A Brief Assessment of the Procompetitive Effects of Organizational Restructuring in the Ag-Biotech Industry

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INTRODUCTION

The agriculture sector has seen significant technological innovation and organizational change over the last two decades, leading to increases in both farm productivity and profitability. These scientific breakthroughs, most notably in crop protection science biotech seed traits and precision farming, were the result of substantial research and development ("R&D") investment. Further, these technological breakthroughs were accompanied by organizational changes — *e.g.*, increasing vertical and horizontal collaboration — that have enabled an increasingly complex industry to productively implement them.

In recent years the need to innovate has only increased. As technology in the sector continues to evolve, companies are increasingly adapting with structural changes to enable more effective R&D. These adaptations include increased collaboration between companies and, at times, integration of firms through mergers and acquisitions ("M&A"). This M&A activity has harmed neither competition, innovation, or investment by new entrants. In fact, combining businesses with complementary R&D has spurred innovation and accelerated the development and deployment of new products, one of the primary goals of the antitrust laws. Advances in biotechnology, crop protection science, and AgTech have provided farmers with increasingly sophisticated tools to meet the challenges of increasing demand for food

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and diminishing natural resources. Far from harming innovation, M&A activity in the agriculture industry has been accompanied by tremendous increases in R&D spending by existing and new companies and enhanced agricultural productivity.

Criticisms of agricultural industry M&A activity — and to the current, proposed Bayer-Monsanto and Dow-DuPont mergers in particular — are based on one or more of several common misconceptions about the industry, innovation, competition, and the deals themselves. This paper identifies and responds to several of those misconceptions, focusing in particular on the claims raised in a 2016 working paper produced by the Agricultural and Food Policy Center at Texas A&M University, entitled *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices* ("Texas A&M Report" or "Report").[1] Fundamentally, the Texas A&M Report incorporates flawed or incomplete antitrust law and economics in its condemnation of the pending mergers by alleging likely harms without considering their likely countervailing and procompetitive benefits. Further, the potential harms alleged are premised on unsound or outdated economic theory, or rooted in inconsistent or inaccurate characterizations of the deals, the industry, and its competitive dynamics. The Report's substantial flaws make it an unsuitable guide to proper antitrust policy regarding the proposed deals.

I. BALANCING ANTICOMPETITIVE RISKS AGAINST PROCOMPETITIVE BENEFITS

The key challenge facing any proposed antitrust enforcement action is distinguishing procompetitive from anticompetitive conduct. Balancing the potential harms with the likely procompetitive benefits of a transaction is central to merger law and enforcement policy. Thus, for example, when assessing horizontal mergers, courts and enforcement agencies employ a structured balancing test to weigh the likely

[1] Henry Bryant *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, Agricultural and Food Policy Center, The Texas A&M University System, Working Paper 16-2 (Sept. 2016), *available at* https://www.afpc.tamu.edu/pubs/0/675/WP_16-2.pdf.

anticompetitive effects of a potential restraint against its potential procompetitive, efficiency-enhancing benefits.[2]

Nevertheless, antitrust errors are inevitable because mergers (and other conduct) can have both procompetitive and anticompetitive effects simultaneously, and distinguishing between them requires a necessarily imperfect understanding of the unique competitive dynamics of markets relevant to each transaction.[3] But the risk of error is unnecessarily compounded by the unfortunate tendency in many enforcement decisions (and outside analyses) to condemn business practices that are not well understood, or for which an efficiency explanation is rooted in a business' unique, risk-adjusted expectations regarding future innovation (both its own and the market's more generally). In order to help ensure that consumer-welfare-enhancing mergers are not unduly rejected, it is crucial that merger analyses aimed at assessing proposed transactions take efficiency considerations seriously.

Thus, when analyses like the Texas A&M Report purport to analyze the pending agricultural industry mergers, but address only alleged harms or pay scant attention to procompetitive effects, they present an incomplete perspective that is inappropriate on its own for policy guidance. As a partial corrective, therefore, this paper offers a brief but, we believe, more accurate overview of the complex, sometimes counterintuitive, and potentially advantageous competitive dynamics of the agricultural industry. It places the proposed deals within a more complete context, highlighting the potential benefits that may arise from the organizational shifts they entail.

Of crucial importance, the frequent focus on simplistic characterizations of industry concentration, derived, essentially, from counting the number of large firms, is misplaced. While concentrated industries *can* be marked by a risk of anticompetitive conduct, concentration may also be a product of the efficient organization of industry, particularly in response to the demands of effective innovation. Thus, "[t]o

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[2] Department of Justice, *The Merger Guidelines and the Integration of Efficiencies into Antitrust Review of Horizontal Mergers*, *available at* https://www.justice.gov/archives/atr/merger-guidelines-and-integration-efficiencies-antitrust-review-horizontal-mergers.

[3] "To a large extent, predictions about these efficiencies depend less on models and more on fact-specific data than is true on the anticompetitive effects side of the ledger." Daniel A. Crane, *Rethinking Merger Efficiencies*, 110 MICH. L. REV. 347, 355 (2011).

assess fully the impact of a merger on market performance, merger authorities and courts must examine how a proposed transaction changes market participants' incentives and abilities to undertake investments in innovation."[4] And, importantly,

> [i]nnovation can dramatically affect the relationship between the pre-merger marketplace and what is likely to happen if the proposed merger is consummated.... **[This requires consideration of] how innovation will affect the evolution of market structure and competition. Innovation is a force that could make static measures of market structure unreliable or irrelevant**, and the effects of innovation may be highly relevant to whether a merger should be challenged and to the kind of remedy antitrust authorities choose to adopt.[5]

At first blush, the Texas A&M Report accurately describes the market, noting that increased concentration has correlated with innovation:

> Over the past few decades, development of new types of pesticides and seeds have substantially improved agricultural productivity. Agricultural input markets have evolved and family owned and small businesses gave way to larger enterprises that integrated plant breeding, conditioning, production, marketing, and other functions. This evolution in the industry was coupled with increasing market concentration in seed and chemical supply and the industry was further shaped by widespread mergers and acquisitions. The agrochemical companies bought hundreds of independent biotechnology and seed companies, and merged with one another.[6]

But it falters when it concludes that

> [t]his has resulted in an industry that is comprised primarily of six large multinational firms.... The market power resulting from the structural changes in agricultural input industries make farmers pay higher prices

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[4] Michael L. Katz and Howard A. Shelanski, *Merger Policy and Innovation: Must Enforcement Change to Account for Technological Change?* in INNOVATION POLICY AND THE ECONOMY (Adam B. Jaffe, Josh Lerner and Scott Stern, eds., 2005) 109, 110.

[5] *Id.* (emphasis added).

[6] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 26-7.

> for purchased inputs. Seed prices in the U.S. have increased by larger percentages than other farm inputs in recent years."[7]

As the Report itself previously noted, "these big firms increased their sales faster than others in the industry by offering better products or services (often an outgrowth of larger R&D investments), improving their marketing ability, and offering competitive prices (often through economies of scale)."[8] Whatever the claimed price effects of increased concentration, if they are not accompanied by an assessment of industry-wide increases in innovation and of quality improvements that may have accompanied the price increases, it is impossible to conclude that they are an indication of anticompetitive conduct — or even that they are harmful at all. Rather, price increases accompanied by concomitant or even greater quality increases, as well as increased market innovation (that may result in future quality improvements), are consistent with consumer-welfare-enhancing behavior, and these benefits must also be evaluated before any conclusions can be drawn.

