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Moonshots

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MOONSHOTS

Matthew T. Wansley*

In the last half-century, technological progress has stagnated. Rapid advances in information technology disguise the slow pace of productivity growth in other fields. Reigniting technological progress may require firms to invest in moonshots—long-term projects to commercialize innovations. Yet all but a few giant tech firms shy away from moonshots, even when the expected returns would justify the investment. The root of the problem is corporate structure. The process of developing a novel technology does not generate the kind of interim feedback that shareholders need to monitor managers and managers need to motivate employees. Managers who anticipate these agency problems invest in incremental innovations instead.

In the last few years, a new structure designed to commercialize long-term innovations has emerged—the venture carveout. A venture carveout is a private company with one or two public company parents, outside private investors, and employee ownership. The parents provide intellectual property and a long-term strategic commitment. The private investors supply patient capital that insulates the project from short-term shareholder pressure. The employees' equity motivates them to bring a product to market. The first venture carveouts are attempting to commercialize autonomous vehicles. If they succeed, they will validate a new model for innovation. This Article argues that venture carveouts could

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enable more companies to invest in moonshots, compete with the tech giants that dominate our economy, and accelerate technological progress.

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I. INTRODUCTION

In the last half-century, technological progress has stagnated.[1] The century from 1870 to 1970 brought electricity, running water, indoor plumbing, central heating, refrigeration, anesthetics, antibiotics, telephones, television, automobiles, and airplanes.[2] Life expectancy at birth rose from forty-five to seventy-two.[3] But since the early 1970s, progress has been incremental.[4] Paul Krugman illustrates the

1 *See* ROBERT J. GORDON, THE RISE AND FALL OF AMERICAN GROWTH 16 (2016) (showing the decline in productivity growth from 1970–2014).

2 *See id.* at 3–6 (reviewing technological progress between 1870–1970).

3 *Id.* at 1.

4 *See id.* at 523–26 (reviewing technological progress since 1970). Productivity growth briefly spiked from 1995 to 2004 but slowed again after

productivity slowdown with "the kitchen test": look around your kitchen and ask which technologies wouldn't have been available fifty years ago.[5] If you find an object that passes the test, it's probably a laptop or a mobile phone. Innovation has become synonymous with information and communications technology—computers, smartphones, and the internet—because there have been so few transformative technologies in other fields.

Some economists believe that the economy has simply picked the low-hanging fruit.[6] But there are plenty of emerging technologies with the potential to reignite productivity growth—artificial intelligence, renewable energy, synthetic biology, regenerative medicine, and nanotechnology.[7] The problem is that it could take billions of dollars and many years for these technologies to reach consumers. The state plays an important role in innovation by funding basic scientific research.[8] Still, private firms must eventually develop technological advances into new products and services. When a project to commercialize a new technology requires sustained infusions of capital over many years, it's called a moonshot.[9] Moonshots can generate

2005. *See* Chad Syverson, *Challenges to Mismeasurement Explanations for the US Productivity Slowdown*, 31 J. ECON. PERSPS. 165, 168–71 (2017).

5 Paul R. Krugman, *The Kitchen Test*, N.Y. TIMES (Jan. 30, 2011, 12:29 PM), https://krugman.blogs.nytimes.com/2011/01/30/the-kitchen-test/ [https://perma.cc/FK3M-GMA6].

6 *See* GORDON, *supra* note 1, at 593–601 (predicting that currently-emerging technologies will not reignite productivity growth); *see generally* TYLER COWEN, THE GREAT STAGNATION (2011) (arguing that the economy is at a technological plateau).

7 *See* Noah Smith, *Techno-optimism for 2022*, NOAHPINION (Dec. 8, 2021), https://noahpinion.substack.com/p/techno-optimism-for-2022 [https://perma.cc/F8CJ-859U] (reviewing the prospects of emerging technologies).

8 *See generally* MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE (2013) (arguing that the state plays a greater role in innovation than economists have recognized).

9 The tech conglomerate Alphabet has popularized the term "moonshot" as a label for its long-term investments, most of which involve commercializing new technologies. *See* Alphabet Inc., Annual Report (Form 10-K) 5 (Feb. 2, 2021) (describing moonshots as "high-risk, high-reward"

attractive returns if they succeed, but companies can be reluctant to take the risk.

Corporate law scholars have long debated whether the structure of the modern public corporation discourages long-term investments. One group of influential lawyers, judges, and scholars—the "short-termists"—argues that public company managers are forced to prioritize short-term stock performance over long-term shareholder value.[10] The short-termists contend that managers forgo long-term investments because they fear being targeted by activist hedge funds seeking quick returns.[11] The short-termists propose to remedy the problem by insulating boards of directors from shareholder pressure.[12] Another group of scholars—let's call them the "skeptics"—has criticized the short-termists' claims.[13] The skeptics argue that shareholder pressure makes managers more accountable. They contend that board

long-term projects). In other contexts, the term is used to describe risky and important projects that require intense but short-term investment. *See A New Meaning of 'Moonshot'*, MERRIAM-WEBSTER (Jan. 2020), https://www.merriam-webster.com/words-at-play/moonshot-words-were-watching [https://perma.cc/E3JX-QNP6] ("This use of moonshot refers to a project or venture that is intended to have deep-reaching or outstanding results after one heavy, consistent, and usually quick push.").

10 *See* William W. Bratton & Michael L. Wachter, *The Case Against Shareholder Empowerment*, 158 U. PA. L. REV. 653, 702 (2010); Martin Lipton & Steven A. Rosenblum, *A New System of Corporate Governance: The Quinquennial Election of Directors*, 58 U. CHI. L. REV. 187, 202–05 (1991); Leo E. Strine, Jr., *One Fundamental Corporate Governance Question We Face: Can Corporations Be Managed for the Long Term Unless Their Powerful Electorates Also Act and Think Long Term?*, 66 BUS. LAW. 1, 9–19 (2010).

11 *See* Martin Lipton, *Important Questions About Activist Hedge Funds*, HARV. L. SCH. F. ON CORP. GOVERNANCE (Mar. 9, 2013), https://corpgov.law.harvard.edu/2013/03/09/important-questions-about-activist-hedge-funds/ [https://perma.cc/4KE2-PD95]; Leo E. Strine, Jr., *Who Bleeds When the Wolves Bite?: A Flesh-and-Blood Perspective on Hedge Fund Activism and Our Strange Corporate Governance System*, 126 YALE L.J. 1870, 1938–51 (2017).

12 *See* Lipton & Rosenblum, *supra* note 10, at 242.

13 *See generally* Lucian A. Bebchuk, *The Myth that Insulating Boards Serves Long-Term Value*, 113 COLUM. L. REV. 1637, 1687 (2013); Mark J. Roe, *Stock Market Short-Termism's Impact*, 167 U. PA. L. REV. 71 (2018).

insulation would lead managers to take excessive pay and fund vanity projects.[14]

In recent years, empirical research has bolstered the skeptics' position. Studies have shown that board insulation don't increase long-term shareholder value.[15] Yet studies have also shown that firms targeted by activist hedge funds are more likely to cut spending for research and development (R&D), just as the short-termists claim.[16] These results suggest that the short-termist critique may be missing important nuance. It's possible that managers may be passing on certain valuable long-term investments, but board insulation is too blunt an instrument to solve the problem. In this Article, I defend a more modest and specific short-termist argument, one that I hope the skeptics will embrace. I argue that moonshots present agency problems that other long-term projects don't create. Then I show how the market has developed a new corporate structure designed to address these problems, which relies on a more subtle form of insulation.

A company attempting a moonshot confronts extreme uncertainty. The company's managers might not learn for years if the technology will work, if consumers will demand it, or if it will ultimately be profitable. The uncertainty creates two overlapping agency problems. The first is a *monitoring problem*: shareholders can't easily observe the performance of the managers overseeing the project.[17] The second is a *motivation problem*: managers can't give their employees the

14 *See* Bebchuk, *supra* note 13, at 1679.

15 *See, e.g.*, Lucian A. Bebchuk et al., *The Long-Term Effects of Hedge Fund Activism*, 115 COLUM. L. REV. 1085, 1103–06 (2015).

16 *See* John C. Coffee, Jr. & Darius Palia, *The Wolf at the Door: The Impact of Hedge Fund Activism on Corporate Governance*, 41 J. CORP. L. 545, 574–77 (2016).

17 *See* Zohar Goshen & Assaf Hamdani, *Corporate Control and Idiosyncratic Vision*, 125 YALE L.J. 560, 579–83 (2016) (arguing that agency costs between investors and entrepreneurs can prevent entrepreneurs from realizing their idiosyncratic vision); Michael C. Jensen & William H. Meckling, *Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure*, 3 J. FIN. ECON. 305, 312–30 (1976) (modeling the firm as an agency relationship with the owner as the principal and the manager as the agent and emphasizing the owner's monitoring costs).

right incentives to bring the technology to market.[18] Managers who anticipate these agency problems won't invest in a moonshot even if they believe it has a positive net present value.

The monitoring problem arises because the process of commercializing a new technology doesn't always generate interim feedback that would reassure shareholders.[19] Investors are often willing to finance an innovation project when early results from the project—revenue trends, user growth, clinical trial data—reliably indicate future profitability. But moonshots can require years of unstructured experimentation, and they can target untested markets. Managers might be unable or unwilling to share the information that gives them confidence in the project because the information is qualitative, tacit, or confidential. When managers worry that they won't be able to reduce this information asymmetry quickly enough to convince shareholders that they are faithful agents, they won't greenlight the project.

The motivation problem arises because managers can't easily give employees the incentives to bring the new technology to market.[20] Managers may fear that employees will treat the project like academic research—an exploration of interesting ideas, rather than a focused effort to build a profitable product. Managers could overcome this agency problem if they gave the employees a financial stake in the moonshot's future profits. But it's hard to do that if the project is housed inside a larger company. Managers can't properly motivate the employees by rewarding them with the company's stock, because its price wouldn't track the value of the moonshot alone. It would fluctuate with changes in the value of the company's existing lines of businesses. Managers also can't create stock that directly tracks the value of the

18 *See* Joseph Bankman & Ronald J. Gilson, *Why Start-Ups?*, 51 STAN. L. REV. 289, 299–305 (1999) (explaining the failure of mature companies to innovate as a problem of giving proper incentives to employees).

19 *See infra* Section II.B and accompanying notes.

20 *See infra* Section II.C and accompanying notes.

moonshot, because there is no external market that assigns it a price.

The most innovative part of the economy, the venture capital (VC) market, has developed structural solutions to these agency problems.[21] A venture-backed startup is an innovation project organized as an independent business. Its capital structure addresses the motivation problem. The startup's entrepreneurs and employees are granted equity, which gives them a stake in the company's success.[22] The stock is usually illiquid, so the value that employees create is locked in until the startup is acquired or goes public. The strong incentives attract employees who believe in the project and motivate them to bring the technology to market.[23] VCs have also developed strategies to monitor entrepreneurs. VCs take an active role in their portfolio companies' management, often by serving on their boards of directors.[24] They receive frequent updates on the startup's progress behind closed doors. VCs finance startups in twelve- to twenty-four-month stages, so the VCs' credible threat to not fund the next stage creates strong incentives for entrepreneurs to deliver

[21] *See generally* PAUL A. GOMPERS & JOSH LERNER, THE VENTURE CAPITAL CYCLE (2d ed. 2006) (analyzing the structure of VC markets from an agency cost perspective); William A. Sahlman, *The Structure and Governance of Venture-Capital Organizations*, 27 J. FIN. ECON. 473, 493–503, 506–13 (1990) (introducing the agency cost model of VC investing); *see also* Robert P. Bartlett, III, *Venture Capital, Agency Costs, and the False Dichotomy of the Corporation*, 54 UCLA L. REV. 37, 48–61 (2006) (reviewing and critiquing the agency cost model); Ronald J. Gilson, *Engineering a Venture Capital Market: Lessons from the American Experience*, 55 STAN. L. REV. 1067, 1078–92 (2003) (enriching the agency cost model by analyzing provisions in VC contracts).

[22] GOMPERS & LERNER, *supra* note 21, at 161; Sahlman, *supra* note 21, at 508.

[23] Sahlman, *supra* note 21, at 510–11.

[24] *See* GOMPERS & LERNER, *supra* note 21, at 244 (providing evidence, from a sample of VC financings, showing that the average startup board has one or two VC directors).

growth.[25] VCs also syndicate their investments, which gives them a second opinion on a startup's value.[26]

But there's a catch. The structure of the VC market favors *short-term* innovation.[27] The cause is a second-order monitoring problem. The VCs' investors—the institutional investors who are limited partners (LPs) in VC funds—need to monitor the VCs. The LPs motivate VCs by giving them 20% of the fund's profits and an annual management fee equal to 2% of the fund's assets.[28] However, they still run the risk that VCs will squander their capital and live off the management fees. The LPs remedy this monitoring problem by requiring that VC funds have a limited life, typically ten years.[29] At the end of a fund's life, the LPs can assess the VC's performance and decide whether to invest in the VC's next fund. The limited life of VC funds requires VCs to exit their investments through acquisition or an initial public offering (IPO) only a few years after they invest.[30] Consequently, VCs look for startups that can scale quickly and exit on their timeline.[31]

In recent years, the VC market has become even more focused on short-term innovations. Startups are increasingly

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25 *See id.* at 171–200 (providing evidence that VCs use staged financing to reduce information asymmetries and agency costs); Sahlman, *supra* note 21, at 506–07.

26 *See* GOMPERS & LERNER, *supra* note 21, at 255–70 (providing evidence that VCs syndicate investment to gain outside information about a startup's value).

27 *See infra* Section III.A.

28 Josh Lerner & Ramana Nanda, *Venture Capital's Role in Financing Innovation: What We Know and How Much We Still Need to Learn*, 34 J. ECON. PERSP. 237, 254 (reporting that VCs typically receive 20% of the capital gains and a management fee equal to 1.5–2.5% of capital under management).

29 *See* Andrew Metrick & Ayako Yasuda, *The Economics of Private Equity Funds*, 23 REV. FIN. STUD. 2303, 2304 (2010).

30 *See* Lerner & Nanda, *supra* note 28, at 253 (reporting that, in a typical VC fund, VCs have five years to invest capital "and then are expected to use the remaining period to harvest their investments").

31 *See id.* at 245 (explaining that the limited lives of VC funds lead VCs to select "investment opportunities where the ideas can be commercialized and their value realized through an 'exit' within a reasonably short period").

choosing to exit by acquisition instead of IPO.[32] Some incumbent tech companies appear to be using acquisitions to choke off potential competitors.[33] In some cases, incumbents have shut down development of a startup's technology quickly after acquiring it.[34] VCs are also increasingly concentrating their investments in startups that develop software, because it can scale faster than other technologies.[35] Startups that focus on atoms, not bits—hardware, materials, and energy technology—are receiving a smaller share of capital.[36] These market dynamics may be leading VCs to pass on transformative technologies. In the words of one infamous VC: "We wanted flying cars, instead we got 140 characters."[37]

But there's new hope for flying cars—and other, more socially valuable technologies. In the past several years, a new structure designed to commercialize long-term innovations has emerged. I call it the "venture carveout." A venture carveout is a private company with one or two public company parents, outside private investors, and employee ownership. In the language of corporate finance, the parent "carves out" part of the equity of its subsidiary so that outside investors and employees can own part of the new company. The first venture carveouts were formed in response to the agency problems of developing a particularly expensive and complex technology—autonomous vehicles (AVs).[38]

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32 *See* Mark A. Lemley & Andrew McCreary, *Exit Strategy*, 101 B.U. L. REV. 1, 18 (2021).

33 *See id.* at 19 (providing evidence that in 2014, "eight of the ten largest disclosed acquisitions appear to have been by incumbents of nascent or potential rivals").

34 *See* Colleen Cunningham et al., *Killer Acquisitions*, 129 J. POL. ECON. 649, 691–94 (2021) (estimating that 5.3–7.4% of pharmaceutical acquisitions are killer acquisitions).

35 *See* Lerner & Nanda, *supra* note 28, at 245–48.

36 *See id.*

37 Dan Wang, *Why Is Peter Thiel Pessimistic About Technological Innovation?*, MEDIUM (Sept. 10, 2014), https://medium.com/@danwwang/why-is-peter-thiel-pessimistic-about-the-future-of-technology-d2897f9659bb [https://perma.cc/6JGT-UGBZ].

38 *See infra* Section IV.A.

The deployment of AVs could transform society. AVs could dramatically cut traffic fatalities, increase mobility for seniors and people with disabilities, and free up time spent on driving.[39] But developing AVs will take a tremendous amount of time and money. Companies have been working to commercialize the technology for more than a decade.[40] Investors have poured in more than $16 billion of capital.[41] The federal government, academic labs, and venture-backed startups have all played a role in developing the technology.[42] But now most of the leading players in the industry have converged on the venture carveout structure.[43]

Consider Cruise, the first venture carveout. Cruise is a privately-held Delaware limited liability company (LLC).[44] It was born as a venture-backed startup.[45] General Motors (GM) acquired it in 2016.[46] After the acquisition, GM let Cruise

39 *See* JAMES M. ANDERSON ET AL., AUTONOMOUS VEHICLE TECHNOLOGY 9–40 (2016), https://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf [https://perma.cc/B7PN-QWET] (assessing the costs and benefits of AV technology).

40 *See* John Markoff, *Google Cars Drive Themselves, in Traffic*, N.Y. TIMES (Oct. 9, 2010), https://www.nytimes.com/2010/10/10/science/10google.html [https://perma.cc/B4UJ-QYN2] (disclosing Google's AV project for the first time).

41 Amir Efrati, *Money Pit: Self-Driving Cars' $16 Billion Cash Burn*, THE INFORMATION (Feb. 5, 2020, 7:01 AM), https://www.theinformation.com/articles/money-pit-self-driving-cars-16-billion-cash-burn (on file with the Columbia Business Law Review).

42 *See infra* Section V.A and accompanying notes.

43 *See infra* Section V.A and accompanying notes.

44 GM Cruise Holdings LLC, Fifth Amended and Restated Limited Liability Company Agreement § 1.02 (Dec. 18, 2019), https://www.sec.gov/Archives/edgar/data/1467858/000146785820000028/ex-1028xcruisexfifthar.htm [https://perma.cc/GZH3-GJSF] [hereinafter Cruise Agreement].

45 *See* Bill Vlasic & Mike Isaac, *General Motors to Buy Cruise Automation in Push for Self-Driving Cars*, N.Y. TIMES (Mar. 11, 2016), https://www.nytimes.com/2016/03/12/business/general-motors-to-buy-cruise-automation-in-push-for-self-driving-cars.html [https://perma.cc/5W87-JKEY].

46 *Id.*

retain some operational autonomy. Then in 2018, GM decided to experiment with a new structure. Cruise became a meaningfully independent legal entity. Cruise's employees were granted equity in Cruise, not in GM.[47] Cruise raised outside capital from GM's competitor Honda, other public companies like Microsoft and Walmart, the Japanese conglomerate SoftBank, and the investment management firm T. Rowe Price.[48] Cruise is now valued at over $30 billion.[49] In the last few years, three of Cruise's competitors also became venture carveouts: Alphabet's Waymo, Ford and Volkswagen's Argo, and Hyundai's Motional.[50]

Venture carveouts solve the motivation problem as a venture-backed startup would. Employees receive stock in the carveout, not in the parent company. Their equity stakes give them strong incentives to commercialize the carveout's technology. The value of that equity is locked in until the carveout is acquired or has an IPO, which motivates them to bring a product to market. The carveout's managers are technical experts, which makes it easier for them to assess their employees' efforts on technical tasks. Venture carveouts also borrow from VCs' strategies to mitigate monitoring costs. The carveout's investors fund it in stages, using each new funding round to check in on progress. The investments are syndicated, so each investor can rely on the willingness of the other investors to keep funding the carveout as a costly signal of its value. The carveout's investors also participate in board meetings, where they can acquire private information on the technology's progress.

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47 Kirsten Korosec, *In Recruiting Win, GM's Cruise Employees Offered Equity in Cruise*, TECHCRUNCH (Aug. 31, 2018, 8:00 PM), https://techcrunch.com/2018/08/31/in-recruiting-win-gms-cruise-employees-offered-equity-in-cruise/ [https://perma.cc/AL8Z-CFCE].

48 *See infra* Section IV.A and accompanying notes.

49 Michael Wayland, *Walmart Investing in GM's Cruise Self-Driving Car Company*, CNBC (Apr. 15, 2021, 9:21 AM), https://www.cnbc.com/2021/04/15/walmart-investing-in-gms-cruise-self-driving-car-company.html [https://perma.cc/A7BC-Q7SD].

