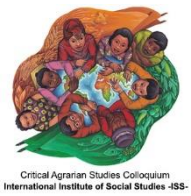

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Bigger is not Always Better: Drives and Implications of the Recent Agribusiness Megamergers

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Abstract

The global agrifood industry is undergoing profound upheaval, with a spate of mergers, acquisitions and deals that are consolidating the sector. The mergers announced in 2015 and 2016, for example -- including Dow and Dupont, ChemChina and Syngenta, and Bayer and Monsanto -- are poised to change the face of the agricultural inputs sector. This paper examines the political and economic dynamics surrounding these large transnational agribusiness megamergers and reflects on the broader implications of these deals for global environmental and food politics. The paper advances two arguments. First, it makes the case that the current wave of mergers is in some ways similar to past waves of consolidation in the sector, but also different in important ways. Past mergers in the sector were driven largely by technological innovation and integration along with strengthened intellectual property protection. Further technological innovation and integration remains important for today's mergers, but it is not the only driver. The current mergers are also deeply shaped by increased financialization in the agrifood sector that has prioritized investor demands for profits in ways that encourage corporate consolidation. Second, the paper argues that past episodes of consolidation in the sector had important implications for questions of economic fairness, farmer autonomy, environmental sustainability and political power, and that the proposed mergers are likely to result in even more pronounced effects on these fronts. Yet while these concerns are wide-ranging, the evaluation measures used by regulatory bodies to assess the impacts of the mergers only partially capture the ways in which they affect economic fairness, and say little on questions of environmental impact, farmer autonomy, and power inequities.

Introduction

The agricultural input industry is poised to become even more concentrated following the recent announcements of three giant megamergers among its top market players. The mergers announced in 2015 and 2016 – including Dow and Dupont, ChemChina and Syngenta, and Bayer and Monsanto – are currently being reviewed by regulators. If they are approved, the number of dominant firms will be reduced from six to four. These corporate deals are part of a broader trend that has seen a marked increase in the number of global mergers and acquisitions across a range of sectors since 2014, compared to the post financial crisis years when the number of deals fell dramatically. Many of the newly sought mergers and acquisitions have been labeled "megamergers" because of their enormous size, in the multi-billion-dollar range, with the combined value of deals across all sectors approaching US$ 3-4.5 trillion annually since 2014.[1]

The proposed megamergers in the agricultural input industry, collectively worth over US$ 250 billion, have sparked enormous debate. On one hand, they have revitalized questions critics have long raised about corporate dominance in this sector, in particular regarding the implications for competition and innovation, prices, farmer autonomy, the environment, and political influence. On the other hand, the corporations involved in these merger deals have insisted that the proposed tie-ups are a net win for both society and the environment. They have portrayed the mergers as essential to capitalize on what they see as a necessary trend in the sector – a move toward more integrated high-tech farming that they argue is necessary to secure enough food, sustainably produced, to meet the world's food demand over the next 50 years.

This paper seeks to explore this debate in more depth, by examining the driving forces behind the current mergers and assessing their likely impact should they proceed. The paper advances two main arguments. First, it makes the case that the current wave of mergers is in some ways similar to past waves of consolidation in the sector, but also different in important ways. Past mergers in the sector were driven largely by technological innovation and integration along with strengthened intellectual property protection for seeds. Further technological innovation and integration remains important for today's mergers, but it is not the only driver. The current mergers are also deeply shaped by increased financialization in the agrifood sector that has prioritized investor demands for profits in ways that encourage corporate consolidation. Second, the paper also argues that past episodes of consolidation in the sector had important implications for questions of economic fairness, farmer autonomy, environmental sustainability and political power, and that the proposed mergers are likely to result in even more pronounced effects on these fronts. Yet while these concerns are wide-ranging, the evaluation measures

[1] Massoudi, Fontanella-Khan, and Weinland 2016.

used by regulatory bodies to assess the impacts of the mergers only partially capture the ways in which they affect economic fairness, and say little on questions of environmental impact, farmer autonomy, and power inequities.

Agricultural Input Industry Concentration in Historical Perspective

Corporate concentration in the agricultural input industry has increased in recent decades to a point where a handful of firms control a significant proportion of agricultural seed and chemical sales. The degree of corporate concentration today sits in sharp contrast to the situation just over 100 years ago. From the early 20th century to the early 21st century, technological change and intellectual property rights protection on plant material had profound effects on the seed sector. The former enabled firms to develop new seed varieties, including those that were complementary with agrochemicals, and the latter afforded firms the ability to enlarge their research and development (R&D) budgets in ways that enabled them to take advantage of both economies of scale and scope for those products.[2]

From Seed Saving to the Big Six

In the 19th century, farmers typically saved their own seeds, which they openly shared with neighbours. In the early 20th century, as seed certification programs that promised better and more uniform seed quality began to spread in the US, farmers began to source seeds from small family-run enterprises that specialized in multiplying certified seed varieties that were available within the public domain.[3] The seed varieties available to these firms were typically those developed by researchers in publicly funded land-grant institutions and public agencies.[4] The US and other governments considered seed research to be a public good because research and development costs were high, which dissuaded private sector firms from taking on the task of developing new seed varieties.

In the late 1920s and early 1930s, public breeders developed hybrid corn seed varieties that outperformed earlier varieties. This development led to important changes in the industry. Hybrid varieties inherently offered intellectual property (IP) protection for plant developers because they could not be saved from season to season and deliver the same yield, and this encouraged more private firms to enter the field of seed research and development.[5] From the 1930s and 40s onward, private-sector breeding became a major source of crop seeds[6] and the use of hybrid

[2] Fuglie et al. 2011; Fulton and Giannakas 2001; Lesser 1998.
[3] Fernandez and Just 2007
[4] Moretti and Matringe 2006.
[5] Fernandez-Cornejo 2004; Howard 2015, p. 2.
[6] Moretti and Matringe 2006.

seed varieties expanded rapidly in the US.[7] By 1965, for example, over 95% of the corn crop planted in the US was sown with hybrid seeds.[8]

The 1970s saw considerable consolidation of firms in the seed industry, following the adoption of legal property rights for plant breeders and developers. The International Union for the Protection of New Varieties of Plants (UPOV) was established in 1961 in Europe, a move that sought to stimulate private investment in new plant varieties by establishing property rights for breeders at the national level. In the United States, the passage of the 1970 Plant Variety Protection Act (PVPA) provided similar strengthening of property rights for plant breeders for sexually propagated plant varieties.[9] These developments led to increased R&D expenditure by private firms in the seed industry because the new IP protections enabled firms to recoup costs by giving them exclusive market rights for their varieties for 20-25 years.[10]

The growing interest by the private sector in the development of agricultural seeds spurred a wave of corporate mergers and acquisitions in the sector in the 1970s in which a large number of smaller, independent seed companies were bought out by larger companies, the latter including some agricultural chemical firms that specialized in pesticides – including both insecticides that targeted insect pests and herbicides that targeted weeds. The number of firms in the chemical industry had been significantly reduced a decade earlier after series of mergers that accompanied flagging profits linked to more stringent safety and environmental regulations at the time.[11] According to Bryant et al., there were over 70 pesticide manufacturers in the US in the 1960s, and this number was reduced to around 8 by 2010.[12] The chemical and seed company mergers of the 1970s represented a vertical integration of these industries, and saw some large companies such as Ciba Geigy, Sandoz, and Royal Dutch/Shell purchase seed companies as a means by which to capitalize on the profit potential in the seed industry.[13] According to Fernandez, more than 50 seed firms were purchased by large companies in the pharmaceutical, petrochemical and food sectors following the adoption of the 1970 PVPA.[14]

There was a further solidification of IP protection over seeds when the PVPA was strengthened in 1980, and that same year a US Supreme Court decision, *Diamond vs. Chakrabarty*, extended patent rights to genetically engineered microorganisms.[15] This landmark legal decision to allow patents on genetically modified organisms sparked a wave of research in agricultural biotechnology for

[7] Fernandez-Cornejo and Just 2007, p. 1270.
[8] Fernandez-Cornejo 2004, p. 25.
[9] Howard 2015; Fernandez-Cornejo 2004, p. 26.
[10] Fernandez-Cornejo and Just 2007, p. 1270; Kloppenburg and Kenney 1984.
[11] Fernandez-Cornejo and Just 2007.
[12] Bryant et al. 2016, p. 7.
[13] Moretti and Matringe 2006. Fulton and Giannakas 2001; Hayenga 1998.
[14] Fernandez-Cornejo 2004, p. 26.
[15] Lesser 1998; Fernandez-Cornejo 2004, p. 21.

commercial purposes, leading to further development of genetically modified seeds. Intellectual property rights for genetically modified seed varieties were further extended with a 1985 court decision that granted patent protection for seeds and plants derived from agricultural biotechnology. These developments led to a significant rise in R&D spending on agricultural biotechnology by agricultural input companies throughout the 1980s.[16]

By the mid-1990s, with the approval of genetically modified crops for commercial planting in a number of countries, another wave of mergers, acquisitions, and joint ventures transformed the sector. Firms in this wave of consolidation sought to capitalize on economies of scale in the face of high research and development costs for agricultural biotechnology. These mergers, which continued through the mid-2000s, further cemented the linkage between the agricultural chemical and seed industries. The former bought up small and medium-sized enterprises in both the seed industry and the agricultural biotech sector as they sought to capitalize on the prospects for biotechnology to enhance product complementarity between seeds and agrochemicals.[17]

Patents held by these firms on many of the primary agrochemicals were nearing their expiry dates in the late 1990s and early 2000s, and the development of new seeds that were designed to work with specific chemicals was a strategy firms embraced as a way to lock in sales of both seeds and chemicals. Firms in the sector were able to take advantage of economies of scope by developing seed and chemical technologies together in an integrated way, which was less expensive than developing these products separately. Several firms, for example, developed plant varieties that were resistant to the application of their own brand of agrochemicals. The idea was that farmers could spray chemical herbicides to control pests such as weeds without worry that those chemicals would damage the crops. Monsanto, for example, engineered crops that were resistant to Roundup, its top herbicide, based on the chemical glyphosate. This move was attractive to farmers who wanted easy solutions to save time and effort, but it effectively locked customers into purchasing both products. Most mergers at that time resulted from firms seeking access to seeds, genes and platform technologies needed to develop these integrated seed and agrochemical products.[18]

This period saw DuPont, a chemical company, acquire the largest seed company at the time, Pioneer Hi-Bred, in 1999. Pioneer had itself acquired a number of smaller seed companies throughout the 1970s and 1980s, in previous merger waves. In 2000, AstraZeneca and Novartis, both specializing in pharmaceuticals and chemicals, merged and spun off their own agricultural chemical arm to form Syngenta.[19] Monsanto also purchased a number of seed and biotech companies in the 1990s, and merged with pharmaceutical firm Pharmacia & Upjohn in 2000, from

[16] Howard 2015, p. 2.
[17] Fuglie et al. 2012.
[18] Fuglie et al. 2011; see also Moretti and Matringe 2006.
[19] Lipin et al. 1999.

which its agricultural input business was spun off as Monsanto in 2002.[20] Dow Chemical purchased Mycogen, a seed and biotech firm in the mid-1990s, and also purchased various seed, chemical and biotech firms after 2000 to form Dow AgroSciences. And in 2002 Bayer acquired Aventis, which itself was the product of a merger of AgrEvo and Rhone Poulenc in 1999.

The result of these rapid and extensive mergers of the 1990s-early 2000s was the reduction of a significant segment of the market to just six massive firms by 2009 that controlled around 75% of the agricultural input market. According to Howard, some 200 independent seed companies were purchased by the top 10 agricultural input companies over the 1996-2013 period.[21] This concentration created barriers to entry for smaller firms, securing an enormous market share for the companies that dominated the sector. As Fuglie notes, "Of 27 crop biotechnology SMEs [small and medium scale enterprises] that were acquired between 1985 and 2009, 20 were acquired either directly by one of the Big 6 or by a company that itself was eventually acquired by a Big 6 company."[22] The resulting firms saw huge growth in market share from 1994-2013.[23] In this period, the four largest seed firms nearly tripled their market share, from 21% in 1994 to 58% in 2013. In agricultural chemicals, the share of the top four firms more than doubled from 29% to 62% in that same period.[24]

From this brief historical review, it is clear that the mergers in these earlier waves of consolidation were largely the product of technological innovation supported by IP protection for seeds, plant genetic material, and plants. Higher costs for research and development first for hybrids, and then for genetically engineered traits and plants, encouraged firms to get bigger in order to maintain their competitive edge in research and development, and IP protections provided them with the capacity to recoup those costs by holding exclusive rights to their products for the duration of the patent. The consolidation of the industry started gradually, but accelerated rapidly after the 1970s-90s.

Megamergers on the Menu

Today, the global agricultural input business is worth around US$100 billion per year. In the years immediately following the global food and financial crises that erupted in 2008, the industry performed well, as high agricultural commodity prices meant that demand for farm inputs soared, as farmers sought to increase production. But after 2013, when agricultural commodity prices began to fall, the performance of these firms became weaker and shareholders of these firms began to seek stronger returns through changes in the major agricultural input firms. At the same time, a big data revolution was underway which began to transform a

[20] Fernandez-Cornejo 2004, p. 32-33.
[21] Howard 2015.
[22] Maisashvili et al. 2016.
[23] Fuglie et al. 2012.
[24] Maisashvili et al. 2016, p. 2; see also Moretti and Matringe 2006, p. 7.

number of sectors, including agriculture. It was in this context that a new wave of merger proposals began to emerge.

