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CLES Research Paper Series
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February 2016

Centre for Law, Economics and Society (CLES)
Faculty of Laws, UCL
London, WC1H 0EG
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Pre-published version of Ioannis Lianos, Dmitry Katalevsky and Alexey Ivanov, The Global Seed Market, Competition Law and Intellectual Property Rights: Untying the Gordian Knot, Concurrences II-2016.

ISBN *978-1-910801-09-3*

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Abstract

The paper explores the competition dynamics of the global seed market. It documents the growth strategies of the major seed companies, in particular their M&A activity and their reliance on complex intellectual property strategies in order to offer a one stop shop solution to farmers. Recent merger activity in this sector (the Monsanto bid to buy Syngenta, the DuPont and Dow merger deal, ChemChina's bid to buy Syngenta) illustrates its rapid transformation from an already concentrated industry to a tight oligopoly on a global scale. The increasing global consolidation of this industry raises new challenges for competition law enforcement authorities dealing with the emergence of new powerful actors at the factor of production (input) level, in view of the broader concerns animating public policy in the food sector and the existence of a nexus of international commitments for biodiversity, sustainability, the right to food etc. By exploring this under-studied but fascinating area of competition law enforcement we open the debate over the inclusion of broader public interest concerns in competition policy and the consideration of its distributive impact from a global perspective.

Keywords: antitrust, competition law, global food value chain, agricultural markets, mergers and acquisitions, seeds, contract agriculture, cross-licensing agreements, factors of agricultural production, biodiversity, sustainability, global commons, IP rights, plant variety protection rights, biotechnology patents, access to germplasm, generic trait

JEL Classification: G34, K10, K21, L4, L40, Q10, Q13, Q18

The Global Seed Market, Competition Law and Intellectual Property Rights: Untying the Gordian Knot

Ioannis Lianos, Dmitry Katalevsky and Alexey Ivanov[1]

I. Introduction

The food supply chain is generally depicted as composed by three main levels: agricultural production, industrial processing and wholesale or retail distribution. At a closer look, however, the food supply chain becomes more complex, involving a number of other stages and links that add value to the chain either in the form of goods or services inputs. The food industry is heavily dependent on scarce resources like arable land, water and genetic resources (a limited biodiversity). At each level of the supply chain, firms as well as other organizational forms perform specific activities supplying goods or services. Moreover, at the same level there may be one or more firms performing the same or complementary activities, adding specific value at their stage of activity. The food supply chain, as a whole, originates before the agricultural sector, with the factor market (for example the seed provider) and ends with the final consumer.

The power relations in the global food value chain are characterized by international actors and local producers operating within the geographic area determined by the logistics of the product. Issues of distribution of the total surplus value of the global food chain are thus paramount and should inevitably influence competition law enforcement.

This paper will focus on the upper segment of the market — that of the factors of production and in particular seed players, and their relations with the other segments of the value chain, i.e. farmers. Global seed producers (Monsanto, Syngenta,

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DuPont, Pioneer, BASF, etc.) continue to increase their global presence in the "seed chain" and have recently acquired critical market influence in key food exporting regions[2]. Combined with the natural complexity of global food production-supply chains, any disruption in seeds supply may cause a systemic food shock of a global magnitude. There have also been some significant changes at the upstream level of the food value supply chain which reinforce the power these global seed players exercise over a significant part of the global food value chain.

First, these players develop intellectual property rights (IPRs) strategies, providing them a reward for the significant value they add to the chain through R&D, but also in order to reinforce their dominance towards farmers, capturing the significant part of the value added along the whole food pipeline. Agriculture has become increasingly technology driven (biotech, crop protection, microbial solutions, big data and analytics software). In the current value chain context, to remain competitive and to stay in business, farmers have to adapt the latest technologies from the global factors providers, who use intellectual property protection or Big Data as a bargaining tool in their relations with farmers. This makes farmers critically dependent on global agriculture technology providers and may lead to the development of bottlenecks. Farmers' labor is increasingly commoditized causing social tensions, in particular in emergent economies and the developing world. Competition law is seen in some quarters as a possible response to this increasing power of global seed platforms.