50 *See infra* Section IV.A and accompanying notes.

Venture carveouts differ from venture-backed startups in the long-term commitment from their corporate parents. Cruise is GM's sole bet on AVs, and GM isn't only seeking a financial return. GM is hedging against the risk that AVs will disrupt its core auto manufacturing business. Cruise's outside investors include public companies that want access to private information about AV technology and institutional investors interested in a long-term bet. GM's commitment to Cruise gives the outside investors more confidence that Cruise can overcome short-term setbacks.[51] At the same time, the carveout's managers owe a duty of loyalty to the carveout, not to the parent. GM's public shareholders can be assured that GM's directors aren't running Cruise as a personal vanity project because GM doesn't completely control it. The net effect is that Cruise is partially, but not fully, insulated from shareholder pressure.

It's too early to know if venture carveouts will succeed. The carveouts developing AVs have yet to bring the technology to market. In October 2022, Ford and Volkswagen's Argo became the first venture carveout to shut down.[52] Argo was never able to raise private funding. In an earnings call announcing the closing of Argo, Ford's CFO explained that "it's become clear that the technology required to achieve profitable commercialization of [full] autonomy at scale is going to take much longer than we previously expected."[53]

But Waymo, Cruise, and Motional are still pushing forward despite growing economic headwinds. If they succeed,

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[51] *Cf.* Margaret M. Blair, *Locking in Capital: What Corporate Law Achieved for Business Organizers in the Nineteenth Century*, 51 UCLA L. REV. 387, 423–54 (2003) (arguing that the rise of the corporate form in the nineteenth century encouraged business stakeholders to make firm-specific investments by locking in capital).

[52] *See* Kirsten Korosec, *Ford, VW-Backed Argo AI Is Shutting Down*, TECHCRUNCH (Oct. 26, 2022, 2:49 PM), https://techcrunch.com/2022/10/26/ford-vw-backed-argo-ai-is-shutting-down/ [ttps://perma.cc/UP37-Z37S].

[53] *Third Quarter 2022 Earnings Conference Call*, FORD MOTOR CO. (Oct. 26, 2022, 5:00 PM), https://s201.q4cdn.com/693218008/files/doc_financials/2022/q3/Ford-Q3-2022-Earnings-Call-Transcript.pdf [https://perma.cc/QMT7-CCVU].

venture carveouts could change the structure of innovation. Many of the moonshots of the last century were undertaken by the research divisions of monopolists—AT&T's Bell Labs, IBM Research, and Xerox PARC.[54] Corporate R&D spending today is heavily concentrated in the largest tech companies.[55] Venture carveouts could enable moderately-sized companies to invest in moonshots, compete with the tech giants, and reignite technological progress.

This Article proceeds in four parts. Part II describes the agency problems that lead companies to forgo long-term innovation. Part III shows how the unconventional structures of innovative companies address these problems. Part IV introduces venture carveouts and explains why the companies commercializing AVs have converged on this new structure. Part V considers whether venture carveouts could help bring other transformative technologies to market.

II. THE MOONSHOT PROBLEM

The first moonshot was a government project. NASA didn't have to placate any shareholders. When private firms attempt to commercialize new technologies, though, investors must remain convinced for the duration of the project that their capital is being put to good use. But moonshots don't generate interim feedback that can reassure shareholders like other corporate investments do. Therefore, companies will only invest in moonshots if they can find other strategies to manage the radical uncertainty.

A. The Short-Termism Debate

In public companies, managers act as agents of the shareholders. It's black letter law that managers must act to

54 *See infra* Section V.A and accompanying notes.

55 Joshua P. Zoffer, *Short-Termism and Antitrust's Innovation Paradox*, 71 STAN. L. REV. ONLINE 308, 312 (2019) (finding that five tech firms "accounted for nearly a quarter of reported R&D spending for the entire S&P 500 in 2017"); *see also infra* Section IV.A and accompanying notes.

maximize long-run shareholder value.[56] The short-termists believe that the structure of the modern public corporation undermines that goal. They argue that public company managers are forced to prioritize the short-term performance of their company's stock price over long-term shareholder value.[57] Managers must focus obsessively on the next quarterly earnings report. They forgo long-term projects that they expect would be profitable when they believe the stock market would react negatively in the short term.[58] In recent years, short-termists have focused their critique on the influence of activist hedge funds.[59] They argue that managers fear that activist hedge funds will target their companies and therefore avoid long-term investments that could attract activists.[60]

The short-termists propose to remedy this problem by insulating boards of directors from shareholder pressure.[61] They advocate for staggered board elections or longer director terms.[62] The short-termists emphasize the information asymmetries between directors and dispersed, mostly passive

56 *See In re* Trados Inc. S'holder Litig., 73 A.3d 17, 37 (Del. Ch. 2013) (explaining that the duty of loyalty requires directors to "maximize the value of the corporation over the long-term for the benefit of the providers of equity capital").

57 Bratton & Wachter, *supra* note 10, at 696–716; Lipton & Rosenblum, *supra* note 10, at 202–05; Strine, *supra* note 10, at 9–19.

58 *See* Bratton & Wachter, *supra* note 10, at 700–01 (arguing that markets may misprice long-term projects and thus managers who seek to maximize their company's stock price in the short term may pass on investing in valuable projects).

59 *See* Lipton, *supra* note 11; Strine, *supra* note 11, at 1938–51.

60 *See* Lipton, *supra* note 11; Strine, *supra* note 11, at 1938–51.

61 *See* Lipton & Rosenblum, *supra* note 10, at 229–48; *see also* Bratton & Wachter, *supra* note 10, at 715–16 (arguing against further empowering shareholders); Strine, *supra* note 10, at 3–4 ("The ability of central management to innovate and pursue risky strategies has been protected by corporate law's adoption of a republican, rather than direct, model of corporate democracy.").

62 *See* Lipton & Rosenblum, *supra* note 10, at 229–48 (proposing a series of reforms to insulate directors, including five-year terms).

shareholders.[63] They argue that directors would invest in projects that would increase long-term shareholder value if they weren't forced to deliver short-term profits.[64]

The skeptics argue that insulating directors won't serve shareholder interests. Lucian Bebchuk, a leading skeptic, contends that board insulation can "increase slack, empire building, excessive pay, and other forms of private benefits."[65] Other scholars worry that managers who feel free to disregard feedback about their short-term performance will make overconfident or overly optimistic decisions.[66] Some skeptics go further and question the short-termists' core thesis that the stock market rewards companies that prioritize short-term profits. One of these skeptics, Mark Roe, argues that the success of tech companies like Alphabet, Amazon, Apple, Meta, and Microsoft is inconsistent with pervasive short-termism.[67] Roe contends that the tech giants "are quintessential long-term companies. They do much R&D. Their current earnings cannot justify their current stock price; only a belief that they will grow long-term does."[68]

Empirical research has cast doubt on the short-termists' strongest claims. For example, one recent study by Bebchuk and his collaborators finds that activist hedge fund interventions don't decrease shareholder value in the aggregate five years after the intervention.[69] Yet there is also empirical evidence that companies targeted by activist hedge funds reduce their R&D expenditures.[70] In some cases,

63 *See* Bratton & Wachter, *supra* note 10, at 696–705 (reviewing evidence of information asymmetries between managers and shareholders).

64 *See* Lipton & Rosenblum, *supra* note 10, at 225–28 (describing the potential benefits of their plan to insulate directors).

65 *See* Bebchuk, *supra* note 13, at 1679.

66 *See* Michael Barzuza & Eric Talley, *Long-Term Bias*, 2020 COLUM. BUS. L. REV. 104, 135–72.

67 *See* Roe, *supra* note 13, at 98–100.

68 *Id.* at 98.

69 *See* Bebchuk et al., *supra* note 15, at 1103–06 (finding, in a study of 2,000 activist hedge funds interventions from 1994 to 2007, net improvements in share value five years after the intervention); *see also* Bebchuk, *supra* note 13, at 1668–76 (reviewing earlier empirical evidence).

70 *See* Coffee & Palia, *supra* note 16, at 574–77.

managers of activist hedge funds have openly stated that they intend to create value by forcing their targets to shut down R&D operations.[71] It's possible that activist hedge fund pressure *both* reduces agency costs *and* causes some managers to forgo investing in valuable long-term projects.

One weakness of the short-termism debate is that the participants have made arguments at a high level of generality. The short-termists usually argue that managers are systematically biased against long-term projects as a class. For example, Marty Lipton, a leading short-termist, claims that "corporations have sacrificed research and development expenses, capital expenditures, market development, and new business ventures, simply because they promise to pay off only in the long term."[72] But not all long-term projects are the same. Most long-term projects might not create the kind of information asymmetry that could lead shareholders or activist hedge funds to pressure managers into bad decisions. Moonshots are special cases because the radical uncertainty of commercializing a new technology *does* create serious information asymmetries and agency problems.

B. The Monitoring Problem

Suppose that a risk-neutral investor (the principal) lets a manager (the agent) invest money on the investor's behalf.[73] The manager must decide between spending that money on one of two projects, S and L. The investment will have three stages: (1) allocation, (2) interim review, and (3) liquidation. At the allocation, the investor gives the manager the money, and the manager chooses which project to fund. At the interim review, the investor evaluates the manager's performance to date and decides whether to continue the project. At the liquidation, the profits are returned to the investor. Now suppose that the manager believes that L has a higher expected return than S at the time of the liquidation. But the

71 *See id.* at 577–80.

72 Lipton & Rosenblum, *supra* note 10, at 210.

73 *See* Jensen & Meckling, *supra* note 17, at 308–09 (modeling the firm as a relationship between the stockholder principal and the manager agent).

manager also believes that S has a higher expected return than L at the time of the interim review.

The manager must consider more than her own assessment of the expected return. She must also account for the effect of the investor's monitoring regime. The information asymmetry between the investor and the manager at the interim review may be fatal to L.[74] If the investor cancels L at the interim review, the manager won't ever be able to show that L would have been profitable. Therefore, the manager will only decide to fund L if she predicts that she will persuade the investor to stick with L at the interim review even though it hasn't yet generated attractive returns. If not, the manager will decide to fund S instead, even though she believes S has a lower expected return. In this hypothetical, the manager's anticipation of the monitoring problem—her concern that her investors will view her as an unreliable agent—has led her to make a decision against what she believes to be the company's long-term interests.

In a public corporation, the shareholders are the investor principal, and the corporation's board of directors and executives are the manager agent. The interim review—the shareholders' monitoring device—is the quarterly earnings report. Corporate managers will only fund a project if they predict they will be able to persuade shareholders of the project's expected profitability throughout its duration. Otherwise, the shareholders might decide the managers are unreliable agents and replace them. A manager's ability to persuade depends on three related factors: (1) the availability of information about L's prospects, (2) the costs of sharing that information, and (3) the sophistication of the investor.

The availability of information about an innovation project varies by technology and market. A project need not be profitable at the time of the interim review to justify

[74] Bengt Holmstrom makes a similar point in his analysis of the motivation problem. He explains that, when there is an information asymmetry and a potential misalignment of interests between the principal and the agent, the principal cannot trust the agent's opinion about whether to continue an innovation project. *See* Bengt Holmstrom, *Agency Costs and Innovation*, 12 J. ECON. BEHAV. & ORG. 305, 318–19 (1989).

investment at the allocation. Market prices reflect *expected* profits.[75] The question is whether the project will generate feedback by the interim review that is a reliable proxy for profits. This feedback can take many forms. Tesla was unprofitable for its first seventeen years,[76] but consumer demand for its early models may have convinced investors that subsequent models might be profitable. Instagram had no revenue when Facebook acquired it for $1 billion.[77] Facebook bought it because Mark Zuckerberg saw how quickly it was gaining users.[78] Some biotech companies go public before the Food and Drug Administration (FDA) approves their first drug.[79] Investors in public capital markets are willing to bet on promising data from a clinical trial or even preclinical studies.[80] In each of these cases, the proxy reduces uncertainty about the project's future profitability enough to enable investment.

Some kinds of information that would give a rational manager confidence in L's progress can't be effectively communicated. She could see qualitative evidence of L's

75 This analysis is consistent with the semi-strong form of the efficient capital markets hypothesis. It assumes only that some privately-held information about expected profits is not incorporated into stock prices. *See* Ronald J. Gilson & Reinier H. Kraakman, *The Mechanisms of Market Efficiency*, 70 VA. L. REV. 549, 554–65 (1984) (explaining the efficient capital markets hypothesis).

76 Neal E. Boudette, *Tesla Has First Profitable Year, but Competition Is Growing*, N.Y. TIMES (Jan. 27, 2021), https://www.nytimes.com/2021/01/27/business/tesla-earnings.html [https://perma.cc/F4UV-37YD].

77 Shayndi Raice & Spencer E. Ante, *Insta-Rich: $1 Billion for Instagram*, WALL ST. J. (Apr. 10, 2012, 3:55 AM), https://www.wsj.com/articles/SB10001424052702303815404577333840377381670 [https://perma.cc/M5Q8-KZZR].

78 *See* Casey Newton & Nilay Patel, *'Instagram can hurt us': Mark Zuckerberg Emails Outline Plan to Neutralize Competitors*, VERGE (July 29, 2020, 2:07 PM), https://www.theverge.com/2020/7/29/21345723/facebook-instagram-documents-emails-mark-zuckerberg-kevin-systrom-hearing [https://perma.cc/WPY6-GKKW].

79 Tess Cameron & Chris Morrison, *2020 Biotech IPOs Shatter All the Records*, 20 NATURE REV. DRUG DISCOVERY 93, 94 (2021).

80 *See id.*

progress that can't be easily reduced to a quantitative metric. Or she could see progress on an internal quantitative metric that outside experts haven't validated. The manager's confidence could be based on tacit knowledge, absorbed through her daily interactions with the employees working on the project. She could be relying on the opinion of employees whom *she* believes to be credible, but whose opinion wouldn't carry as much weight with outsiders. Not all projects progress linearly. The manager's team may have run down a lot of dead ends. The knowledge they gained from pursuing the dead ends may convince them that one of the remaining paths will pay off. But investors may be unimpressed with a report on insight-generating failures.

In other circumstances, sharing feedback about L may be possible, but not worth the cost. The manager might put herself at a competitive disadvantage if she discloses the information that gives her confidence in a project. Companies sometimes face a "double trust dilemma": customers can't value an innovation until it's disclosed, but once it's disclosed, customers or competitors can copy it instead of buying it.[81] In some cases, patents can solve the dilemma.[82] A patent gives the company a monopoly over the patented idea, so the company can disclose it while still charging licensees for the right to use it. But many innovations aren't patentable or are more complex than the information that a patent discloses. An innovation may be a combination of trade secrets. If so, the company may need to rely on contracts to protect its confidential information.[83] A public company can't sign non-disclosure agreements with all of its current and prospective shareholders.

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81 *See* ROBERT D. COOTER & HANS-BERND SCHÄFER, SOLOMON'S KNOT: HOW LAW CAN END THE POVERTY OF NATIONS 27 (2012); *see also* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609 (Nat'l Bureau of Econ. Research ed., 1962).

82 *See* Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 242–45 (2012).

83 *See id.* at 262–66.

The manager is also at the mercy of the investors' sophistication. Many investments in early-stage technology companies are made through professional intermediaries like VCs. Even within the VC industry, firms and partners specialize in certain markets or technologies. Biotech startups, for example, often raise funding from specialist VC firms.[84] Sophisticated, specialist intermediaries can better evaluate tacit or technical information and recognize industry-specific patterns that predict success. But relying on specialists limits the number of potential investors, and intermediaries charge for their services, which raises the cost of capital.

To be sure, monitoring problems can arise in any long-term project. But long-term projects to commercialize new technologies—moonshots—create especially strong monitoring problems. The more novel a technology is, the greater the information asymmetries become. The performance of new technology might not be measurable with existing metrics. The targeted market might not exist yet. Specialist intermediaries might not have set up shop. Likewise, the longer the time needed for development, the more crippling the information asymmetries become. As time passes, more investors will approach their time horizons and demand stronger evidence of the project's progress. For these reasons, managers are especially likely to forgo investing in moonshots.

C. The Motivation Problem

Suppose that shareholders' limited ability to monitor a project's progress did not restrain managers from investing in moonshots. The manager would still need to overcome an internal agency problem. In this case, the manager is the principal. The employees she supervises are the agent. The manager faces some of the same information asymmetries that create the monitoring problem for her shareholders. The manager won't face confidentiality barriers, but she might not be able to evaluate the tacit, qualitative, or technical

84 *See* Lerner & Nanda, *supra* note 28, at 248.

information that gives the engineers working on the project confidence that it's progressing. Consequently, she will worry that the employees will use her budget to develop technology they find interesting, rather than focus on bringing a product to market. She might even worry the employees will hide evidence of failure and keep the project going when it should be shut down.[85]

The manager has a potential solution available. A highly motivated agent needs less monitoring.[86] The manager can structure the employees' compensation to give them strong incentives to turn the company's technology into a profitable product. She could give each of the employees an ownership stake in the project and prevent them from liquidating that stake until the project was complete.

In practice, though, managers at established companies often fail to properly motivate their employees to develop innovations. The root of the problem is that the innovation project is housed within the same organizational structure as other lines of business. Managers therefore find it hard to (1) reward the employee who created the invention that led to the innovation, (2) provide strong incentives to employees without distorting their time allocation, (3) assess each individual's contribution, and (4) assess the overall value of the project.

Employees generally don't receive specific rewards for inventions related to their work during the course of their employment. They sign agreements that assign the intellectual property rights to their work-related inventions to their employer.[87] At some companies, employees receive a

85 *See* Holmstrom, *supra* note 74, at 318 (explaining that renegotiating the continuation of a project will be costly when there is an information asymmetry between the manager and an engineer and the engineer has "human capital at stake, which the firm cannot appropriate").

86 *See* FRANK H. EASTERBROOK & DANIEL R. FISCHEL, THE ECONOMIC STRUCTURE OF CORPORATE LAW 9 (2d ed. 1996) ("Another way around the difficulty of monitoring the work of the firm's employees is to give each the right to some profits from the firm's success. Each then will work hard and monitor the work of colleagues, lest their subpar performance reduce his rewards.").

87 *See* Adam Starr, *The Employee's Idea, The Employer's Property: How to Capture Employee Intellectual Property*, MARKOWITZ HERBOLD PC,

modest bonus if the idea leads to a patent.[88] But for the most part, employees must hope that their managers will take their contribution into account when reviewing compensation. The dynamic is like an internal version of the double trust dilemma. It's hard for the customer (the manager) to value the invention before the seller (the employee) discloses it. But once the employee discloses, the manager can exploit the invention without providing additional compensation to the employee. Therefore, an individual employee's motivation to develop and share inventions is relatively weak.

The manager could motivate employees to develop innovative ideas by assigning *internal* property rights to employees' work-related inventions. But this would create a perverse incentive for employees to attempt to "perfect" their internal property rights by hoarding information related to their inventions.[89] These hoarding activities would divert the employees from their own productive work and limit the productivity of other employees, who could no longer benefit from the hoarded information.[90] Therefore, companies don't assign internal property rights, and employees with innovative ideas often leave for startups.

Even when an employee shares an invention and the manager decides to fund a project to commercialize it, the manager still must figure out how to create strong incentives to motivate the employees to turn the invention into a product. The opportunity to earn additional compensation for work on

https://www.markowitzherbold.com/The-Employee-s-Idea-The-Employer-s-Property-How-to-Capture-Employee-Intellectual-Property [https://perma.cc/59SJ-PQPQ] (last visited Feb. 5, 2023); Tina A. Syring & Felicia J. Boyd, *Employer and Employee Ownership of Intellectual Property: Not As Easy As You Think*, THOMSON REUTERS (Dec. 2014), https://store.legal.thomsonreuters.com/law-products/news-views/corporate-counsel/employer-and-employee-ownership-of-intellectual-property-not-as-easy-as-you-think [https://perma.cc/K6X9-44GJ].

88 *See* Seth Fiegerman, *In Tech, Patents Are Trophies—And These Companies Are Dominating*, CNN (June 19, 2018, 2:04 PM), https://money.cnn.com/2018/06/19/technology/tech-patents/index.html [https://perma.cc/FA5G-AENB].

89 *See* Bankman & Gilson, *supra* note 18, at 303–04.

90 *See id.* at 304.

the innovation project might distort how employees allocate their time. They might neglect preexisting projects, for which strong incentives aren't available.[91] Even if the employees assigned to the innovation project work exclusively on that project and are walled off in a separate division, the strong incentives might arouse the jealousy of employees working on more routine projects.[92] Savvy employees outside the innovation division might lobby for a transfer. Companies try to avoid radically different compensation schemes for employees at the same level of experience or responsibility.