Over the 2011-2015 period, Monsanto made several failed attempts to acquire the Swiss agrochemical firm Syngenta, the most recent being an offer in August 2015 of US$46 billion. Such a merger would fuse one the largest seed companies with one of the largest agrochemical companies, boosting the former's portfolio while offering an opportunity to relocate its headquarters to Europe in order to lighten its US tax burden in a tax inversion manoeuvre.[25] When Syngenta repeatedly rebuffed the deal, Monsanto's CEO Hugh Grant then insisted the firm was better off alone. Analysts, however, saw Monsanto as itself vulnerable to a takeover because its shares had declined by around 20% over the course of 2015 as it was entangled in legal disputes and questions over the safety of glyphosate, the key ingredient in its top selling herbicide, Roundup.

At the end of 2015, Dow and DuPont – two of the biggest and oldest chemical firms in the US – announced that they were merging into a new US$130 billion company. The Dow-DuPont deal is largely seen as a 'merger of equals', as the two firms are roughly the same size, and have a similar product mix of both agrochemicals and seeds. The merger announcement took many by surprise, although both companies were under pressure from activist investors since at least 2014.[26] The firms claim the aim of the merger is to eliminate duplicative R&D spending, including in their crop breeding activities. The merger is expected to generate around US$3 billion in cost savings per year, US$1.3 billion in agriculture alone.[27] The new firm, if approved, will be called DowDupont, and will eventually split into three parts (approximately 18-24 months after the merger), one of which will focus exclusively on agricultural chemicals and seeds (with the other two focusing on materials sciences and speciality products). The agricultural unit is estimated to generate around US$19 billion in sales per year, and this firm will have a commanding presence in the market.[28]

Less than two months later, in February 2016, ChemChina announced its purchase of Syngenta for US$43 billion. ChemChina is primarily a chemical firm whose portfolio includes agrochemicals. It is one of China's largest state owned firms, with US$45.6 billion in annual revenues and 140,000 employees. Syngenta specializes in both agrochemicals and agricultural biotechnology, and had over US$13.4 billion in sales in 2015, putting it at the top of the agrochemical market. This acquisition, if approved, will be the biggest Chinese overseas takeover in history. Many suspect that China is positioning itself to improve its crop production in the face of growing demand for food and a rising population.[29]

[25] Terazono et al. 2015.
[26] Crooks 2015.
[27] Dow and DuPont 2015.
[28] Bartz and Roumeliotis 2016.
[29] Mitchell et al. 2016; Stevenson, Bray and Tsang 2016.

Immediately after the announcement of the ChemChina-Syngenta deal, it became clear that the remaining players were discussing possible moves that would enable them to remain competitive. Monsanto had engaged in merger talks with BASF, but no deal emerged as a result. In May 2016, Bayer announced that it had made an offer to acquire Monsanto. Monsanto was open to the takeover, but was not happy about the offer price. Bayer's second attempt in mid-2016 was also rebuffed for the same reason. In mid-September 2016, Bayer successfully negotiated the purchase of Monsanto in a US$66 billion deal. Bayer stressed that it is seeking to create a "leading integrated agricultural business" with this acquisition. Monsanto is not only the world's top producer of genetically engineered seeds, but also had recently purchased Climate Corp, a big data precision farming firm that has developed a sophisticated platform for farm level data. The merger will result in yet another giant firm in the agricultural inputs industry.

Table 1: Three Giant Mergers: The Big Six Plus ChemChina

Company	Bayer	Monsanto	Dow	Dupont	ChemChina	Syngenta	BASF
Size of deal	$66bn (acquisition)		$130bn (merger)		$43bn (acquisition)		Not applicable
Sales (2015)	€46.3bn	US$15bn	US$49bn	US$25bn	US$45bn	US$13.4bn	€70.4bn
Employees	116,800	20,000+	53,000	52,000	140,000	28,704	112,435
Country	Germany	US	US	US	China	Switzerland	Germany
% of Global Seed Market in 2013	3%	26%	4%	21%	Not available	8%	Not applicable
% of Global Pesticide Market in 2013	18%	8%	10%	6%	Not available	20%	13%

Sources: Company websites; ETC Group 2015b.

These three megamergers, depicted in Table 1, promise to reshape the agricultural inputs landscape. They will effectively reduce the number of dominant firms in the sector from six to just four. German agrochemical firm BASF has not ended up in a merger deal with any of the other big firms so far in this round, but some have speculated that it will likely buy up any of the firms that the other players will be forced to divest from as a result of the anti-trust reviews of the mergers.[30]

What's Driving the Merger Wave This Time Around?

As outlined above, the literature on the previous rounds of mergers in the agricultural inputs sector makes a strong case that consolidation at the time was driven in large part by changes in the technological processes of seed breeding as well as accompanying intellectual property protections for seed breeding

[30] Chazan 2016a.

innovations.[31] Large research and development expenditures were required to continue innovation in the sector as seed breeding became more complex with the advent of agricultural biotechnology, which is why corporations needed to rely on intellectual property protection as well as the acquisition of firms with the seed materials and biotech know how to ensure that they would be compensated for their investments. It is tempting to assume that the most recent wave of mergers is also driven by similar dynamics around plant innovation and property rights over seeds. This is the narrative that the firms themselves are pushing. At a September 2016 US Senate hearing on concentration in the seed and agrochemical industry, Executive Vice-President and Chief Technology Officer of Monsanto stressed: "...the solutions we need can only come if companies embrace new technology, increase their investments, and accelerate research and development (R&D). And *that's* why you are seeing the latest round of mergers right now."[32]

Indeed, on the surface it is clear that the three proposed mergers consist of match ups of firms that bring together those with more expertise on the seed breeding side of the equation with those with more expertise on the agrochemical side of the equation. In this sense, then, the mergers could be viewed as a reinforcement of the marriage of seed and chemical companies into integrated packages for farmers that stylize chemicals to specific seeds. A closer look at the specifics of these three recent megamergers, however, reveals that while dynamics around access to and intellectual property protection for plant genetic material remain important to the firms that are poised to merge, they are not the only or even perhaps the main driver of this round of corporate consolidation in the sector. A range of forces appear to be at play in driving this wave of concentration, some of which apply more specifically to individual merger deals than to others.

Two main types of influence appear to be driving the mergers this time around. First, there are incentives at the firm level, regarding product development and the struggle for market share of those products, that are encouraging the tie-ups of certain industries in the sector. This includes factors linked to access to plant genetic material for the further development of agricultural biotechnology seed-chemical combinations, as noted above. But it also includes new technological developments such as digital farming platforms that have fundamentally different research and development dynamics from agricultural biotechnology. Second, the broader economic environment also influences firms' decisions to pursue merging with their rivals. Weak financial performance of the firms, shareholder pressures and ownership structures, and the low interest rates have also created conditions in which firms see financial benefits in merging. Of course, the factors at the firm level interact in complex ways with the broader economic context, but a closer look at the features within each of these types of influence helps to give a fuller picture of what is driving consolidation in the agricultural input sector at this time.

Firm Level Motivations: Cementing Technological Integration

[31] See, for example, Fuglie et al. 2011; Lesser 1998; Fulton and Giannakas 2001.
[32] Fraley 2016.

A review of the proposed mergers reveals that the relevant firms are still very much committed to a strategy of linking genetically modified seeds and agrochemicals in stylized packages as a key product line. This element is clear in all three proposed mergers. For Dow and DuPont, the latter clearly has superior seed breeding capacities and access to extensive plant genetic material to continue its research and product development on genetically engineered crops. DuPont is currently the second largest seed company, with around 21% of global sales of seeds. DuPont was originally a chemical company prior to its purchase of Pioneer Hi-Bred in 1999, and it still produces agrochemicals, but only holds around 6% of the global pesticide market today. Dow Chemical Corporation, on the other hand, has more expertise in the crop protection chemical market, where it holds around 10% of global sales of pesticides, for example, while it commands only 4% of the global market in seeds.[33]

Similarly, the matchup of Bayer and Monsanto brings together the former's dominance in the agrochemical market, in which it holds 18% of global sales of pesticides, with the latter's dominance in the seed market, for which it holds approximately 26% of the global seed market. The combination of ChemChina and Syngenta may not at first reflect this matching of complementary product lines, as both are primarily agrochemical companies. But Syngenta, despite holding the largest share of global agrochemical sales of the big six, also has important research and development in agricultural biotechnology seed development that is attractive to ChemChina, which has to date been solely a chemical company with no expertise in seed development.

Although this complementarity between agrochemicals and agricultural biotechnology is evident in each of the three mergers, there are some differences from the merger waves that took place in the 1970s and 1990s. Those earlier merger clusters directly followed a strengthening of intellectual-property protections on plant genetic material that rewarded larger research and development operations that could spawn innovation. This time around, however, there were no major changes to IP rules that preceded the push for new mergers. The ETC group has suggested that patents are no longer spurring innovation in any case, now that the market shares of the top firms have gotten so big.[34] In at least two of the cases, Dow-DuPont and Bayer-Monsanto, a key rationale given by the firms for the mergers is a reduction in the duplication of research and development costs, which raises some questions about their commitment to developing new innovative products.

The case of ChemChina purchasing Syngenta is a clear case of a chemical company with no seed expertise purchasing a company that has such expertise, and in that respect mirroring the types of matchups that occurred in the previous rounds of mergers. Although China does not at present allow commercial planting of

[33] The percentages cited in these paragraphs draw on ETC Group 2016.
[34] ETC Group 2015, p.14.

genetically modified (GM) crops, it is now widely speculated that it is preparing to reverse those regulations. China has long had its own research program in genetically modified crops, and the country released a policy paper in early 2016 calling for a cautious rollout of GM crop technology in the food sector.[35] Syngenta, which owns around 7000 seed varieties, would give China access to plant genetic material for the country's GM crop research.[36] The opening of the Chinese market to GM crops is a significant draw for the agrochemical and seed companies more generally, especially as demand for GM crops and associated chemicals have peaked in North America and are weak in other key markets, such as Latin America. Moreover, the new GM varieties that the big six firms are rolling out are not as dramatically revolutionary as they were in the first generation during the 1990s.[37] The Bayer-Monsanto merger is also poised to capitalize on potentially growing market demand in the Asia-Pacific.[38] Bayer already has significant investments in the region, and Monsanto recently agreed to a joint venture with SinoChem, another state-owned chemical company in China, regarding seed development.[39]

The rapid succession of deals may also be linked to competitive pressure to consolidate as other firms among the big six make plans to merge. In such an environment, firms may be seeking to expand their market share as a way to compensate for reduced growth that might arise from fresh innovations.[40] This explanation would be in line with the observation by some analysts that patents and market concentration serve as substitutes for one another.[41] Indeed, patents on the first generation of genetically engineered seeds will expire over the next decade, which may be adding pressure to the firms to expand market share for their existing packages of chemical and seed combinations as a way to counteract any competition that may come from generic brands.

At the same time, however, the expiry of patents on GM crops will only occur one variety at a time, and the firms are already marketing second-generation GM varieties that are still under patent protection. The big six are also developing more new varieties, not just with novel individual traits, but also varieties with stacked traits and cross licensing agreements that have the same effect as patent protection. Bringing new GM crop and chemical products to market still requires a large R&D budget, as the costs of development and regulatory approval remain high. According to the ETC Group, the cost of bringing a new pesticide to market is on average US$256 million, whereas the cost of bringing a new seed variety to market is on average US$136 million.[42] Several of the big six firms are also currently securing research collaborations and licencing arrangements to access gene editing technology, which promises even lower cost and faster means by which to alter the

[35] Mitchell et al. 2016.
[36] Kynge et al. 2016.
[37] Chazan 2016b.
[38] Chazan and Whipp 2016.
[39] Terazono 2016.
[40] Terazono 2016.
[41] Maisashvili et al. 2016.
[42] ETC Group 2015a.

genetic makeup of seed varieties, with less regulatory oversight.[43] Whether the current push for consolidation is about expanding market share or further development of chemical-seed packages, or both, the marriage of seeds and agrochemicals has a handsome payoff for these firms.