Second, the development of new technologies has led to the emergence of a diverse group of players: crop protection and seed companies, equipment companies, fertilizer companies, retail distributors, and pure-play digital start-ups. These seek to develop an "integrated offering of equipment and services for farmers," enabling them to "gradually build a compelling one-stop solution that will

[2] The "seed chain" consists of three basic components: "research and plant breeding; seed multiplication; and marketing and distribution": Niels P. Louwaars et al., Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries, (World Bank Report, February 2005), available at http://www.iprsonline.org/resources/docs/LouwaarsCGN_Plants_05.pdf, pp. 28-29 (noting the differences between developed and developing countries in the way the different components of the industry are structured. Seed multiplication, marketing, and distribution are essentially considered a commercial operation in developed countries, with research and plant breeding essentially carried out by commercial enterprises, in particular for high value seed crops, like maize, cotton, soybean, vegetables. In developing countries research and plant breeding is essentially carried out by the broader public or "parastatal" sector, or farmers' themselves (farmers' seed systems), while the other operations are considered more as vehicles for technology transfer rather than a commercial operation).

allow them to compete for the lion's share of the market"[3]. Consequently, these companies develop strategies in order to develop new capabilities and exploit different sources of revenue by "applying new technology or by expanding across the value chain or geographically"[4]. This is achieved by significant merger and acquisition (M&A) activity, leading to higher levels of concentration on several markets. Market players therefore have made the choice of positioning themselves as fully integrated providers, or the orchestrators of a network, or partners of an established network[5], which may lead to the development of bottlenecks in the food supply chain affecting consumers and other market actors, such as farmers.

The competition authorities in the U.S. and Europe were, so far, mostly supportive to this trend of economic concentration, which took different forms, such as corporate mergers, joint research enterprises and patent pools created by the leading global seed companies. This policy approach is primarily based on the theory that such concentration will increase innovation (probably espousing the Schumpeterian argument about innovation in this sector[6]), while not much attention is paid to the consequences such concentration may entail for the operation of the global food value chain as a whole, the power relations between the seed companies and other economic actors down the chain, as well as the incentive and ability of these other economic actors to innovate. The global value chain approach helps us understand the competitive interactions in the area from a different angle[7].

We will first explore these dynamics, by examining the role of IP rights in the development of the industry and the way the significant M&A activity played out in the structure of the industry. We will then delve into the competitive strategy of seed platforms and the likely development of the industry in the near future. Finally, we will examine how this new configuration may be of relevance to competition law

[3] Boston Consulting Group, Crop Farming 2030 – The Reinvention of the Sector (April 2015), available at https://www.bcgperspectives.com/content/articles/process-industries-innovation-crop-farming-2030-reinvention-sector/, p. 10.
[4] Ibid., p. 12.
[5] Ibid., p. 15.
[6] For the classic question of the appropriate market structure for innovation, see Philippe Aghion et al., Competition and Innovation: An Inverted U Relationship, (2005) 120(2) The Quarterly Journal of Economics 701-728.
[7] On the Global Value Chain approach, see, inter alia, Gary Gereffi, John Humphrey and Timothy Sturgeon, The Governance of Global Value Chains, (2005) 12 Review of International Political Economy 78; Kevin Sobel-Read, Global Value Chains: A Framework for Analysis, (2014) 5 Transnational Legal Theory 364-373.

enforcement and more generally the response of competition authorities, which has been quite timid so far in this economic sector.

II. The expansion of intellectual property rights in the food value chain

Historically, plant and seed material were regarded as communal resources to be freely shared. Farmers were incentivized to save, replant, and resell seeds to other farmers, the dominant paradigm for trait development being farmer sharing[8]. Starting with the mechanization and the use of tractors in the late 19th century and most recently with the granting of the first plant biotechnology patent in 1992, IP rights have long been used in the agricultural sector in order to stimulate research, development, and innovation. They also formed the basis for the emergence of a private seed industry following the Green revolution of the 1960s-1970s. Initially funded by the public sector, the Green revolution led to an important increase of productivity at a higher cost for the independence of farmers that have until then ensured the effort of innovation in the sector by developing crop diversity (a decentralised and highly fragmented innovation environment)[9]. Farmers became dependent on external seeds, which led to the emergence of a private seed market. The new varieties introduced by the Green revolution required also sharp increases in the use of fertilizers and pesticides, which added to the dependence of farmers on the private market and increased the need for credit. The development of biotech and genetic engineering in the 1990s had also profound implications for the development of the industry and the process of its privatization[10]. Hybrid crops provide high yields but also lose this advantage the following generation, thus leading farmers to buy new seeds regularly.