The manager would also need to assess each employee's contribution to divvy up the payout. With more conventional projects, the manager knows how to evaluate employee performance. She can look at the quarterly sales figures, see if the expenses were under budget, or call up customers to see if they are satisfied. But with an innovation project, information asymmetries complicate the manager's task. The combination of the strong incentives needed to motivate the employees and the difficulty of assessing each employee's contribution creates the risk that employees will engage in wasteful "influence activities."[93] Employees might, for example, selectively conceal information to increase their share of the credit.[94] The manager may mistakenly reward the employees who are most skilled at influencing, rather than those who have contributed the most to the project.[95] When managers anticipate the risk of influence activities, they may standardize compensation or adopt policies to limit the kinds of information they will use in evaluating performance.[96] Both

91 *See* Holmstrom, *supra* note 74, at 314.

92 *See* Bankman & Gilson, *supra* note 18, at 301–02 ("Given employees' marked tendency to overestimate their own performance, providing intense incentives achievable by only some employees can result in a perception of unfairness by other employees. This results in decreased productivity by the demoralized workers.").

93 Paul Milgrom & John Roberts, *An Economic Approach to Influence Activities in Organizations*, 94 AM. J. SOC. 154, 156–57 (1988).

94 *See id.* at 156.

95 *See id.*

96 *See id.* at 157–58.

of these responses make it harder to create the right incentives for innovation.

In addition to measuring each employee's contribution, the manager would need to value the project as a whole. This is a hard problem because there is no market value for the project.[97] The manager could compensate the employees with the company's stock, but the price of the stock would be too noisy to create the right incentives.[98] Changes in the value of the company's other lines of business would distort the employees' payouts.[99] Innovation projects can increase in value tenfold or more, but the stocks of mature companies rarely do. The manager could try to have the company's accountants periodically estimate the project's value, but it would be difficult to reach a consensus value without predictable cash flows or market values for comparable projects. The employees would also find it hard to trust the company's valuation.[100] If the project were successful, the employees would have no recourse if the company opportunistically undervalued it.

Companies have tried to remedy this problem by creating an external market for company divisions with "tracking stock."[101] This works best when the tracked division has cash

97 *See* Edward M. Iacobucci & George G. Triantis, *Economic and Legal Boundaries of Firms*, 93 VA. L. REV. 515, 536 (2007) (explaining that motivating the manager of a corporate division is challenging if the division is integrated because "the firm has a choice between using the market's assessment of the entire firm or relying only on internal information to tailor compensation more closely to the manager's performance").

98 *See id.* at 568 (explaining that a divisional manager compensated in firm-wide stock "internalizes fluctuations . . . over which she has little, if any, control" and is subject to exogenous risks affecting the company's value, including careless performance by other managers).

99 *Cf.* Holmstrom, *supra* note 74, at 319 (explaining that when a startup is acquired, the market no longer separately tracks its value and the acquiror's stock isn't a good proxy because the value of the acquired startup "would be confused with contributions from the rest of the corporation").

100 *See* Iacobucci & Triantis, *supra* note 97, at 568 (observing that linking a divisional manager's compensation to an internal accounting of the division's value "carries its own uncertainty and potential for influence costs").

101 *Id.* at 536–39.

flows that the company is already reporting. To create a market for stock that tracks the value of an innovation project, a company would need to make new, project-specific disclosures to investors. This would reintroduce the monitoring problem: there might not be enough sharable information for investors to be willing to bet on the project. The value of tracking stock also can't be fully divorced from the value of the company's other lines of business. A company's common shareholders are its residual claimants. At dissolution, they are entitled to a pro rata share of all the company's remaining assets. Tracking stock is likewise given the same rights against all of the company's assets.[102] Therefore, the value of tracking stock will inevitably be affected by changes in the value of the company as a whole, and not just the value of the innovation project.

Ultimately, the manager of a mature company facing the motivation problem is stuck in a position similar to the investor facing the monitoring problem. The extreme uncertainty inherent in innovation makes it hard to supervise agents. Crafting strong incentives to substitute motivation for monitoring isn't easy either, especially within established companies. If the innovation will take many years to commercialize, the motivation problem is acute. As a consequence, managers will often decide to forgo investing in moonshots.

III. STRUCTURE AND TECHNOLOGY

Companies that specialize in innovation often have unconventional structures. Startups, joint ventures, and equity carveouts are all organized differently from a typical public corporation. These structures all attempt to solve the monitoring and motivation problems that innovation creates, but each one is adapted to the specific features of the technology that the company is trying to develop. These structures offer insights into how companies that house moonshots should be designed.

102 *Id.* at 536.

A. Venture-Backed Startups

A venture-backed startup is an innovation project housed in an independent business. Its capital structure addresses the motivation problem. The startup compensation model is designed to create strong incentives: entrepreneurs and the employees they hire often take below-market salaries.[103] The entrepreneurs receive stock, and the employees receive options to purchase stock.[104] The options typically start vesting after the employee's first year with the company and then vest gradually over the following three years.[105] A startup's equity is highly illiquid. Employee shareholders are usually locked into their investment until the startup exits through an acquisition or IPO.[106]

Equity compensation aligns the entrepreneurs' and employees' financial interests with the market value of the startup.[107] They know the price of their stock could increase by an order of magnitude or more in a successful exit. The strong incentives attract employees who believe in the startup's technology and business plan and are willing to tolerate the risk that the startup will fail.[108] Once they join the startup, the strong incentives motivate them to develop the startup's technology, cooperate with their coworkers, and grow the business. California, the jurisdiction home to the world's largest VC market, doesn't enforce noncompete provisions in employment contracts.[109] The combination of

103 Sahlman, *supra* note 21, at 508.

104 *Id.*

105 Yifat Aran, *Beyond Covenants Not to Compete: Equilibrium in High-Tech Startup Labor Markets*, 70 STAN. L. REV. 1235, 1264 (2018).

106 *See* Darian M. Ibrahim, *The New Exit in Venture Capital*, 65 VAND. L. REV. 1, 6–15 (2012).

107 GOMPERS & LERNER, *supra* note 21, at 161; Sahlman, *supra* note 21, at 508.

108 Sahlman, *supra* note 21, at 510–11 (describing the sorting effect of entrepreneur compensation).

109 *See* CAL. BUS. & PROF. CODE § 16600 (West 2018). For an argument that California's ban on noncompetes was critical to its growth as a VC market, *see* Ronald J. Gilson, *The Legal Infrastructure of High Technology*

vesting plans and a ban on noncompetes entices employees to keep working at a startup for as long as they continue to believe in its growth potential.[110]

Entrepreneurs who found startups are often experts in the technology their company is developing. Their technical knowledge helps them assess the company's progress towards commercialization and the contributions of individual employees. Startups usually focus on one core product or service, which simplifies decisions about allocating time or effort. Startups are unencumbered by depreciating assets, inherited customer or supplier relationships, or other obligations that distract managers at mature businesses. Entrepreneurs can focus exclusively on commercializing the startup's technology and expect that their employees will be faithful agents.

VCs have also developed strategies to monitor entrepreneurs. VCs vet startups exhaustively. One recent survey of VCs found that, in a given year, the average VC firm screens 200 startups and invests in only four.[111] Once VCs decide to invest, they take an active role in their portfolio companies' management. They often serve on their boards as directors or observers.[112] At board meetings, VCs get access to tacit, qualitative, and confidential information that enables them to assess the startup's progress.

VCs motivate entrepreneurs the same way the entrepreneurs motivate their employees: with strong equity incentives. VCs invest in startups through convertible

Industrial Districts: Silicon Valley, Route 128, and Covenants Not to Compete, 74 N.Y.U. L. REV. 575, 607–09 (1999).

110 *See* Aran, *supra* note 105, at 1268–73.

111 Paul A. Gompers et al., *How Do Venture Capitalists Make Decisions?*, 135 J. FIN. ECON. 169, 170 (2020).

112 *See* GOMPERS & LERNER, *supra* note 21, at 244; Sahlman, *supra* note 21, at 506; *see also* Steven N. Kaplan & Per Strömberg, *Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts*, 70 REV. ECON. STUD. 281, 287–89 (2003) (finding that VCs obtain the right to a board seat in 40% of cases in a sample of 213 VC investments in 119 startups).

preferred stock.[113] In a successful acquisition or IPO, the VCs will convert their preferred stock to common stock, the same class of stock that the entrepreneurs and employees have. But in a less successful exit, the VCs preferred stock gives them a better payout than the startup's employees. The preferred stock carries a liquidation preference that typically entitles the VCs to have their investment paid back before common shareholders get a penny.[114] VCs' convertible preferred stock aligns VCs and entrepreneurs towards the goal of maximizing the value of the common stock. Entrepreneurs know that a lukewarm exit will leave them with nothing.

VCs finance startups in stages. They don't fund the entire commercialization process upfront. Instead, they invest in startups in rounds that fund operations for the next twelve to twenty-four months.[115] A VC's credible threat to not fund the next round creates another strong incentive for the entrepreneurs to perform.[116] It might appear that staged financing could function as an interim review that would push entrepreneurs to select projects that will impress VCs at the time of the next round rather than projects that will pay off over a longer term. But VCs have a greater ability to absorb tacit, confidential, or qualitative information than public company shareholders do. The time that VCs spend in board meetings gives them a more sophisticated understanding of the startup's technology and reduces the information asymmetry between the VCs and the entrepreneurs. The combination of the VC's power to discontinue funding if internal milestones aren't met and the privacy of board

113 Ronald J. Gilson & David M. Schizer, *Understanding Venture Capital Structure: A Tax Explanation for Convertible Preferred Stock*, 116 HARV. L. REV. 874, 879 (2003).

114 *See* Brian J. Broughman & Jesse M. Fried, *Carrots and Sticks: How VCs Induce Entrepreneurial Teams to Sell Startups*, 98 CORNELL L. REV. 1319, 1343 (2013).

115 SCOTT KUPOR, SECRETS OF SAND HILL ROAD 116 (2019).

116 *See* GOMPERS & LERNER, *supra* note 21, at 171–200 (discussing the incentives within each stage of the investment life cycle); Sahlman, *supra* note 21, at 506–07.

meetings creates incentives for entrepreneurs to make realistic projections about future progress.[117]

VCs also syndicate their investments.[118] One VC firm will lead a fundraising round (invest the largest share) and other VC firms will follow (invest more modest shares). Syndication allows VCs to diversify their risks and to invest in more startups than they could if they had to fund rounds alone.[119] VCs gain valuable information about the startup's value from their well-informed and similarly-motivated co-investors.[120] For example, many VCs would feel more confident investing in a startup if Sequoia were betting on it too. The combination of convertible preferred stock, staged financing, and syndication solves the agency problems between VCs and entrepreneurs and enables VCs to invest in the face of extreme uncertainty.[121]

The structure of the VC market succeeds at producing innovative companies. Less than 0.5% of U.S. companies receive VC funding,[122] but those companies are disproportionately successful. VCs backed 56% of the companies that went public between 1995 and 2018 and were still alive in 2019.[123] Among that group, the former venture-backed startups accounted for 89% of R&D spending.[124] The patents that venture-backed companies file are more general, more original, and more highly cited than patents filed by

117 Gilson, *supra* note 21, at 1081.

118 *See* GOMPERS & LERNER, *supra* note 21, at 255–71.

119 *See* Bartlett, *supra* note 21, at 55.

120 *See id.* at 56.

121 *See id.* at 52.

122 *See* Manju Puri & Rebecca Zarutskie, *On the Lifecycle Dynamics of Venture-Capital- and Non-Venture-Capital-Financed Firms*, 67 J. FIN. 2247, 2248 (2012) (finding that venture-backed startups accounted for 0.11% of companies founded between 1981 and 2005).

123 Lerner & Nanda, *supra* note 28, at 240. This figure excludes financial companies and companies founded before 1980. For a more detailed analysis using earlier numbers that reaches similar conclusions, see Will Gornall & Ilya A. Strebulaev, *The Economic Impact of Venture Capital: Evidence from Public Companies* 6–9 (Stanford Graduate Sch. of Bus., Working Paper No. 3362, 2015).

124 Lerner & Nanda, *supra* note 28, at 241.

other companies.[125] Some of the largest publicly traded companies—including Alphabet, Amazon, Apple, Meta, and Microsoft—once received VC funding.[126]

But the structure of the VC market encourages *short-term* innovation. [127] The underlying problem is that VCs don't invest their own money—they are intermediaries. That means that the VC market has two levels of monitoring problems. We have seen how VCs solve the *startup-level* monitoring problem, in which the VCs are the principals, and the entrepreneurs are their agents. But there is also a *fund-level* monitoring problem, in which VCs are the agents, and the VCs' investors are the principals. [128]

VC funds are organized as limited partnerships with the VCs serving as general partners. The limited partners (LPs) are primarily institutional investors—mutual funds, pension funds, sovereign wealth funds, and university endowments.[129] A venture fund starts when VCs raise capital from LPs. Then the VCs invest the money in a portfolio of startups. VC funds typically last ten years.[130] Some VC partnership agreements permit VCs to extend a fund for up to two years.[131] By the end of the fund's life, the VCs must deliver the returns to the LPs.

The fund-level monitoring problem arises because LPs are passive investors. They don't have the time or expertise to supervise the VCs closely. LPs can partially substitute motivation for monitoring.[132] VC compensation is partially incentive-based: VCs earn "carried interest"—typically 20% of the fund's profits—and an annual management fee equal to

125 *See* Sabrina T. Howell et al., *How Resilient Is Venture-Backed Innovation? Evidence from Four Decades of U.S. Patenting* 2 (National Bureau of Economic Research, Working Paper No. 27150, 2020).

126 Lerner & Nanda, *supra* note 28, at 237.

127 *See infra* Section III.A.

128 *See infra* Section III.A.

129 *See* Metrick & Yasuda, *supra* note 29, at 2304.

130 *Id.*

131 Lerner & Nanda, *supra* note 28, at 253.

132 *See* Sahlman, *supra* note 21, at 493–499.

around 2% of the total assets in the fund.[133] In theory, the carried interest should overcome the agency problem by motivating the VCs to maximize the fund's profits. To some extent, it does. But if carried interest perfectly aligned the interests of LPs and VCs, LPs wouldn't need to insist that funds have limited lives.[134] LPs could just ask VCs to deliver the returns whenever the VCs believed that continued investment would no longer increase expected returns, after accounting for the time value of money.

In practice, the limited life of the fund is a critical part of the LP's strategy to solve the monitoring problem. It's important to remember that the management fee is annual, while the carried interest is based on the fund's net profits over its ten-year life. As VC funds have grown in size, VCs' management fees have risen proportionally, but their expenses have risen more slowly due to economies of scale.[135] LPs fear that VCs will raise larger-than-optimal funds to increase the annual management fees and live off the fees.[136] This fear is well-founded. One study found that the average VC fund earned about two-thirds of its revenue through management fees.[137] LPs mitigate this risk by requiring VCs to liquidate their funds within ten years so that the LPs can assess their performance. LPs can decide not to invest again with VCs who didn't deliver sufficient returns.[138]

The fund-level monitoring problem explains why the VC market focuses on short-term innovation. VCs plan to exit their investments within the ten-year life of a fund. VCs have

133 *See* Metrick & Yasuda, *supra* note 29, at 2311 (presenting data on carried interest and management fee terms in a study of ninety-four VC funds).

134 *See* Sahlman, *supra* note 21, at 494 (arguing that the limited life of VC funds is designed to mitigate agency costs).

135 Lerner & Nanda, *supra* note 28, at 254.

136 *See id.* (observing that management fees can become a "profit center" for VC firms).

137 Metrick & Yasuda, *supra* note 29, at 2328.

138 *See* GOMPERS & LERNER, *supra* note 21, at 378 (explaining that the limited lives of funds "puts pressure on young venture capital firms to establish a reputation and raise a new fund within a short, predetermined time").

increasingly asked LPs to extend the lives of VC funds for additional years.[139] But ten years remains the target.[140] Therefore, when VCs vet startups, they look for companies that have a good chance of a successful exit within that timeframe.[141] Ten years may sound like a long time, but it takes a few years after the VCs raise capital to choose which startups to include in their portfolios.[142] The process of exiting can take time, too. A savvy startup will want to court multiple prospective buyers to create a bidding war. If the startup goes public, the VCs usually can't sell their shares until the end of a lock-up period after the IPO.[143] As a consequence, VCs start to look for exit opportunities within a few years of completing their investments.

VCs' need to exit their investments quickly influences which technologies they fund. VCs are increasingly concentrating their investments in software. Consider Charles River Ventures, a VC firm founded in 1970.[144] Only eight of the eighteen portfolio companies in its first fund were in investments related to information and communication technology and health care.[145] The fund invested in startups developing a diverse set of technologies, including "high-strength fabrics for balloons" and "birth control for dogs."[146] By December 2019, though, 90% of Charles River Ventures'

139 *See* Diane Mulcahy, *The New Reality of the 14-Year Venture Capital Fund*, INSTITUTIONAL INV. (Feb. 19, 2015), https://www.institutionalinvestor.com/article/b14z9vv7hjbt6y/the-new-reality-of-the-14-year-venture-capital-fund [perma.cc/2DUH-RSNV].

140 *See id.* (noting that despite pervasive extensions, VC funds are still "structured with a projected ten-year life").

141 *See* Lerner & Nanda, *supra* note 28, at 245.

142 *See id.* at 253 (explaining that, in a ten-year fund, VCs "typically have five years in which to invest the capital and then are expected to use the remaining period to harvest their investments").

143 *See* Lemley & McCreary, *supra* note 32, at 30–31 (arguing that the post-IPO lock-up period leads VCs to prefer exiting their investments by acquisition).

144 Lerner & Nanda, *supra* note 28, at 246.

145 *Id.*

146 *Id.*

portfolio companies were developing products and services related to information technology.[147]

Charles River's experience is typical. From 1985 to 1989, VCs invested about 42% of their funds in software or consumer and business products and services, 42% in hardware, and the balance in biotech.[148] From 2015 to 2019, VCs put about the same amount into biotech, but less than 10% of their funds in hardware.[149] The rest went to software.[150]

The advantage of software is that it can be developed and scaled up quickly. It's never been easier to build a software company. Startups can now rent server time from the cloud instead of buying computer hardware, which reduces the amount of capital they need to raise at early stages.[151] This has led many VCs to adopt a "spray and pray" strategy in which they invest in a larger number of software startups and take a more limited role in their governance.[152] In the past two decades, VC investments in software have yielded much greater returns than investments in hardware, health care, or cleantech.[153] It's no surprise, then, that VCs continue to focus on software, even though there are promising emerging technologies in other fields.

B. Asset Partitioning

The techniques that enable companies to fund moonshots start with asset partitioning. A company "partitions" assets by placing them in separate legal entities. Most lawyers think of

147 *Id.* at 246–47.

148 *See id.* at 247.

149 *See id.* at 247 fig. 2.

150 *Id.*

151 *See* Michael Ewens et al., *Cost of Experimentation and the Evolution of Venture Capital*, 128 J. FIN. ECON. 422, 425 (2018).

152 *See id.* at 431–34.

153 *See* Lerner & Nanda, *supra* note 28, at 246 ("[A]n investment in the software deals between December 1991 and September 2019 would have yielded an annualized gross return of 24 percent per annum, far greater than investments in hardware (17 percent), healthcare (13 percent), or clean-tech (2 percent).").

asset partitioning as a way for companies to comply with regulations in different jurisdictions, to reduce their tax burden, or to protect assets from creditors. But partitioning can also be used to separate an innovation project from more mature lines of business. For instance, a company could create a wholly-owned subsidiary and place all the assets of the project—intellectual property, equipment, and contracts with employees and third parties—in the subsidiary. Asset partitioning enables (1) asset-specific financing, (2) asset-specific governance, (3) bundled contracts, and (4) stronger incentives.

The advantage of asset-specific financing is easiest to illustrate with debt financing. Suppose that a company owns and manages a bookselling business and a rocket business.[154] Now suppose that a book publisher is considering selling books to the company on credit. The publisher needs to assess the company's creditworthiness. The publisher will likely be well-informed about the finances of the company's bookstore operations and credit risks that affect the bookselling industry generally. But the publisher would have to spend time and money researching the rocket industry to assess the credit risks of the rocket business. The publisher will charge a premium for a risk it can't confidently assess. The company can avoid paying this premium by partitioning the bookstore assets into one subsidiary and the rocket assets into another. Then the publisher can contract directly with the bookstore subsidiary without having to worry about the rocket business's credit.