Another firm level motivation for the mergers is the strengthening of information platforms to support farming, as big data has become increasingly applied to farming contexts.[44] In the case of Bayer-Monsanto, this appears to be a large motivation for consolidation, to bring together the seed-chemical package offered by the firm with new digital information systems. In 2012, Monsanto purchased Climate Corp., which is a leading developer of this type of digital farming technology which it combines with the provision of crop insurance. These new farming information platforms rely on satellite images and sophisticated software programs that can analyze climate and soil conditions in individual fields, giving farmers specific prescriptions regarding which seeds, chemicals and other inputs are required in order to maximize yields. The announcement for the merger between Bayer and Monsanto emphasizes these technological programs alongside its seed traits and chemical products, which it refers to as "integrated solutions,"[45] such that the firm can be a "one-stop shop" for farmers.[46]

Locking farmers into these information technology platforms can serve the purpose of replacing the need for patents on plant genetic material. Farmers who sign onto these platforms are often asked to send big data from their fields back via satellite to the firm, and they become reliant on the firm for input prescriptions. These platforms are increasingly being tied to specific equipment companies, such as John Deere tractors.[47] The development of these platforms, while expensive, is very different from the development of crop chemicals and traits, because they face far fewer regulatory hurdles and as such are much easier to bring to market.[48] This may be a strategy, then, to use less expensive technological innovation to lock in sales of their own brands of seeds and chemicals that are designed work with the specific software. The ETC Group warns that equipment companies may be the next acquirers of the agrochemical and seed firms to complete the digital farming platform, as already there are significant licencing agreements between the big six firms and major farm equipment manufacturers.[49]

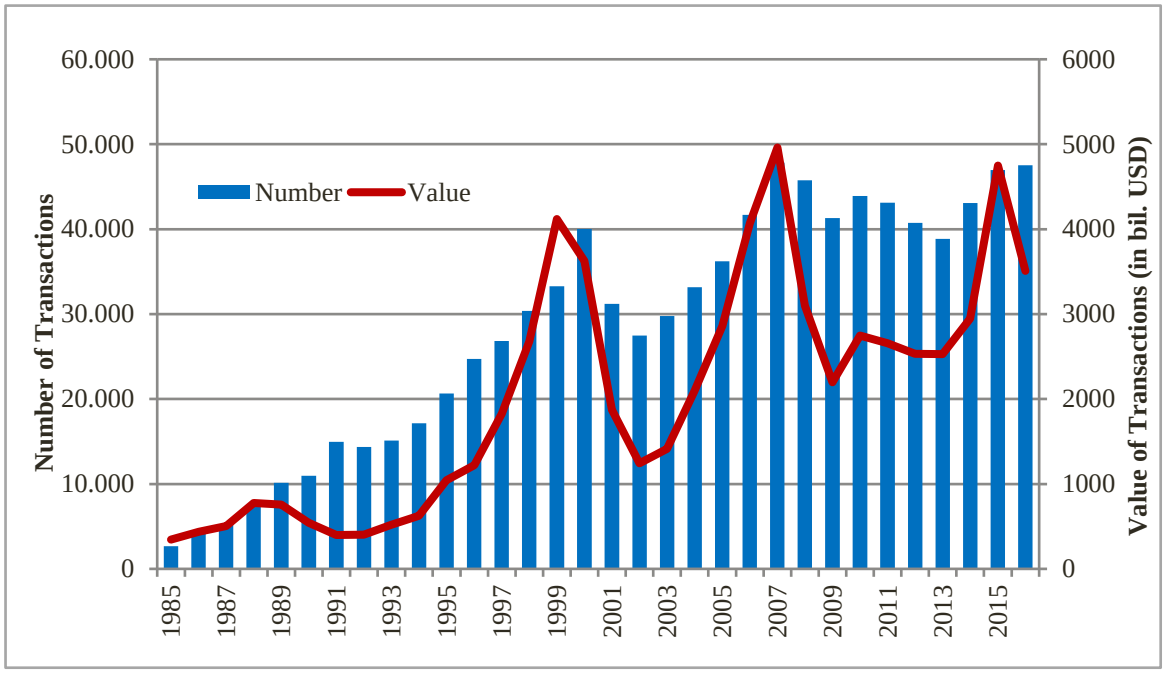
The Broader Economic Context: The Effects of Financialization in the Food System

Recent years have seen mergers not only in the agribusiness sector, but also across a range of sectors. Total mergers and acquisitions across all sectors reached a peak

[43] Hayley 2016.
[44] Bronson and Knezevic 2016.
[45] Bayer Statement Sept. 14, 2016.
[46] Chazan 2016b.
[47] Lianos et al. 2016.
[48] Burwood-Taylor 2016.
[49] ETC Group 2015b.

in 2015, and in 2016 still exceeded levels in the previous five years, as shown in Figure 1 below. This flurry of merger activity signals that factors beyond the firm and product level have also contributed to an environment that is conducive to corporate consolidation more generally. Financialization – the growing importance of financial motives, actors, and trends in shaping activity in the global economy – has become more pronounced in recent years.[50] Scholars have highlighted the ways in which financialization of the global economy, and the agrifood sector in particular, has transformed the sector into one that focuses on short term payouts over longer term sustainability.[51]

Figure 1: Worldwide Mergers & Acquisitions (across all sectors)



Source: Institute for Mergers, Acquisitions and Alliances: https://imaa-institute.org/mergers-and-acquisitions-statistics/

Financialization is seen by many analysts as a key factor in the rising importance of shareholder value (i.e. return on equity), rather than other goals (such as job creation and long-term building of the firm), as a benchmark of the performance of firms in the global economy.[52] When firms do not deliver the short-term profits financial investors expect, even when outside economic conditions are the cause of the downturn, they become vulnerable to shareholder pressure to make changes in the corporate structure, including pursuing mergers, in order to deliver returns. Historically low interest rates since the financial crisis have contributed to these pressures, as it is relatively easy for firms to borrow funds to acquire their rivals. These financial dynamics have played into each other in ways that help to explain the scope and timing of the recent merger activity among the big six firms in the agricultural input industry.

[50] Epstein 2005.
[51] Isakson 2014; Clapp 2014.
[52] Ferreira et al. 2009; van der Zwan 2014; Froud et al. 2000.

Weak agricultural commodity prices have had an important impact on the financial performance of agricultural input firms in recent years. In the early 2000s, financial investors were drawn into the sector in search of high returns based on a narrative centered on scarcity of resources – energy, minerals, food – and rising prices as experienced in the 2007-08 food price crisis and oil price increase.[53] But after 2013, the global commodity price boom began to lose its steam. Agricultural commodity prices fell dramatically, as did economic growth in key emerging economies that are reliant on agriculture, including Argentina and Brazil, the latter of which was the largest market for agrochemicals in 2014.[54] During the commodity boom, these countries were a key source of market growth for the big six firms. But with weaker agricultural commodity prices and lower growth, farmers, especially in emerging economies, did not have sufficient income to purchase agricultural inputs, and weakened demand translated into poor financial performance for the big six.

Each of the big six firms had lacklustre returns in 2015-2016 compared to the overall stock market indices. Syngenta's net income, for example, fell 17% in 2015, due to declining profits in Latin America as demand for its products shrank. Its merger with ChemChina provides a hedge against weak grain prices and weak input demand in Latin America.[55] In 2015, DuPont had its lowest returns in nearly a decade, as farmer demand dropped in the face of weak grain prices, particularly in Brazil, where the company has heavy exposure.[56] Low oil prices, at the same time, meant that the US was an ideal location for the petrochemicals industry, which could help to provide a hedge for the Dow-DuPont tie up, given that both firms are also key producers of a broader class of petrochemicals beyond agrochemicals. Monsanto similarly had weak financial performance in 2015-2016, also linked lower commodity prices, which dampened demand for its Roundup herbicide. And lastly, Bayer also underperformed relative to the overall stock market in this same period.

It was in this broader context that shareholder pressure came down on agribusiness for companies to improve their returns, including pressure to restructure as a means to save costs and shore up profits. Shareholder activism – when one or several investors purchase a large number of shares in a firm that they consider undervalued and then exert pressure on the firm's management to increase its returns – has been on the rise in a financialized global economy.[57] According to George and Lorsch, activist investors, even with just a few percentage points of the shares, can push for major changes within firms: "With increasing frequency they get deeply involved in governance—demanding board seats, replacing CEOs, and advocating specific business strategies." The preferred strategies of activist investors can include pressure to restructure, including undertaking mergers and acquisitions.[58]

[53] Ghosh 2010.
[54] ETC Group 2015a.
[55] Noel 2016.
[56] Mordock 2016.
[57] Stockhammer 2010; George and Lorsch 2014.
[58] Ferreira et al. 2009, p. 4.

In the Dow and DuPont cases, there were several activist investors pushing the two firms to make structural changes that ultimately led to the merger. Activist investor Nelson Peltz's Trian hedge fund purchased just under a 3% stake in DuPont in 2013, and immediately began to push for a restructuring of the firm. Daniel Loeb's Third Point hedge fund acquired just over 2% of Dow's shares. These amounts may seem small, but they are enough for these investors to make vocal demands for change at the firms. Both investors felt the firms were not performing at their full potential, and made their assessments clear to the firms' leadership.[59] The Dow-DuPont merger came just a few short months after resignation of DuPont CEO Ellen Kullman, who had fought off a proxy challenge from Peltz earlier in 2014-2015, in which he pushed for a breakup of the firm. Although she was able to stop the restructuring that Peltz sought, weak performance of the firm throughout the period led to broader demands from the board for a change in leadership. Soon after she stepped down, the Dow-DuPont merger was announced. Kullman was not thrilled with the outcome. Of this kind of deal, she lamented: "Break up, recombine. Breakup, recombine. That doesn't create any value except for bankers and lawyers."[60]

Activist investor pressure was also a factor in Syngenta's dealings with Monsanto and ChemChina. Monsanto sought to engage with Syngenta shareholders directly to play up the benefits of its proposed takeover in 2015, and hedge fund Paulson and Co. was rumoured to have built up a large stake in Syngenta shares, in an attempt to push the firm to accept the deal, although it ultimately fell through.[61] Syngenta's refusal of the deal sent the firms shares into free-fall, dropping 20% within days, which resulted in the resignation of Syngenta's CEO at the time. To placate shareholders, Syngenta undertook a US$2 billion share buyback in Sept 2015, and signalled that the sector would look quite different in six months – likely foreshadowing acceptance of its purchase by ChemChina only a few months later.[62]

Shareholders are not always in favour of mergers, however. Their views depend on whether they see merging with another firm as adding value to their shares. Many of Bayer's shareholders, for example, were initially unhappy with the firm's bid for Monsanto, intent on keeping the company's focus on pharmaceuticals, rather than building up its agricultural inputs business. They were wary of expanding the firm's agrochemicals portfolio, and were skeptical of the poor environmental reputation of Monsanto, which many saw as damaging shareholder value. Some analysts, though, argued that the merger would increase Bayer's returns from 7-8% per year to the range of 11-12% per year. In the end, Bayer's shareholders approved the takeover.[63]

[59] Crooks 2015.
[60] Quoted in Gandel 2016.
[61] Terazono 2015a; Massoudi and Fontanella-Khan 2015.
[62] Terazono 2015b.
[63] Chazan 2016a.

In addition to encouraging activist investors, financialization in the agrifood sector has influenced consolidation in the sector in other ways. The institutionalization of savings through pension funds and other institutional investors more broadly is becoming more common. A large share of institutional investors' funds is now managed by professional asset managers, who are typically rewarded based on their investment performance. As a result, asset management firms have strong incentives to push the firms in which they invest for better returns. Pension funds and other large institutional investors such as university endowment funds are typically known as 'passive investors' because they buy in through indexes that track shares of groups of companies from which they cannot easily divest. Institutional investors typically hold around 70-80% of US publicly traded firms, and often the same asset management firms hold shares across a number of firms in the same industry.[64] The top asset management firms own 10-20% of most American companies, including those in the same sectors.[65]

Despite managing the money of 'passive' investors, financial investment firms that sell index products to institutional investors often engage directly with the firms in which they invest, particularly if they are concerned about their performance. But even if they don't directly engage with firms to apply pressure, most firms understand the concerns of these asset managers and are likely to act accordingly.[66] This translates into constant pressure on firms to generate more profits based on shareholder value, and in this context mergers are a common response because they offer a simple and immediate strategy to boost returns, even though it is not based on a solid base of corporate growth.[67] Interestingly, it is not just individual firm performance that matters in this context, but industry performance across an entire sector, including competitors. In other words, when all the firms in a sector do well, so do the investors because they have a stake in all or most of those firms.

This kind of common and concentrated ownership is strikingly evident in the agricultural input industry. For example, Blackrock, Capital Group, Fidelity, The Vanguard Group, State Street Global Advisors and Norges Bank Investment Management each own significant shares in each of the big six companies. The scope of this common ownership in the sector is shown in Table 2 below.

Table 2: Percentage of Shares Held in the Big Six by Large Asset Management Firms

[64] Azar et al. 2016.
[65] *The Economist* 2016; Azar et al. 2016.
[66] Azar et al. 2016.
[67] Spross 2015.