[8] Margaret Llewelyn, The Legal Protection of Biotechnological Inventions: An Alternative Approach, (1997) 19 European Intellectual Property Review 115, 117. The UN Convention on Biological Diversity, which entered into force on 29 December 1993, is still recognizing the importance of communal "knowledge, innovations and practices," and encourages its signatories to "promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices," and further encourages the "equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices" (Article 8(j)).

[9] See, Stephen .D. Biggs & Edward J. Clay, Sources of innovations in agricultural technology, (1981) 9 World Development 321-336 (distinguishing between formal and informal agricultural research and development, farmers having played and still playing a significant role in informal R&D).

[10] Daryl Lim, Living with Monsanto, (2015) Michigan State Law Review 559, 566-567.

Genetically modified (GM) (and shortly genetically edited following the development of the CRISPR/Cas technology) seeds are at the centre of the innovative effort in modern agriculture, the plant science industry being one of the world's most R&D intensive industries, with no more than 10 big corporations controlling almost 50% of all seeds planted on earth right now (some estimates putting this figure to 73%, in 2010 up from 37% in 1995)[11]. The plant biotechnology R&D industry now consists of six large firms, a varying number of smaller firms, and public-sector research organizations. The degree of consolidation of this industry is remarkable if one takes into account that in the early 1980s there were more than two hundred different seed companies and that many agricultural chemical companies had both seeds and agricultural chemicals[12].

A lot of these companies control IPRs. In the seed business, IPRs consist of patents, plant variety rights, trademarks, trade secrets, and geographical indications[13]. These IP rights enable seed companies to prevent farmers from saving seeds of the protected variety, sharing it with their neighbours or selling it informally ("brown bagging"), but also to prevent competing plant breeders from using a protected variety in the development of a new variety (cumulative innovation), and to prevent competing seed producers from multiplying and marketing the protected variety without a license or using a protected product name and logos[14]. Seed laws requiring compulsory seed certification with the aim to police seed quality also provide some form of protection to breeders, in the absence of IPRs.

Until recently, patents on living organisms were not recognized. In *Diamond vs Chakrabarty*, the US Supreme Court extended patent claims to life sciences, this leading to the emergence of the biotechnology industry[15]. In 1985, the USPTO expanded patent protection to genetically modified traits in *Ex Parte Hibberd*[16]. In 2001, the US Supreme Court held for the first time in in *J. E. M. Ag Supply, Inc. v.*

[11] See ETC Group, Who will control the Green Economy? (November 2011), available at http://www.etcgroup.org/sites/www.etcgroup.org/files/publication/pdf_file/ETC_wwctge_4web_Dec2011.pdf.
[12] See, our analysis Section 3.
[13] For a description, see UNIDROIT, Intellectual Property Rights and Contract Farming, Study 80-A – Doc. 1 Add. 18 (August 2014), available at http://www.unidroit.org/english/documents/2014/study80a/wg04/s-80a-01-add18-e.pdf
[14] Niels P. Louwaars et al., Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries, (World Bank Report, February 2005), available at http://www.iprsonline.org/resources/docs/LouwaarsCGN_Plants_05.pdf, p. 27.
[15] Diamond v. Chakrabarty, 447 U.S. 303 (1980).
[16] 227 U.S.P.Q. 443 (Board of Patent Applications and Interferences, 1985).