II. INNOVATION IN THE AGRICULTURE INDUSTRY

For a number of reasons, a significant amount of merger activity arises in innovative industries. Among other things, mergers are often an efficient way for innovative firms to increase research and production capacity, and to obtain the specific resources necessary for commercialization and distribution of their innovations. Mergers can also help innovative firms manage the flow of information and improve upon its innovation potential. Most importantly, mergers among innovative firms enable them to combine their R&D resources, learn from each other, and coordinate their investment decisions. And particularly in mature, innovative industries — where the next step in increasing productivity may entail both significant investment as well as the complex coordination of diversified and specialized firms engaged in interrelated R&D — a broad range of firm sizes may be important to the industry's continued advancement.[9]

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[7] *Id.* at 27.

[8] *Id.* at 4.

[9] *See generally* Joanna Shepherd, *Consolidation and Innovation in the Pharmaceutical Industry: The Role of Mergers and Acquisitions in the Current Innovation Ecosystem*, 20 J. HEALTH CARE L. & POL'Y _ (*forthcoming* 2017), *available at* https://ssrn.com/abstract=2937852.

The limited increase in consolidation that comes from a merger, in other words, may be important not only for optimizing innovation *within* the merging firms, but it may also be key to facilitating innovation *throughout* an industry. "In industries in which most innovation originates externally… analyses should be less concerned with mergers' impacts on internal innovation, and more focused on whether consolidation will increase demand for externally-sourced innovation and, ultimately, increase aggregate drug innovation."[10]

The agricultural inputs sector is assuredly at this mature stage in its development. With the advent of complex, nascent, data-driven "AgTech,"[11] the development of breakthrough scientific advances (like CRISPR, *e.g.*,),[12] ongoing scientific and technological advances in chemical, biological and mechanical processes, and increasing global demand that puts a premium on squeezing out ever more yield from crops, the cost, complexity, and competition for agricultural industry innovation are high and rapidly increasing. Organizational changes — including, most obviously, mergers — are an inevitable, and potentially vital, aspect of the industry's evolution.

A. Optimizing Research & Development

The modern agriculture industry has witnessed rapid advances in biotech, chemical science, and mechanical technology. Due to the expense, time, and intellectual capital involved in developing new biotechnology and crop protection products, and because no single company has a monopoly on all the products in high-demand, collaboration between agriculture firms is common. One way this collaboration has occurred historically is through cross-licensing. For example, in order for Company *A* to produce a crop that is resistant to Company *B*'s herbicide, it may have to license a trait patented by Company *B* in order even to begin researching its product, and it

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[10] Joanna Shepherd, *Understanding Innovation Markets in Antitrust Analysis*, TRUTH ON THE MARKET (Mar. 30, 2017), *available at* https://truthonthemarket.com/2017/03/30/understanding-innovation-markets-in-antitrust-analysis-ag-biotech-symposium/.

[11] *See, e.g.*, Suren G. Dutia, *AgTech: Challenges and Opportunities for Sustainable Growth*, Ewing Marion Kauffman Foundation (April 2014), *available at* http://www.kauffman.org/~/media/kauffman_org/research%20reports%20and%20covers/2014/04/agtech_challenges_opportunities_for_sustainable_growth.pdf.

[12] *See* Maywa Montenegro, *CRISPR Is Coming to Agriculture – With Big Implications for Food, Farmers, Consumers and Nature*, ENSIA (Jan. 28, 2016), *available at* https://ensia.com/voices/crispr-is-coming-to-agriculture-with-big-implications-for-food-farmers-consumers-and-nature/.

may need further licenses (and other inputs) from Company *B* as its research progresses in unpredictable directions.

While the agriculture industry has a long history of successful cross-licensing arrangements between agricultural input providers, licensing talks can, of course, break down (and do so for any number of reasons), potentially thwarting a nascent product before research has even begun — or, possibly worse, well into its development. The cost of such a breakdown is not merely the loss of the intended product; it is also the opportunity cost of the foregone products Company *A* could have been developing, as well as the costs of negotiation.

To mitigate the risks inherent in these arm's-length negotiations, as well as to avoid other impediments to efficient R&D (like delays resulting from waiting years for Company *B* to fully develop and make available a chemical before it engages in negotiations with Company *A*), firms may merge to fully integrate their knowledge and capabilities. Where these and other impediments may arise, integration may well be the lowest-cost way of organizing assets in order to maximize their value.[13] This is especially true for R&D-intensive industries where intellectual property and innovation are fundamental to obtaining or maintaining a competitive advantage.[14] Absent integration, neither party would have an incentive to fully disclose the nature of its intellectual property and innovation pipeline. Integration can thus increase both the likelihood and the efficiency of information sharing, enabling managers to effectively evaluate and reorganize assets in ways that maximize return on investment.[15]

Such integration solves the bargaining and long-term planning problems by unifying the interests and management of the two companies. Merged companies — especially in the agriculture industry, where firms frequently rely on other companies' innovation to develop their own products — are better able to coordinate investment decisions (instead of waiting to see what the other company produces), avoid duplication of research, adapt to changing conditions and the unanticipated course

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[13] Michael Sykuta, *Innovation Trends in Agriculture and their Implications for M&A Analysis*, TRUTH ON THE MARKET (Mar. 31, 2017), *available at* https://truthonthemarket.com/2017/03/31/innovation-trends-in-agriculture-and-their-implications-for-m-a-analysis-ag-biotech-symposium/.

[14] *Id.*

[15] *Id.*

of research, pool intellectual property, and bolster internal scientific capability more effectively.[16]

As this suggests, the relative benefits of mergers are particularly pronounced when companies with complementary R&D portfolios combine — *e.g.*, those of a company focused on crop protection R&D and those of a company focused on seeds and traits R&D. In such circumstances, concurrent, in-house R&D of seeds and traits and crop protection optimizes the process of introducing products to market. Where one product's effectiveness is in part a function of another's (as when a seed trait must be engineered to ensure that a plant is resistant to a particular herbicide), bringing research and development for each component under one roof can enable the firms to better ensure that each of the products works together to maximize agricultural yield at the lowest cost.

Of particular importance, integration allows firms to engage in coordinated, parallel R&D rather than sequential R&D. Not only does this enable products to be brought to market more quickly, it also enables firms to freely reallocate their full R&D budget between the complementary products over the course of development as real-time feedback may dictate. Such efficient reallocations may not be possible with separate firms operating with distinct R&D budgets and limited information sharing.

Thus, unified development better facilitates joint testing, prioritization, and integration, greatly reducing the amount of time between the discovery phase and market introduction — in some cases by as much as 13 years.[17] Also, combined product portfolios resulting from unified development generate more data to analyze at each level of the product stack, resulting in more effective data-driven feedback and more efficient targeting of R&D resources.

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[16] Geoffrey A. Manne, *Innovation-Driven Market Structure in the Ag-Biotech Industry*, TRUTH ON THE MARKET (Mar. 31, 2017), *available at* https://truthonthemarket.com/2017/03/31/innovation-driven-market-structure-in-the-ag-biotech-industry-ag-biotech-symposium/.

[17] *The Value of Plant Science Innovations to Canadians*, RIAS, Inc. Report (2015), *available at* http://croplife.ca/wp-content/uploads/The-Value-of-Plant-Science-Innovations-to-Canadians_RIAS-Inc.pdf ("To bring a new pest control product to market takes up to 10 years and USD $256 million.... To bring a modern plant breeding product globally to market takes up to 13 years and USD $136 million.").

