paper No. 127, July 2020, pp. 26-48.

[36] Lazonick, *Sustainable Prosperity in the New Economy?,* ch. 3.

[37] Control by activists with a small fraction of outstanding shares is made possible by the SEC-sanctioned proxy voting system, as detailed in Lazonick and Shin, *Predatory Value Extraction*, chs. 5-7.

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