Pioneer that utility patents may be issued for crops and other flowering (sexually reproducing) plants and can be combined with plant variety rights protection[17]. With a utility patent, patent-holders can sue farmers and rivals for patent infringement and pursue litigation to enforce licensing agreements. Utility patents are routinely used for genetically modified traits, traditional germplasm and biotechnology research tools. The germplasm consists in the living tissue from which new plants can be grown and contains information on the species' genetic make-up (the hereditary material in a plant coded in its DNA). The traits are engineered by insertion of foreign genes into the plants. These genes may be single or stacked and usually confer a desirable attribute to the seed, for instance herbicide or insect resistance. The emergence of IP protection, with an extensive reliance on utility patents, led to a shift of the paradigm from public sector innovation to private sector innovation, particularly in plant technologies and molecular level agricultural biotechnology[18].

The scope of patentability is more narrowly delineated in Europe, where plant varieties and essential biological processes are excluded from patent protection[19], also in view of the need to avoid a double protection under patent law and the *sui generis* plant variety protection resulting from the UPOV (Union for the Protection of New Varieties of Plants) Convention[20].

However, the European Directive 98/44/EC on the legal protection of biotechnological inventions led to the possibility of patenting when the technical feasibility of the invention is not confined to a specific plant variety[21]. In 1999, the Enlarged Board of Appeal of the European Patent Office stated that "(a) patent

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[17] J. E. M. Ag Supply, Inc. v. Pioneer Hi-Bred International, Inc., 534 U.S. 124 (2001). This overlapping protection was significant as U.S. Plant variety protection legislation [7 U.S.C. §§ 2543-2544] conferred "less robust protection than utility patents" as it allows farmers to save seeds for replanting and provides for a research exception for private, non-commercial uses of protected seed. See, Daryl Lim, Living with Monsanto, (2015) Michigan State Law Review 559, 567.

[18] Paul W. Heisey, John L. King and Kelly Day Rubenstein, Patterns of Public-Sector and Private-Sector Patenting in Agricultural Biotechnology, (2005) 8 AGBIOFORUM 73.

[19] Article 53(b) of the European Patent Convention (EPC). According to this provision,

> "European patents shall not be granted in respect of: […] (b) plant or animal varieties or essentially biological processes for the production of plants or animals; this provision shall not apply to microbiological processes or the products thereof".

See also, Article 4(1) of Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, OJ 1998 L 213/13, which stipulates that "essentially biological processes for the production of plants or animals" "shall not be patentable".

[20] International Convention of the Protection of New Varieties of Plants, Ger.-Neth.-U.K., Dec. 2, 1961, 815 U.N.T.S. 89 (revised Nov. 10, 1972, Oct. 23, 1978 and Mar. 19, 1991).

[21] Article 4(2) of Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, OJ 1998 L 213/13. According to Article 2 of Directive 98/44/EC, "(a) process for the production of plants or animals is essentially biological if it consists entirely of natural phenomena such as crossing or selection".

cannot be granted for a single plant variety but can be granted if varieties may fall within the scope of its claims"[22]. Indeed, according to Recital 31 of the Biotechnology Directive, "a plant grouping which is characterised by a particular gene (and not its whole genome) is not covered by the protection of new varieties and is therefore not excluded from patentability even if it comprises new varieties of plants". Plant varieties may also fall within the scope of patent claims when they are the direct product of a patented non-biological technical process.

The most recent jurisprudence of the Enlarged Board of Appeal (EBA) of the EPO has reduced even further the patentability exception enshrined in Article 53(b) EPC, even for a patent claim for a product that is directly obtained and/or defined by an "essentially biological process". The EBA held that "the fact that the only method available at the filing date for generating the claimed subject-matter is an essentially biological process for the production of plants disclosed in the patent application does not render a patent claim directed to plants or plant material other than a plant variety unallowable".[23] In essence, the EBA found that the patentability exception in Article 53(b) EPC for "essentially biological processes for the production of plants" had to be interpreted narrowly and did not extend beyond the excluded processes in order to cover products defined or obtained by such processes. Hence, a product resulting from an "essentially biological process for the production of plants or animals" may be patented as long as (i) the patentability requirements (novelty, inventive step, industrial application) are satisfied, (ii) the claim defines the product to be covered, either in a product format or in a product-by-process format, and (iii) the patent does not claim a single plant variety, which is something that is explicitly excluded from the scope of patentability under Article 53(b) EPC.

[22] Transgenic Plant/NOVARTIS II, G 001/98 [2000] OJ 111.