Finally, integration of complementary products can also result in the formulation of entirely *new* products or functionalities that might otherwise never emerge. Consider, by analogy, the advantages that Apple's tightly-knit ecosystem of software and hardware provides to computer and device users. Such tight integration isn't the *only* way to compete (as Android's success attests), but it has frequently proven to be a successful model, not least because it gives rise to some functions (*e.g.*, handoff between Macs and iPhones) that are difficult, if not impossible, in less-integrated systems.[18]

The Texas A&M Report fails to account for these substantial, beneficial effects. Instead, it maintains that the effects of integration would be to erect barriers to entry and fails to acknowledge the potential benefits in terms of enhanced innovation, product quality, consumer choice, and competition.

B. Conglomerate Effects

Concerns about negative conglomerate effects — from mergers combining firms with complementary products (often in a vertical relationship with each other) — making life harder for new entrants and small businesses are not new; in fact, they are decidedly out of date. From 1965 to 1975, the United States encountered numerous conglomerate mergers. Among the theories of competitive harm advanced by courts and antitrust authorities to address their presumed negative effects was incumbent firm entrenchment.[19] Under this theory, mergers could be blocked if they made an incumbent into a stronger or more efficient competitor in ways not available to other firms, including by giving it access to a broader line of products.[20]

While perhaps plausible in theory, for over a decade the Department of Justice ("DOJ") was unable to identify any conditions under which conglomerate effects would give a merged firm the ability and incentive to anticompetitively raise prices or restrict output.[21] Instead, the DOJ ultimately determined that the theorized harms of

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[18] *Id.*

[19] Deborah Platt Majoras, Deputy Assistant Attorney General, Antitrust Division, U.S. Department of Justice, KPMG/Chicago Graduate School of Business, Mergers and Acquisitions Forum (Sep. 27, 2002), *available at* https://www.justice.gov/atr/speech/merger-enforcement-antitrust-division-0.

[20] *See, e.g.*, FTC v. Proctor & Gamble Co., 386 U.S. 568, 588-89 (1967).

[21] *Conglomerate Mergers And Range Effects: It's A Long Way From Chicago To Brussels*, Address by William J. Kolasky, Deputy Assistant Attorney General, Antitrust Division, U.S. Department of

foreclosure and enhanced barriers to entry by smaller firms were remote and easily outweighed by the potential benefits, which include

> providing infusions of capital, improving management efficiency either through replacement of mediocre executives or reinforcement of good ones with superior financial control and management information systems, transfer of technical and marketing know-how and best practices across traditional industry lines; meshing of research and distribution; increasing ability to ride out economic fluctuations through diversification; and providing owners-managers a market for selling the enterprises they created, thus encouraging entrepreneurship and risk-taking.[22]

Consequently, the DOJ concluded in the 1982 Merger Guidelines that it should rarely, if ever, interfere to mitigate presumed conglomerate effects.[23] To find such harms, the DOJ has reasoned, would require satisfying a highly attenuated chain of causation that "invites competition authorities to speculate about what the future is likely to bring."[24] Such speculation includes but is not limited to: weighing whether rivals can match the merged firm's costs, guessing whether rivals will exit or firms will not re-enter the market in response to price increases above pre-merger levels, and assessing whether what buyers may gain through possibly lower, pre-merger prices is more than what they lose through improved quality and even lower prices in the future. The sheer breadth and complexity of the theorizing required does not inspire confidence that even the most clairvoyant regulator would properly make trade-offs that would ultimately benefit consumers.[25]

Justice, at George Mason University Symposium (Nov. 9, 2001), *available at* https://www.justice.gov/atr/speech/conglomerate-mergers-and-range-effects-its-long-way-chicago-brussels.

[22] *Id.* (*citing* ROBERT H. BORK, THE ANTITRUST PARADOX 248-49 (1978)).

[23] Department of Justice, *1982 Merger Guidelines*, Section V 1(A), *available at* https://www.justice.gov/archives/atr/1982-merger-guidelines.

[24] U.S. Department of Justice, *Note for Discussion at Roundtable on Portfolio Effects in Conglomerate Mergers*, at 214, (Oct. 15, 2001), *available at* http://www.oecd.org/competition/mergers/1818237.pdf.

[25] *Id.*

Nothing in the economics (or the law) has changed, and, in the U.S. at least, conglomerate mergers generally remain unproblematic and unchallenged.[26] And this is only more true in the case of vertical mergers. As Francine Lafontaine and Margaret Slade discuss in their leading survey of the economic literature on vertical integration:

> [O]verall a fairly clear empirical picture emerges. The data appear to be telling us that efficiency considerations overwhelm anticompetitive motives in most contexts. . . . It says that, under most circumstances, profit maximizing vertical-integration decisions are efficient, not just from the firms' but also from the consumers' points of view. Although there are isolated studies that contradict this claim, the vast majority support it. Moreover, even in industries that are highly concentrated so that horizontal considerations assume substantial importance, the net effect of vertical integration appears to be positive in many instances. We therefore conclude that, faced with a vertical arrangement, the burden of evidence should be placed on competition authorities to demonstrate that that arrangement is harmful before the practice is attacked.... Given the weight of the evidence, it behooves government agencies to reconsider the validity of such restrictions.[27]

For the pending agricultural-biotechnology mergers there are no special factors that would contradict this presumption that the conglomerate effects of improved product quality and expanded choices for farmers likely outweigh the potential harms.

C. Consumer and Industry Benefits

Over the past two decades, as even the Texas A&M Report acknowledges, the agricultural industry has produced staggering technological and scientific advances, all while large firms were combining and acquiring smaller companies. This

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[26] In Europe, as well, the trend is unmistakably away from antitrust enforcement against conglomerate mergers. The EU's 2008 non-horizontal merger guidelines note that "conglomerate mergers in the majority of circumstances will not lead to any competition problems," European Commission, *Guidelines on the Assessment of Non-horizontal Mergers Under the Council Regulation on the Control of Concentrations Between Undertakings*, para. 92, *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:265:0006:0025:en:PDF.

[27] Francine Lafontaine & Margaret Slade, *Vertical Integration and Firm Boundaries: The Evidence*, 45 J. ECON. LIT. 629, 677 (2007).

restructuring allowed firms to better develop and distribute advanced, integrated products. And these advancements have yielded significant benefits to farmers and consumers.

Innovations in agricultural biotechnology have increased yields significantly — adding, for example, 158 million metric tons of soybeans and 322 million metric tons of corn to global production since the mid-1990s.[28] On average, yields of genetically modified ("GM") crops increased by 22% worldwide between 1995 and 2014.[29] This increase in yields outpaced yield growth in non-traited markets, and, without these advancements, productivity would almost certainly have been significantly lower.[30]

To take just one illustrative example, consider the effect on yields in comparable, concentrated, corn-growing regions following the introduction (or lack thereof) of GM seeds. In Illinois, following the introduction of biotech corn in 1997, annual yield gains increased by 29% to 1.8 bushels per acre for the period from 1997 to 2015, from 1.4 bushels per acre for the period 1970 to 1997.[31] In contrast, annual yield gains slowed considerably in France — a non-traited market — declining 79% to 0.5 bushels per acre in the 1997 to 2015 period from 2.4 bushels per acre in the 1970 to 1997 period.[32]

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[28] Graham Brookes & Peter Barfoot, *Global Income and Production Impacts of Using GM Crop Technology 1996-2014*, 7 GM CROPS & FOOD 38, 50 (Apr. 2016), *available at* http://www.tandfonline.com/doi/full/10.1080/21645698.2016.1176817.