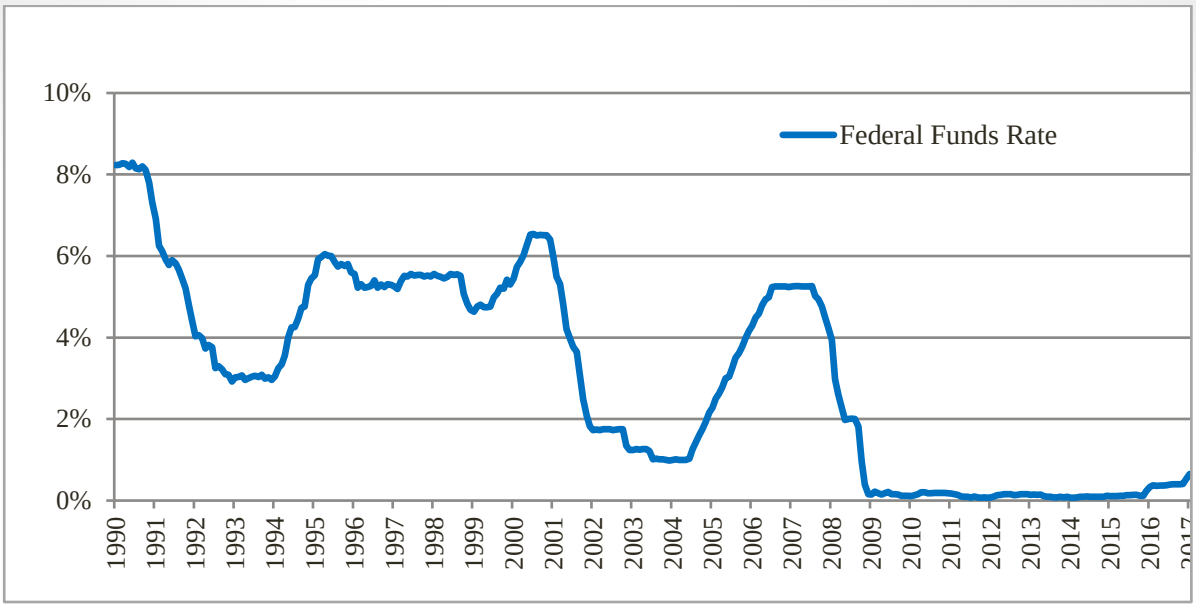
	Monsanto	Bayer	Dow	DuPont	Syngenta	BASF
BlackRock	5.76%	10.09%	6.11%	6.61%	6.00%	8.30%
Capital Group	2.68%	3.68%	3.60%	10.69%	4.01%	0.91%
Fidelity	3.12%	1.71%	1.17%	3.54%	0.21%	0.50%
The Vanguard Group, Inc.	7.33%	2.30%	6.27%	6.87%	2.28%	2.31%
State Street Global Advisors	4.63%	0.50%	4.14%	5.01%	0.40%	0.45%
Norges Bank Investment Management (NBIM)	0.81%	1.64%	0.43%	0.63%	1.75%	3.00%
% Owned by the Top 6 Firms Before Mergers:	**24.34%**	**19.93%**	**21.72%**	**33.36%**	**14.65%**	**15.47%**

Source: Thomson Reuters Eikon Database (percentage of shares as of Dec.31, 2016).

Adding to these ownership dynamics is a context of very low interest rates that have made corporate borrowing highly attractive. Seven years of historically low interest rates globally has made corporate borrowing not only cheap, but also easy, which is handy for financing giant mergers. The *Financial Times* reported in 2015 that many firms were also "sitting on large piles of cash" which has encouraged them to make deals.[68] Investment banks have also actively sought to encourage the financing of merger deals as a way to increase their own profits.[69] As a result of these conditions, firms were borrowing money to pay dividends to shareholders and to buy back shares to raise capital. The deals in question are indeed being funded along these lines: ChemChina's purchase of Syngenta is mostly being financed through debt. The firm has a debt level of 9.5 times its annual earnings, indicating that it is highly leveraged already.[70] Bayer's net debt is expected to quadruple when the deal with Monsanto closes.[71] Both ChemChina and Bayer are borrowing from a suite of banks and lending institutions to finance the deals.[72]

Figure 2: US Interest Rates (Federal Funds Rate) 1990-2017

[68] Fontanella-Khan and Massoudi 2015.
[69] Turner 2016.
[70] Kynge et al. 2016.
[71] Massoudi, Fontanella-Khan and Chazan 2016.
[72] Massoudi, Fontanella-Khan and Chazan 2016; Massoudi, Weinland, Atkins, Donnan and Jopson 2016.



Source: St. Louis Federal Reserve

Implications of Concentration in the Sector

There are many implications of the proposed agribusiness megamergers that require careful consideration. Government regulators typically focus their analyses of merger activity on questions of corporate concentration and its potential impact on market competitiveness and innovation. Regulatory authorities in jurisdictions where these firms do business are looking at the mergers, and can decide, based on their analyses, whether to allow them to proceed within their jurisdiction. Monsanto, for example, stated that it will need to file its merger intention with regulatory authorities in about 30 different jurisdictions.[73] The United States, Europe, Canada are all currently reviewing these merger proposals, as well as a number of developing countries including Brazil, a major market for these firms. While government regulators focus on the potential for anticompetitive outcomes that may result from merger activity, farmer groups and civil society organizations who share those concerns have also flagged other potential implications, including equity, sustainability, and corporate lobby power.[74] The firms involved in these mergers have stated their confidence that regulators will not find evidence of anticompetitive effects from the corporate tie-ups, due to the complementarity of the products in which each firm specializes.[75] Monsanto CEO Hugh Grant, for example, noted in a joint investor conference call the day the merger deal was announced:

> Monsanto and Bayer are two different, but highly complementary businesses. We're confident that we'll obtain the necessary regulatory approvals. Our Board of Directors underwent a

[73] Bartz and Roumeliotis 2016.
[74] Several open letters and public statements have been signed by groups. See, for example, American Antitrust Institute et al. 2016; Friends of the Earth 2017.
[75] See, for example, Werner Baumann and Hugh Grant interview with CNBC 2016.

> comprehensive evaluation process, alongside legal and financial advisors including assessing a broad range of strategic options and opportunities.[76]

It is worth noting that antitrust legislation has become weaker in a number of countries in recent decades.[77] In the US, for example, following a period of leniency early in the 20th century, antitrust authorities took a harder line in the 1936-1972 period and considered situations where any one firm had 35% or more of the market to have too much market power. Since the 1970s, however, rules have become more relaxed, especially with the rise of neoliberalism and free market attitudes after the 1980s.[78] Economists have also become more central to the increasingly complex analyses of antitrust authorities, bringing with them more openness to the idea that concentration can in some cases bring greater efficiencies that might offset some of the costs of concentrated market power. Antitrust enforcement in the US has also tended to be more stringent under Democratic administrations, and more lenient in Republican ones. The *Financial Times*, for example, has noted that more deals were stopped under US President Obama than was the case under former US President G.W. Bush.[79]

The merger enforcement guidelines, at least in the US, EU and Canada, tend to focus almost exclusively on the effect of mergers on competition.[80] Such a focus is important, as it helps to uncover the ways in which mergers might result in higher prices, in this case, for both farmers and consumers. Whether market concentration translates into market power depends on the extent to which new firms in the sector face barriers to entry. If it is difficult for new firms to even enter the sector, concentration can result in anti-competitive practices, such as raising prices.[81] A focus on competition also helps to give regulators a sense of how mergers might influence future innovation, with competitive markets being seen as generally conducive to innovation.[82]

The focus of regulators on competition is important, but it is also incomplete. *The Economist Magazine* notes that the focus of regulators on competition is limited even in an economic sense, however, as antitrust authorities do not typically review the broader impact of patent holdings, and can only touch on the effect of institutional shareholder ownership on competition.[83] Further, as shown below, merger guidelines in these countries do not even consider other possible impacts of corporate mergers, such as their potential effects on the environment, and the distribution of political power.

[76] Monsanto 2016.
[77] Howard 2009.
[78] The Economist 2016.
[79] Crow and Jobson 2016.
[80] EU 2004; US Department of Justice 2010; Canada Competition Bureau 2011.
[81] OECD 2007.
[82] Shapiro 2002.
[83] The Economist 2016.

The Impact on Competition and Innovation

Antitrust regulators typically evaluate the competitive impact of a merger by calculating the extent to which the merged firms will change the dynamics of the marketplace for the products it sells. It is not as simple as testing whether a market is more concentrated because a merger results in fewer market players. Rather, regulators weigh the cost of market concentration against any efficiencies that may arise from economies of scale and scope, as well as innovation. As King notes, mergers and acquisitions can have both positive and negative impacts with respect to competition. If they result in market dominance that will stifle competition and raise prices, then the effects are most likely to be negative. But if they result in more efficient markets resulting from economies of scale, even if there are fewer suppliers in the market, then they might be viewed more positively.[84] The aim is to determine whether the changes a merger brings to a sector makes it easier for firms to collude.

The Herfindahl-Hirschman Index (HHI) and the four-firm concentration ratio (CR4) are common metrics used by analysts to determine market concentration within the sector. The HHI is calculated by adding the square of the market share of each firm participating in the market for a particular product. If only one firm was present in the market, the HHI would be 10,000, indicating a monopoly. If there are thousands of suppliers within a market, the HHI would be closer to zero, signalling a competitive market. If the HHI is less than 1500, the market is generally considered to be competitive. If the HHI is in the range of 1500 to 2500, the market is generally considered to be moderately concentrated. And if the HHI exceeds 2500, the market is considered to be highly concentrated. Regulators look to see what the change in HHI is as a result of a proposed merger. Changes over 150 to 200 raise more concern among regulators than a change in HHI that is less than 150.

The CR4 measures the market share of the top four firms within a market. Economists typically consider markets with a CR4 rating under 40% to be very competitive. Markets with a CR4 rating in the 40-60 range are considered to be moderately concentrated. And markets with a CR4 over 60 are considered to be highly concentrated.[85] The US antitrust enforcement guidelines as well as the European Union guidelines use the HHI to determine levels of market concentration and changes to the competitive nature of markets resulting from mergers. Canada uses the CR4 as well as the HHI in making its determinations, although its threshold for considering highly concentrated markets is a CR4 over 65%.

The firms proposing the megamergers have all claimed that their products are largely complementary, with little product overlap, such that their respective mergers would not result, in their view, in a more concentrated market for their products. Bayer and Monsanto, and Syngenta and ChemChina, have also added that

[84] King 2001.
[85] Naldi and Flamini 2014.

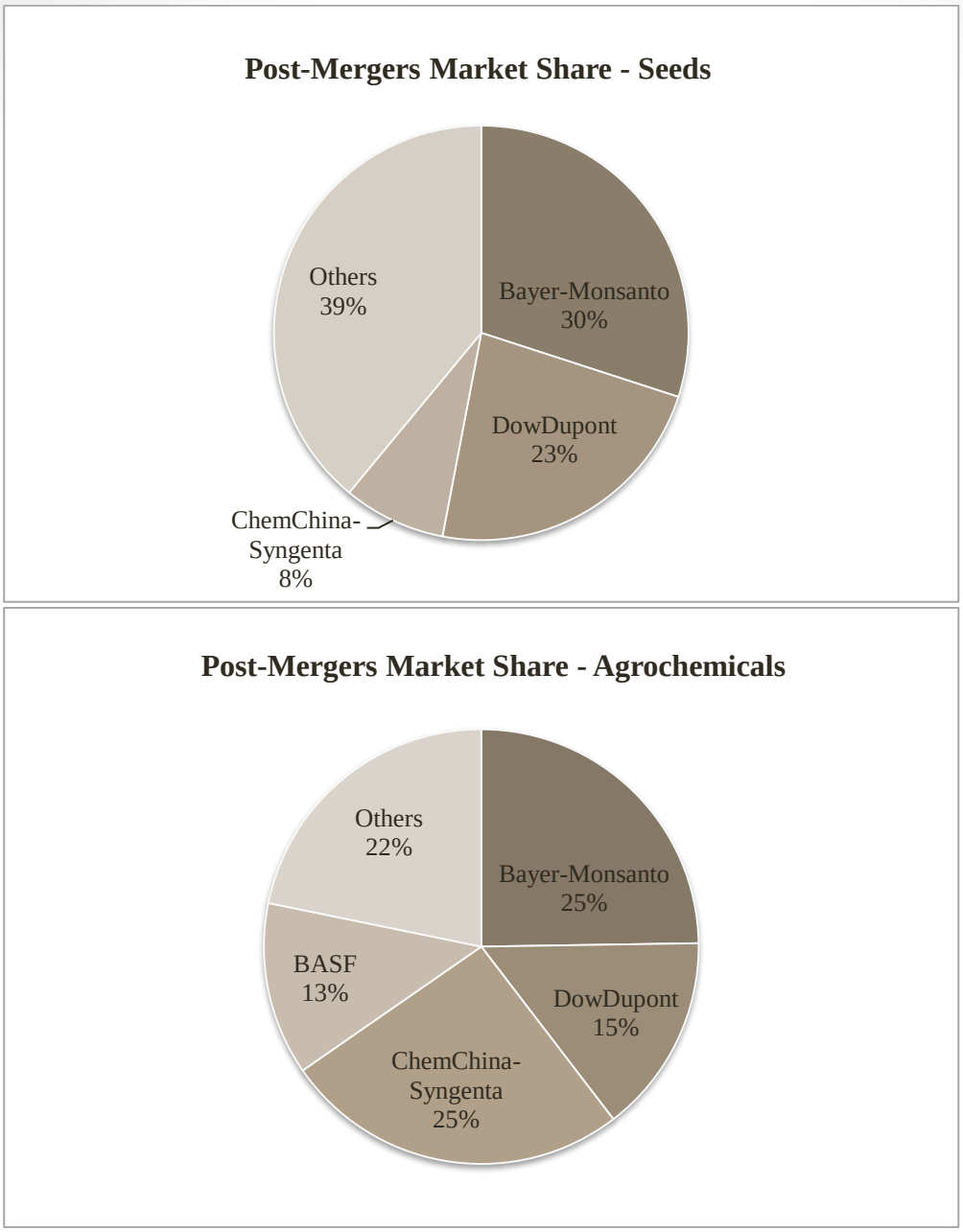
they have different regional strengths, and that their merger would thus not result in excessive concentration in any one region. The firms have all done preliminary analyses of the markets for their products, and proceeded to negotiate the deals on the assumption that they would pass regulatory hurdles. In the case of ChemChina-Syngenta and Bayer-Monsanto, the firms negotiated large break-up fees (in the order of US$3 billion that the acquirer pays the acquired) should the deals not clear regulatory approval. The firms all stand ready to make concessions to regulators, should they be requested to sell off any aspects of their businesses to allay concerns about concentration.