[23] Enlarged Board of Appeal, EPO, Appeal number T 1242/06, Case G 0002/12, Tomato II (March 25, 2015); Enlarged Board of Appeal, EPO, Appeal number T 0083/05 - 3.3.04, Case G 0002/13, Broccoli II (March 25, 2015). It is noteworthy that the Enlarged Board of Appeal emphasized that "there is no general notion of an obligatorily restrictive construction of exceptions to patentability, for example, such as that adopted by the Court of Justice of the European Union (CJEU) when insisting on a narrow interpretation of exceptions to or derogations from fundamental EC Treaty principles embodied in the four freedoms" (case G002/13, p. 41). Hence, the exclusion of patentability incorporated in Article 53(b) EPC of "essentially biological processes for the production of plants" does not cover any product of such a process, but only excludes biological breeding processes *sensu stricto.*

This is a very favourable position for large agrochemical corporations[24] and contrasts with the more restrictive approach followed by some EU member States' patent legislation, which exclude product claims from patentability where the claimed products have been generated by an essentially biological process for the protection of plants[25].

Opportunities for access to proprietary knowledge through IP law are generally limited. The EU biotechnology directive includes the possibility of compulsory cross-licensing for non-exclusive use where a breeder cannot acquire or exploit a plant variety right without infringing a prior patent, inasmuch as the licence is necessary for the exploitation of the plant variety to be protected. This is subject to payment of an appropriate royalty on reasonable terms[26]. Nevertheless, the conditions to apply for compulsory cross-licensing are quite restrictive, as applicants must show that "(a) they have applied unsuccessfully to the holder of the patent or of the plant variety right to obtain a contractual licence; (b) the plant variety or the invention constitutes significant technical progress of considerable economic interest compared with the invention claimed in the patent or the protected plant variety"[27].

According to the TRIPS agreement, every country must have at least *sui generis* protection for plants. Article 27.3(b) allows WTO members to exclude "plants and animals other than micro-organisms and essentially biological processes for the production of plants and animals other than biological and microbiological processes", provided that they offer patents or establish "an effective sui generis system" of protection for plant varieties. Yet, the WTO stays short in defining precisely what constitutes an "effective *sui generis* system".

Many jurisdictions protect plant varieties through the UPOV (Union for the Protection of New Varieties of Plants) Convention, which was adopted in 1961, in

[24] See, the discussion in Timo Minssen & Ana Nordberg, The Impact of Brocolli II & Tomato II on European patents in conventional vreeding, GMO's and Synthetic Biology: The grand finale of a juicy patents tale?, (2015) 34 (3) Biotechnology Law Report 81-98.
[25] Enlarged Board of Appeal, EPO, Appeal number T 0083/05 - 3.3.04, Case G 0002/13, Broccoli II (March 25, 2015), pp. 64-65 [Part VIII(2)6d] referring to recent amendments to this effect in the German Patent Act of 1936 (as amended in 2013) and in the Dutch Patent Act 1995 (as amended in 2014). However, as the EBA noted, "no such amendments have been made in […] the United Kingdom, […] France […] Austria […] and Switzerland". It remains to be seen if the Court of Justice of the EU will adopt such a narrow interpretation of the exclusion of patentability of products deriving from essentially biological processes, when interpreting the exclusion rule under Article 4(1) of the Biotechnology Directive, the CJEU not being bound by the EBA jurisprudence.
[26] Article 12, Article 4(2) of Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, OJ 1998 L 213/13.
[27] Ibid.

order to safeguard the interests of farmers and breeders with exemptions permitting farmers to save seed from one growing season to another and allowing breeders to use protected seeds for research purposes[28]. UPOV is an intergovernmental organization, most of its members being developed industrialised countries, which administers common rules for the recognition and protection of plant variety protection globally. Plant variety rights constituted the main form of *sui generis* IP protection until the U.S. Supreme Court opened the possibility in *Diamond v. Chakrabarty* for living organisms, such as germplasm and GM traits to constitute patentable subject matter.

Like patents, plant variety protection provides patent-like rights to plant breeders. These *sui generis* IPRs protect the genetic makeup of a specific plant variety, the criteria for protection being novelty, distinctness, uniformity and stability. Plant variety protection confers a bundle of rights to the developer of a novel combination of genes manifested as a distinct, uniform, and stable variety (the phenotype of the variety), without any need to prove an inventive step nor a specific utility, as title is provided solely on the evaluation of the variety's value in terms of genetic quality.