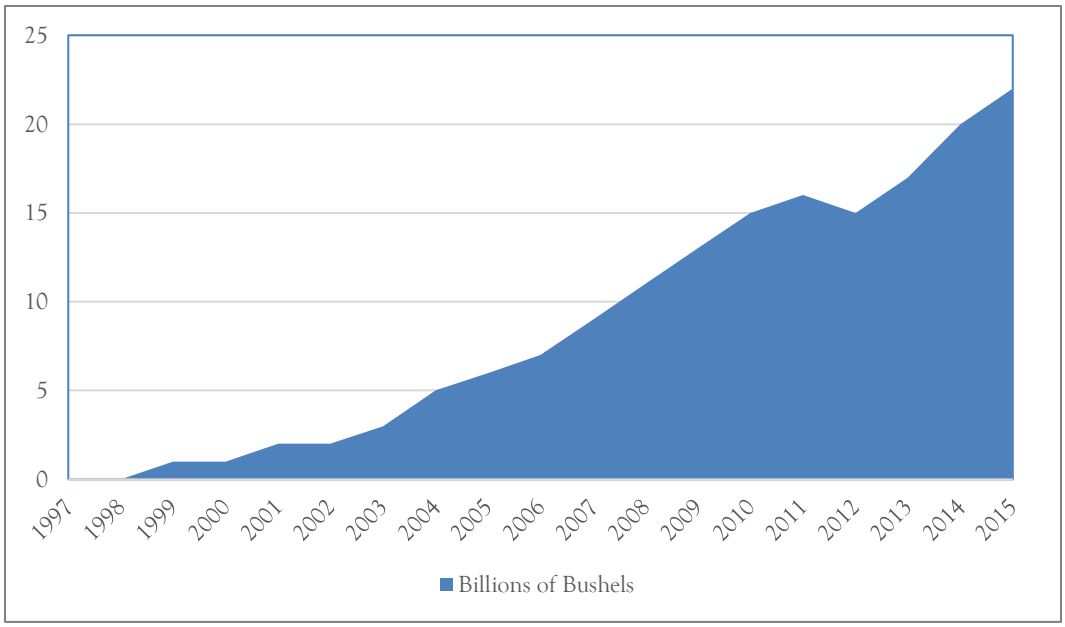
[29] Wilhelm Klümper & Matin Qaim, *A Meta-Analysis of the Impacts of Genetically Modified Crops*, 9(11) PLOS ONE (Nov. 3, 2014), at 4, *available at* http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111629.

[30] *Id.*

[31] Calculated using Eurostat data (http://ec.europa.eu/eurostat/data/database) and raw yield and acreage data from USDA (https://quickstats.nass.usda.gov/).

[32] *Id.*

Figure 1: Estimated Aggregate Increase in U.S. Corn Productivity Due to Biotechnology, Illinois vs. France



The proliferation of GM crops has also resulted in cost savings in other facets of farm management and operation, which have, in turn, enabled farms to benefit from economies of scale and scope. For example, GM soybeans, corn, and cotton contributed on average to a reduction in chemical pesticide use by 37% per planted acre from 1995 to 2014.[33] In addition to direct cost savings,[34] the use of GM crops reduces the time farmers must spend in monitoring crops and administering crop-protection chemicals. Broader use of GM crops and crop protection products (in this case, herbicides) have also enabled significant savings of time and of labor and fuel

[33] Klümper & Qaim, *supra* note 29, at 4.

[34] While 65% of the gains in productivity over the last two decades were from yield and production gains, 35% were from cost savings. *See* Graham Brookes & Peter Barfoot, *GM Crops: Global Socio-Economic and Environmental Impacts 1996-2014*, PG Economics Ltd, UK (May 2016), *available at* https://gmoanswers.com/sites/default/files/2016globalimpactstudymay2016.pdf. In 1996, the net return over operating costs per planted acre of corn in the US was $209. By 2015 net return was up 33% to $279. For soybeans, in 1996 the net return over operating costs per planted acre in the US was $176. By 2015, the net return over operating costs increased 34% to $237. Calculated using cost, yield, price, and acreage data from USDA, https://quickstats.nass.usda.gov/.

expense by eliminating the need for plowing, thus reducing loss from tillage and erosion.[35] These time and cost savings enable farmers to allocate time and resources to more productive activities, including by expanding the size of their farms or diversifying their crops.

Overall, these cost savings and productivity enhancements contributed to a 69% increase in global farm profits between 1995 and 2014.[36]

III. CONTINUED INNOVATION THROUGH ORGANIZATIONAL ADAPTATION

The agriculture industry as a whole has experienced dynamic M&A activity over the past two decades. The Texas A&M Report asserts that the emergence of biotechnology was a major driver of this consolidation, but, in reality, the motivation for and extent of the consolidation varies between sectors.[37] Mergers within the seeds and traits segment, which has seen the most widespread and rapid consolidation in the industry, have been driven primarily by the benefits of coordination among complementary technologies and the benefits of economies of scale in crop biotech R&D.[38] Crop protection mergers, on the other hand, have been driven largely by economies of scale in complying with stricter (and more costly) environmental and safety regulations, the more complex demands of maturing markets, and the need to compete effectively with new, generic competitors.[39]

After the advent of GM seeds, the industry saw its first major increase in M&A activity: Hundreds of mergers took place in the seeds and traits segment starting in

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[35] Jorge Fernandez-Cornejo, *et al.*, *Conservation Tillage, Herbicide Use, and Genetically Engineered Crops in the United States: The Case of Soybeans*, 15(3) AGBIOFORUM 231, 237 (Apr. 2013), *available at* https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/35118/ConservationTillageHerbicideUse.pdf.

[36] Klümper & Qaim, *supra* note 29, at 4.

[37] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 4.

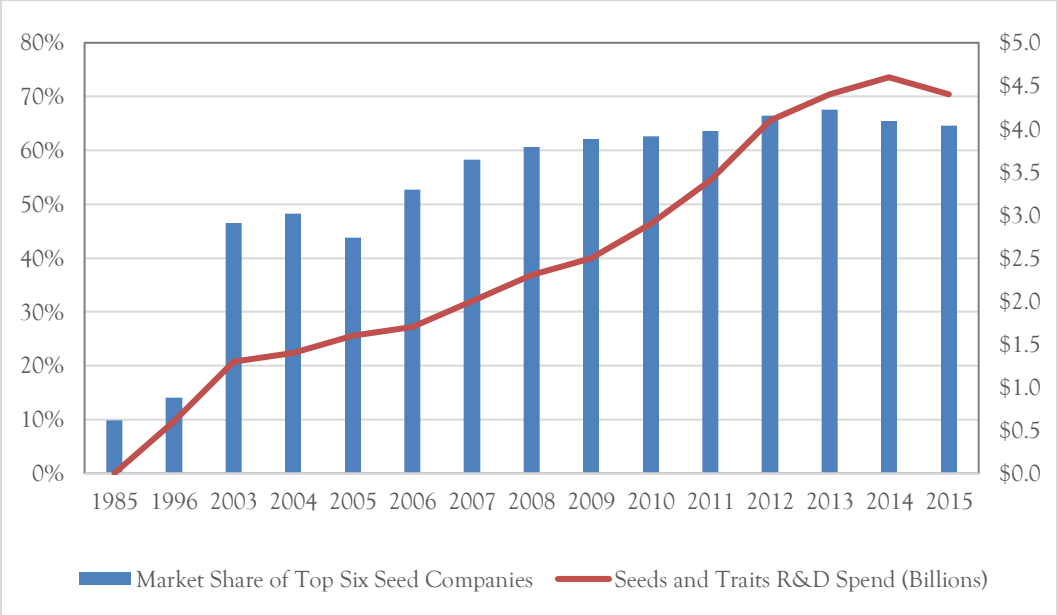
[38] Keith O. Fuglie, *et al.*, *Rising Concentration in Agricultural Input Industries Influences New Farm Technologies*, 10 AMBER WAVES (Dec. 2012), at 4, *available at* https://www.ers.usda.gov/amber-waves/2012/december/rising-concentration-in-agricultural-input-industries-influences-new-technologies/.