While each merger on its own would affect the market in specific ways, the impact of all three mergers on the market at the same time complicates the work of the regulatory authorities considerably. In this context, critics have weighed in to add their voice to the debates. The ETC Group warns that if all three of these deals are given the green light by regulators, around two thirds of the world's seed and agrochemical markets will be controlled by just three giant firms. Post-mergers, the top four firms, including BASF, would control 73% of the chemical and seeds industries. This puts the CR4 well into the highly-concentrated market category (see Figure 3). Even prior to the mergers, the top four firms in the seed and chemical industries commanded a CR4 level at around 60% (see Figure 4).

Regulatory authorities are most likely to examine concentration levels for specific crops in specific markets. Here the levels of concentration appear to be even more extreme. In the United States, for example, both DuPont and Monsanto already each hold 35% of the corn seed market, while Dow and Syngenta each hold around 6% of that market. This puts the CR4 for corn seed in the US at approximately 82%. Similarly, for soy seeds, these same four firms together hold approximately 76% of the market. For cotton, the concentration in the US market is even more extreme, at around 91% held by the top four firms.[86] In Canada, approximately 93% of canola seeds sown in the country contain traits owned by either Monsanto or Bayer (47% and 46%, respectively, in 2010).[87] If these two firms merge, the resulting firm would hold a near monopoly in canola seed in Canada.

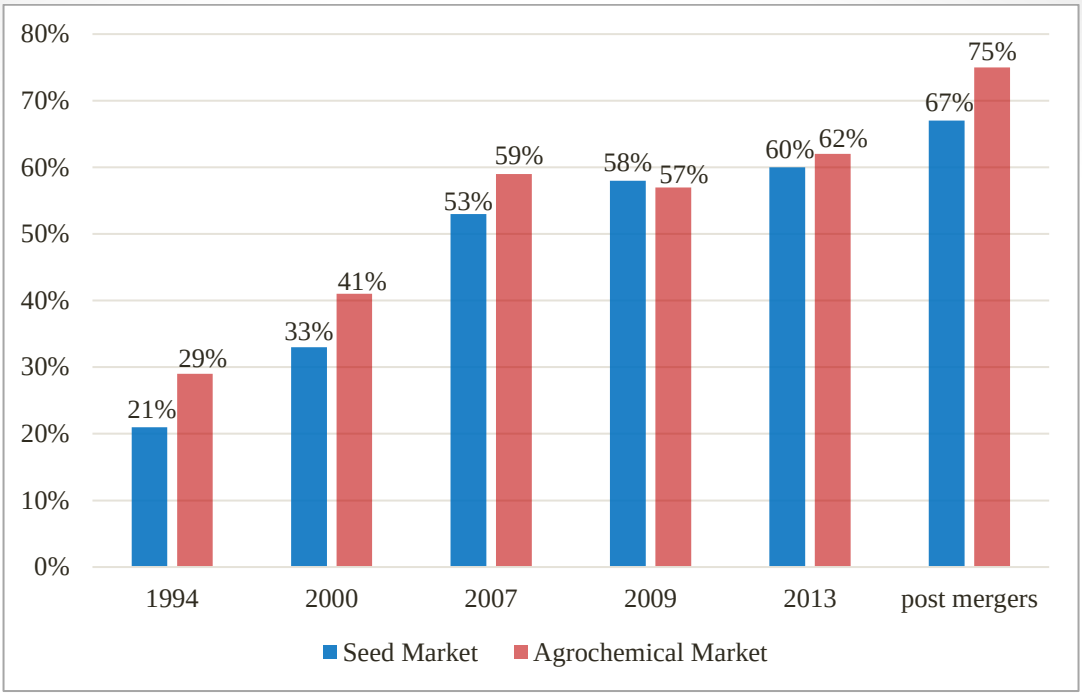
Figure 3: Post-Merger Market Shares for Seeds and Agrochemicals

[86] Bryant et al. 2016, p. 6.
[87] Clapp et al. 2016.



Source: ETC Group 2016

Figure 4: Global CR4 Seeds and Agrochemicals



Sources: Compiled from data in Fuglie 2011; ETC Group reports

Bryant et al. find that the HHI in the US prior to the mergers was already greater than 2500 for corn and cotton, and for soy it was close to that figure, at 2360.[88] If the mergers proceed as planned, the HHI would increase substantially and put all of these crops into the "highly concentrated" category. The proposed mergers, if approved, would result in increased marked concentration for corn by over 400 HHI points (to reach a level of 3110), an increase in cotton by 2401 HHI points (to reach a level of 5205), and an increase in soy by 350 HHI points (to reach a level of 2701), as shown in Table 3.[89]

Table 3: HHI Values for Corn, Soybeans and Cotton Before and After Proposed Mergers

	Corn	Soybeans	Cotton
Before mergers	2696	2360	2804
After mergers	3110	2705	5205

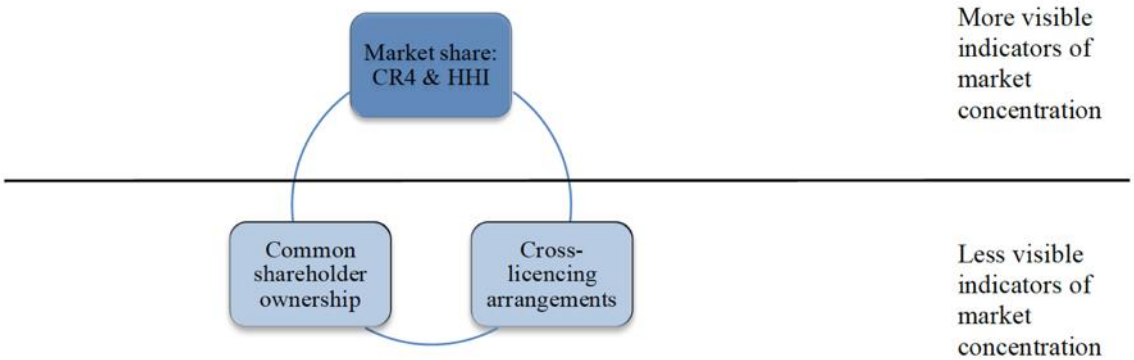
Source: Bryant et al., 2016

Beyond concentration ratios as determined by market share, there are other aspects, not always examined by regulatory authorities, that may intensify the effects of market concentration. Some analysts make the case that cross-licensing arrangements between the big six agribusiness firms are anti-competitive because

[88] Bryant et al. 2016, p. 24.
[89] Bryant et al. 2016, p. 24.

such arrangements only deepen their market power.[90] The HHI does not take into account collaborative R&D and cross-licencing agreements, which analysts argue results in more concentrated markets that present barriers to new entrants into the market.[91] It is difficult to know the full extent of cross-licensing agreements between the big six companies, because this information is not publicly disclosed. Howard has outlined some of the agreements that can be discerned by examining products on the market that contain stacked traits owned by multiple firms. He argues that these cross-licencing agreements present strong barriers to entry for small firms in a highly-concentrated industry.[92] Multiple and overlapping patent claims – known as "patent thickets" – in the agricultural biotechnology sector also tend to present barriers to entry for new firms because it is costly for them to navigate the patent landscape.[93] Such barriers may also contribute to further consolidation in the sector.[94]

Figure 5: Sources of Market Power in the Agribusiness Input Sector



Other analysts have raised concerns that firms within a sector may command more market power as a result of their common shareholder ownership structure as outlined above (Table 2). As shareholders, large asset management firms pressure CEOs of these firms to deliver returns, which can impede competition because higher prices across all firms mean better returns all around for investors. According

[90] Howard 2015; Friends of the Earth 2017.
[91] Oehmke and Wolf 2003.
[92] Howard 2009.
[93] Bryant et al. 2016, p. 12; Maisashvili et al. 2016. On patent thickets, see Shimmelpfennig 2004.
[94] Pray et al. 2005.

to Azar et al., common ownership in the airline industry results in concentration that is 10 times what traditional measures such as HHI reveal.[95] As common ownership is clearly an issue with the big six having significant shares owned by the same large asset management firms, this is an important aspect of market concentration to consider, and further research is needed to examine this phenomenon more fully in the agribusiness industry. These less visible sources of market concentration are depicted in Figure 5.

The level of concentration that is likely to result from the mergers will have important implications for innovation. In the past, the merger of smaller firms in the sector to form larger ones did result in larger R&D budgets for the merged firms that enabled companies to develop new seed traits and varieties, as outlined above. Fuglie shows that by the late 2000s, however, increased concentration in the sector slowed the intensity of private research on biotech corn, cotton and soy relative to what would have been the case without that level of concentration.[96] This may be related to the point, noted above, that market concentration tends to be associated with fewer patents, indicating a lower incentive to innovate as market share rises.[97]

The companies engaged in the current restructuring of the sector, however, have argued that the proposed mergers will encourage further innovation in the sector and that it enables them to take advantage of cost savings due to economies of scale and scope.[98] Bayer and Monsanto, for example, are advertising what they see as benefits arising from more integrated farming solutions, combining seed traits, crop protection, and digital farming platforms, as noted above. But at the same time, the firms have clearly stated that they are planning to make cutbacks to R&D budgets, rather than increasing them. Both Dow-DuPont and Bayer-Monsanto have widely advertised that their proposed deals would result in significant “synergies”, referring to cost savings as a result of their ability to eliminate duplicative research and development expenditures. In addition to indicating a decline in R&D expenditures, which is likely to further stifle innovation, it is highly unlikely that these cost savings will be passed on to consumers, due to the phenomenon of shareholder pressure for returns, as outlined above. If this is the case, it is more likely that firms will seek to improve profits through raising prices, rather than through innovation or lowering prices in line with their cost savings.

Equity Concerns: Prices and Farmer Autonomy

Regulators are concerned about market concentration and the potential for anti-competitive behavior not just because it can dampen innovation, but just as importantly because it can have negative effects on equity. If companies are able to increase prices for their products simply on account of their having more market power, rather than as a result of innovation, consumers are likely to be harmed.

[95] Azar et al. 2016.
[96] Fuglie et al. 2012.
[97] Maisashvili et al. 2016.
[98] Massoudi 2016.

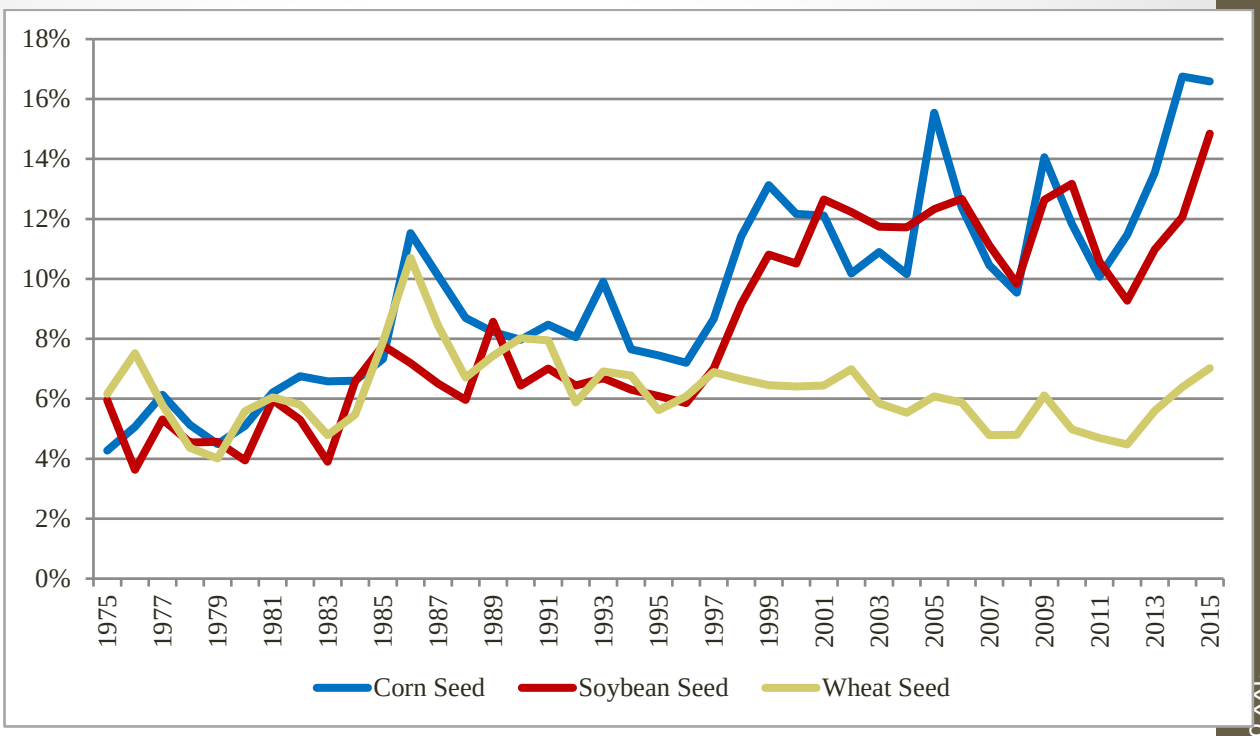
The companies involved in the mergers claim that the products they offer will result in higher agricultural production, and as a result they assert that farmers and consumers will be better off. Critics claim that the mergers are likely to result in higher prices for farmers and consumers without any accompanying benefits from the firms' products.[99]

To better understand the likely price implications from the mergers, it is helpful to look at past trends in previous merger rounds. Already some 15 years ago, the US Government Accountability Office (GAO) found that seeds derived from agricultural biotechnology were more expensive than conventionally bred seeds.[100] This is likely due to high and rising technology licensing fees for GM seeds, which have been a growing share of feed costs for farmers in recent decades. Technology licensing fees were easy to track until recently, because they appeared on a separate line in seed contracts farmer signed with firms. But now technology fees are rolled into seed prices, making it hard to separate out their effect on seed prices. In 2007, technology fees made up around 30-75% of the cost of GM seeds in the US and EU, and at the time were still rising.[101]

Data from the USDA show that from 1975-2015 the price of corn and soy seed per acre as a percentage of the amount of revenue farmers received for those crops per acre nearly tripled for both crops (see Figure 6 below). Seed prices for corn and soy also increased by more than the rate of inflation over the same period, as shown in Figure 7 below which adjusts seed prices for inflation. Of course, there are many factors that affect changing farm input prices, and it is difficult to isolate the effect of market power from others.[102] But because technology fees make up a significant proportion of GM seed costs, one can assume that a continuation of high-tech farming will only result in a similar or greater proportion of farmer costs that go to technology fees. Moreover, some studies have found that seed prices tend to be higher when firms integrate into one firm, compared to seed prices under cross-licencing arrangements.[103] It is interesting to note that the prices for wheat seeds did not increase at the same pace as corn and soy. The lower price of wheat seeds is due to the fact that wheat is not a genetically modified crop and thus does not have technologies fees associated with it. There is relatively little private sector R&D in wheat seeds, with much of the US wheat seed varieties provided by the public sector.