Similar reasoning applies to equity financing.[155] Investors may be enthusiastic about the growth potential of the rocket industry in an era of space tourism. But they may be pessimistic about brick-and-mortar bookstores. Investors will pay less to invest in the rocket business if they must take on the risk that the company's value will fall because the bookstore business declines. Savvy investors might be able to

154 *See* Henry Hansmann & Reinier Kraakman, *The Essential Role of Organizational Law*, 110 YALE L.J. 387, 399 (2000) (offering a similar hypothetical).

155 *See* Iacobucci & Triantis, *supra* note 97, at 535–39.

hedge against the risk by shorting other booksellers, but they will charge a premium for the hassle of hedging. If the company puts the rocket business in a separate subsidiary and allows investors to buy stock in the subsidiary, investors will give the subsidiary more favorable terms. The investment is a "pure play" on the rocket business.

Asset partitioning can also allow a company to tailor the governance structure for particular assets.[156] Suppose a natural gas company wanted to branch out into the solar energy business. The optimal board of directors for those two businesses could be different.[157] The natural gas business might need directors with expertise in chemical engineering, and the solar business might need directors with expertise in battery technology. The solar energy business might want to market to utilities that currently rely on natural gas to get them to switch to solar. In theory, the company's directors should approve that strategy if it would increase the company's net profits. But directors with skills, experience, and supplier and customer relationships tied to the natural gas industry might not want to undercut the market that makes them valuable to the company.[158] Placing the solar business in a subsidiary and giving it solar-specific directors would reduce these conflicts.

Asset partitioning can also increase the value of a corporate division by making it easier to sell. A subsidiary is a bundle of contracts.[159] The subsidiary's employees, suppliers, customers, and business partners all contract with the subsidiary. If those contracts were with the parent—as they would be if the project was structured as a corporate division, rather than a subsidiary—the parent would have to negotiate a right of assignment with all of their counterparties

156 *See id.* at 554–57.

157 *See id.* at 555–56.

158 *See id.*; *see also* CLAYTON M. CHRISTENSEN, THE INNOVATOR'S DILEMMA 42-48 (2000) (arguing that managers prioritize the innovation needs of existing customers).

159 *See* Kenneth Ayotte & Henry Hansmann, *Legal Entities as Transferable Bundles of Contracts*, 111 MICH. L. REV. 715, 725–28 (2013).

before selling the project.[160] Bundling the contracts in a subsidiary reduces the transaction costs of a sale and therefore raises the value of the subsidiary.

Asset partitioning can also solve the motivation problem. The managers in charge of a subsidiary face stronger incentives than the managers of a corporate division. When a parent company partitions risky assets into a subsidiary, it protects the parent's assets from the subsidiary's creditors. That effectively gives the parent a put option on the subsidiary.[161] If the subsidiary defaults, the parent can simply abandon the subsidiary, which limits the parent's losses to the assets it placed in the subsidiary.

The parent's option to abandon the subsidiary also reduces the parent's incentive to invest in internal uses for the subsidiary's assets.[162] That can be a salutary change in incentives if the subsidiary houses an innovation project. The parent may be less likely to direct the subsidiary's assets to deliver incremental improvements to the parent's existing customers.[163] The manager of the subsidiary likewise gains a stronger incentive to develop independent uses for the subsidiary's assets.[164] She also gains more freedom to develop the assets as she sees fit because she no longer has to compete with other divisions seeking to use the assets.[165]

The manager of a subsidiary can motivate her employees more effectively than the manager of a corporate division. She doesn't need to worry that giving employees strong incentives for work on an innovation project will distract them from other tasks or cause employees from other divisions to seek a transfer. But designing incentive compensation is still tricky. If the subsidiary is wholly owned, there is no market signal of the subsidiary's value. The subsidiary's employees still have to worry that the parent will opportunistically undervalue the

160 *See id.* at 732–35.

161 *See* Kenneth Ayotte, *Subsidiary Legal Entities and Innovation*, 6 REV. CORP. FIN. STUD. 39, 40 (2017).

162 *See id.* at 41.

163 *See* CHRISTENSEN, *supra* note 156, at 42–48.

164 *See* Ayotte, *supra* note 159, at 41.

165 *See id.*

subsidiary if the innovation project succeeds. It should not be surprising, then, that the most successful forms of innovation subsidiaries involve outside investors.

C. Innovation Subsidiaries

Innovation subsidiaries can be divided into three categories: joint ventures, spinoffs, and equity carveouts. A joint venture (JV) is an independent legal entity owned by two parent companies.[166] The archetypal form is the drug development JV.[167] An established pharmaceutical company and venture-backed biotech startup form a JV to bring a new drug to market. The pharmaceutical company contributes experience with clinical trials and the FDA's premarket approval process.[168] The startup contributes novel technology and research scientists.[169] Both companies cede some control over the project by partitioning their assets into an entity with independent governance. They are willing to do so because their interests are closely aligned. Both parents want to see the drug come to market. If the new drug doesn't pan out, the JV structure protects both companies' assets. Asset protection may not matter to the asset-light startup, but it's critical for the pharmaceutical company.

The success of the drug development JV model isn't easily replicable in other markets. The odds of a new drug making it to market are low,[170] and the process can take nine to thirteen

166 In most states, joint ventures are functionally equivalent to partnerships. *See* Sarath Sanga, *A Theory of Corporate Joint Ventures*, 106 CAL. L. REV. 1437, 1448–51 (2018).

167 *See* Ronald J. Gilson, *Locating Innovation: The Endogeneity of Technology, Organizational Structure, and Financial Contracting*, 110 COLUM. L. REV. 885, 910–14 (2010) (analyzing the drug development JV).

168 *See id.* at 911–12.

169 *See id.*

170 *See id.* at 910–11 ("Out of 5,000 to 10,000 compounds that are initially screened, it is estimated that only 250 survive preclinical testing, and the FDA ultimately approves only about 20% of drugs that begin human testing.").

years.[171] But the path is clear.[172] Managers at pharmaceutical companies understand what data they need to produce in clinical trials to get a new drug approved. They also know in advance what the market for a new drug will be: the population of patients with the condition that the drug is intended to treat.[173] Pharmaceutical companies employ drug scientists who can vet biotech startups and assess the progress of JVs. The combination of a predictable market, established metrics for assessing progress, and in-house technical expertise solves the monitoring problem.[174] More unfamiliar innovations can't be managed so easily.

A spinoff is at the opposite end of the control spectrum from a wholly-owned subsidiary. In a spinoff, the parent company sells all of the shares of the innovation subsidiary to public investors. The spinoff can now easily solve the motivation problem. The spinoff's managers and employees now own the spinoff's public stock and can direct their efforts exclusively to growing the newly public company. But a newly spun off company must deal with a monitoring problem. It is now accountable to public investors and must disclose its quarterly earnings. Therefore, a company is more likely to spin off an innovation subsidiary at the end of the commercialization process, when it can provide investors with information that

171 *See id.* at 910.

172 *See* Lerner & Nanda, *supra* note 28, at 246 (explaining that VC interest in biotech startups "is tied to the drug approval and reimbursement system that enables investors to accurately project the market value of a new drug if it is successful in passing through clinical trials.") (internal citation omitted).

173 *See* WILLIAM H. JANEWAY, DOING CAPITALISM IN THE INNOVATION ECONOMY 57 (2d ed. 2018) ("With well-defined target patient populations and third-party funding of demand—conditioned 'only' on successfully gaining FDA approval—the prospective revenues of a biotech start-up can actually be modeled at launch, unlike any venture in any other field.").

174 *See* William R. Kerr, Ramana Nanda & Matthew Rhodes-Kropf, *Entrepreneurship as Experimentation*, 28 J. ECON. PERSP. 25, 39 (2014) ("[A] biotech company can undertake a first experiment to show that a project that originally seemed to have had a 0.1 percent chance of becoming a blockbuster drug has in fact a 5 percent chance. . . . [P]harmaceutical companies are willing to buy the remaining 1-in-20 opportunity for their drug development portfolios.").

indicates a path to profitability and receive a good price for the spinoff's stock. After a spinoff, the former parent must deal with the company it spun off through contract.[175] If the parent jointly develops technology with the spinoff, it risks opportunism.

An equity carveout is a partial spinoff of a subsidiary. The parent carves out part of the subsidiary's equity for public investors, carves out another part for employees, and keeps the remaining part for itself. The public investors contribute capital. The employees contribute labor. The parent company contributes intellectual property, equipment, and facilities.

The equity carveout solves the motivation problem by giving its employees strong incentives. The employees get shares in the carveout, not the parent. The employees don't have to worry about the company undervaluing their shares, because the market sets their value.[176] The carveout also reduces monitoring costs between the parent's shareholders and the parent's managers. The parent's shareholders can gain confidence that the parent's managers aren't funding a vanity project because the carveout was able to raise capital from public shareholders. The weak point in the equity carveout structure is that the carveout's public shareholders may struggle to monitor the carveout. These public shareholders will primarily be passive investors, who can't easily observe the carveout's progress towards commercialization.

The energy company Thermo Electron experimented with equity carveouts between 1983 and 1998.[177] Thermo generally used carveouts for late-stage innovation projects. Its first

175 *See* Iacobucci & Triantis, *supra* note 97, at 521–23 (explaining spin-offs as a tradeoff between the benefits of asset-specific financing and the costs of contracting with the parent).

176 *See id.* at 536 (concluding that the goal of tracking stock "is far better achieved by establishing a distinct legal entity to hold the assets and using alternative restructuring forms such as spin-offs and equity carve-outs.").

177 *See* Benjamin C. Powell, *Equity Carve-outs as a Technology Commercialization Strategy: An Exploratory Case Study of Thermo Electron's Strategy*, 30 TECHNOVATION 37, 41–44 (2010).

carveout, Thermedics, was working to develop an artificial heart.[178] Thermedics received its first outside investment from Venrock Associates, a VC firm.[179] But two months later, Thermedics took a much larger investment from public investors.[180] Over time, Thermo conducted twenty-three carveouts.[181] It developed a policy for determining when to carved out a subsidiary. The project had to be in need of outside capital, expected to grow revenues at 30% per year once it received the capital, and able to garner an attractive stock price in the public markets.[182] The policy suggests that Thermo's managers knew that public investors would only bet on a carveout if its technology was sufficiently advanced to generate meaningful revenue.

Thermo's experiment with equity carveouts was a qualified success. One hundred dollars invested in Thermo at 1983 (when the carveouts started) would have grown to $1,667 by the end of 1995 (when they ended).[183] The same $100 would have yielded only $524 in a portfolio of firms in Thermo's industry and only $381 in the S&P 500 over the same period.[184] Thermo phased out the carveouts in the late 1990s as the parent company faced market headwinds and its empire of carveouts grew unwieldy to manage.[185] But Thermo's experiment shows how creatively-designed corporate structures can overcome the agency problems that otherwise impede innovation.

IV. VENTURE CARVEOUTS

A venture carveout is a private company with one or two public company parents, outside private investors, and employee ownership. It resembles an equity carveout, except

178 *Id.* at 42.
179 *Id.*
180 *Id.*
181 *Id.* at 37.
182 *Id.* at 42.
183 *Id.* at 43.
184 *Id.*
185 *See id.* at 43–44.

for the critical difference that it remains a private company. Venture carveouts evolved as an adaptation to the challenges of developing autonomous vehicle technology. Several of the major players in the AV industry have converged on this novel structure, which suggests that it has real economic advantages. Whether the venture carveouts will actually bring AV technology to market will depend on how they weather increasing demands for liquidity and potential conflicts about strategy and exit.

A. History

Investments in AV technology today are measured in billions. But the most important investment in the development of AVs was a modest $1 million. The investor was the Defense Advanced Research Project Agency (DARPA), the U.S. military unit famous for its role in creating the internet.[186] In 2004, DARPA organized the Grand Challenge, a race for robotic vehicles across a 142-mile course in the Mojave Desert.[187] The agency promised to award $1 million to the winner.[188] Fifteen teams, mostly academic labs, entered the race.[189] None of the vehicles finished. In fact, no vehicle got farther than eight miles.[190] But DARPA was undaunted.

186 For a critical history of DARPA, see generally SHARON WEINBERGER, THE IMAGINEERS OF WAR (2017).

187 Alex Davies, *An Oral History of the DARPA Grand Challenge, the Grueling Robot Race That Launched the Self-Driving Car*, WIRED (Aug. 3, 2017, 9:00 AM), https://www.wired.com/story/darpa-grand-challenge-2004-oral-history/ [https://perma.cc/6X2G-YVS6].

188 Marsha Walton, *Robots Fail to Complete Grand Challenge*, CNN (May 6, 2004, 10:44 AM), https://www.cnn.com/2004/TECH/ptech/03/14/darpa.race/ [https://perma.cc/JF45-RQAY].

189 *See* Joseph Hooper, *From DARPA Grand Challenge 2004DARPA's Debacle in the Desert*, POPULAR SCI. (June 4, 2004, 10:00 AM), https://www.popsci.com/scitech/article/2004-06/darpa-grand-challenge-2004darpas-debacle-desert/ [https://perma.cc/ALY2-KSFY].

190 *See* GRAND CHALLENGE 2004 FINAL REPORT, DEF. ADVANCED RSCH. PROJECTS AGENCY 8–9 (2004), https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/D

In 2005, it hosted a second Grand Challenge on a similar course. This time, it offered $2 million to the winner.[191] The teams learned quickly. Five vehicles finished the race.[192] A Stanford team won the prize.[193]

The second DARPA Grand Challenge had shown that robotic vehicles could navigate rough terrain without human intervention. But DARPA wanted to develop vehicles that could operate autonomously under realistic conditions. In 2007, the agency organized a third race that became known as the Urban Challenge.[194] Vehicles competing in the Urban Challenge had to navigate intersections, merges, U-turns, and parking—all while complying with California traffic law.[195] The prize was again $2 million.[196] But this time DARPA provided some upfront development funding to the

ARPA/15-F-0059_GC_2004_FINAL_RPT_7-30-2004.pdf [https://perma.cc/6UQT-V7ZP].

191 *The Grand Challenge*, DEF. ADVANCED RSCH. PROJECTS AGENCY, https://www.darpa.mil/about-us/timeline/-grand-challenge-for-autonomous-vehicles (last visited Jan. 8, 2022) [https://perma.cc/R4WK-MFFM].

192 *See Stanford Team Wins Robot Race*, NBC NEWS (Oct. 7, 2005, 3:07 PM), https://www.nbcnews.com/id/wbna9621761, [https://perma.cc/V3AG-F9FD].

193 *Id.*

194 John Voelcker, *Autonomous Vehicles Complete DARPA Urban Challenge*, IEEE SPECTRUM (Nov. 1, 2007), https://spectrum.ieee.org/transportation/advanced-cars/autonomous-vehicles-complete-darpa-urban-challenge [https://perma.cc/42WV-MXQ3].

195 *See id.*

196 Kate Greene, *Prelude to a Robot Race*, MIT TECH. REV. (Nov. 2, 2007), https://www.technologyreview.com/2007/11/02/223183/prelude-to-a-robot-race/ [https://perma.cc/4QAT-HR6T].

competitors.[197] Six teams completed the course.[198] Carnegie Mellon won the prize.[199]

The DARPA Challenges attracted the attention of Sergey Brin and Larry Page, the founders of Google. They had attended the second Grand Challenge in disguises.[200] The success of the Urban Challenge raised the possibility of developing robotic vehicles for civilian driving. In 2009, Google quietly assembled a team of engineers, led by alums of the DARPA Challenges, to explore whether AV technology could be commercialized.[201] In 2010, a *New York Times* reporter discovered the program, known as Project Chauffeur.[202] The race to build AVs had begun.

In the early 2010s, Google and the automakers took different approaches to developing AV technology. Google worked to develop fully autonomous vehicles. The company decided on that approach after a brief experiment in which it let employees test partially autonomous prototype vehicles on

197 David Orenstein, *Enter "Junior": Stanford Team's Next-Generation Robot Joins DARPA Urban Challenge*, STANFORD UNIV. (Feb. 12, 2007), https://news.stanford.edu/pr/2007/pr-junior-021407.html [https://perma.cc/P22G-P6F2].

198 Mike Hanlon, *Six Teams Finish the DARPA Urban Challenge*, NEW ATLAS (Nov. 3, 2007), https://newatlas.com/six-teams-finish-the-darpa-urban-challenge/8288/ [https://perma.cc/7K7N-3YJ9].

199 Byron Spice & Anne Watzman, *Carnegie Mellon Tartan Racing Wins $2 Million DARPA Urban Challenge*, CARNEGIE MELLON UNIV. (Nov. 4, 2007), https://www.cmu.edu/news/archive/2007/November/nov4_tartanracingwins.shtml [https://perma.cc/EK9L-VKRK].

200 Arjun Kharpal, *Google's Larry Page Disguised Himself During a Driverless Car Race to Hire the Founder of His Moonshot Lab*, CNBC (July 31, 2017, 7:49 AM), https://www.cnbc.com/2017/05/11/google-larry-page-moonshot-lab.html [https://perma.cc/6MJ2-ZRLV].

201 Dana Hull, *The PayPal Mafia of Self-Driving Cars Has Been At It a Decade*, BLOOMBERG (Oct. 30, 2017, 5:00 AM), https://www.bloomberg.com/news/features/2017-10-30/it-s-been-10-years-since-robots-proved-they-could-drive [https://perma.cc/LY2M-5PAK] (discussing how seven engineers who were part of the Stanford and Carnegie Mellon DARPA Challenge teams worked on Google's AV project).

202 Markoff, *supra* note 40. *See also infra* note 220.

public roads.[203] Employees were caught on video "napping, putting on makeup and fiddling with their phones as the vehicles traveled up to 56 [miles per hour]."[204] Google abruptly cancelled the experiment and committed to full autonomy. It even designed a car that didn't need a steering wheel or brake pedals.[205] The automakers kept developing partially autonomous vehicles. They envisioned that advanced driver-assistance systems (ADAS)—features like adaptive cruise control, collision avoidance, and lane centering—would gradually take over more driving tasks from the human driver.[206]

Google and the automakers also disagreed about how to deploy AVs. At the time, ridehailing services like Uber and Lyft were growing rapidly.[207] Google planned to deploy its AVs in an autonomous ridehailing or "robotaxi" service.[208] The automakers planned to keep selling vehicles, rather than

203 *See* Paresh Dave, *Google Ditched Autopilot Driving Feature after Test User Napped Behind Wheel,* REUTERS (Oct. 31, 2017), https://www.reuters.com/article/us-alphabet-autos-self-driving/google-ditched-autopilot-driving-feature-after-test-user-napped-behind-wheel-idUSKBN1D00MD. . .il=0 [https://perma.cc/VPF6-6GQZ].

204 *Id.*

205 John Markoff, *Google's Next Phase in Driverless Cars: No Steering Wheel or Brake Pedals*, N.Y. TIMES (May 27, 2014), https://www.nytimes.com/2014/05/28/technology/googles-next-phase-in-driverless-cars-no-brakes-or-steering-wheel.html [https://perma.cc/92AD-ZW4N].

206 *See, e.g.*, *Toyota to Launch Advanced Driving Support System Using Automated Driving Technologies in Mid-2010s*, TOYOTA (Oct. 10, 2013), https://pressroom.toyota.com/toyota-advanced-driving-support-system-technology/ [https://perma.cc/U6D6-2RTV].

207 *See* LAWRENCE D. BURNS & CHRISTOPHER SHULGAN, AUTONOMY 246–47 (2018) (explaining how the rise of Uber and Lyft influenced Google's thinking about how to deploy AVs) (on file with the Columbia Business Law Review).

208 *See id.* at 246 (recounting that engineers working on Project Chauffeur saw "on-demand mobility" as the goal) (on file with the Columbia Business Law Review).

rides.[209] They had invested decades of marketing dollars in the idea of individual vehicle ownership. And they had built up networks of dealerships that they were reluctant to abandon.

The tech industry favored Google's direct-to-full-autonomy approach. VCs started to invest in startups developing fully autonomous vehicles.[210] In 2015, Uber shook up the industry by poaching about forty engineers from robotics labs at Carnegie Mellon, the same institution that had won the DARPA Urban Challenge.[211] Uber's headquarters was in San Francisco, but it built a new office for its AV project, later named Uber Advanced Technologies Group (ATG), in Pittsburgh.[212] At the time, Uber was then one of the world's most highly valued startups, but its ride-hailing business was wildly unprofitable.[213] Its leadership believed that replacing Uber drivers with software would make ride-hailing profitable. Uber's founder Travis Kalanick said that developing AVs was "existential" for the company.[214]

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209 *See id.* at 199–201 (describing the auto industry's skepticism towards fully autonomous vehicles in the early 2010s) (on file with the Columbia Business Law Review).