[39] *Id.*

the mid-1990s and continuing into the first decade of the 21st century.[40] And during that time, ten of the largest seed and trait R&D firms were either acquired by or merged into the top companies in the sector.[41]

Along with these transactions, innovation and R&D spending *increased* over the same timeframe.[42] And innovation has not ceased or slowed down since, but has grown rapidly continuing into this decade, evidenced by the steady introduction of new products, dynamic new market entrants (most notably AgTech startups) and continually increasing R&D spending.

Figure 2: Top Six Seeds and Traits Companies, Combined Market Share and Overall Industry R&D Spend



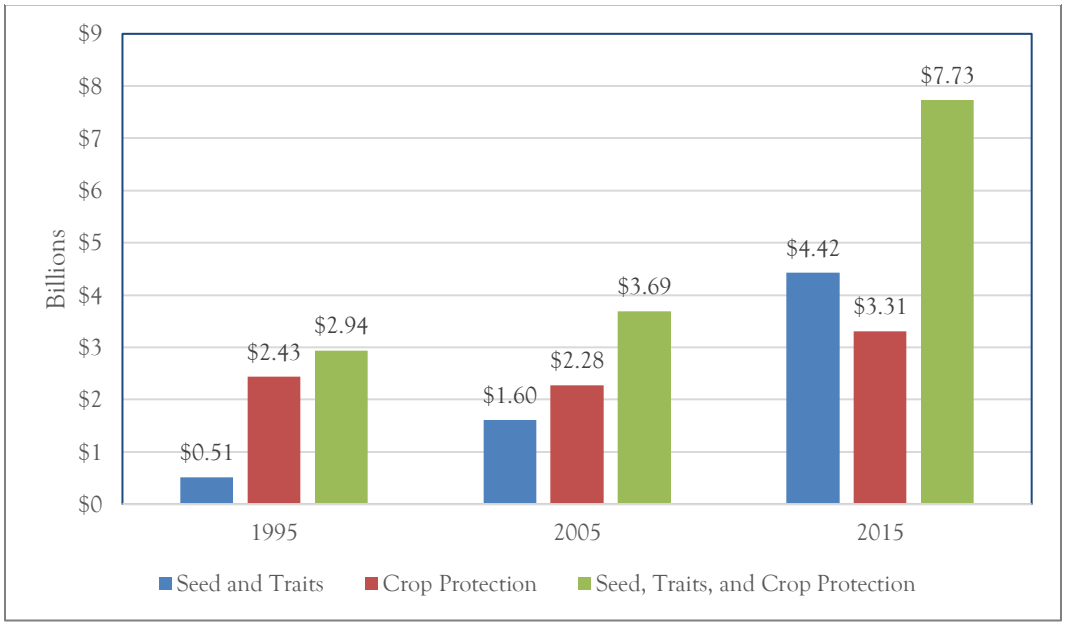
[40] *See e.g.*, P.H. Howard, *Visualizing Consolidation in the Global Seed Industry*. 1 SUSTAINABILITY 1266, 1267 (Oct. 2009), *available at* http://www.mdpi.com/2071-1050/1/4/1266.

[41] *Id.* at 1274.

[42] Keith O. Fuglie, *et al.*, *Research Investments, and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide*, United States Department of Agriculture, Economic Research Report No. 130, (Dec. 2011) 39, *available at* http://ageconsearch.tind.io//bitstream/120324/2/err-130.pdf#page=49.

In fact, R&D spending within the seeds and traits industry increased nearly 773% between 1995 and 2015 (from roughly $507 million to $4.4 billion), while the combined market share of the six largest companies in the segment increased by more than 550% (from about 10% to over 65%) during the same period.[43] R&D spending also increased (although not by as much) in the crop protection sector ($2.4 billion to $3.3 billion) during this time.[44] And, following their merger, Bayer and Monsanto alone have committed to spend another $16 billion on R&D over six years.[45] Other large industry players have made similar commitments.

Figure 3: Research and Development Spend in the Seed, Traits and Crop Protection Industry



[43] Phillips McDougall, *R&D Expenditure Study of Leading Agriculture and Chemical Companies 1995-2015* (2016) (on file with the authors).

[44] *Id.*

[45] Monsanto, *Joint Statement: Monsanto, Bayer CEOs meet with new administration* (Jan. 17, 2017), *available at* http://news.monsanto.com/news/joint-statement-monsanto-bayer-ceos-meet-new-administration.

While we cannot know for certain how large these companies' R&D investments would be without the merger, it is notable that these levels of investment suggest at minimum a continuation of current trends.[46] Moreover, as discussed below, with the high rate of third-party investment in recent years likely continuing (or increasing), there is reason to believe that R&D investment by large firms like Bayer and Monsanto would be crowded out in part, absent restructuring. But by internalizing most interconnected R&D pipelines and outsourcing other, complementary investment to new entrants, the combined firm is more likely than each firm operating separately to increase investment.[47]

A. Innovation Throughout the Agricultural Industry

While scrutiny of the pending mergers focuses on biotechnology, innovation in the industry is intricately interwoven with developments in other areas of agricultural technology, which substantially affects the proper assessment of the industry's competitive and innovation-related dynamics.

Beginning in the 1990s, the development of global positioning systems (GPS) and GPS-enabled equipment, for example, created new opportunities for precision agriculture — dubbed "precision farming" — whether for the application of crop inputs, crop management, or yield monitoring.[48] The current wave in agriculture technology — referred to as "digital farming" — capitalizes on the vast amounts of data made available by precision farming by aggregating it across farms and employing "Big Data" analytics to provide better prescriptive insights to farmers.

Digital farming services work in conjunction with other agricultural technologies to assist farmers in the range of decisions they must make in order to maximize yields —

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[46] *See* Matthew Clancy, Keith O. Fuglie, & Paul Heisy, *U.S. Agricultural R&D in an Era of Falling Public Funding,* United States Department of Agriculture, Economic Research Service (Nov. 2016), *available at* https://www.ers.usda.gov/amber-waves/2016/november/us-agricultural-rd-in-an-era-of-falling-public-funding/.

[47] *Cf.* Joanna Shepherd, *Understanding Innovation Markets in Antitrust Analysis*, *supra* note 10.