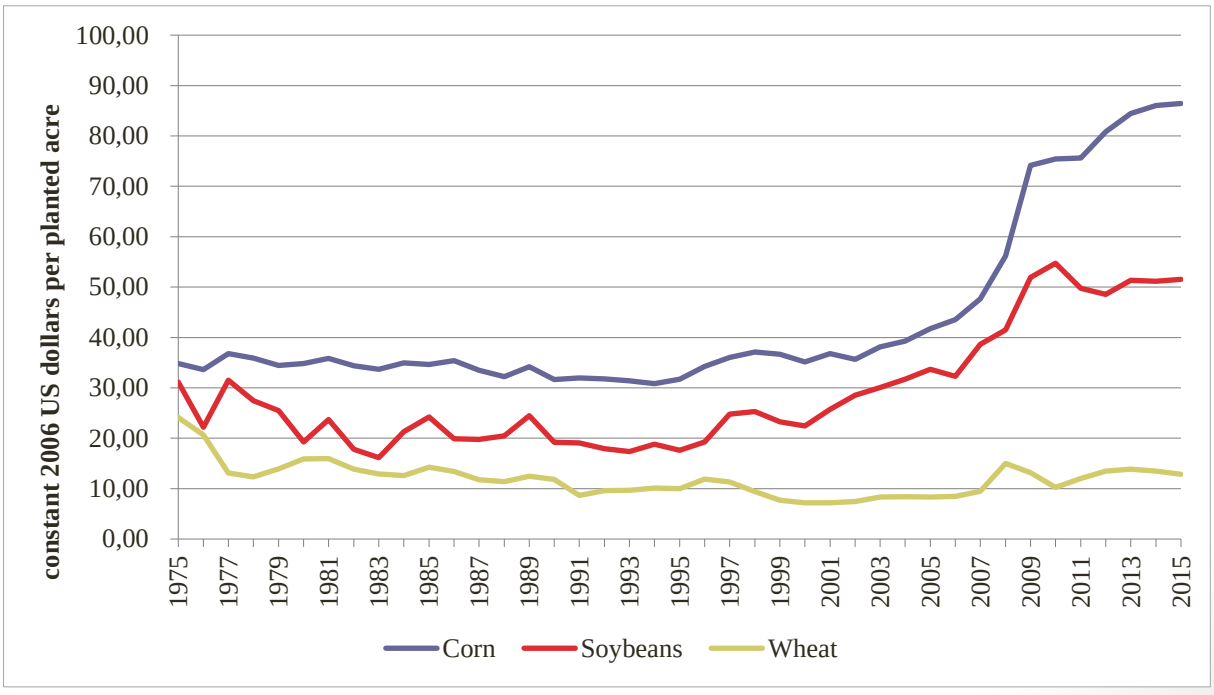
Figure 6: Corn and Soy Seed Prices as a Percentage of Gross Value of Production per Acre

[99] Friends of the Earth 2017.
[100] Cited in American Antitrust Institute et al. 2016.
[101] Fuglie et al. 2011, p. 13.
[102] Fuglie et al. 2012.
[103] Stiegert et al. 2010.



Source: USDA Data

Figure 7: Inflation Adjusted US Seed Costs 1975-2015



Sources: USDA Data and CPI data

Looking specifically at the Dow-DuPont and Bayer-Monsanto mergers, Bryant et al. calculated seed price increases that are likely to result from the mergers. They found that seed price increases for corn are likely to be in the 1.6 to 6.3 percentage range, and the price increase for soy seed is likely to be in the 1.3 to 5.8 percentage range. The predicted effect of the Bayer-Monsanto merger on cotton seed prices is much more pronounced, at a 17.4 to 19.2% increase.[104]

The merging firms claim that their plans for enhanced technology integration will result in greater overall agricultural production, which should offset those price increases. However, there has been little evidence of this effect from agricultural biotechnology and chemical packages thus far. The vast majority of the agricultural biotechnology traits marketed by the merging firms are not designed to increase yield. Rather, nearly all of the traits marketed by these firms are for herbicide tolerance (HT) (allowing farmers to spray more chemicals) or insect resistance (IR), or increasingly, through stacked traits that combine various HT and IR traits. Of course, protecting seeds from weeds and insects can result in greater output per field, but even there the evidence is scant that GM seeds outperform conventional seeds.[105]

If this trend continues, higher seed costs without higher yields will mean greater production costs for farmers per unit of output. This will most likely translate into either lower incomes for farmers, or higher food prices for consumers, or some combination of both. Either way, the effect of rising seed prices is likely to exacerbate income inequality. Civil society critics have argued that the mergers will likely have an adverse effect on those who are already in poverty, by making food less affordable, as farmers are likely to pass on at least some of the increased cost of production to consumers.[106]

A further equity implication of the mergers is the impact of corporate concentration on farmer autonomy and choice. This is an important equity aspect of corporate concentration, and it is not clear how much it is considered by regulators when they evaluate proposed mergers. Farmer organizations and civil society groups have highlighted the impact of integrated seed and chemical technology on farmer autonomy in recent decades. It is increasingly difficult for farmers in North America, for example, to access non-genetically modified seeds for crops in which GM seeds have become dominant – in particular corn, soy, cotton and canola. Howard, for example, notes that 40% of farmers in Illinois in 2009 could not access non-GM seed.[107] As a result, farmers increasingly are feeling stuck on a GM technology treadmill. A coalition of farmer and civil society groups highlighted growing farmer dependence on high tech seeds and chemicals in a letter to US regulators opposing the merger of Dow and DuPont: “The seed companies have fostered a dependence

[104] Bryant et al. 2016, p. 26.
[105] CBAN 2015a.
[106] Friends of the Earth 2017.
[107] Howard 2009.

on seed and chemical cropping systems with declining effectiveness – and the industry's response has been to develop newer and more expensive traits."[108] This dependence is particularly acute for small scale farmers in developing countries, who face an unfair playing field in the face of higher prices and reduced choice.

Environmental Risks

The big six input companies claim that their proposed mergers will result in more sustainable agricultural outcomes because they will deliver products that are more efficient for farmers – delivering higher yields and requiring fewer chemicals. According to Bayer CEO Werner Bauman, the combination of Bayer and Monsanto "represents the kind of revolutionary approach to agriculture that will be necessary to sustainably feed the world as we enable growers with a broad set of enhanced agricultural solutions."[109] NGO and farmer groups are less enthusiastic, expressing concern that the mergers will result in a further entrenchment of the industrial agricultural model in ways that threaten the environment. Already there is widespread scientific consensus that industrial modes of agriculture, based on large-scale monoculture and chemical farming are a major contributor to climate change, environmental toxins, soil erosion, and biodiversity loss.[110] These problems, critics argue, will only be reinforced if the mergers are allowed to proceed.[111]

The seed and chemical packages that the newly merged companies plan to offer are largely based on their continued push of genetically modified crops. By 2007, 98% of the global acreage planted with GM crops was already sown with seeds supplied by the big six companies.[112] Over 85% of genetically modified crops are engineered to be resistant to the application of chemical herbicides, the most common being glyphosate, the active ingredient in Monsanto's Roundup.[113] Other companies have engineered seeds that are resistant to other chemicals, such as Bayer's Liberty herbicide. When herbicide tolerant seed varieties were first introduced, the companies argued that they would bring environmental benefits because they would allow farmers to spray their fields less often, and with chemicals that are less toxic than other chemical crop sprays.

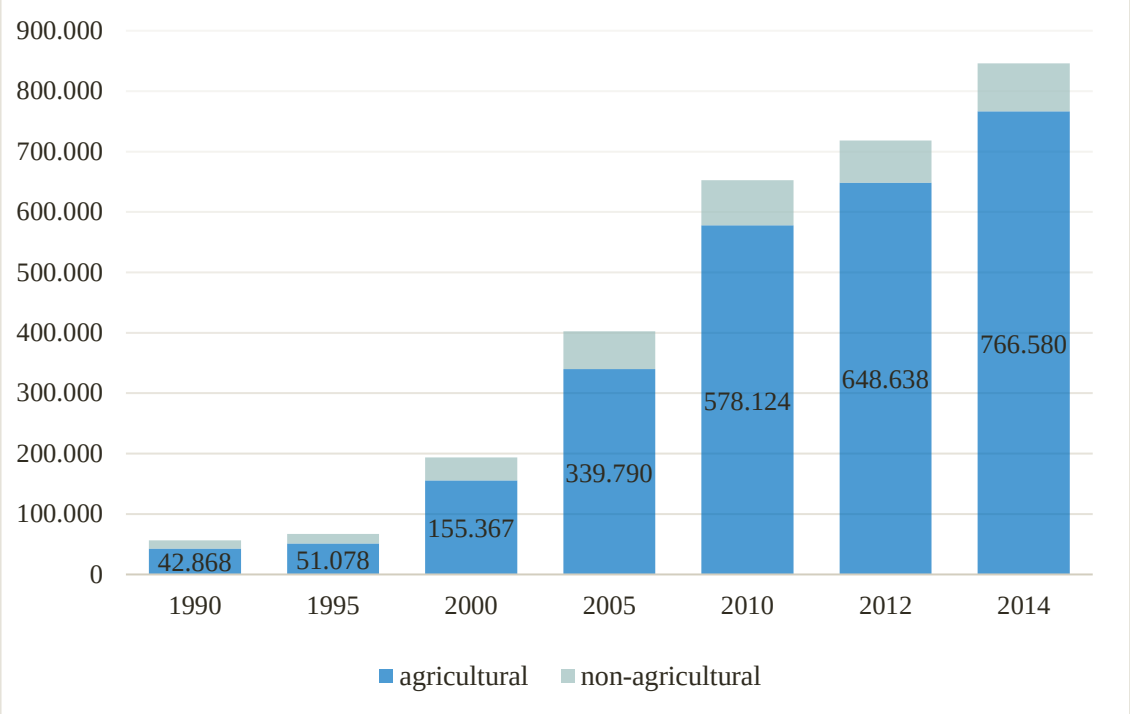
As GM crop acreage has grown globally over the past two decades, however, so has the application of herbicide sprays, as shown in Figure 8. According to Benbrook, from 1996 to 2014, global agricultural glyphosate use increased nearly 15-fold.[114] This increase is the product not just of growing acreage planted with GM crops, but also an increased rate of application as weeds have become increasingly resistant

[108] American Antitrust Institute et al. 2016.
[109] Quoted in Massoudi 2016.
[110] E.g. Foley et al. 2011.
[111] Friends of the Earth 2017; American Antitrust Institute et al. 2016.
[112] ETC Group 2013.
[113] ISAAA Data – see figure.
[114] Benbrook 2016.

to the chemical.[115] The increased application of pesticides presents numerous environmental and health risks. Although initially herbicide glyphosate was promoted as a relatively benign pesticide, there are growing concerns about its safety. In 2015, the World Health Organization issued a statement naming glyphosate as "probably carcinogenic to humans"[116], although a later study concluded that exposure through diet was unlikely to cause cancer.[117] There remains controversy, however, over its effects in both occupational and dietary exposure.[118]

Figure 8: Global Glyphosate Use (1000kg)

[115] CBAN 2015b.
[116] WHO 2015.
[117] Kelland 2016.
[118] Myers et al. 2016.



Source: Benbrook 2016

Industrial agriculture based on high tech seed and chemical packages has also been associated with a narrowing of crop genetic resources. The big six companies tend to focus on packages for a handful of key crops: corn, soy, canola, and cotton. These crops are typically grown in large-scale monoculture fashion that poses a threat to agricultural biodiversity.[119] Herbicide tolerant varieties sprayed with glyphosate and other agrochemicals can damage plant genetic diversity in and around fields, which can pose a threat to wildlife, including key pollinators such as bees and butterflies that rely on those plants for their survival.[120] There are also likely to be fewer seed varieties available if firms merge and cut their research and development budgets as planned.