Although plant variety protection laws can provide exemptions for breeders, allowing them to use protected varieties for further breeding, and for farmers, allowing them to save seeds from their harvest, these exceptions are provided under highly restricted conditions and these regimes have become more and more similar to the protection provided by patents, in particular since the 1991 UPOV Convention.

The boundaries of these IP rights have also been broadly interpreted. In *Erawu-Jacquery v La Hesbignonne*, the Court of Justice of the EU held that a prohibition on the sale or export of basic seeds by the IP right holder was not subject to Article 101 TFEU since considerable investment had been made in developing the basic seed. According to the Court, "a person who has made considerable efforts to develop varieties of basic seed which may be the subject-matter of plant breeders' rights must be allowed to protect himself against any improper handling of those

[28] International Convention of the Protection of New Varieties of Plants, Ger.-Neth.-U.K., Dec. 2, 1961, 815 U.N.T.S. 89 (revised Nov. 10, 1972, Oct. 23, 1978 and Mar. 19, 1991).

varieties of seed" and "to that end, the breeder must be entitled to restrict propagation to the growers which he has selected as licensees"[29].

The plant variety protection rights have also been implemented in developing countries and emergent economies, under direct or indirect pressure from developed countries, in the context of bilateral trade and investment agreements containing an obligation for developing countries to embrace UPOV rules.

It has been noted, that many developing countries' governments were critical of IPRs protection in the area of biological resources, "partly because of their own (varied) national histories of community ownership of biological resources and partly because patenting has become a central mechanism for the capture (and exploitation by developed country-based corporations) of natural resources and their genetic materials"[30].

Implementation of the UPOV rules and other forms of IPRs protection in the sphere of biological resources in the developing countries highlights an important tension between different approaches to incentivising innovation in this area. Traditional approaches based on principles of sharing and open access to knowledge run into conflict with an exclusionary approach based on privatization of genetic information and controlled methods of production.

We can see, for instance, in the case of India that the scope of IPRs protection in the area of biological resources has been interpreted differently so as to provide increased opportunities of access to genetic information. India's (the Protection of Plant Varieties and Farmers' Rights Act 2001, or hereinafter PVPFR Act), which became fully operational in 2007, requires that the breeder or any other person entitled to produce, market and sell the seeds of a registered variety must make such seeds or propagating materials available to farmers "in a timely manner" in order to "satisfy their requirements" and "at a reasonable market price"[31]. A number of provisions in the PVPFR Act directly or indirectly recognize specific rights of, or grant entitlements to, farmers and the farming community[32]. Farmers have the

[29] Case 27/87 SPRL Louis Erauw-Jacquery v La Hesbignonne SC [1988] ECR 1919. See also, Case 258/78, Nungesser v. Commission [1982] ECR 2015, para. 10.
[30] Christopher May and Susan K. Sell, Intellectual Property Rights: A Critical History (Lynne Rienner Pub, London, 2006), p. 191.
[31] Protection of Plant Varieties and Farmers' Rights Rules, 2003 (as amended in 2012), Rule 36A.
[32] For a description see Sujith Koonan, India's sui generis system of plant variety protection, (January 2014), available at http://www.quno.org/sites/default/files/resources/QUNO%20India%20-%20plant%20variety%20protection%20-%202014.pdf.

right to ‘save, use, sow, resow, exchange, share or sell’ farm produce including seed of a protected variety in the same manner as they were entitled to prior to the PVPFR Act, without however that involving the right to sell branded seed of a protected variety. Farmers are also entitled to recognition and reward in cases where the genetic material they preserved and improved is used in developing new varieties. Farmers have the right to claim compensation from the breeder, if the variety they purchased fails to perform as per the disclosure made by the breeder. Finally, they are immune from infringement legal action, if such infringement was innocent.

Most importantly, the Authority in charge of the implementation of the Act is empowered to issue a compulsory license after three years of registration, if the breeder fails to satisfy the reasonable requirements of the public for the seed or other propagating material or that the seed or propagating material has not been made available to the public at a reasonable price.