210 Mark Harris, *Meet Zoox, the Robo-Taxi Start-up Taking on Google and Uber*, IEEE SPECTRUM (May 20, 2015), https://spectrum.ieee.org/meet-zoox-the-robotaxi-startup-taking-on-google-and-uber [https://perma.cc/5NFC-BJ72].

211 Mike Ramsey & Douglas MacMillan, *Carnegie Mellon Reels After Uber Lures Away Researchers*, WALL ST. J. (May 31, 2015), https://www.wsj.com/articles/is-uber-a-friend-or-foe-of-carnegie-mellon-in-robotics-1433084582 [https://perma.cc/7TLM-RTUG].

212 *See id.*

213 Eric Newcomer & Jing Cao, *Uber Bonds Term Sheet Reveals $470 Million in Operating Losses*, BLOOMBERG (June 29, 2015), https://www.bloomberg.com/news/articles/2015-06-30/uber-bonds-term-sheet-reveals-470-million-in-operating-losses [https://perma.cc/5W7P-EV8X].

214 Max Chafkin, *Uber's First Self-Driving Fleet Arrives in Pittsburgh This Month*, BLOOMBERG (Aug. 18, 2016, 6:30 AM), https://www.bloomberg.com/news/features/2016-08-18/uber-s-first-self-driving-fleet-arrives-in-pittsburgh-this-month-is06r7on [https://perma.cc/VL7L-DPXZ].

Auto industry executives gradually began to change their minds and embrace full automation.[215] They realized that developing fully autonomous vehicles would require organizational changes. They didn't need a team of automotive engineers in Detroit. Instead, they needed PhDs from Stanford and Carnegie Mellon and software developers from Silicon Valley—engineers who demanded the compensation and independence they would expect from a startup. The automakers also needed to think differently about their business model and learn how to sell rides and not vehicles. If the automakers didn't adapt, Google might crush them. These practical exigencies set in motion the events that led to venture carveouts.[216]

General Motors made the first move. In 2016, GM acquired a small, San Francisco-based, venture-backed startup named Cruise for $581 million.[217] Cruise's founder and CEO Kyle Vogt was a twentysomething MIT-dropout software entrepreneur.[218] GM decided not to integrate Cruise with its Michigan-based ADAS team.[219] Instead, Cruise would stay in San Francisco and focus on developing fully autonomous vehicles to be deployed in a robotaxi service.[220]

215 *See* BURNS & SHULGAN, *supra* note 207, at 280–85 (describing the evolution of the automaker's attitudes towards fully autonomous vehicles).

216 *See infra* Section V.A.

217 *See* Vlasic & Isaac, *supra* note 45; Gen. Motors Co., Annual Report (Form 10-K) 65 (Feb. 7, 2017).

218 *Cruise's Kyle Vogt*, FORBES, https://www.forbes.com/profile/kyle-vogt/. . .sh=5a031d4846aa [https://perma.cc/XH2S-JMQN] (last visited Jan. 8, 2022); Justine Hofherr, *MIT Dropout Wants to Turn Your Normal Car Driverless*, BOSTON.COM, https://www.boston.com/cars/news-and-reviews/2015/07/10/mit-dropout-wants-to-turn-your-normal-car-driverless/ (July 10, 2015), [https://perma.cc/URB8-ZLJ6].

219 Michael Wayland, *GM Lets Its Autonomous Unit Be Autonomous*, AUTO. NEWS (June 19, 2017), https://www.autonews.com/article/20170619/MOBILITY/170619761/gm-lets-its-autonomous-unit-be-autonomous [https://perma.cc/5DPH-AZ7X].

220 Kevin Kelly, *GM to Acquire Cruise Automation to Accelerate Autonomous Vehicle Development*, GEN. MOTORS (Mar. 11, 2016), https://news.gm.com/newsroom.detail.html/Pages/news/us/en/2016/mar/0311-cruise.html [https://perma.cc/9B9G-29RT].

Less than a year later, Ford followed GM's lead. Ford announced that it was investing $1 billion in a company named Argo AI.[221] Argo had only existed for a few months as a startup and hadn't raised much capital.[222] But its founders were well known in the industry—one had been the software lead for Carnegie Mellon's DARPA team.[223] Argo set up shop in Mountain View, California and in Pittsburgh.[224] Its founders said they were focused on building fully autonomous vehicles and considering a range of possibilities for deploying them.[225]

Around the same time, Google's Project Chauffeur gained its independence. In 2015, Google had undergone a corporate restructuring in which its businesses became separate entities under a new parent company called Alphabet.[226] Project Chauffeur was housed in X, an Alphabet subsidiary designed to support moonshots.[227] In 2016, Alphabet created

221 *Ford Invests in Argo AI, a New Artificial Intelligence Company, in Drive for Autonomous Vehicle Leadership*, FORD MEDIA CTR. (Feb. 10, 2017), https://media.ford.com/content/fordmedia/fna/us/en/news/2017/02/10/ford-invests-in-argo-ai-new-artificial-intelligence [https://perma.cc/7TCV-65WE].

222 *See* Kirsten Korosec, *An Inside Look at Ford's $1 Billion Bet on Argo AI*, VERGE (Aug. 16, 2017, 3:15 PM), https://media.ford.com/content/fordmedia/fna/us/en/news/2017/02/10/ford-invests-in-argo-ai-new-artificial-intelligence [https://perma.cc/8RJ7-NNZL] (reporting that Argo had raised only a seed investment).

223 *See* Hull, *supra* note 201.

224 *See* Korosec, *supra* note 222.

225 Paul Lienert & Ben Klayman, *Argo Takes Different Road to Skirt Self-Driving Challenges*, REUTERS (Dec. 11, 2019, 6:10 AM), https://www.reuters.com/article/us-autos-self-driving-argo-focus/argo-takes-different-road-to-skirt-self-driving-challenges-idUSKBN1YF18C [https://perma.cc/4UT7-GD4L].

226 Conor Dougherty, *Google to Reorganize as Alphabet to Keep Its Lead as an Innovator*, N.Y. TIMES (Aug. 10, 2015), https://www.nytimes.com/2015/08/11/technology/google-alphabet-restructuring.html [https://perma.cc/P57B-C8NP].

227 Oliver Franklin-Wallis, *Inside X, Google's Top-Secret Moonshot Factory*, WIRED (Feb. 17, 2020, 6:00 AM), https://www.wired.co.uk/article/ten-years-of-google-x [https://perma.cc/WQS3-U9EM].

a new subsidiary for Project Chauffeur and named it Waymo.[228]

When Cruise, Argo, and Waymo were formed, they were wholly-owned subsidiaries of their parents. But over the next few years, their structures evolved. Cruise and Argo each added a second major automaker as an investor and development partner—Cruise partnered with Honda,[229] Argo with Volkswagen.[230] Then each company started issuing their employees equity in the subsidiary, rather than in the parent.[231] They also started raising capital by selling equity in the subsidiary to outside private investors.[232] The parents had effectively carved out part of their subsidiaries' equity. But the parents didn't sell their carveouts' equity to public investors as Thermo Electron had done with its carveouts. Instead, they sold it to employees and outside private investors, just like a venture-backed startup would. This is how the first venture carveouts were born.

Securities filings reveal that Argo granted its employees equity in the carveout in 2017.[233] Cruise did the same for its newly created carveout in 2018.[234] Waymo's structure is less transparent. Alphabet has disclosed in a securities filing that

228 Daisuke Wakabayashi, *Google Parent Company Spins Off Self-Driving Car Business*, N.Y. TIMES (Dec. 13, 2016), https://www.nytimes.com/2016/12/13/technology/google-parent-company-spins-off-waymo-self-driving-car-business.html [https://perma.cc/D4AV-D92V]

229 Kirsten Korosec, *Honda Commits $2.75 Billion to Build Autonomous Vehicles with GM's Cruise*, TECHCRUNCH (Oct. 3, 2018, 8:33 AM), https://techcrunch.com/2018/10/03/honda-commits-2-75-billion-in-partnership-with-gms-cruise [https://perma.cc/75X2-PBLT].

230 Keith Naughton & Christoph Rauwald, *Self-Driving Startup Argo Closes $2.6 Billion Tie-Up with VW*, BLOOMBERG (June 2, 2020, 12:01 AM), https://www.bloomberg.com/news/articles/2020-06-02/self-driving-startup-argo-completes-2-6-billion-tie-up-with-vw [https://perma.cc/M6A3-2HW3].

231 Waymo employees receive equity "settled in" Waymo stock. *See infra* notes 234–36 and accompanying text.

232 *See infra* notes 237–42.

233 Argo AI Holdings, LLC, Notice of Exempt Offering of Securities (Form D) (Nov. 2, 2017).

234 GM Cruise Holdings LLC, Notice of Exempt Offering of Securities (Form D) (Aug. 23, 2018).

its employee compensation includes "stock-based compensation awards settled in the stock of certain Other Bets"—a group of subsidiaries that includes Waymo.[235] Alphabet CFO Ruth Porat has stated that the company uses "equity-based programs" in its subsidiaries and that it has "accrued compensation expenses to reflect increases in the valuation of equity in certain Other Bets."[236] Porat's comments strongly imply that employee equity compensation in Waymo is tied to the value of Waymo, not Alphabet, though the precise mechanism isn't clear.

Each of the venture carveouts has raised billions from its parents or third-party investors. Waymo raised a round of $3.2 billion in 2020 and another $2.5 billion in 2021.[237] Its investors include the VC firm Andreessen Horowitz, the private equity (PE) firm Silver Lake, the hedge fund Tiger Global, institutional investors like the Canada Pension Plan, and public companies with a strategic interest in the technology, including the auto parts supplier Magna and the retailer AutoNation.[238] Cruise received $750 million from Honda in late 2018;[239] $1.15 billion from T. Rowe Price and its existing investors in 2019;[240] and $2.75 billion from Microsoft,

235 Alphabet Inc., Annual Report (Form 10-K) 20 (Feb. 3, 2020).

236 Matt Rosoff, *Some of Alphabet's 'Other Bets' Have Their Own Equity Structures — Just Like Real Start-Ups*, CNBC (Feb. 5, 2019, 4:42 PM), https://www.cnbc.com/2019/02/05/alphabet-other-bets-equity-structure-explained.html [https://perma.cc/42M7-34XZ].

237 John Krafcik, *T. Rowe Price, Perry Creek Capital, Fidelity, and Others Join First Round of Investment in Waymo*, WAYMO: WAYPOINT (May 12, 2020), https://blog.waymo.com/2020/05/t-rowe-price-perry-creek-capital.html [https://perma.cc/BA4L-94Z9].

238 *See* Tekedra Mawakana & Dmitri Dolgov, *Transforming Mobility with the Confidence of World-Class Investors*, WAYMO: WAYPOINT (June 16, 2021), https://blog.waymo.com/2021/06/transforming-mobility-with-confidence.html [https://perma.cc/AS88-5P4P].

239 Press Release, General Motors, Honda Joins with Cruise and General Motors to Build New Autonomous Vehicle (Oct. 3, 2018), https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2018/oct/1003-gm.html [https://perma.cc/8CE6-YYKU].

240 Press Release, General Motors, Cruise Secures $1.15 Billion of Additional Investment (May 7, 2019), https://investor.gm.com/news-

Walmart, and others in 2020.[241] Argo raised $2.6 billion from Volkswagen in 2019, in exchange for a large chunk of its equity.[242]

Another venture carveout, Motional, joined the group in 2020. Motional started out as a JV between Hyundai and the auto parts supplier Aptiv.[243] Aptiv contributed a team of engineers from startups spun out of Carnegie Mellon and MIT.[244] Hyundai contributed $1.6 billion in capital.[245] Motional quickly granted equity in the carveout to its employees.[246] Motional is too young to have raised outside investment, but it otherwise fits the pattern.

Uber ATG was briefly a venture carveout, but its story is a cautionary tale. Its leader, Anthony Levandowski, had worked on Stanford's DARPA team and Google's Project Chauffeur.[247] In 2017, Waymo sued Uber, alleging that Levandowski stole Waymo's trade secrets when he left

releases/news-release-details/cruise-secures-115-billion-additional-investment [https://perma.cc/8CE6-TKUD].

241 Alan Ohnsman, *Walmart Bets on Cruise, Lifting Robotaxi Startup's Latest Round to $2.75 Billion*, FORBES (Apr. 15, 2021, 09:00 AM) https://www.forbes.com/sites/alanohnsman/2021/04/15/walmart-bets-on-cruise-lifting-robotaxi-startups-latest-round-to-275-billion/. . .sh=daa88a5157b4. [https://perma.cc/5JDK-JHQ8]

242 *See* Naughton & Rauwald, *supra* note 230.

243 Press Release, Motional, Introducing Motional: The Hyundai Motor Group and Aptiv Autonomous Driving Joint Venture Unveils New Identity (Aug. 11, 2020), https://motional.com/news/introducing-motional-the-hyundai-motor-group-and-aptiv-autonomous-driving-joint-venture-unveils-new-identity [https://perma.cc/FU2U-75SW].

244 *See* Karl Iagnemma, *Building Safe, Trustworthy Driverless Cars*, APTIV (Sept. 5, 2019), https://www.aptiv.com/en/insights/article/building-safe-trustworthy-driverless-cars [https://perma.cc/JAC5-SEXY].

245 Hyunjoo Jin & Tina Bellon, *Hyundai Motor Group, Aptiv to Set Up $4 Billion Self-Driving Car Venture*, REUTERS (Sep. 23, 2019, 6:03 AM), https://www.reuters.com/article/us-hyundai-motor-autonomous-aptiv/hyundai-motor-group-aptiv-to-set-up-4-billion-self-driving-car-venture-idUSKBN1W80WP [https://perma.cc/3H59-7V99].]

246 Hyundai-Aptiv AD LLC, Notice of Exempt Offering of Securities (Form D) (Apr. 8, 2020), https://www.sec.gov/Archives/edgar/data/0001808016/000095014220001064/xslFormDX01/primary_doc.xml [https://perma.cc/569H-C8AS].

247 *See* Hull, *supra* note 201.

Google.[248] Uber eventually settled the lawsuit, but was forced to fire Levandowski after Levandowski refused to cooperate with a court order to turn over evidence and testimony.[249] (Levandowski later started a religion dedicated to worshipping AI,[250] got convicted of trade secret theft and sentenced to eighteen months in prison,[251] and was pardoned by President Trump.[252])

Uber ATG pressed on without Levandowski. Then, on March 18, 2018, one of its AVs struck and killed a woman walking her bicycle across the street in Tempe, Arizona.[253] It was believed to be the first fatal collision involving a fully autonomous vehicle.[254] The National Transportation Safety Board later concluded that Uber's lax safety practices contributed to the crash.[255] In spite of the crash, Uber ATG

248 Mike Isaac & Daisuke Wakabayashi, *A Lawsuit against Uber Highlights the Rush to Conquer Driverless Cars*, N.Y. TIMES (Feb. 24, 2017), https://www.nytimes.com/2017/02/24/technology/anthony-levandowski-waymo-uber-google-lawsuit.html [https://perma.cc/4WAM-Q9HE].

249 Mike Isaac & Daisuke Wakabayashi, *Uber Fires Former Google Engineer at Heart of Self-Driving Dispute*, N.Y. TIMES (May 30, 2017), https://www.nytimes.com/2017/05/30/technology/uber-anthony-levandowski.html [https://perma.cc/BMS6-QDHR].

250 Mark Harris, *Inside the First Church of Artificial Intelligence*, WIRED (Nov. 15, 2017, 6:00 AM), https://www.wired.com/story/anthony-levandowski-artificial-intelligence-religion/ [https://perma.cc/27NX-H4BP].

251 Press Release, U.S. Att'y Off., N.D. Cal, Former Uber Executive Sentenced to 18 Months in Jail for Trade Secret Theft from Google (Aug. 4, 2020), https://www.justice.gov/usao-ndca/pr/former-uber-executive-sentenced-18-months-jail-trade-secret-theft-google [https://perma.cc/3U8Z-YCPR].

252 Arjun Kharpal, *Trump Pardons Anthony Levandowski, the Engineer Who Stole Self-Driving Car Secrets from Google*, CNBC (Jan. 22, 2021, 9:59 AM), https://www.cnbc.com/2021/01/20/anthony-levandowski-pardoned-after-stealing-trade-secrets-from-google.html [https://perma.cc/RQF2-Q85M].

253 Daisuke Wakabayashi, *Self-Driving Uber Car Kills Pedestrian in Arizona, Where Robots Roam*, N.Y. TIMES (Mar. 19, 2018), https://www.nytimes.com/2018/03/19/technology/uber-driverless-fatality.html [https://perma.cc/4LU4-74WB].

254 *Id.*

255 Press Release, Nat'l Transp. Safety Bd., 'Inadequate Safety Culture' Contributed to Uber Automated Test Vehicle Crash - NTSB Calls for

was able to raise $1 billion in 2019 from Toyota, the auto parts supplier Denso, and SoftBank.[256] But its reputation never fully recovered.

In 2020, Uber agreed to a deal in which it traded the assets of Uber ATG and $400 million in cash to an AV startup named Aurora in exchange for 40% of Aurora's equity.[257] Uber gained 26% of Aurora and Uber ATG's outside investors gained the remaining 14%.[258] After the deal, Aurora, too, briefly resembled a venture carveout. It was a private company with employee ownership and outside private investment.[259] But Uber wasn't ready to be a parent—it had no enthusiasm for continuing to fund Aurora. Uber sold ATG to Aurora under pressure from public investors to get the cash-hemorrhaging subsidiary off of its balance sheets.[260] In 2021, Aurora went

Federal Review Process for Automated Vehicle Testing on Public Roads (Nov. 19, 2019), https://www.ntsb.gov/news/press-releases/Pages/NR20191119c.aspx [https://perma.cc/EQ7P-G35V].

256 Press Release, Toyota, DENSO and SoftBank Vision Fund to Invest $1 Billion in Uber's Advanced Technologies Group (Apr. 19, 2019), https://global.toyota/en/newsroom/corporate/27833386.html [https://perma.cc/3ZDW-4BZL].

257 Lizette Chapman & Dana Hull, *Uber Sells Self-Driving Unit to Aurora, Takes Startup Stake*, BLOOMBERG (Dec. 7, 2020), https://www.bloomberg.com/news/articles/2020-12-07/uber-sells-self-driving-unit-to-aurora-takes-stake-in-startup [https://perma.cc/S2VN-A9D8].

258 Joann Muller & Kia Kokalitcheva, *Uber to Give Up on Self-Driving Tech and Finds a Partner in Aurora Instead*, AXIOS (Dec. 7, 2020), https://www.axios.com/uber-self-driving-aurora-11e66b3d-c467-49ad-8dd5-4f2fa7589fb0.html [https://perma.cc/F227-77CX].

259 *See* Dana Hull, *A Self-Driving Dream Team Gets $530 Million From Sequoia, Amazon*, BLOOMBERG (Feb. 7, 2019, 11:00 AM), https://www.bloomberg.com/news/articles/2019-02-07/aurora-self-driving-startup-gets-funding-from-sequoia-amazon [https://perma.cc/RHS8-QNHS] (reporting Aurora's fundraising before the Uber deal).

260 *See* Julia Mericle, *Here's Why Uber May Sell Its ATG and What It Means for the Industry*, PITT. BUS. TIMES (Nov. 17, 2020, 11:49 AM), https://www.bizjournals.com/pittsburgh/news/2020/11/17/heres-why-uber-may-sell-its-atg.html, [https://perma.cc/QR9G-QTKY].

public through a Special Purpose Acquisition Company (SPAC).[261]

There is another company developing AVs that may evolve into a venture carveout. Like Uber, Lyft briefly experimented with developing AVs in-house.[262] Also like Uber, Lyft faced pressure from public shareholders to stop tying its money-losing ride-hailing business to a money-losing AV R&D project.[263] In 2021, Lyft sold its AV project to Woven Planet Holdings, a subsidiary of Toyota.[264] Woven Planet is a diversified holding company that plans to build a "smart city" in Japan.[265] It remains to be seen whether Toyota will give employees equity ownership in the subsidiary or seek outside funding.

Two of the serious players developing fully autonomous vehicles in the United States aren't using venture carveouts. Apple has been working to develop AVs for several years, but has been characteristically cagey about its plans.[266] Amazon

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261 Andrew J. Hawkins, *Autonomous Vehicle Company Aurora is Now a Publicly Traded Company*, VERGE (Nov. 4, 2021, 10:54 AM), https://www.theverge.com/2021/11/4/22763180/aurora-av-spac-merger-nasdaq-publicly-traded-urmson [https://perma.cc/U6V2-88N8].