The aim of the mergers is to further develop the high-tech genetically modified and agrochemical model of agriculture. With fewer input suppliers on the market, the most likely scenario is further entrenchment of the industrial agricultural model and a crowding out of more resilient forms of farming, such as agroecology. Although the firms are promising greater environmental sustainability, the environmental upshot is anything but clear.

Political Power

Along with concentrating market power, the proposed mergers risk enhancing the political power of large agribusiness firms by reducing the number of well-funded lobby voices that have the ear of policymakers. Corporate lobbying in general

[119] Brown et al. 2016; Altieri 1999.

[120] CBAN 2015b; Brown et al. 2016.

increased markedly from 1997 to 2012.[121] In the US, lobbyists spend around US$2.6 billion per year making their voices heard in Washington, D.C.[122] Agribusiness players are active in the lobby game. In 2013, Monsanto spent nearly US$7 million in lobbying the US government, while Syngenta spent nearly US$1.5 million, and Dow spent nearly US$1 million.[123] Monsanto lobbied in recent years for the approval of Roundup Ready alfalfa and sugar beets, against GM labelling, and for a congressional caucus on 'modern agriculture' which was formed in 2011.[124] Similar lobby efforts have been launched at EU policymakers by the big six firms. In 2015, Dow spent nearly 4 million euro in lobby efforts in Brussels, while BASF spent 2.3 million, Bayer nearly 2 million and Syngenta 1.5 million.[125]

Critics are concerned that this kind of concentrated lobbying results in a favouring of the large-scale industrial agricultural model, and that it will only become more pronounced if the mergers proceed. They worry that the promotion of industrial agriculture also reduces the responsiveness of these firms to farmer and consumer demand for more sustainable agriculture and food systems.[126]

There are recent signals that the regulatory process in the US, even with its shortcomings for its failure to consider all of the potential risks, may be short-circuited due to agribusiness lobby power. Although one of US President Trump's advisors expressed his disapproval of the proposed mergers, there are signs that other powerful voices may win out.[127] The CEOs of Bayer and Monsanto met privately with President-elect Donald Trump just before his inauguration in January 2017, and promised that the merged firm would create 3000 new jobs in the US.[128] How the firms would create new jobs despite cost synergies, however, was not clear.[129] The CEO of Dow also took part in a business leaders' meeting with Trump a several weeks later, as part of an initiative to keep manufacturing jobs in the US. And in December 2016, DuPont's CEO confidently stated that he did not think that the US would block the Dow-DuPont merger.[130] Whether political and lobby power override the regulatory process in the US remains to be seen. Ethics experts, in the meantime however, have called out this private lobbying of those directly at the top as extremely problematic.[131]

Conclusion

The recent agribusiness megamergers are significant events that warrant close evaluation. It is important to understand and consider the forces driving these

[121] The Economist 2016.
[122] Drutman 2015.
[123] Open Secrets 2013.
[124] Union of Concerned Scientists 2013.
[125] Pesticides Action Network Europe 2016.
[126] Friends of the Earth 2017.
[127] Eller 2017.
[128] Sink and Parker 2017.
[129] Philpott 2017.
[130] Fortune Editors 2016.
[131] Boak 2017.

mergers as well as to evaluate their likely impacts. As this paper has shown, the current wave of mergers is the product of both firm-level technology-driven incentives as well as broader economic and financial conditions. These forces are in some ways similar to past waves of mergers in the sector, especially with respect to integrated technology innovations from which firms seek the benefits of economies of scale and scope. But at the same time, intellectual property protections appear to be less significant than they were in the past in spurring consolidation. More recently, financial investor pressure has become a significant driving factor pushing for greater consolidation in the sector, especially as financialization in recent decades has prioritized shareholder value over other social goals.

If they are allowed to proceed, the proposed mergers are likely to have profound effects on the agricultural input sector. Past episodes of consolidation have already led to concerns about the effects on competition and innovation, fair pricing, farmer autonomy, the environment, and the distribution of political power. The current mergers only reinforce these concerns. Regulators, however, are only mandated to narrowly examine the economic impact of corporate mergers on competition, innovation and prices, and even then, only within specific measures of these effects, focused on the HHI and CR4, that miss important ways in which concentration occurs. Moreover, the implications for farmer autonomy, the environment, and lobby power are not explicitly considered within the regulators' mandates. The effect of this regulatory weakness is the prioritization of questionable high-tech farming practices and the returns of financial investors over other social and environmental goals for the agricultural sector.

Civil society and farming groups are seeking to stop these mergers, and have submitted open letters to the US Attorney General and the European Competition authorities to voice their concerns about these mergers.[132] The effects are significant for each individual merger deal, and collectively the impact is likely to be even more pronounced. At the time of writing, news reports noted that both the Dow-Dupont and ChemChina-Syngenta mergers were on the verge of being approved by the European Union, while the Bayer-Monsanto merger is still under review.[133] The US is continuing its analysis of the mergers, while Canada and South Africa have given the ChemChina-Syngenta merger the green light. It is likely that the decisions on all three mergers in most jurisdictions will be forthcoming in the coming months. But it is not at all clear that the regulatory authorities are taking the wider concerns noted in this paper into account.

References

[132] See, for example: http://webiva-downton.s3.amazonaws.com/877/bf/d/9781/2.13_Sign_on_letter_regarding_agricultural_mergers_final.pdf

[133] Toplensky 2017.

Altieri, M.A., 1999. "The Ecological Role of Biodiversity in Agroecosystems. *Agriculture, Ecosystems & Environment*, *74*(1): 19-31.

American Antitrust Institute, Food & Water Watch, and National Farmers Union. 2016. *Letter to U.S. Department of Justice Re: The Proposed Dow-DuPont Merger*. May 31. Online at: https://www.google.ca/search?q=food+and+water+watch+antitrust+institute&ie=utf-8&oe=utf-8&gws_rd=cr&ei=JIybWL2bPI7ljwSeg6eYAw

Azar, José, Martin Schmalz, and Isabel Tecu. 2016. *Anti-Competitive Effects of Common Ownership.* Ross School of Business Paper No. 1235. Online at: https://papers.ssrn.com/sol3/papers2.cfm?abstract_id=2427345

Bartz, Diane and Greg Roumeliotis. 2016. "Bayer's Monsanto Acquisition to Face Politically Charged Scrutiny." *Reuters*. September 15. Online at: http://www.reuters.com/article/us-monsanto-m-a-bayer-antitrust-idUSKCN11K2LG

Bayer. 2016. *Bayer and Monsanto Create a Global Leader in Agriculture*. September 14. Online at: https://www.bayer.ca/en/media/press-releases/newsdetail/?dt=TVRJPQ==&st=1

Benbrook, Charles M. 2016. "Trends in Glyphosate Herbicide Use in the United States and Globally." *Environmental Sciences Europe* 28(3): 15 pages. doi:10.1186/s12302-016-0070-0.

Boak, Josh. 2017. "Trump's CEO Meetings Raise Ethics Questions." *Associated Press*. January 14. Online at: http://bigstory.ap.org/article/7d256125f53643fbb20e4be2bc993a2b/trumps-ceo-meetings-raise-ethics-questions

Bronson, Kelly, and Irena Knezevic. 2016. "Big Data in Food and Agriculture." *Big Data & Society* January-June: 5 pages. doi:10.1177/2053951716648174.

Brown, Mark J.F., Lynn V. Dicks, Robert J. Paxton, Katherine C.R. Baldock, Andrew B. Barron, Marie-Pierre Chauzat, Breno M. Freitas, et al. 2016. "A Horizon Scan of Future Threats and Opportunities for Pollinators and Pollination." *PeerJ 4*(August): 20 pages. doi:10.7717/peerj.2249.

Bryant, Henry, Aleksandre Maisashvili, Joe Outlaw, and James Richardson. 2016. *Effects of Proposed Mergers and Acquisitions Among Biotechnology Firms on Seed Prices*. Agricultural and Food Policy Center, and Texas A&M University. Online at: https://www.afpc.tamu.edu/pubs/0/675/WP_16-2.pdf

Burwood-Taylor, Louisa. 2016. "Why Bayer Invested in 5 Agtech Funds and Big Data is So Exciting", *Agfunder News*. November 1. Online at: https://agfundernews.com/why-bayer-invested-in-5-agtech-funds.html

Canada Competition Bureau. 2011. *Merger Enforcement Guidelines*. Online at: http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/03420.html#wb-tphp

Canadian Biotechnology Action Network (CBAN). 2015a. *Do We Need GM Crops to Feed the World?* Online at: https://gmoinquiry.ca/wp-content/uploads/2015/12/do-we-need-gm-feed-world-report-E-web.pdf

Canadian Biotechnology Action Network (CBAN). 2015b. *Are GM Crops Better for the Environment?* Online at: https://gmoinquiry.ca/wp-content/uploads/2015/05/Are-GM-crops-better-for-the-environment_-E-web.pdf

Chazan, Guy, and Lindsay Whipp. 2016. "Farmers Sound Alarm over Mega Deals." *Financial Times*. September 6.

Chazan, Guy. 2016a. "Bayer Targets One-Stop Shop with Monsanto." *Financial Times*. September 14.

Chazan, Guy. 2016b. "Scepticism Swirls around Bayer's Megadeal." *Financial Times*. September 15.

Clapp, Jennifer, Chelsie Hunt, and Carly Hayes. 2016. "Bigger Isn't Always Better: What the Proposed Agribusiness Mega Mergers Could Mean for Canada." *Food Secure Canada*. Online at: https://foodsecurecanada.org/resources-news/news-media/big-6-agribusiness-mega-mergers-canada

Clapp, Jennifer. 2014. "Financialization, Distance and Global Food Politics." *The Journal of Peasant Studies* 41(5): 797–814. doi:10.1080/03066150.2013.875536.

Crooks, Ed. 2015. "Dow and DuPont Aim to Pre-Empt Activists with Megadeal." *Financial Times*. December 9.

Crow, David, and Barney Jopson. 2016. "M&A Deals Worth $370bn Torpedoed by Obama Administration." *Financial Times*. April 7.

Dow and DuPont. 2015. *DuPont and Dow to Combine in Merger of Equals*. Investor Presentation. December 11. Online at: http://www.dowdupontunlockingvalue.com/wp-content/uploads/2015/12/Investor-Presentation.pdf

Drutman, Lee. 2015. "How Corporate Lobbyists Conquered American Democracy." *The Atlantic*. April 20. Online at: https://www.theatlantic.com/business/archive/2015/04/how-corporate-lobbyists-conquered-american-democracy/390822/

Eller, Donelle. 2017. "Trump Adviser Rastetter wants Mega-Mergers, like DuPont Dow, Blocked." *The Des Moines Register*. January 5. Online at: http://www.desmoinesregister.com/story/money/agriculture/2017/01/05/trump-adviser-rastetter-wants-mega-mergers-like-dupont-dow-blocked/96209976/

Epstein, Gerald (ed.). 2005. *Financialization and the World Economy*. Cheltenham: Edward Elgar.

ETC Group. 2013. *Gene Giants Seek "Philanthrogopoly"*, Communiqué Issue #110. Online at: http://www.etcgroup.org/sites/www.etcgroup.org/files/ETCCommCharityCartel_March2013_final.pdf

ETC Group. 2015a. *The Dominant Narrative*. Online at: http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etcgroup_agmergers_17nov2015.pptx__0.pdf

ETC Group. 2015b. *Breaking Bad: Big Ag Mega-Mergers in Play: Dow + DuPont in the Pocket? Next: Demonsanto?* Communiqué #115. Online at: http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc_breakbad_23dec15.pdf

ETC Group. 2016. *Merge-Santo: New Threat to Food Sovereignty*. Briefing Note. March 23. Online at: http://www.etcgroup.org/content/merge-santo-new-threat-food-sovereignty

European Union (EU). 2004. *Guidelines on the Assessment of Horizontal Mergers under the Council Regulation on the Control of Concentrations between Undertakings*. Online at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52004XC0205(02)&from=EN

Fernandez-Cornejo, Jorge, and Richard E. Just. 2007. "Researchability of Modern Agricultural Input Markets and Growing Concentration." *American Journal of Agricultural Economics* 89(5): 1269–1275. doi:10.1111/j.1467-8276.2007.01095.x.

Fernandez-Cornejo, Jorge. 2004. *The Seed Industry in U.S. Agriculture: An Exploration of Data and Information on Crop Seed Markets, Regulation, Industry Structure, and Research and Development.* Washington, D.C.: USDA. Online at: http://ageconsearch.umn.edu/handle/33671

Ferreira, Miguel, Massimo Massa, and Pedro Matos. 2009. "Shareholders at the Gate? Cross-Country Evidence on the Role of Institutional Investors in Mergers and Acquisitions." *Review of Financial Studies* 23(2): 601–644.

Foley, Jonathan A., Navin Ramankutty, Kate A. Brauman, Emily S. Cassidy, James S. Gerber, Matt Johnston, Nathaniel D. Mueller, et al. 2011. "Solutions for a Cultivated Planet." *Nature* 478(7369): 337–342. doi:10.1038/nature10452.

Fontanella-Khan, James, and Arash Massoudi. 2015. "Maths, Not History, Drives Mergers and Acquisitions." *Financial Times*. June 29.