The effects of UPOV protection on the quality or diversity of plant varieties is a matter for investigation, much commercial breeding being directed at cosmetic changes in order to serve market strategies.

IP right holders may also take measures in order to avoid problems with regard to the implementation of their IP rights, in particular in developing jurisdictions with weak IP enforcement systems. Material Transfer Agreements between the IP right holders and farmers may specify the conditions under which a seed sample will be exchanged. Those holding utility patent rights in seed may sell subject to a contractual provision that bars the farmer from saving seed and using it to grow another generation of crops, thus controlling farmers through purchase agreements.

An example is Monsanto’s Roundup Ready ® Technology Agreement that usually provides that the farmer cannot save seed or any other part of the crop grown from the Monsanto seed for replanting and that the farmer is prohibited from supplying seed to any other person. Violation of these licenses may be regarded as a breach of contract subject to draconic sanctions, the farmer being obliged to pay 120 times the technology fee plus the legal fee if he/she is caught violating the agreement. Enforcement of these contractual clauses involves the continuous inspection of the farmers’ fields by Monsanto’s staff. Binding arbitration constitutes a default dispute resolution mechanism.

One may consider these contractual limitations of traditional farmer seed saving and sharing practices as introducing a restriction to research and seed development by farmers and thus a restriction on innovation. Monsanto may advance that such restrictions are necessary in order to protect its own incentives to innovate, due to its investment in R&D to develop the technology and the need to recoup the costs by the appropriation of the profits arising out of the productivity improvements introduced by its innovative effort.

The seed industry has also put in place biological tools to protect its IP rights by developing hybridization, or more recently through cytoplasmic male sterility, one of the most efficient ways to produce F1 (the first filial generation of offspring of distinctly different parental types) hybrid seeds. Another biological protection is Genetic Use Restriction Technology (GURT), with the development of terminator technologies preventing farmers from saving seeds since the genetically engineered plants will not germinate in subsequent generations or will not express the specific trait (e.g. herbicide resistance) that is protected by IP rights, unless the plant is sprayed with specific chemicals in order to activate the right gene. These biological protection instruments are particularly useful in jurisdictions with weak enforcement of IPRs.

These technologies are protected by patents, a great number of them being held by few global seed companies. This IP-based business environment makes it quite difficult for public institutions to assert themselves in the process of innovation in the seed industry and promote the open access and sharing ethos that was prevalent prior to the expansion of IPRs in this sector of activity. These IP rights related strategies had an impact on the development of a concentrated structure for various factors of production markets and the important consolidation of the seed industry following a wave of M&A activity.

III. The development of a concentrated market

We will focus on the M&A activity of global seed players, before exploring the level of concentration in this market. This concentration is not only limited to seeds. It is also reported that the 10 biggest pesticide firms now control 90% of the global

pesticide market, that 10 companies control 76% of the animal pharmaceutical sales, and that 10 animal feed companies control 52% of the global animal market[33].

The increasing consolidation of the inputs market may raise important public policy concerns, in particular as the share of the total surplus value appropriated by the farmers has considerably fallen. This may be of concern in particular for jurisdictions not disposing of sophisticated state subsidies regimes enabling some transfer of resources to poorer rural communities, highly dependent on agriculture.

A. M&A activity of global seed players

We analysed mergers and acquisition activity of the global seed industry leaders (Monsanto, Syngenta). We used S&P Capital IQ database to conduct our analysis, a recognized M&A intelligence tool[34] which maintains a database of global M&A transactions and other financial information and provides analytics[35].

The results of the analysis are presented in Table 1 (Monsanto), Table 2 (Syngenta), and Table 3 (DuPont Pioneer Hi-Bred). Although the number of targets is the same for Monsanto and Syngenta, our analysis shows that Monsanto was acquiring much bigger targets, spending on M&A almost six times more (USD 11.9bn vs USD 2bn for Syngenta).

[33] ETC, Who will Control the Green Economy? (November 2011), available at http://www.etcgroup.org/sites/www.etcgroup.org/files/publication/pdf_file/ETC_wwctge_4web_Dec2011.pdf.