262 Sarah Buhr, *Lyft Launches a New Self-Driving Division and Will Develop Its Own Autonomous Ride-Hailing Technology*, TECHCRUNCH (July 21, 2017, 11:00 AM), https://techcrunch.com/2017/07/21/lyft-launches-a-new-self-driving-division-called-level-5-will-develop-its-own-self-driving-system/ [https://perma.cc/C3GU-92CP].

263 Joann Muller, *Don't Count on Driverless Cars to Fix Lyft's Profitability Struggles*, AXIOS (Apr. 3, 2019), https://www.axios.com/lyft-autonomous-vehicles-0be97aca-1148-4140-8bc5-5938c8e40c41.html [https://perma.cc/3N47-QQL4].

264 Press Release, Lyft, Woven Planet, a Subsidiary of Toyota, to Acquire Lyft's Self-Driving Car Division (Apr. 26, 2021), https://investor.lyft.com/news-and-events/news/news-details/2021/Woven-Planet-a-subsidiary-of-Toyota-to-acquire-Lyfts-self-driving-car-division/default.aspx [https://perma.cc/RJH2-QS88].

265 River Davis, *A City Tailor-Made for Self-Driving Cars? Toyota Is Building One*, BLOOMBERG (Apr. 26, 2021, 9:08 PM), https://www.bloomberg.com/news/articles/2021-04-26/a-city-tailor-made-for-self-driving-cars-toyota-is-building-one [https://perma.cc/Q323-RNUX].

266 *See* Christopher Mims, *Apple and the End of the Car as We Know It*, WALL ST. J. (May 22, 2021, 12:01 AM), https://www.wsj.com/articles/apple-

acquired the venture-backed AV startup Zoox for more than $1.2 billion in 2020.[267] Zoox had attracted attention for building a bidirectional prototype vehicle, affectionally known as the VH1, for "vaporware horseshit."[268] Amazon has pledged to let Zoox remain independent, stay in California, and continue to focus on robotaxis,[269] but there is speculation that Amazon will divert Zoox's focus to autonomous delivery.[270] Amazon has been compensating Zoox employees with restricted stock units tied to Amazon stock. [271]

The table below summarizes the structures of the major players:

and-the-end-of-the-car-as-we-know-it-11621656010 [https://perma.cc/7H7A-N39].

267 Annie Palmer & Ari Levy, *Amazon to Buy Self-Driving Technology Company Zoox*, CNBC (June 26, 2020, 9:47 AM), https://www.cnbc.com/2020/06/26/amazon-buys-self-driving-technology-company-zoox.html [https://perma.cc/NY8E-RJTL].

268 Ryan Felton, *Secretive Startup Zoox is Building a Bidirectional Autonomous Car from the Ground Up*, JALOPNIK (July 17, 2018, 10:40 AM), https://jalopnik.com/secretive-startup-zoox-is-building-a-bidirectional-auto-1827655145 [https://perma.cc/XX5Z-ZJ5R].

269 Press Release, Amazon, We're Acquiring Zoox to Help Bring Their Vision of Autonomous Ride-Hailing to Reality (June 26, 2020), https://www.aboutamazon.com/news/company-news/were-acquiring-zoox-to-help-bring-their-vision-of-autonomous-ride-hailing-to-reality [https://perma.cc/645C-J76T].

270 *See* Palmer & Levy, *supra* note 267.

271 Stephen Nellis & Jane Lanhee Lee, *Exclusive: Amazon Plans at Least $100 Million to Keep Zoox Talent after $1.3 Billion Deal*, REUTERS (July 9, 2020, 6:03 PM), https://www.reuters.com/article/us-amazon-com-zoox-exclusive/exclusive-amazon-plans-at-least-100-million-to-keep-zoox-talent-after-1-3-billion-deal-idUSKBN24A3C8 [https://perma.cc/38Y7-HUN5].

Major Companies Developing Passenger AVs in the U.S.

	Structure	Parent(s)	Peak Private Valuation
Apple AV Unit	Integrated	Apple	Unknown
Argo	Venture Carveout	Ford/VW	$7.5b (2020)[272]
Cruise	Venture Carveout	GM/Honda	$30b (2021)[273]
Motional	Venture Carveout	Hyundai/Aptiv	$4b (2020)[274]
Waymo	Venture Carveout	Alphabet	$30b (2020)[275]
Woven Planet	Integrated	Toyota	$0.6b (2020)[276]
Zoox	Integrated	Amazon	$1.3b (2020)[277]

[272] Kirsten Korosec, *Self-Driving Startup Argo AI Hits $7.5 Billion Valuation*, TECHCRUNCH (July 30, 2020, 8:41 PM), https://techcrunch.com/2020/07/30/self-driving-startup-argo-ai-hits-7-5-billion-valuation/[https://perma.cc/T73K-T7DJ].

[273] Wayland, *supra* note 49.

[274] Jin & Bellon, *supra* note 245.

[275] Richard Waters, *Valued at $30bn, Waymo Considers Its Next Move*, FIN. TIMES (Mar. 5, 2020), https://www.ft.com/content/ed8dc4ca-5eaf-11ea-b0ab-339c2307bcd4 [https://perma.cc/KB54-RHJZ].

[276] Tina Bellon & Eimi Yamamitsu, *Toyota to Buy Lyft Unit in Boost to Self-Driving Plans*, REUTERS (Apr. 26, 2021, 4:13 PM), https://www.reuters.com/business/autos-transportation/lyft-sells-self-driving-tech-unit-toyota-550-mln-moves-up-profit-timeline-2021-04-26/ [https://perma.cc/5P56-A6C3].

[277] Nellis & Lee, *supra* note 271.

B. Anatomy

The venture carveouts borrow some of the structural features that venture-backed startups use to solve the motivation problem. They grant their employees stock or options to purchase stock in the carveout.[278] The equity compensation attracts employees who believe in the carveout's technology and business plan and can tolerate the risk. It also motivates the employees to develop the technology into a viable product. The employees are locked in until the carveout is acquired or goes public—unless the carveout's managers allow them to sell their stock in a secondary market transaction. Equity compensation also serves a retention function: employees have a strong incentive to keep working for the carveout as long as they continue to believe in its growth potential.

Cruise's experience illustrates this thinking. When Cruise became a venture carveout in 2018, Cruise's CEO Vogt told *TechCrunch* that the company had restructured "so that we could recruit and retain the best talent by giving them direct participation in potential upside in Cruise through owning actual shares in Cruise."[279] In the same *TechCrunch* article, an industry analyst explained that Cruise and Argo were issuing stock in carveouts because "[t]he compensation structure at companies like GM and Ford make it difficult for them to compete with the Google's of the world . . . The potential for a giant, strike-it-rich pay out from an IPO is a carrot that will attract and keep talent that is in high demand."[280]

The venture carveout governance structure also reduces monitoring costs. The directors and managers of the carveout are more likely to have a relevant technical background than the directors and managers of their parent companies. The top

278 *See supra* notes 232–233 and accompanying text.

279 Korosec, *supra* note 47.

280 *Id.*

executives of Waymo,[281] Cruise,[282] Argo,[283] and Motional[284] each participated in the DARPA Challenges. They don't need to convey technical information to a non-technical management layer on top—they are the decisionmakers. Their expertise makes it easier for them to supervise engineers, evaluate their individual contributions on technical tasks, and assess the technology's progress. The carveout structure also allows the managers to focus solely on the task of bringing AV technology to market. They don't need to balance the other concerns of a traditional automaker or a diversified technology company.

Venture carveouts also borrow some of the structural features that VCs use to solve the monitoring problem. Venture carveouts have convertible preferred stock, staged financing, syndication, and board meetings where investors can absorb information in private. For example, Cruise's LLC Agreement, which GM disclosed in a securities filing, indicates that some of Cruise's investors are using convertible preferred stock.[285] These preferred shareholders have the right to convert their shares to common shares to participate

281 *See* Hull, *supra* note 201 (noting that Waymo co-CEO Dmitri Dolgov worked on planning & optimization for the Stanford DARPA Grand Challenge team).

282 *See* John Brandon, *Meet the Founder Trying to Start the Self-Driving Car Revolution*, INC. (Feb. 2015), https://www.inc.com/magazine/201502/john-brandon/the-new-cruise-control-kyle-vogt-cruise-automation.html [https://perma.cc/PW2S-VLCJ] (noting that Cruise co-founder Kyle Vogt worked on the 2005 DARPA Grand Challenge as an MIT undergrad).

283 *See* Hull, *supra* note 201 (noting that Argo's then co-CEO Brian Salesky was the software lead of the Carnegie Mellon DARPA Grand Challenge team).

284 *See* Alan Ohnsman, *Driverless Tech Pioneer Predicts Multiple Winners in Autonomous Car Race*, FORBES (July 11, 2017, 7:00 AM), https://www.forbes.com/sites/alanohnsman/2017/07/11/driverless-tech-pioneer-predicts-multiple-winners-in-autonomous-car-race/. . .sh=548a174c71a4 [https://perma.cc/AW5V-VW7V] (noting that Motional CEO Karl Iagnemma worked on MIT's DARPA Grand Challenge team).

285 *See* GM Cruise Holdings LLC, *supra* note 44, § 2.01(a) (stating that Cruise is authorized to issue multiple classes of preferred shares).

in the upside.[286] They also have a liquidation preference that allows them to recoup some or all of their investment in an underwhelming exit.[287] The preferred shareholders' liquidation preferences give the managers who hold common shares a strong incentive to commercialize the technology and not simply sell the assets quickly to make a modest fortune.

Waymo and Cruise have been financed in stages.[288] Staged financing enables the parent companies and outside private investors to periodically reevaluate their investment based on the venture carveout's progress towards commercialization. The investors' credible threat to not reinvest increases the managers' incentive to deliver progress, though this incentive is tempered by the parent company's longer-term commitment to the carveout.

Waymo and Cruise have raised financing rounds from broad investment syndicates.[289] Argo and Motional syndicated their funding more modestly by taking contributions from two parent companies. Syndication allows the venture carveout to raise more capital than they could raise from one of their parents alone. It also allows the parents to risk less on the carveout. Both the parents and the outside private investors can learn about changes in the value of the carveout from interactions with the other investors.

The venture carveout's investors can also gather information about the carveout's progress by appointing a director or observer to its board. The Cruise Agreement, for example, entitled GM to appoint the chair,[290] SoftBank to

286 *See id.* § 2.10(a).

287 *See id.* § 3.02(a)(i)–(ii).

288 *See supra* notes 237–**Error! Bookmark not defined.** and accompanying text.

289 *See* Kirsten Korosec, *Walmart Helps Push Cruise's Latest Investment Round to $2.75B*, TECHCRUNCH (Apr. 15, 2021, 9:00 AM), https://techcrunch.com/2021/04/15/walmart-helps-push-cruises-latest-investment-round-to-2-75b/ [https://perma.cc/CD6W-SEN6]; Patrick McGee, *Waymo Raises Further $2.5bn for Self-Driving Car Project*, FIN. TIMES (June 16, 2021), https://www.ft.com/content/e0dd4302-c69f-42b6-8a37-549ce113a885 [https://perma.cc/Q4M2-TZVQ].

290 Cruise Agreement, *supra* note 44, § 6.03(b).

appoint another director,[291] and Honda to appoint a board observer.[292] At board meetings, the directors can share tacit, qualitative, or confidential information about the carveout's technology.[293] For example, one metric for measuring the progress of AV technology is the rate at which the AV's human operators "disengage" the autonomous system.[294] All things being equal, a system that requires less frequent disengagements is more advanced. But all things aren't equal. An AV's disengagement rate depends on the geography of the test site.[295] Comparing AV companies' disengagement rates without context would create perverse incentives for those companies to instruct operators to rack up useless miles or keep the autonomous system engaged when it wasn't safe.[296] In a private briefing, managers could present disengagement data with appropriate context and without worrying about perverse incentives.

These similarities between venture carveouts and venture-backed startups are striking. But there's a key difference. The carveout's long-term relationship with its parents reduces monitoring costs and enables long-term investing. The parent and the carveout jointly develop the carveout's core technology. The carveout builds the AV's software, the parent

291 *Id.* § 6.03(a).

292 *Id.* § 6.04.

293 *See id.* § 12.04 (imposing broadly worded confidentiality obligations on the LLC's members, directors, and board observers).

294 Brad Templeton, *California Robocar Disengagement Reports Reveal Tidbits about Tesla, AutoX, Apple, Others*, FORBES (Feb. 9, 2021, 3:44 PM), https://www.forbes.com/sites/bradtempleton/2021/02/09/california-robocar-disengagement-reports-reveal-about-tesla-autox-apple-others/. . .sh=6c7a4b0b7fab [https://perma.cc/T89H-369N].

295 *See* Grace Strickland & John McNelis, *Autonomous Vehicle Reporting Data is Driving AV Innovation Right Off the Road*, TECHCRUNCH (Aug. 4, 2020, 11:45 AM), https://techcrunch.com/2020/08/04/autonomous-vehicle-reporting-data-is-driving-av-innovation-right-off-the-road/ [https://perma.cc/8M5R-TYB7].

296 Andrew Hawkins, *Everyone Hates California's Self-Driving Car Reports*, VERGE (Feb. 26, 2020, 3:06 PM), https://www.theverge.com/2020/2/26/21142685/california-dmv-self-driving-car-disengagement-report-data [https://perma.cc/F6WW-4VE3].

builds the vehicle hardware, and they work together to integrate them. Cruise initially tested its AV software on GM's Chevy Bolt.[297] Now it's jointly developing a custom-made vehicle, the Cruise Origin, with GM and Honda.[298] Argo was testing its software on a Ford Escape.[299] It was also developing an automated minibus with Volkswagen.[300] Motional is working to integrate its AV technology with a Hyundai Ioniq.[301] Waymo's parent Alphabet doesn't sell cars—instead, Waymo has used vehicles from multiple automakers[302]—but Waymo's engineers have "a close working

297 *See* Roberto Baldwin, *Cruise Unveils Origin, A Self-Driving Vehicle with No Steering Wheel or Pedals*, CAR & DRIVER (Jan. 22, 2020), https://www.caranddriver.com/news/a30613209/cruise-automation-self-driving-bus-revealed/ [https://perma.cc/7PHH-YTQG].

298 Press Release, Honda, Honda, Cruise and GM Take Next Steps Toward Autonomous Vehicle Mobility Service Business in Japan (Jan. 20, 2021), https://global.honda/newsroom/news/2021/c210120eng.html [https://perma.cc/8YBP-J942].

299 Breana Noble, *Ford Chooses Hybrid Escape for Self-Driving Service, Begins Testing*, DET. NEWS (Oct. 20, 2020, 4:39 PM), https://www.detroitnews.com/story/business/autos/ford/2020/10/20/ford-argo-ai-chooses-hybrid-escape-self-driving-service/5993329002/ [https://perma.cc/8LVA-NNFX].

300 Michael Wayland, *Volkswagen Plans Self-Driving Electric Microbus with Argo AI by 2025*, CNBC (May 12, 2021, 12:09 PM), https://www.cnbc.com/2021/05/12/volkswagen-plans-self-driving-electric-microbus-with-argo-ai-by-2025.html [https://perma.cc/DM39-TGY7].

301 Sean Szymkowski, *Hyundai Ioniq 5 EV Will Serve as Motional's Next Self-Driving Taxi*, CNET (Apr. 1, 2021, 8:24 AM), https://www.cnet.com/roadshow/news/hyundai-ioniq-5-ev-motional-self-driving-taxi/ [https://perma.cc/RL3U-A5F3].

302 *See, e.g.*, Press Release, Jaguar Land Rover Ltd., Waymo And Jaguar Land Rover Announce Long-Term Partnership, Beginning with Self-Driving Jaguar I-Pace (Mar. 27, 2018), https://www.jaguar.com/news/waymo-partnership.html [https://perma.cc/5BFJ-BVCF]; Michael Wayland, *Fiat Chrysler and Waymo Sign Exclusive Deal on Self-Driving Commercial Vehicles*, CNBC (July 22, 2020, 1:00 AM), https://www.cnbc.com/2020/07/22/fiat-chrysler-and-waymo-sign-deal-on-self-driving-commercial-vehicles.html [https://perma.cc/TV9M-B58M]; Andrew J. Hawkins, *Volvo Will Use Waymo's Self-Driving Technology to Power a Fleet of Electric Robotaxis*, VERGE (June 25, 2020, 2:40 PM),

relationship with [Alphabet]'s in-house team of AI researchers."[303]

The closeness of these relationships facilitates commercialization. The parents can easily transfer intellectual property, equipment, and personnel with each other and their venture carveouts. They can also undertake strategic planning together. For example, GM, Honda, and Cruise can jointly plan what features their new vehicles should have, what markets they will be designed to serve, and how many of them will be needed at different stages of development. The parents' equity stakes in the carveout reduce the incentive for opportunism that could otherwise impede arms-length commercial development deals.[304]

The close-yet-independent relationships between the venture carveouts and their parents also help to reduce monitoring costs in two ways. The closeness gives the outside investors—the institutional investors, the corporate VCs, the independent VC firms, the PE firms, and the hedge funds—confidence in the carveout's long-term viability. The outside investors know that the parents view the carveouts as part of their long-term strategy. The automakers need the carveouts to hedge against the risk that AVs will undermine their core business. Therefore, the outside investors can expect that the parents will continue to make costly investments in the carveouts. To be sure, the parents have the legal right to abandon the carveouts. The carveouts are LLCs, so the parents' liability is limited to what they have invested.[305] But the outside investors know that the parents are more likely to keep supporting the carveouts through setbacks in the

https://www.theverge.com/2020/6/25/21303324/volvo-waymo-l4-deal-electric-self-driving-robot-taxi [https://perma.cc/J5S2-XJ4P].

303 *See* Andrew Hawkins, *Inside Waymo's Strategy to Grow the Best Brains for Self-Driving Cars*, VERGE (May 9, 2018, 8:00 AM), https://www.theverge.com/2018/5/9/17307156/google-waymo-driverless-cars-deep-learning-neural-net-interview [https://perma.cc/LQY9-4DJ6].

304 *Cf.* Sanga, *supra* note 164, at 1460–63 (offering an analogous argument in the context of JVs).

305 *See e.g.*, Argo AI Holdings, LLC, *supra* note 233 (reporting equity issued in the name of Argo AI Holdings, LLC); Cruise Agreement, *supra* note 44, § 1.02 (providing that Cruise is an LLC).

commercialization process than a purely financial investor would be. This point is critical for investing in AV technology because companies have repeatedly pushed back timelines for deployment of AVs.

The outside investors are willing to accept an unusually long time horizon. They are providing asset-specific financing to a project developing AV technology. Like VCs, the outside investors in a venture carveout don't expect short-term profitability. But unlike VCs, they don't expect a quick exit either—they expect the company to deploy AVs as soon as the technology has advanced enough to be commercially viable. In fact, the Cruise Agreement conditioned a series of rights, including a new injection of cash from SoftBank, on Cruise's managers' determination "[a]t any time" that Cruise "is reasonably likely to be ready to commercially deploy vehicles in fully driverless operation."[306]

Each class of investors has its own reasons to be comfortable with a longer time horizon. The institutional investors don't need to worry about VC agency costs because they have cut out the intermediaries altogether. They may be willing to invest directly in the venture carveout because the carveout's parents are willing to bet their capital and long-term strategy on the carveout. The parents' costly commitment to the carveout may reassure the institutional investors that they don't need VCs to vet the investment. Strategic considerations, rather than financial considerations, motivate corporate investors like AutoNation, Magna, Microsoft, Walmart. Investing in a carveout lets them absorb private information about a new technology that may change their businesses. The PE and VC firms that have invested in the venture carveouts—like Silver Lake and Andreessen Horowitz—are blue chip firms that have built a track record that may give them a longer leash from their LPs.

At the same time, the venture carveout structure reduces the monitoring costs for *the parents' shareholders*. Consider the perspective of GM's public shareholders. They would generally be reluctant to allow GM's managers to invest

306 *See* Cruise Agreement, *supra* note 44, § 2.02(b)(i).

billions in a project that might not generate profits for a decade. The shareholders wouldn't receive interim feedback that would indicate that the project was progressing. They would worry that the managers were squandering their cash or using it to extract private benefits.