[48] Remi Schmaltz, *What is Precision Agriculture?,* AGFUNDER NEWS (Apr. 24, 2017), *available at* https://agfundernews.com/what-is-precision-agriculture.html.

from seed selection to planting to application of crop-protection chemicals to harvesting, among other things.[49] As economist Michael Sykuta notes:

> The integration of digital farming data with seed and chemical manufacturing offers obvious economic benefits for farmers and competitive benefits for service providers. Input manufacturers have the incentive (and the resources) to conduct data analytics that individual farmers do not. Moreover, by combining data from a broad cross-section of farms, digital farming service companies have access to the data necessary to identify generalizable correlations between farm plot characteristics, input use, and yield rates. But the value of the information developed through these analytics is not unidirectional in its application and value creation. While digital services may be able to help improve farmers' operations given the current stock of products, feedback about crop traits and performance also informs and enhances R&D for new product development by seed and trait and crop protection firms. By combining product portfolios, agricultural companies can not only increase the value of their data-driven services for farmers, but also more efficiently target R&D resources to their highest-valued use.[50]

And the efficiencies from combining digital farming with other agricultural input technologies is not limited to biotechnology. John Deere has placed sensors on its equipment and combined that information with historical and real-time weather data, soil conditions, crop features and other data to create a platform, MyJohnDeere.com, to provide farmers with valuable insights complementary to its primary, mechanical technology.[51]

Although still in its relatively early stages, digital farming can alter — and already has altered — the competitive landscape in myriad ways. As noted, it has provided incentive for restructuring in order to better enable other input providers to take

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[49] Vonnie Estes, *How Big Data is Disrupting Agriculture from Biological Discovery to Farming Practices*, AGFUNDER NEWS (Jun. 9, 2016), *available at* https://agfundernews.com/how-big-data-is-disrupting-agriculture-from-biological-discovery-to-farming-practices5973.html.

[50] Michael Sykuta, *Innovation Trends in Agriculture and their Implications for M&A Analysis*, *supra* note 13.

[51] *John Deere is Revolutionizing Farming with Big Data*, DATAFLOQ (Feb. 20, 2012), *available at* https://datafloq.com/read/john-deere-revolutionizing-farming-big-data/511.

advantage of its data in designing their own products. Moreover, digital farming is likely to develop tools that act as an effective competitive substitute for other inputs: If 1) the marginal increase in yield from one type of seed is 2) less than or equal to the yield that can be obtained from a less expensive seed, coupled with 3) more-effective decisionmaking because of precision and digital farming tools that 4) cost less than the difference, the new digital tools will act as an effective replacement for more expensive, even if more productive, seeds. And, of course, other examples of competitive disruption are not only possible but likely. Any consideration of the likely competitive effects of the proposed mergers that does not attempt to account for these effects is almost certain to be inaccurate.

IV. PROPERLY MEASURING INNOVATION AND ENTRY

A. The Texas A&M Report Uses Inapt Proxies to Measure Innovation

Like some other incomplete analyses of structural changes in the industry,[52] the Texas A&M Report indeed overlooks these recent developments in agricultural technology. But even with respect to the innovation it *does* measure, the Report relies upon unsuitable proxies to assess innovation.

First, it asserts that patents and concentration are substitutes — *i.e.*, that more concentration is associated with fewer patents, and thus less innovation.[53] This reasoning is flawed, however. While patents may be an interesting measure of ideas that have been documented and protected, they are a flawed measure of the *quality* of the underlying innovation.[54] A single breakthrough patent can generate more revenue — reflecting its higher quality — than hundreds of patents relating to ineffective, inefficient, or unnecessary technology. When scholars adjust the quantity

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[52] *See, e.g.*, *Consolidation and Competition in the U.S. Seed and Agrochemical Industry: Hearing Before the Senate Judiciary Committee* (Sep. 20, 2016) (Statement of Diana L. Moss), *available at* https://www.judiciary.senate.gov/meetings/consolidation-and-competition-in-the-us-seed-and-agrochemical-industry.

[53] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 3-4.

[54] Jeffery Phillips, *Patents Generated is a Poor Measure of Innovation Success*, INNOVATION ON PURPOSE (May 26, 2010), *available at* http://innovateonpurpose.blogspot.com/2010/05/patents-generated-is-poor-measure-of.html.

of patents for quality using additional indicators such as decisions to renew or litigate, much of an apparent decline in research productivity based on patent *quantity* can fall away.[55] By relying solely on patent *quantity*, however, the Texas A&M Report presents an unreliable analysis.

Moreover, as discussed below, larger firms are increasingly "outsourcing" innovation to smaller, specialized companies and new entrants. These firms may be more efficient in their patenting behavior, and the organizational shift likely signals not less innovation, but more targeted and productive R&D expenditure, resulting in perhaps less, but generally more valuable, patenting across the industry.[56]

Second, the Report errs by stating categorically that exits of small and medium enterprises have outweighed new entry in recent years without — again — assessing the quality and dynamism of new entrants. Moreover, merely counting entering and exiting firms fails to account for what happens to exiting firms.[57] In many cases, a firm's "exit" does not truly represent a loss of innovative capacity but, rather, a restructuring of that capacity via integration with other firms. Instead, proper analysis of the agriculture sector must take into account that

> [i]n many consolidated firms, increases in efficiency and streamlining operations free up money and resources to source external innovation. To improve their future revenue streams and market share, consolidated firms can be expected to use at least some of the extra resources to

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[55] *See, e.g.,* Jean O. Lanjouw & Mark Schankerman, *The Quality of Ideas: Measuring Innovation with Multiple Indicators*, National Bureau of Economic Research Working Paper 7345 (Sep. 1999), at 19, *available at* http://www.nber.org/papers/w7345.pdf.

[56] Economist Joanna Shepherd documents precisely this dynamic in the pharmaceutical industry:

> Smaller companies generally have a less bureaucratic organization structure that allows for more nimble decision-making. With only a small group of key decision-makers, smaller companies can stay sharply focused on the company's strategic goals and make quick decisions to fund promising projects or kill unsuccessful projects at an early stage. In contrast, in larger companies with highly bureaucratic structures and multiple divisions, decision-making takes substantially longer and the optimal decision may sometimes succumb to office politics and competing conflicts of interest.

Joanna Shepherd, *Consolidation And Innovation In The Pharmaceutical Industry*, *supra* note 9, at *20.

[57] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 7.

> acquire external innovation. This increase in demand for externally-sourced innovation increases the prices paid for external assets, which in turn incentivizes more early-stage innovation in small firms and biotech companies. Aggregate innovation increases in the process![58]

Depending on the specific timeframe, this dynamic could appear to entail more exit that entry, even while overall and over a longer timeframe innovation is increasing.

Regardless, new entry does not appear to be decreasing by any reasonable measure. Over 1,500 startups valued at an average of $3.9 million were involved in the agriculture ecosystem in early 2017, reflecting the dynamism of the industry even outside its biggest firms.[59] Meanwhile, investment in AgTech (*e.g.*, digital and precision farming technologies) increased from $400 million in 2010 to $3.2 billion in 2016, funded by several hundred distinct investors.[60] Investment in agriculture biotechnology startups increased to $719 million in 2016, a 150% increase over the previous year.[61] Not only have startups and institutions entered the market, they are working to develop new technology at a rapid pace. Since 2013, over 2,261 applications have been made for permits to develop traits by over 138 unique companies and research institutions.[62]

Many startups are receiving backing from companies not traditionally associated with the agriculture industry. In March 2017, GV, formerly known as Google Ventures, co-led a $40 million investment in Farmer's Business Network, Inc., a company seeking to disrupt the industry by crowdsourcing information on prices and product information and leveraging that information to directly sell 500 different farm

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[58] Joanna Shepherd, *Understanding Innovation Markets in Antitrust Analysis*, *supra* note 10.

[59] *Agriculture Startups*, ANGELLIST, *available at* https://angel.co/agriculture (last visited Apr. 24, 2017).

[60] *AgTech Investing Report, Year in Review 2016*, AGFUNDER (Jan. 31, 2017) at 10, *available at* https://research.agfunder.com/2016/AgFunder-Agtech-Investing-Report-2016.pdf.

[61] *Id.* at 17.