Fortune Editors. 2016. "Donald Trump Won't Block Dow-Dupont Mega Merger." *Reuters*. December 8. Online at: http://fortune.com/2016/12/08/donald-trump-dupont-dow/

Fraley, Robert. 2016. "Prepared Testimony of Dr. Robert T. Fraley, Executive Vice President and Chief Technology Officer, Monsanto", Senate Committee on the Judiciary Hearing on Consolidation and Competition in the U.S. Seed and Agrochemical Industry. September 20. Online at:

https://www.judiciary.senate.gov/imo/media/doc/09-20-16%20Fraley%20Testimony.pdf

Friends of the Earth. 2017. Sign-on Letter on Agrochemical and Seed Industry Mergers. On file with author.

Froud, Julie, Colin Haslam, Sukhdev Johal, and Karel Williams. 2000. "Shareholder Value and Financialization: Consultancy Promises, Management Moves." *Economy and Society* 29(1): 80–110. doi:10.1080/030851400360578.

Fuglie, Keith, Paul Heisey, John King, Carl Pray, Kelly Day-Rubenstein, David Schimmelpfennig, Sun Ling Wang, and Rupa Karmarkar-Deshmukh. 2011. *Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide.* USDA Economic Research Service. Online at: https://www.ers.usda.gov/webdocs/publications/err130/11777_err130_1_.pdf

Fuglie, Keith, Paul Heisey, John King, and David Schimmelpfennig. 2012. "Rising Concentration in Agricultural Input Industries Influences New Farm Technologies." *Amber Waves*. December 3. Online at: https://www.ers.usda.gov/amber-waves/2012/december/rising-concentration-in-agricultural-input-industries-influences-new-technologies/

Fulton, Murray, and Konstantinos Giannakas. 2001. "Agricultural Biotechnology and Industry Structure." *AgBioForum* 4(2): 137–151.

Gandel, Stephen. 2016. "DuPont's Former CEO Just Took a Major Swipe at Dow Chemical Deal." *Fortune*. October 18. Online at: http://fortune.com/2016/10/18/ellen-kullman-dupont-dow-deal/

George, Bill, and Jay W. Lorsch. 2014. "How to Outsmart Activist Investors." *Harvard Business Review* 92(5): 88–95.

Ghosh, Jayati. 2010. "The Unnatural Coupling: Food and Global Finance." *Journal of Agrarian Change* 10(1): 72–86.

Hayenga, Marvin. 1998. "Structural Change in the Biotech Seed and Chemical Industrial Complex." *AgBioForum* 1(2): 43–55.

Hayley, Andrea. 2016. "New Technology Spurs Consolidation in Seed Industry." Epoch Times. September 27. Online at: http://www.theepochtimes.com/n3/2162211-why-crispr-is-key-to-massive-agribusiness-consolidations/

Howard, Philip H. 2009. "Visualizing Consolidation in the Global Seed Industry: 1996–2008." *Sustainability* 1(4): 1266–1287. doi:10.3390/su1041266.

Howard, Philip H. 2015. "Intellectual Property and Consolidation in the Seed Industry." *Crop Science* 55(6): 2489–2495. doi:10.2135/cropsci2014.09.0669.

Isakson, S. Ryan. 2014. "Food and Finance: The Financial Transformation of Agro-Food Supply Chains." *The Journal of Peasant Studies* 41(5): 749–775. doi:10.1080/03066150.2013.874340.

Kelland, Kate. 2016. “U.N. Experts Find Weed Killer Glyphosate Unlikely to Cause Cancer.” *Reuters*. May 16. Online at: http://www.reuters.com/article/us-health-who-glyphosate-idUSKCN0Y71HR

King, John L. 2001. *Concentration and Technology in Agricultural Input Industries*. USDA Economic Research Service, Agriculture Information Bulletin Number 763. March. Online at: https://www.researchgate.net/profile/John_King15/publication/23516824_Concentration_and_Technology_in_Agricultural_Input_Industries/links/0c96051ddba4f06fa4000000.pdf

Kloppenberg, Jack, and Martin Kenney. 1984. “Biotechnology, Seeds and the Restructuring of Agriculture.” *Critical Sociology* 12(3): 3–17.

Kynge, James, Tom Mitchell, and Arash Massoudi. 2016. “M&A: China’s World of Debt.” *Financial Times*. February 11.

Lesser, William. 1998. “Intellectual Property Rights and Concentration in Agricultural Biotechnology.” *AgBioForum* 1(2): 56–61.

Lianos, Ioannis, Dmitry Katalevsky, and Alexey Ivanov. 2016. *The Global Seed Market, Competition Law and Intellectual Property Rights: Untying the Gordian Knot*. Centre for Law, Economics and Society, UCL. Online at: https://www.ucl.ac.uk/cles/research-paper-series/research-papers/cles-2-2016

Lipin, Steven, Anita Raghavan, and Stephen D. Moore. 1999. “AstraZeneca, Novartis Confirm Plans to Merge, Spin Off Agrochemical Units.” *Wall Street Journal.* December 2. Online at: https://www.wsj.com/articles/SB944092897505924463

Maisashvili, Aleksandre, Henry Bryant, J. Marc Raulston, George Knapek, Joe Outlaw, and James Richardson. 2016. "Seed Prices, Proposed Mergers and Acquisitions Among Biotech Firms." *Choices* 31(4): 11 pages. Online at: http://www.choicesmagazine.org/choices-magazine/submitted-articles/seed-prices-proposed-mergers-and-acquisitions-among-biotech-firms

Massoudi, Arash, and James Fontanella-Khan. 2015. “Monsanto Gives Up on $46bn Syngenta Deal.” *Financial Times*. August 26.

Massoudi, Arash, Don Weinland, Ralph Atkins, Shawn Donnan, and Barney Jopson. 2016. “ChemChina Plays Down Alarm over $44bn Syngenta Bid.” *Financial Times.* February 3.

Massoudi, Arash, James Fontanella-Khan, and Don Weinland. 2016. “Final Quarter of Blockbuster Deals Boosts M&A Activity.” *Financial Times*. December 29.

Massoudi, Arash, James Fontanella-Khan, and Guy Chazan. 2016. “Bayer Braced for Tough Scrutiny over $66bn Monsanto Deal.” *Financial Times*. September 14.

Massoudi, Arash. 2016. “Watchdogs Weigh Up Pros and Cons of Seed Mergers.” *Financial Times*. November 30.

Mitchell, Tom, Christian Shepherd, and Ralph Atkins. 2016. “Syngenta Offers ChemChina Seeds of GM Growth.” *Financial Times*. February 3.

Monsanto. 2016. *Monsanto Company*. United States Securities and Exchange Commission (SEC) Filing. Online at: https://www.sec.gov/Archives/edgar/data/1110783/000119312516711104/d250543ddefa14a.htm

Mordock, Jeff. 2016. "A Wildly Different DuPont a Year After Peltz Defeat." *The News Journal*, Delaware Online. April 29. Online at: http://www.delawareonline.com/story/money/2016/04/29/duponts-wild-ride/83650956/

Moretti, Irene Musselli, and Olivier Matringe. 2006. *Tracking the Trend Towards Market Concentration: The Case of the Agricultural Input Industry*. Geneva: UNCTAD. Online at: http://www.ecolomics-international.org/iprsa_unctad_2006_gm_ag_incr_concentration_olivier_matringe_irene_musselli_moretti.pdf

Myers, John Peterson, Michael N. Antoniou, Bruce Blumberg, Lynn Carroll, Theo Colborn, Lorne G. Everett, Michael Hansen, et al. 2016. "Concerns over Use of Glyphosate-Based Herbicides and Risks Associated with Exposures: A Consensus Statement." *Environmental Health* 15(19): 13 pages. doi:10.1186/s12940-016-0117-0.

Naldi, Maurizio, and Marta Flamini. 2014. *The CR4 Index and the Interval Estimation of the Herfindahl-Hirschman Index: An Empirical Comparison.* Online at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2448656

Noel, Andrew Marc. 2016. "Syngenta Says U.S. Talks over ChemChina Bid 'Constructive'." *Bloomberg*. July 22. Online at: http://www.bloomberg.com/news/articles/2016-07-22/syngenta-says-regulatory-talks-over-chemchina-bid-constructive

Oehmke, James, and Christopher Wolf. 2003. "Measuring Concentration in the Biotechnology R&D Industry: Adjusting for Interfirm Transfer of Genetic Materials." *AgBioForum* 6(3): 134–140.

Open Secrets. 2013. *Agricultural Services/Products: Summary*. Online at: http://www.opensecrets.org/lobby/indusclient.php?id=A07&year=2013

Organisation for Economic Cooperation and Development (OECD). 2007. Competition and Barriers to Entry. *OECD Observer Policy Brief*. January. Online at: http://www.oecd.org/competition/mergers/37921908.pdf

Pesticide Action Network Europe. 2016. *Another Inconvenient Truth: Pesticides Companies Flood EU Institutions Paying Millions of Euros in Lobbying*. Online at: http://www.pan-europe.info/press-releases/2016/11/another-inconvenient-truth-pesticides-companies-flood-eu-institutions-paying

Philpott, Tom. 2017. "Trump is Ready to Bless Monsanto and Bayer's Massive Merger." *Mother Jones*. January 19. Online at: http://www.motherjones.com/environment/2017/01/monsanto-bayer-trump-antitrust

Pray, Carl, James Oehmke, and Anwar Naseem. 2005. "Innovation and Dynamic Efficiency in Plant Biotechnoogy: An Introduction to the Researchable Issues." *AgBioForum* 8 (2&3): 52-63.

Schimmelpfennig, David. 2004. "Agricultural Patents: Are they Developing Bad Habits?" *Choices*. 1st Quarter. Online at: http://www.farmdoc.illinois.edu/policy/choices/20041/2004-1-04.pdf

Shapiro, Carl. 2002. "Competition Policy and Innovation." *OECD Science, Technology and Industry Working Papers*, 2002/11, OECD Publishing, Paris. Online at: http://dx.doi.org/10.1787/037574528284

Sink, Justin, and Mario Parker. 2017. "Bayer-Monsanto Pledge Investment, Jobs After Trump Meeting." *Bloomberg Politics*. January 17. Online at: https://www.bloomberg.com/politics/articles/2017-01-17/bayer-to-invest-8-billion-and-add-3-000-jobs-trump-aide-says

Spross, Jeff. 2015. "Why the Great Merger Frenzy of 2015 Signals Another Recession." *The New York Times*. December 10.

Stiegert, Kyle W., Guanming Shi, and Jean Paul Chavas. 2010. "Innovation, Integration, and the Biotechnology Revolution in U.S. Seed Markets." *Choices* 25(2): 7 pages.

Stevenson, Alexandra, Chad Bray and Amie Tsang. 2016. "ChemChina Deal Reflects Drive to Meet Food Needs." *The New York Times*. February 3.

Stockhammer, Engelbert. 2010. *Financialization and the Global Economy*. Political Economy Research Institute Working Paper 240. Online at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.434.2586&rep=rep1&type=pdf

Terazono, Emiko, Arash Massoudi, and James Fontanella-Khan. 2015. "Monsanto Targets Tax Inversion Strategy with Syngenta Offer." *Financial Times*. June 8.

Terazono, Emiko. 2015a. "Monsanto Keeps up the Pressure on Syngenta." *Financial Times*. July 23.

Terazono, Emiko. 2015b. "Syngenta Plans $2bn Share Buyback." *Financial Times*. September 3.

Terazono, Emiko. 2016. "Monsanto Operating Chief Sees a Crop of Seed and Chemical Deals." *Financial Times*. March 15.

The Economist. 2016. "Too Much of a Good Thing." *The Economist Magazine*. March 26.

Toplensky, Rochelle. 2017. "ChemChina Takeover of Syngenta Nears EU Approval." *Financial Times*. March 3.

Turner, Matt. 2016. "We Just Got a Rare Insight into How Wall Street Dealmakers Make Their Money." *Business Insider*. September 12. Online at:

http://www.businessinsider.com/mergers-acquisitions-advice-on-wall-street-2016-9

Union of Concerned Scientists. 2013. *Lobbying and Advertising: 8 Ways Monsanto Fails at Sustainable Agriculture: #6*. Online at: http://www.ucsusa.org/food_and_agriculture/our-failing-food-system/genetic-engineering/lobbying-and-advertising.html#.WJSmnFerf5o)

U.S. Department of Justice. 2010. *Horizontal Merger Guidelines*. Online at: https://www.justice.gov/atr/horizontal-merger-guidelines-08192010

Werner Baumann and Hugh Grant interview with CNBC. 2016. September 14. Online at: http://www.cnbc.com/2016/09/14/first-on-cnbc-cnbc-transcript-bayer-ceo-werner-baumann-and-monsanto-ceo-hugh-grant-speak-with-cnbcs-david-faber-on-squawk-on-the-street-today.html

World Health Organization (WHO). 2015. *IARC Monographs Volume 112: Evaluation of Five Organophosphate Insecticides and Herbicides*. International Agency for Research on Cancer. Online at: http://www.iarc.fr/en/media-centre/iarcnews/pdf/MonographVolume112.pdf

Zwan, Natascha van der. 2014. "Making Sense of Financialization." *Socio-Economic Review* 12(1): 99–129. doi:10.1093/ser/mwt020.

Nazioarteko Hizketaldia

ELIKADURAREN ETORKIZUNA ETA NEKAZARITZAREN ERRONKAK XXI. MENDERAKO:

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