But GM's investments in Cruise reassure GM's shareholders in three ways. First, the investments are more transparent. Cruise is raising funds at discrete intervals and the dollar figures are publicly disclosed. It's more difficult for GM's managers to tunnel those funds to themselves.

Second, GM is syndicating its investments. That means GM needs to spend less capital than it would otherwise spend to develop AVs, and to hedge against the risk that AVs will cannibalize its core business. Cruise's managers must repeatedly persuade outside investors that Cruise is making progress. Managers are less likely to make wasteful investments when they must rely on external capital rather than internal cash flows.[307] The outside investors' willingness to invest also provides a market signal that Cruise is making progress. In a sense, these outside investors are providing vetting services to Cruise's public shareholders without charging a fee.

Third, Cruise has independent, asset-specific governance. Cruise's directors owe fiduciary duties to Cruise, not to GM, except in a few specified circumstances.[308] The directors appointed by Honda, Softbank, and other investors should be motivated to ensure that Cruise's assets aren't being used for the private benefit of GM's managers. It may seem counterintuitive that GM's shareholders would want to put some of GM's assets under the control of third parties who don't have a direct stake in growing the value of GM. But the third parties have a stake in growing the value of Cruise, which would grow the value of GM's share of Cruise.

307 Barzuza & Talley, *supra* note 66, at 179.

308 *See* Cruise Agreement, *supra* note 44, § 5.08(b).

C. Foreseeable Risks

It's too early to know if the venture carveout experiment will succeed. The most obvious question is: will the carveouts' backers have the patience that the structure was designed to enable if economic conditions deteriorate? For Argo's backers, the answer was no. When Argo shut down in October 2022, Ford's new CEO Jim Farley admitted to analysts that the decision was motivated in part by Argo's inability to secure more private financing and the daunting prospects of taking it public.[309] He emphasized the "opaqueness . . . of the view to return capital" from investments in fully autonomous vehicles.[310] Ford's CFO noted that Argo had been in operation for over five years, yet the "horizon" for generating revenue was still "far out."[311]

The venture carveouts that persevere may face some of the same problems that late-stage startups encounter—employee liquidity pressure and conflicts about exit.[312] They may also face the problem that corporate JVs face—conflicts about strategy between two competing parents. The greatest challenge is unique to the venture carveout structure—conflicts between the carveout and the parents' existing lines of business. The viability of venture carveouts as a general solution for incubating moonshots will depend on whether they can overcome these challenges.

The venture carveouts could face liquidity pressure from either their outside investors or their employees. Liquidity pressure is the predictable result of investor lock-in.[313] The outside investors should know they have signed up for an

309 *See* Ford Motor Co., *supra* note 53, at 9 ("We were very clear that the Argo journey would include access to public markets over the last year. And we feel like that's a lot more challenged. So yes, we looked at possible partnerships and funding.").

310 *Id.* at 8.

311 *Id.* at 9.

312 *See* Elizabeth Pollman, *Startup Governance*, 168 U. PA. L. REV. 155, 209–16 (2019) (describing liquidity pressure and conflicts over exit in late-stage startups).

313 *See* Ibrahim, *supra* note 106, at 8–15 (explaining how investor lock-in leads to liquidity pressure).

investment with a long time horizon, but the horizon could be even further away than they expect. Human beings have limited financial time horizons too. Employees who work at a venture carveout for several years will have vested equity that is worth a lot on paper but can't be converted to cash. Like venture-backed startups, venture carveouts can grant employees a second set of options, which would start a new vesting schedule.[314] But if the employees are rational investors, they will eventually want to diversify risk rather than concentrate risk in one especially risky asset.[315] Employees will put pressure on the carveout's managers to take the carveout public, sell it to another company, or allow employee shareholders to trade on the secondary markets.

Liquidity pressure might force venture carveouts to exit prematurely. A venture carveout, like a startup, will exit on more favorable terms once its product has a clear path to profitability. The carveouts developing AVs won't have clinical trial data that can assuage investors. They may need to show that passengers are willing to ride their robotaxis and pay fares that exceed the operating costs. If the carveouts decide they must exit before they have developed a viable robotaxi, they may need to switch to a less ambitious business model. To date, no company focused primarily on developing robotaxis has gone public, though Argo considered going public before it shut down.[316] In 2021, three startups working on autonomous trucking—Aurora,[317] Embark,[318] and

314 *See* Aran, *supra* note 105, at 1264.

315 *See* Ibrahim, *supra* note 106, at 17.

316 *See* Keith Naughton, *Ford-Backed Self-Driving Startup Argo AI Mulling IPO This Year*, BLOOMBERG (Apr. 2, 2021, 6:35 PM), https://www.bloomberg.com/news/articles/2021-04-02/ford-backed-self-driving-startup-argo-ai-mulling-ipo-this-year [https://perma.cc/L3F9-F33B].

317 Kimberly Chin, *Self-Driving Startup Aurora to Go Public Through SPAC*, WALL ST. J. (July 15, 2021, 1:53 PM), https://www.wsj.com/articles/self-driving-startup-aurora-to-go-public-through-spac-11626371629 [https://perma.cc/M3DN-NHRX].

318 Amrith Ramkumar, *Self-Driving Truck Startup Embark to Go Public in $5.2 Billion SPAC Deal*, WALL ST. J. (June 23, 2021, 3:58 PM),

TuSimple[319]—went public. Investors appear to believe that autonomous trucking is either an easier technological problem to solve or a more predictable market to serve.

The venture carveouts could reduce liquidity pressure by allowing some of their employees or outside investors to sell their stock in private secondary markets.[320] In 2022, Cruise announced a liquidity program that would allow its employees to sell their vested equity to GM or other investors at quarterly intervals.[321] The downside of letting rank-and-file employees sell is that their incentives to grow the business diminishes.[322] The downside of letting outside investors sell is that other prospective investors might draw an adverse inference from the sellers' decisions, even if it was motivated purely by liquidity needs. The carveouts will need to control the secondary markets carefully to maintain a shareholder base with long time horizons.

The venture carveouts must also manage their parents' competing interests. GM and Honda compete with each other, and so did Ford and Volkswagen. Competitors sometimes form JVs.[323] The co-venturers in a JV can mitigate their conflicting interests by agreeing to a contractual covenant not to compete.[324] But these covenants are tricky to craft because

https://www.wsj.com/articles/self-driving-truck-startup-embark-to-go-public-in-5-2-billion-spac-deal-11624442400 [https://perma.cc/3RYB-QP57].

319 James Thorne, *TuSimple Raises $1.3B+ in First Autonomous Vehicle IPO*, PITCHBOOK (Apr. 15, 2021), https://pitchbook.com/news/articles/tusimple-IPO-Nasdaq-autonomous-vehicle [https://perma.cc/65RD-ESSS].

320 *See* Ibrahim, *supra* note 106, at 16–20 (describing the private secondary markets).

321 Kyle Vogt, *A New Kind of Equity Program*, CRUISE (Mar. 18, 2022), https://getcruise.com/news/blog/2022/a-new-kind-of-equity-program/ [https://perma.cc/XD4J-6WWH].

322 *See* Ibrahim, *supra* note 106, at 30–31 (explaining but also critiquing the view that the opportunity to cash out on the secondary market diminishes strong incentives).

323 *See* Sanga, *supra* note 166, at 1453–54 (studying a JV between competitors Boeing and Lockheed Martin).

324 *See id.* at 1454–55.

they must be able to survive antitrust scrutiny.[325] Co-venturers typically solve this problem by defining in detail the markets in which they will cooperate through the JV and the markets in which they will compete.[326] In some cases, dividing the market is easy. A pharmaceutical company doesn't need to worry about its drug development JV undermining its existing drugs if the new drug is marketed to an identifiable patient population that the existing drugs don't serve. The venture carveouts developing AVs aim to serve a market that might overlap with either, or both, of the parents' existing businesses. The potential conflicts of interest between the carveouts' parents could keep their corporate lawyers busy.

Even if a venture carveout's parents get along, it may still encounter another kind of conflict of interest—strategic disagreement between its business and its parents' other lines of business. The parents may be tempted to steer the carveout away from markets in which the parents already compete. Every passenger who rides in a Cruise robotaxi has less of a need to buy a Chevy Malibu. The parents may also be tempted to divert the carveout's resources back to their existing lines of business. In fact, GM may have already succumbed to that temptation.

In December 2021, GM CEO Mary Barra forced out Cruise's CEO Dan Ammann and reinstalled Kyle Vogt, Cruise's founder, whom Ammann had earlier replaced.[327] *Bloomberg* reported that Barra and Ammann had disagreed about Cruise's strategy.[328] Barra and GM's board "were pushing a grand vision that included transferring [knowledge from Cruise] to create luxury Cadillacs, self-driving cars sold at retail or delivery vehicles for GM's new electric-van

325 *See id.* at 1458–59.

326 *See id.* at 1455 (describing how Boeing and Lockheed divided the markets in which they would compete and would collaborate through a JV).

327 *See* David Welch, *GM's Barra Dismissed Cruise CEO Ammann Over Mission, IPO*, BLOOMBERG (Dec. 20, 2021, 9:45 AM), https://www.bloomberg.com/news/articles/2021-12-19/gm-s-barra-dismissed-cruise-ceo-ammann-over-mission-ipo-timing [https://perma.cc/4KE6-84YD].

328 *See id.*

business."[329] Barra also wanted Cruise to "enhance GM's own assisted-driving features."[330] Ammann, however, "thought Cruise needed to focus on starting its taxi business before spreading its resources" and wanted to put Cruise on a path to IPO soon.[331] These competing strategic visions proved irreconcilable.

GM's decision to force out Ammann illustrates how the potential for conflict between a venture carveout and its parent is built into the carveout's structure. Ammann was fulfilling his role as a fiduciary of Cruise's shareholders by seeking to maximize the value of Cruise as an independent entity. Likewise, Barra was fulfilling her role as a fiduciary of GM's shareholders, at least as she saw it. GM's shareholders stand to gain not only from growth in Cruise, but also growth in GM's other lines of business, including its ADAS-equipped conventional vehicles. Yet Barra may have inadvertently destroyed value for GM by compromising Cruise's independence. GM's stock price fell significantly when news of Ammann's departure broke.[332]

In theory, a venture carveout's outside investors could help to protect the carveout's independence in a dispute with its parent. But that's not what happened at Cruise. Shortly after GM forced out Ammann, Cruise's largest outside investor, SoftBank, decided to quit. In the Cruise Agreement, SoftBank had committed to make an additional investment once Cruise's managers determined that Cruise "was reasonably likely to be ready to commercially deploy vehicles in fully driverless operation."[333] In February 2022, Cruise determined that the clause had been triggered.[334] But SoftBank never

329 *Id.*

330 *Id.*

331 *Id.*

332 *See id.* (reporting that "GM's stock price fell 5.5% on Dec. 17, more than the day's drop in the broader markets").

333 Cruise Agreement, *supra* note 44, § 2.02(b)(i).

334 In November 2021, Cruise started testing fully driverless AVs on public roads in San Francisco during low-traffic nighttime hours. *See* Rebecca Bellan, *Cruise Launches Driverless Robotaxi Service in San Francisco*, TECHCRUNCH (Nov. 3, 2021, 7:34 PM),

made the anticipated investment. Instead, GM paid $2.1 billion to buy out SoftBank's share of Cruise.[335] Then GM invested an additional $1.35 billion of its own cash into Cruise.[336]

Cruise may have lost more than a checkbook when SoftBank quit. GM's shareholders can no longer count on SoftBank to monitor Cruise's progress. The risk that GM's managers turn Cruise into a GM vanity project has increased. Cruise's growth may depend on how much Vogt, its once and returning CEO, and Honda, its other development partner, are willing to assert Cruise's independence.

By contrast, recent developments at Waymo show how outside private investors can play a constructive role. According to public reporting in the summer of 2021, Waymo decided to expand its testing from the Phoenix suburbs to San Francisco on the advice of its outside investors.[337] According to anonymous sources, the investors wanted Waymo to enter

https://techcrunch.com/2021/11/03/cruise-launches-driverless-robotaxi-service-for-employees-in-san-francisco/ [https://perma.cc/XEK7-UQBV]. Then, in February 2022, Cruise obtained permission from California regulators to charge fares for robotaxi rides, as long as a safety driver was behind the wheel. *See* Press Release, Cal. Pub. Util. Comm'n, CPUC Issues First Autonomous Vehicle Drivered Deployment Permits (Feb. 28, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M455/K694/455694131.PDF_[https://perma.cc/42EX-3CS7]. Cruise also Cruise also opened a "public waitlist" for free fully driverless rides. *See* Andrew J. Hawkins, *Cruise Launches Public Waitlist for its Robotaxis in San Francisco*, VERGE (Feb. 1, 2022, 12:00 PM), https://www.theverge.com/2022/2/1/22912553/cruise-public-waitlist-robotaxi-autonomous-san-francisco [https://perma.cc/B698-7T8C]. The combination of these events led Cruise's managers to determine that commercial deployment was reasonably likely. *See* Cruise Agreement, *supra* note 44, § 2.02(b)(i).

335 Michael Wayland et al., *GM to Buy SoftBank's Stake in Cruise Self-Driving Unit for $2.1 Billion*, CNBC (Mar. 18, 2022, 6:07 PM), https://www.cnbc.com/2022/03/18/gm-to-buy-softbanks-stake-in-cruise-self-driving-unit.html [https://perma.cc/4Q3U-46UV].

336 *Id.*

337 *See* Sarah Krouse, *Investors Pressured Waymo to Focus on Business Sooner*, THE INFORMATION (June 30, 2021, 6:00 AM), https://www.theinformation.com/articles/investors-pressured-waymo-to-focus-on-business-sooner_(on file with the Columbia Business Law Review).

a city where it "might actually be able to build a real business someday."[338] So far, the expansion looks promising. In 2022, Waymo started offering fully driverless rides in San Francisco.[339] Waymo's investors' intervention shows how outside investors in a venture carveout can contribute independent strategic advice. Waymo's willingness to heed their advice suggests that Waymo is not wholly beholden to Alphabet. A venture carveout's autonomy may prove critical to its success.

V. A NEW MODEL FOR INNOVATION

The first venture carveouts were formed by particular companies (the automakers and Alphabet) to incubate a particular technology (AVs) at a particular time (the late 2010s). Could other companies use this same structure to develop other technologies in the future? History suggests that the key ingredients for success are (1) parent companies that are large but not giant, (2) emerging technologies with the potential to disrupt an established industry, and (3) the availability of capital from private investors.

A. Which Companies?

The structures of the major companies developing AVs reveal an interesting pattern. The auto companies, except for Toyota, have all invested in venture carveouts.[340] The tech companies, except for Alphabet, have kept their AV programs integrated.[341] The differences in structure largely track differences in market capitalization. The tech companies are valued in the trillions, and the auto companies are all valued in the tens or hundreds of billions.

The table below shows the relationship between market cap and structure:

338 *Id.*

339 The Waymo Team, *Taking Our Next Step in the City by the Bay*, WAYMO: WAYPOINT (Mar. 30, 2022), https://blog.waymo.com/2022/03/taking-our-next-step-in-city-by-bay.html [https://perma.cc/A6CM-WB7S].

340 *See supra* Section IV.A and accompanying notes.

341 *See supra* Section IV.A and accompanying notes.

Parent Companies of AV Units in the U.S. by Market Capitalization[342]

Parent	Market Cap ($b)	AV Unit	Structure
Apple	$2,446	(Apple)	Integrated
Alphabet	$1,354	Waymo	Venture Carveout
Amazon	$1,054	Zoox	Integrated
Toyota	$197.4	Woven Planet	Integrated
Volkswagen	$83.08	Argo (closed)	Venture Carveout
Ford	$53.19	Cruise	Venture Carveout
GM	$57.36	Argo (closed)	Venture Carveout
Honda	$41.61	Cruise	Venture Carveout
Hyundai	$32.09	Motional	Venture Carveout
Aptiv	$31.35	Motional	Venture Carveout

342 *Market Capitalization of Apple*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/apple/marketcap/ [https://perma.cc/CD6B-U3NS] (last accessed Feb. 5, 2023); *Market Capitalization of Alphabet (Google) (GOOG)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/alphabet-google/marketcap/ [https://perma.cc/FW4J-M87G] (last accessed Feb. 5, 2023); *Market Capitalization of Amazon (AMZN)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/amazon/marketcap/ [https://perma.cc/45JC-GKWE] (last accessed Feb. 5, 2023); *Market Capitalization of Toyota (TM)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/toyota/marketcap/ [https://perma.cc/649H-JTWN] (last accessed Feb. 5, 2023); *Market Capitalization of Volkswagen (VOW3.DE)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/volkswagen/marketcap/ [perma.cc/KJV3-K7PV] (last accessed Feb. 5, 2023); *Market Capitalization of Ford (F)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/ford/marketcap/ [perma.cc/8U77-VPY7] (last accessed Feb. 5, 2023); *Market Capitalization of General Motors (GM)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/general-motors/marketcap/ [perma.cc/V4FS-7NWL] (last accessed Feb. 5, 2023); *Market Capitalization of Honda (HMC)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/honda/marketcap/ [perma.cc/P7A2-HT85] (last accessed Feb. 5, 2023); *Market Capitalization of Hyundai (HYMTF)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/hyundai/marketcap/ [perma.cc/C2VP-BNRY] (last accessed Feb. 5, 2023); *Market Capitalization of Apriv (APTV)*, COMPANIESMARKETCAP.COM, https://companiesmarketcap.com/aptiv/marketcap/ [perma.cc/29J9-P6YA] (last accessed Feb. 5, 2023).

What explains this pattern? Part of the answer is that Amazon and Apple don't need the venture carveout structure because they can fund their AV program with internal cash flows. If they formed carveouts, they would have to share control and profits with outsiders. But that can't be a complete answer. If public investors are bullish about AV investments, then the auto companies should be able to finance their AV programs in public capital markets. If they are bearish, then Amazon and Apple should, in theory, feel pressure to either invest the cash they are spending on AVs on more promising projects or return it to shareholders as a dividend.

However, the tech companies may have more freedom to invest in moonshots because their size partially insulates them from shareholder pressure. Alphabet, Amazon, and Apple dominate their primary markets.[343] The expected cash flows from those markets may give them the luxury of investing in moonshots without pushback from shareholders. Some of the most important innovations of the last century emerged from corporate R&D labs at very large firms, which were, to varying degrees, monopolists.[344] AT&T's Bell Labs developed transistors, lasers, and major modern programming languages.[345] Xerox's Palo Alto Research Center (PARC) developed the graphical user interface, the computer mouse, and ethernet.[346] IBM Research developed

343 *See* Lina M. Khan, *The Separation of Platforms and Commerce*, 119 COLUM. L. REV. 973, 985–1000, 1005–08 (2019) (arguing that Amazon, Alphabet, and Apple dominate key markets as both platforms for producers and competitors with the same producers).

344 *But see* C. Scott Hemphill & Tim Wu, *Nascent Competitors*, 168 U. PA. L. REV. 1879, 1886 (2020) (acknowledging the Bell Labs and Xerox PARC examples, but responding that "over the same period, a significant number of disruptive innovations . . . have come out of very small firms with new technologies unproven at the time: examples include the Bell Telephone Company, RCA, MCI, Genentech, Apple, Netscape, and dozens of others").

345 *See generally* JON GERTNER, THE IDEA FACTORY: BELL LABS AND THE GREAT AGE OF AMERICAN INNOVATION (2013).

346 *See generally* MICHAEL A. HILTZIK, DEALERS OF LIGHTNING: XEROX PARC AND THE DAWN OF THE COMPUTER AGE (2000).

the floppy disk, the hard disk drive, and the first portable computer.[347]

Alphabet is attempting to build a contemporary Bell Labs. Alphabet calls its subsidiary X a "moonshot factory."[348] Waymo is X's most high-profile spin-off. X's other projects include drone delivery, geothermal energy, underwater cameras, kite-based wind energy, balloon-based internet access, energy storage in molten salt tanks, atmospheric water harvesting, and the infamous augmented reality eyeglasses, Google Glass.[349] Some of these projects have "graduated" from X to become separate subsidiaries of Alphabet or fully independent companies.[350]

Alphabet has faced occasional criticism from analysts for the size of its speculative R&D spending.[351] Its 2020 Annual Report discloses a net loss of about $4.5 billion from its Other Bets segment, which includes both Waymo and X.[352] But the Report declares, in a section titled "Moonshots": "[W]e will not shy away from high-risk, high-reward projects that we believe in because they are the key to our long-term success."[353] Alphabet's large R&D investments are not unique among the large tech companies. An analysis in 2017 found that "Alphabet, Amazon, Apple, Facebook, and Microsoft together accounted for nearly a quarter of reported R&D spending for the entire S&P 500."[354]

The concentration of R&D spending in the five tech giants has interesting implications for the short-termism debate.