[62] Calculated using data from Information Systems for Biotechnology, Virginia Tech University (last visited Apr. 24, 2017), http://www.isb.vt.edu/search-release-data.aspx.

chemicals, fertilizers, seeds and seed treatments, purportedly at a 50% discount from major suppliers.[63]

Recognizing the need adapt to disruptive innovation, to incorporate it into their own R&D, and to ensure an ongoing pipeline of new, innovative firms, established companies in the agriculture industry are increasingly investing in startups. As one industry investing report notes:

> The large agribusinesses understand that new innovation is key to their future, but the [relative] lack of M&A [by the largest agribusiness firms in 2016] highlighted their uncertainty about how to approach it. They will need to make more acquisitions to ensure entrepreneurs keep innovating and VCs keep investing.[64]

And established firms have certainly been investing in recent years.[65] Monsanto's $930 million purchase of Climate Corp. in 2013, for example, was cited as the tipping point for a "gold rush of new digital" AgTech startups.[66] The company's venture arm, Monsanto Growth Ventures ("MGV") continues to be active. From its inception in 2013 through 2016, MGV made an estimated 17 investments in 12 companies comprised of precision agriculture technologies (40%), life science companies (20%), agricultural biologicals (30%), and new crops and new business models (10%).[67]

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[63] *See* Alex Konrad, *How Farmers Business Network Plans to Disrupt Big Agra, One Farm at a Time*, FORBES (Mar. 7, 2017), *available at* https://www.forbes.com/sites/alexkonrad/2017/03/07/farmers-business-network-takes-on-big-agra-with-funding-from-gv/#7457fba15d86; Lora Kolodny, *Farmer's Business Network cultivates $40 million to help farmers buy seeds at favorable prices*, TECHCRUNCH (Mar. 7, 2017), *available at* https://techcrunch.com/2017/03/07/farmers-business-network-cultivates-40-million-to-help-farmers-buy-seeds-at-favorable-prices/.

[64] *AgTech Investing Report, Year in Review 2016*, *supra* note 60, at 8.

[65] *Id.* at 8-9. Although 2016 in particular saw a relative decline in investment dollars from 2015, the total number of deals increased 10% over the number of deals in 2015 due to an increase in the number of early-stage seed investments.

[66] Arama Kukutai, *Can Digital Farming Deliver on its Promise?*, PRECISIONAG.COM (Apr. 28, 2016), *available at* http://www.precisionag.com/professionals/can-digital-farming-deliver-on-its-promise/.

[67] Louisa Burwood-Taylor, *Monsanto Growth Ventures to Close First Portfolio of AgTech Investments – Exclusive*, AGFUNDER NEWS (Jan. 5, 2016), *available at* https://agfundernews.com/monsanto-growth-ventures-to-close-first-portfolio-of-agtech-investments-exclusive5199.html.

MGV's total disclosed investment is estimated at $213 million.[68] Aside from other, undisclosed MGV investments, Syngenta's investment arm, Syngenta Ventures, has a portfolio of 13 companies, including companies that provide chemicals, precision agriculture analytics, earth imaging satellites, LED lighting technology, and equipment manufacturers of extremely high speed grain quality sorting machines.[69] Recognizing the need to invest in or acquire externally sourced innovation, other large companies in the sector also have active venture arms, including BASF Venture Capital, DuPont Ventures, and Dow Venture Capital.

In an industry continually reshaped by technological advancements, and which can change dramatically with the introduction of a single new trait, chemical, or piece of equipment, agriculture companies devote substantial resources to both internal R&D as well as to startup investments and acquisitions. Externally sourced innovation has been, and continues to be, an important source of technological innovation for the industry. And the increased demand for such innovation following the mergers will plausibly increase the prices paid for external assets, which will in turn encourage the formation of more early-stage startups and the innovations they produce.[70]

B. The Texas A&M Report Incorrectly Asserts that the Agricultural-Biotechnology Market Is Not Contestable

In fact, given the increasing number of active AgTech startups, it appears that entrepreneurs' expectation of economic profit associated with entry is sufficient to overcome any barriers to entry or exit enjoyed by the incumbents.[71] This is a strong indication that the market is contestable, incentivizing incumbents to behave in a competitive manner.[72]

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[68] *Overview: Monsanto Growth Ventures*, CRUNCHBASE, *available at* https://www.crunchbase.com/organization/monsanto-growth-ventures#/entity (last visited May 7, 2017).

[69] Syngenta Ventures, *available at* https://www.syngentaventures.com/node/406.

[70] Joanna Shepherd, *Understanding Innovation Markets in Antitrust Analysis*, *supra* note 10.

[71] Levi A. Russell, *Contestability Theory in the Real World*, TRUTH ON THE MARKET (Mar. 30, 2017), *available at* https://truthonthemarket.com/2017/03/30/contestability-theory-in-the-real-world-ag-biotech-symposium/.

[72] *Id. See generally* WILLIAM J. BAUMOL, JOHN C. PANZAR & ROBERT D. WILLIG, CONTESTABLE MARKETS AND THE THEORY OF INDUSTRY STRUCTURE (1982).

As evidence that the agricultural biotechnology market is not contestable, the Texas A&M Report asserts there are significant barriers to entry and input mark-ups by market participants due to market concentration.[73] Regarding barriers to entry, the Report claims that intellectual property rights have significant negative structural impacts, incentivizing downstream consolidation and impeding innovation.[74] But this overlooks the contemporary understanding of the role of IP in antitrust analysis:

> Courts and the antitrust agencies in recent decades have evidenced a greater appreciation of the importance of intellectual property in promoting innovation and, accordingly, the need to incorporate this recognition into a dynamic analysis of competitive effects.... [A]ntitrust law and patent law are complementary, with both seeking to encourage innovation and competition.[75]

It also overlooks the extensive history of cross-licensing discussed above and the strong evidence suggesting that the mergers will not adversely affect the long-standing prevalence of agricultural input providers supplying competitors with products while simultaneously competing with them.[76] And contrary to what these claims would suggest, "a clear picture of the industry... show[s] that patents are fairly evenly distributed among competitors."[77] Moreover, the industry's allegedly "onerous licensing agreements"[78] have a number of procompetitive justifications that go unmentioned in the Report:

> The complained-of licensing practices, meanwhile, have well-established pro-competitive justifications. Field-of-use restrictions allow [a firm] to

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[73] Bryant *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 11-13.

[74] *Id.* at 11-12.

[75] ANTITRUST MODERNIZATION COMMITTEE REPORT AND RECOMMENDATIONS 37 (2008).

[76] Allen Gibby, *Conglomerate Effects and the Incentive to Deal Reasonably with other Providers of Complementary Products*, TRUTH ON THE MARKET (Mar. 30, 2017), *available at* https://truthonthemarket.com/2017/03/30/conglomerate-effects-and-the-incentive-to-deal-reasonably-with-other-providers-of-complementary-products/.

[77] Geoffrey A. Manne & Joshua D. Wright, *A First Principles Approach to Antitrust Enforcement in the Agricultural Industry*, 5 CPI ANTITRUST CHRONICLE 9 (Spring 2010).

[78] Bryant *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 12.