347 *See generally* EMERSON W. PUGH, BUILDING IBM: SHAPING AN INDUSTRY AND ITS TECHNOLOGY (1995).

348 *Moonshot Thinking*, X DEV. LLC, https://x.company/moonshot/ [https://perma.cc/SD8Z-PD6C].

349 *See Projects*, X DEV. LLC, https://x.company/projects/ [https://perma.cc/Z8R3-S8C5].

350 *See id.* (listing graduated companies).

351 *See, e.g.*, Leonid Bershidsky, Opinion, *Google's Main Business Could Use Some Moonshots*, BLOOMBERG (May 8, 2021, 8:00 AM), https://www.bloomberg.com/opinion/articles/2021-05-08/google-s-other-bets-should-focus-on-its-main-business [https://perma.cc/ZR2U-AVYK].

352 Alphabet Inc., Annual Report (Form 10-K) 38 (Feb. 2, 2021).

353 *Id.* at 5.

354 Zoffer, *supra* note 55, at 312.

Recall Mark Roe's argument that the stock market's enthusiasm for these R&D-heavy companies is evidence against pervasive short-termism.[355] Roe may be right that investors are willing to bet on these companies in part because of the potential value that their R&D could create. But it's also possible that the causal arrow points in the opposite direction. Shareholders may tolerate these companies' investments in long-term innovation *because* they face less competition in their primary markets. Size and market power can partially insulate managers.

It may be dangerous for society to rely on a few large firms to fund long-term innovation. First, it makes R&D vulnerable to political headwinds. If regulators decide to break up the tech giants—as some scholars and policymakers have proposed[356]—the cash flowing into R&D investments may dry up. Even more modest antitrust enforcement might erode the tech companies' insulation from shareholder pressure and lead them to focus more on short-term profits. In addition to the potential economic and political costs of monopoly power, there may be indirect costs to concentrating long-term technological development in such a small number of companies. A few executives have control over which projects get funded, and their biases may influence the direction of technological progress.

Venture carveouts offer a strategy for large-but-not-giant companies—like GM—to compete with the tech giants on long-term innovation. The parents of a carveout need to be large enough to contribute a significant amount of capital. At least one of the carveout's parents also needs to have other assets to contribute—talent, equipment, intellectual property—to make it more than just an investor. The critical advantage of venture carveouts, though, is that the parent's shareholders don't need to trust the parent's managers to fund the whole project indefinitely. To be sure, the venture

355 *See* Roe, *supra* note 13, at 98–100.

356 *See* TIM WU, THE CURSE OF BIGNESS: ANTITRUST IN THE NEW GILDED AGE 132-33 (2018); Steven C. Salop, *Invigorating Vertical Merger Enforcement*, 127 YALE L.J. 1962, 1982 (2018); Lina M. Khan, Note, *Amazon's Antitrust Paradox*, 126 YALE L.J. 710, 800 (2017).

carveout structure can be useful for tech giants too, as Waymo illustrates. But Alphabet didn't separate Waymo into an independent subsidiary for the first six years of its AV program,[357] and it didn't raise outside capital for roughly the first decade. Carveouts are more useful for the underdogs.[358]

Joseph Schumpeter described capitalism as a "perennial gale of creative destruction."[359] New firms develop new technologies and new business models, destroy incumbent firms, and deliver progress. The past fifty years of technological development offers plenty of examples that fit Schumpeter's vision. AT&T, Xerox, and IBM still exist as public companies, but they have been eclipsed by companies that developed operating systems, search engines, e-commerce, smartphones, and social networks. However, the current tech giants have now been dominant for many years. If the next generation of transformative technologies require moonshots—and neither VC markets nor more modestly sized companies are able to fund them—then the tech giants' ability to fund moonshots may help them remain dominant. It's reasonable to doubt whether hidebound automakers like GM can compete with innovative tech firms like Alphabet.[360] We have already seen that Ford and Volkswagen gave up. But venture carveouts give the competition a fighting chance.

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357 *See* Daisuke Wakabayashi, *Google Parent Company Spins Off Self-Driving Car Business*, N.Y. TIMES (Dec. 13, 2016), https://www.nytimes.com/2016/12/13/technology/google-parent-company-spins-off-waymo-self-driving-car-business.html [https://perma.cc/DC7G-AC3U].

358 *See* Daisuke Wakabayashi, *Waymo Includes Outsiders in $2.25 Billion Investment Round*, N.Y. TIMES (Mar. 2, 2020), https://www.nytimes.com/2020/03/02/technology/waymo-outside-investors.html [https://perma.cc/A4RY-FY8K].

359 JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM AND DEMOCRACY 84 (1947).

360 *See* Brad Templeton, *GM/Cruise Leaks Show Them Ridiculously Behind Waymo. It's Time for Better, More Public Metrics*, FORBES (June 10, 2019, 7:45 AM), https://www.forbes.com/sites/bradtempleton/2019/06/10/gmcruise-leaks-show-them-ridiculously-behind-waymo-its-time-for-better-more-public-metrics/. . .sh=b60f0ac15b13 [https://perma.cc/K4YY-6Y4K].

B. Which Technologies?

We know that venture carveouts will be used for moonshots—innovation projects with high development costs, long commercialization periods, and high expected returns. When development costs are low, corporations don't need to raise capital from outside investors. When commercialization periods are short, the VC market will fund development. When the expected returns are modest, profit-seeking companies won't invest at all.

Are some moonshots more likely to be funded than others? The experience of the first venture carveouts suggests that disruptive technologies might be strong candidates, contrary to the conventional wisdom. The term "disruptive technology" was coined by business scholar Clayton Christensen in the late 1990s.[361] Christensen argues that incumbent firms predictably neglect the risk that their businesses will be disrupted.[362] They focus on developing "sustaining technologies"—technologies that "improve the performance of established products, along the dimensions of performance that mainstream customers in major markets have historically valued."[363] They disregard disruptive technologies, which "underperform established products in mainstream markets" but appeal to "fringe" customers because they are "cheaper, simpler, smaller, and, frequently, more convenient to use."[364] But over time, Christensen contends, disruptive technologies improve in performance and cannibalize the market for established products.[365]

AVs fit Christensen's definition of disruptive technology well. A passenger comparing the performance of today's robotaxis to conventional vehicles would be underwhelmed. AVs drive slowly and often take circuitous routes to avoid left

361 *See* CHRISTENSEN, *supra* note 158, at 10–11.

362 *Id.*

363 *Id.* at 11.

364 *Id.*

365 *See id.* at 28–33 (describing this process in the disk drive industry).

turns.[366] They can only drive in favorable weather conditions, on pre-mapped roads, in a small number of metropolitan areas.[367] The market for taxi rides in these cities is orders of magnitudes smaller than the market for conventional vehicles. But it's likely that AV performance will eventually improve, and consumers will start buying fewer cars and more robotaxi rides.

The first few years of AV development played out as Christensen would have predicted. Google, a new entrant to the transportation market, invested in developing the disruptive technology. The incumbent automakers mostly ignored them. According to Larry Burns, the former head of R&D at GM and later an advisor to Project Chauffeur, when Google's engineers met with GM managers to discuss collaborating on AVs, GM "responded to Google's entreaties with an arrogance" that alienated the Google team.[368] GM focused on developing incremental improvements to the ADAS technology that they were already selling to their existing customers. But the history of the AV industry and Christensen's theory diverged in 2016. GM bought Cruise and stated that it would focus on developing fully autonomous vehicles to be deployed in a robotaxi service.[369] In Christensen's terms, the incumbent had declared it would develop the disruptive technology and focus on the fringe market. Then other incumbents—Ford, Volkswagen, Honda, and Hyundai—made similar decisions.[370]

It was the fear of disruption that created venture carveouts. GM's managers didn't brainstorm a list of

366 *See, e.g.*, Amir Efrati, *With Waymo Robotaxis, Customer Satisfaction Is Far from Guaranteed*, INFORMATION (Mar. 22, 2019, 6:31 AM), https://www.theinformation.com/articles/with-waymo-robotaxis-customer-satisfaction-is-far-from-guaranteed (on file with the Columbia Business Law Review).

367 *See Test Tracking Tool*, NAT'L HIGHWAY SAFETY TRAFFIC ADMIN., https://www.nhtsa.gov/automated-vehicle-test-tracking-tool [https://perma.cc/T94Q-ERLA] (displaying AV testing locations).

368 BURNS & SHULGAN, *supra* note 205, at 281.

369 *See* Kelly, *supra* note 220.

370 *See supra* Section IV.A and accompanying notes.

promising technologies on a whiteboard. They witnessed Google's progress in developing AVs, and they began to fear that AVs could undercut their existing business of manufacturing human-driven vehicles. According to Burns, GM's leadership began to "realize that changes in mobility were coming—and that they could destroy GM's business."[371] GM's managers bought Cruise to hedge against that risk. Then they turned Cruise into a venture carveout once they realized that they needed outside capital to bring AVs to market and equity compensation to recruit talented engineers. Similar fears led Ford, Volkswagen, Honda, and Hyundai to invest in carveouts too.

Why did the incumbents react differently this time? The auto executives may have read Christensen's work and followed his advice. They may have been motivated by seeing how software had upended other industries or how electric vehicles were disrupting their own industry.[372] It's also possible that AVs are the rare kind of emerging technology that technical experts can predict will be disruptive many years before it comes to market. The potential of the disruptive technologies that Christensen studied—small disk drives, hydraulic excavators, and minimill steel—may only have been clear in hindsight.[373]

There are speculative technologies being researched today that may eventually become commercially viable. A venture carveout could help the aircraft industry develop next generation supersonic jets,[374] the pharmaceutical industry

371 BURNS & SHULGAN, *supra* note 207, at 282.

372 This is Burns' theory. *See id.* at 284 ("The automakers looked at the Google self-driving car project, and they foresaw a future in which the automobile became the latest example in a business trend that had already affected two other software-heavy devices, personal computers and smartphones.").

373 *See* CHRISTENSEN, *supra* note 158, at 20–35 (disk drives), 60–69 (excavators), 79–84 (minimill steel).

374 *See* Roy Furchgott, *Can Supersonic Air Travel Fly Again. . .*, N.Y. TIMES (Nov. 1, 2021), https://www.nytimes.com/2021/11/01/business/supersonic-plane-travel-concorde.html [https://perma.cc/RQL3-EW7H].

develop synthetic organisms,[375] or the energy industry develop nuclear fusion, if and when more research indicates that these technologies are commercially viable.[376] But there's no guarantee that companies will take these opportunities. The energy industry wasted decades fighting regulation rather than developing solar and wind technology—precisely the kind of moonshot for which a venture carveout would have been useful. And, of course, as Argo illustrates, new technologies only benefit from venture carveouts if their backers are willing to stick with them when the going gets tough.

The history of AV technology shows how government research programs can build technical consensus that sparks private development. DARPA generated no revenue. But the results of the DARPA Challenges led Google to investigate whether commercializing AVs was viable. Unsuccessful venture-backed startups can serve a similar role. Startups may fail to bring a technology to market, yet still make enough progress to convince technical experts that a better-funded or better-managed organization could commercialize it. The opinion of technical experts can influence investors and pressure managers at larger businesses to act. If the market conditions are right, they can form venture carveouts to complete the commercialization process.

C. Why Now?

The venture carveout didn't emerge until 2018. We can learn why it didn't emerge earlier by considering its ancestor, the equity carveout. Thermo Electron developed equity

375 *See* Yiren Lu, *The Gene-Synthesis Revolution*, N.Y. TIMES (Nov. 24, 2021), https://www.nytimes.com/2021/11/24/magazine/gene-synthesis.html [https://perma.cc/KJ63-AL2G].

376 *See* Stanley Reed, *Nuclear Fusion Edges Toward the Mainstream*, N.Y. TIMES (Oct. 18, 2021), https://www.nytimes.com/2021/10/18/business/fusion-energy.html [https://perma.cc/X2V8-QK7W].

carveouts in the early 1980s.[377] As we saw in Part II, Thermo's equity carveouts had a public company parent and significant employee ownership.[378] Public shareholders owned the carveout's remaining shares. The venture carveout's innovation was substituting outside private investors for public ones. That innovation was made possible by recent developments in capital markets. Thermo Electron might not have been able to raise large amounts of capital from private investors when it formed its first equity carveout in the early 1980s.

The availability of private capital has increased dramatically in the last few decades. The increase is in part due to deregulation.[379] In 1982, the SEC promulgated Regulation D, which created safe harbors from registration for securities offerings to accredited investors.[380] Regulation D greatly expanded opportunities for private placements. Then in 1990, the SEC deregulated the resale of private securities, through the adoption of Rule 144A, which permits unregistered securities to be resold to large institutional investors.[381] The SEC has since amended Rule 144, so that it now permits private securities to be resold after a holding period.[382] The net effect of this deregulation was to make it easier to sell private securities and to increase their liquidity.

377 As early as the late 1960s, corporations were using spinoffs to raise capital for technology projects. *See* TOM NICHOLAS, VC: AN AMERICAN HISTORY 243–44 (2019).

378 *See* Powell, *supra* note 177, at 41–42.

379 *See* Elisabeth De Fontenay, *The Deregulation of Private Capital and the Decline of the Public Company*, 68 HASTINGS L.J. 445, 467–70 (2017).

380 *See id.* at 467; *See* Sec. Exch. Comm'n, Revision of Certain Exemptions from Registration for Transactions Involving Limited Offers and Sales, S.E.C. Release No. 33-6389, 47 Fed. Reg. 11,251 (Mar. 8, 1982); 17 C.F.R. §§ 230.500-08.

381 De Fontenay, *supra* note 379, at 468; *See* Sec. Exch. Comm'n, Resale of Restricted Securities; Changes to Method of Determining Holding Period of Restricted Securities under Rules 144 and 145, Release No. 33-6862, 55 Fed. Reg. 17933 (Apr. 30, 1990); 17 C.F.R. § 230.144A.

382 *See* De Fontenay, *supra* note 379, at 468; 17 C.F.R. § 230.144.

In 2018, more than $1.4 trillion in capital was raised through Regulation D Rule 506(b) offerings.[383]

The new universe of private capital markets includes (1) larger and longer-term funds managed by traditional VC firms; (2) corporate VC; and (3) new specialist "late-stage" investors. Each of these sources of private capital helps to make venture carveouts viable.

We have seen how the traditional VC model, with its limited life funds, favors short-term innovation.[384] But the model is changing. VCs are increasingly asking their LPs to extend the lives of their funds.[385] VCs are also raising much larger funds. In the first quarter of 2020, nearly half of all VC capital was raised from funds of $1 billion or more.[386] One VC firm that exemplifies this trend is Andreessen Horowitz, which now has $16.5 billion in assets under management.[387] It's probably not a coincidence that Andreessen Horowitz, which that much cash to invest, was willing to take the long-term bet that Waymo represented.

Corporate VC started to take off the 1960's but grew significantly in the 1980's.[388] Its growth has accelerated in recent years. One study found that corporate VC investments represented 26% of all VC dollars invested in 2017, up from 20% in 2012.[389] Corporate VCs are especially likely to invest in venture carveouts because they pursue strategic goals in

383 Sec. Exch. Comm'n, Concept Release on Harmonization of Securities Offering Exemptions, 84 Fed. Reg. 30460, 30466 (June 26, 2019).

384 *See supra* Section III.A.

385 *See* Mulcahy, *supra* note 139.

386 James Thorne, *Mega-Funds Thrive Despite Hard Times for Small and First-Time VCs*, PITCHBOOK (Apr. 14, 2020), https://pitchbook.com/news/articles/mega-funds-thrive-despite-hard-times-for-small-and-first-time-vcs [https://perma.cc/9LXU-4QTZ].

387 Press Release, Andreessen Horowitz, Fund VII and Growth Fund II, (Nov. 20, 2020), https://a16z.com/2020/11/20/fund-vii-and-growth-fund-ii/ [https://perma.cc/QZ7V-ECVM].

388 *See* NICHOLAS, *supra* note 377, at 243–44.

389 Michael Brigi et al., *How the Best Corporate Venturers Keep Getting Better*, BOSTON CONSULTING GRP. (Aug. 22, 2018), https://www.bcg.com/en-us/publications/2018/how-best-corporate-venturers-keep-getting-better [https://perma.cc/GSJ9-TTKL].

addition to financial returns.[390] Corporate VCs can use investments to learn more about an emerging technology or to gain an inside track to a commercial deal with the company developing it. That's why Microsoft and Walmart invested in Cruise and Magna and AutoNation invested in Waymo.[391] Corporate VCs can also tolerate long-term bets because they invest directly. They don't need to return the capital to LPs.

In the last decade, new classes of investors—including mutual funds, pension funds, and sovereign wealth funds—have started to invest directly in late-stage startups.[392] Each of these classes of investors traditionally invested through VC intermediaries. Disintermediation lets investors dispense with the fees they pay to VCs, which increases their net returns. It could also let investors take a longer-term perspective, because they don't have to worry about monitoring VC performance. The cost of disintermediation, however, is that these investors might lack the specialized skills that VCs have honed.

The most interesting of these late-stage investors is a new kind of intermediary. In 2017, the Japanese conglomerate SoftBank raised the Vision Fund, an unprecedented $100 billion private investment fund.[393] Its mission was to "own pieces of all the companies" that stand to benefit from artificial intelligence.[394] The Vision Fund has proved controversial. Its largest investor is the sovereign wealth fund of Saudi Arabia.[395] It made large investments in two of the most scandal-prone startups of the last decade, Uber and

390 *See* Darian M. Ibrahim, *Corporate Venture Capital*, 24 U. PA. J. BUS. L. 209, 224–25 (2021).

391 *See supra* Section IV.A and accompanying notes.

392 *See* Pollman, *supra* note 312, at 175.

393 Katie Benner, *Masayoshi Son's Grand Plan for SoftBank's $100 Billion Vision Fund*, N.Y. TIMES, (Oct. 10, 2017), https://www.nytimes.com/2017/10/10/technology/masayoshi-son-softbank-vision-fund.html [https://perma.cc/59HK-N4UW].

394 *Id.*

395 Peter Eavis & Michael J. de la Merced, *SoftBank Bet Big on Disruptive Companies. Many Have Not Paid Off.*, N.Y. TIMES (Sept. 26, 2019), https://www.nytimes.com/2019/09/26/business/softbank-wework-masayoshi-son.html [https://perma.cc/Y295-GBP2].

WeWork.[396] But there's no doubt that the Vision Fund made it easier for private companies to raise capital.

The flood of capital pouring into private companies has facilitated the rise of venture carveouts. Public companies can turn to these investors to help finance moonshots that their shareholders wouldn't have. It's hard to know whether the easy availability of private capital is cyclical or the new normal. It's also not yet clear if the non-traditional investors who are funding venture carveouts will prove skilled at corporate governance or patient enough for long-term investing. Softbank's relationship with Cruise illustrates both the potential of outside investors and the doubts about its sustainability. The venture carveouts, like the technologies they develop, are still experimental.

VI. CONCLUSION

The rise of venture carveouts suggests raises questions for both sides of the short-termism debate. For the skeptics, the question is: why would the managers of the public companies developing AVs have chosen the venture carveout structure if the public capital markets were willing to fund the pro-jects? The parent companies would have kept more control over their AV projects—and would be positioned to capture more of the value they create—if they structured them as wholly-owned subsidiaries.

If the parents were just looking for a vehicle for joint development, they could have chosen the simpler and more familiar JV structure. If they were just looking to give public investors a pure play on AV development, they could have chosen equity carveouts. The distinctive feature of venture carve-outs is that they enable private financing of long-term projects. The parents would not have needed to incur the increased cost of raising private financing if public financing were available on equally attractive terms.

For the short-termists, the question is: if the stock market has a strong short-term bias, why have the parent companies or their managers not been punished? AVs are a

396 *See id.*

quintessential high-risk, high-reward long-term project. To be sure, the parent companies have hedged their risk and reduced their costs by using the venture carveout structure, but they are still spending hundreds of millions or billions of their own money without a return in the fore-seeable future. The directors and managers are not relying on board insulation to protect themselves, yet no activist hedge fund has targeted these investments.

Short-term bias may be a more subtle problem than the short-termists claim, but not an illusion. It may be that public shareholders won't generally fund long-term projects that won't generate reliable interim feedback. Yet they may be willing to fund part of those projects if private investors will share the cost and provide monitoring. If that's right, then the structure of innovative companies may be more important—and the future of innovation more fragile—than has previously been appreciated.