> allocate production more efficiently among licensees and… ensure optimal use and branding of its property…. In the case of Monsanto's licenses, the restrictions found in licenses to competitors… maintain quality control, where a user of the seed would be unable to tell if any bad—or good—functioning was attributable to the Monsanto seed trait or not.
>
> The extent to which Monsanto licenses its intellectual property to competitors is striking, and field-of-use restrictions are essential to this widespread distribution of Monsanto's innovation. "In sum, one would not ordinarily expect output under a license-plus-field-of-use restriction to be less than output with no license at all, and it could be significantly greater."[79]

For decades, antitrust scholars have been skeptical of claims that firms have incentives to deal unreasonably with providers of complementary products, and the agriculture biotechnology industry seems to bear this out.[80] This is because discriminating anticompetitively against complements often devalues the firm's own platform.[81]

Returning to Apple by analogy again, Apple's App Store is more valuable to iPhone users because it includes messaging apps like WeChat, WhatsApp, and Facebook Messenger, even though they compete directly with iMessage and FaceTime. By excluding these apps, Apple would devalue the iPhone to hundreds of millions of its users who also use these apps. In the case of the pending mergers, not only would a combined Dow-DuPont and Bayer-Monsanto offer their own combined product stacks, the firms' platforms increase in value by providing a broad suite of alternative cross-licensed product combinations.[82] And, of course, the combined stacks (independent of whether they are entirely produced by a merged Dow-DuPont or

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[79] Manne & Wright, *supra* note 77, at 9-10 (*quoting* HERBERT HOVENKAMP, *ET AL.*, IP AND ANTITRUST: AN ANALYSIS OF ANTIRUST PRINCIPLES APPLIED TO INTELLECTUAL PROPERTY LAW (2004 SUPP.), at §33.4).

[80] Brent Skorup & Adam Thierer, *Uncreative Destruction: The Misguided War on Vertical Integration in the Information Economy*, Mercatus Center Working Paper No. 12-29 (Oct. 2012), at 10, *available at* https://www.mercatus.org/system/files/UncreativeDestruction_SkorupandThierer_v1-0.pdf.

[81] *Id.*

[82] Gibby, *supra* note 76.

Bayer-Monsanto) that offers sufficiently increased value to farmers over other packages or non-packaged alternatives, will — and should — win in the end.[83]

Finally, the Texas A&M Report argues that market power gained through agricultural biotechnology mergers in turn raises input prices.[84] But it makes this claim assuming a level of innovation associated with differentiated products while demanding undifferentiated commodity prices.[85] This approach is inconsistent. The report acknowledges that innovation in the agricultural industry is necessary, but demands pricing conditions that would deprive companies of the reasonable return on their investment that incentivizes such innovation. The two do not add up, and the disconnect demonstrates a lack of understanding of how these markets operate and what drives innovation. The Report also claims if a market is highly profitable, the industry is less competitive.[86] Profitability is not a reliable measure of competition, however.[87] Antitrust remedies predicated on using a firm's profit data to infer market power carry an unacceptable risk of harming innovation, competition, and consumers.[88] It is the precisely the opportunity to enjoy a temporary period of excess returns, or "entrepreneurial rents," that drives firms to invest and enter the market.[89]

CONCLUSION

One inconvenient truth for the "concentration reduces innovation" premise inherent in critical assessments of agricultural-biotechnology industry mergers like the Texas A&M Report, is that, as the industry has experienced more consolidation, it has also become *more*, not less, productive and innovative. Between 1995 and 2015,

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[83] *Id.*

[84] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 13.

[85] *See* Jon C. Phillips & H. Christopher Peterson, *Product Differentiation and Target Marketing by Agricultural Producers*, 2004 J. OF THE ASFMRA 64, *available at* http://ageconsearch.umn.edu/bitstream/198504/2/214.pdf.

[86] Bryant, *et al.*, *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*, *supra* note 1, at 12.

[87] *See* Harold Demsetz, *Two Systems of Belief About Monopoly,* in INDUSTRIAL CONCENTRATION: THE NEW LEARNING 164 (Harvey J. Goldschmid, *et al.* eds., 1974); Robert H. Bork & J. Gregory Sidak, *The Misuse of Profit Margins to Infer Market Power*, 9 J. COMP. L. & ECON. 511 (Sep. 2013).

[88] Bork & Sidak, *id.* at 513.

[89] *Id.* at 522.

for example, the market share of the largest seed producers and crop protection firms increased substantially.[90] And yet, over the same period, annual industry R&D spending increased over 750 percent.[91] Meanwhile, as mentioned above, the resulting innovations have increased crop yields by 22%, reduced chemical pesticide use by 37%, and increased farmer profits by 69%.[92]

As even the industry's most consistent critics have had to acknowledge:

> [E]xpensive R&D programs in genomics may be possible only under the relatively large scale (and scope) created by concentration. Vertical efficiencies such as reduced transactions costs and coordination achieved by exploiting the complementarities between traits and traited seed assets can also reduce costs. Closer, more precise coordination between levels in the transgenic supply chain may result in more efficient creation of new transgenic varieties in increasingly differentiated product markets.[93]

The pending agricultural-biotechnology mergers seem at least as likely to continue these trends as to impede them. A merger like Bayer-Monsanto, for example, would combine Monsanto's specialized seed development capabilities with Bayer's chemical R&D and distribution strengths, and it would enable each of these to improve in tandem with the other. Paired with an expanded focus on data platforms, the combined company would be positioned to develop a more effective and valuable suite of complementary products to help farmers lower costs, increase yields, and provide digital tools to meet the demands of next generation farming. Compared with today's model, where biotechnology development is still largely sequenced and comes together only at the point of commercialization, a combined entity should be better positioned to deliver integrated solutions and advanced products to consumers in a faster and more efficient manner by capitalizing on concurrent R&D and the complementary expertise of the two companies. The merged firms should also be better able to help finance, integrate, and coordinate development of a broad set of

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[90] Phillips McDougall Report, *supra* note 43.

[91] *Id.*

[92] Klümper & Qaim, *supra* note 29, at 4.

[93] Diana L. Moss, *Transgenic Seed Platforms: Competition Between a Rock and a Hard Place?*, American Antitrust Institute White Paper (Oct. 23, 2009), at 15, *available at* http://www.antitrustinstitute.org/sites/default/files/AAI_Platforms%20and%20Transgenic%20Seed_102320091053.pdf.

emerging scientific and technological developments throughout the industry. And there is little reason to think that a merged firm will have less incentive to continue to broadly license out its technologies in ways that should benefit other firms in the industry and, ultimately, farmers.

The agriculture industry has experienced increased M&A activity for much of the past two decades. The result has been an industry characterized by a broad range of firms better able to innovate and introduce new products to market more efficiently. Traditionally, consolidation sometimes raises the concern that it may reduce the incentives of merged firms to innovate. The agriculture industry, however, has experienced the opposite dynamic: firms have been driven to consolidate *in order to innovate* and remain competitive in the face of new entrants and technological and scientific developments. Meanwhile, consolidation has actually spurred new entry and new innovation.

The recent announcements of mergers between Dow and DuPont, ChemChina and Syngenta, and Bayer and Monsanto suggest that these trends are continuing in response to new market conditions and a marked uptick in scientific and technological advances. As in past periods of consolidation, the industry is well positioned to see an *increase* in innovation as these new firms unite complementary expertise to pursue more efficient and effective research and development, compete more effectively with AgTech startups, and incentivize new entry and investment throughout the industry.

As one of us has previously summed up the state of concentration and innovation in the industry and its implications for merger review:

> Thus it is not surprising that the period of increasing innovation has been accompanied with an increase in concentration as innovating firms assembled the necessary complementary assets to develop and commercialize their innovations, often through vertical and horizontal mergers and acquisitions. The remarkable gains in biotech seed development since the industry's infancy less than 20 years ago, along with the complexities of the industry and our limited understanding of the economic significance of organizational choices in the industry, should counsel strongly against hasty antitrust intervention in the industry. Consumers enjoy significant benefits from innovation that must be considered before responding too quickly or improperly to

complaints about increased concentration, especially if the complaints come primarily from competitors.[94]

[94] Manne & Wright, *supra* note 77, at 9.