[34] S&P Capital IQ is a part of McGraw Hill Financial, Inc., a leading provider of data, research and analytics (http://www.spcapitaliq.com/).

[35] For our analysis we counted only mergers and acquisition deals but did not include capital raising deals (private placement, public offering), share buybacks, spin-offs and split-offs. We concentrated mostly on completed deals (marked as "closed"), and tried to exclude internal deals (i.e., where transactions were held between headquarters and subsidiaries or within subsidiaries). For Monsanto and DuPont Pioneer Hi-Bred we covered a period from 1995 till February 20, 2016; for Syngenta a period between 2000 and February 20, 2016. In addition to S&P Capital IQ we also used corporate press releases as well as other publicly available information. Since for some transactions of Monsanto, Syngenta, and Du Pont Pioneer financial values remain undisclosed, the figures in Table 1-3 are based on publicly available information for deals with disclosed data.

Table 1. Mergers and acquisitions of Monsanto (1995-2015)

	1995-2005	2006-2010	2010-2015	Subtotal
Number of Deals	10	11	9	**30**
of which				
seeds, ag. products (crops, cereals, etc.)	9	9	1	19
fertilizers / pesticides / chemicals	-	-	1	1
biotech products	-	-	5	5
other (IT, peat, distribution, animal feed, etc.)	1	2	2	5
Total transaction volume*, USDm	6 974,77	3 486,85	1 519,0	**11 980,62**

Table 2. Mergers and acquisitions of Syngenta (2000-2015)

	2000-2005	2006-2010	2011-2015	Subtotal
Number of Deals	6	16	8	**30**
of which				
seeds, agriculture products (crops, cereals, etc.)	5	11	4	20
traditional fertilizers / pesticides / chemicals	-	-	-	-
biotech (pesticides, other)	-	1	2	3
others (IT, peat, distribution, animal feed, etc.)	1	4	2	7
Total transaction volume*, USDm	654,28	607,62	741,57	**2 003,47**

Table 3. Mergers and acquisitions of DuPont Pioneer (1995-2015)

	1995-2005	2006-2010	2011-2015	Subtotal
Number of Deals	1	10	1	**12**
of which				
seeds, agriculture products (crops, cereals, etc.)	1	7	1	9
traditional fertilizers / pesticides / chemicals	-	-	-	-
biotech (pesticides, other)	-	1	-	1
others (IT software)	-	2	-	2
Total transaction volume*, USDm	n/a	n/a	n/a	

**based on publicly disclosed information*

Prior to emergence of Syngenta in 1999, from 1995 till 2000 Monsanto kept itself busy by actively consolidating the market via acquisitions of leading players such as Dekalb Genetics (USD 2.2bn), Cargill Seeds Operations (USD 1.4bn), and other recognized players in the area of corn, sunflower, soybean and cotton seeds. Over the period of 2000-2010 Monsanto continued to acquire leading players of the seed market often with a market capitalization close to or exceeding a billion US dollars, i.e. Seminis (USD 1,7bn; 2005), Delta and Pine Land Company (USD 1,6bn; 2006), De Ruiter Seeds Group (0,86bn; 2008).

A notable exception from a series of seeds targets was a recent acquisition of the Climate Corporation (USD 0,93bn, 2013). The company is known for producing software and hardware as well as insurance products for farmers for weather monitoring and agronomic modelling. The size of the transaction indicates a serious bet by Monsanto in the diversification of its business model into IT-type of services. A number of transactions over the period of 2010-2015 were marked as biotech (microbes, microRNA technology, small molecule pharmacology, synthetically derived vaccines and anti-microbials, ribonucleic acid interference products, etc.).

In 2015 Monsanto announced a USD 45bn bid to acquire Syngenta. The bid was rejected by Syngenta shareholders. It was estimated that the merged company could alone control 45% of the commercial seed market and a 30% share of pesticides market (based on 2014 financial reports)[36].

Syngenta emerged as a spin-off, after the merger between the agrochemical business of pharmaceutical corporation AstraZeneca and the seeds and crop protection business of Novartis. Between 2000 and 2015 Syngenta continued steady M&A activity; however the company pursued smaller size targets compared to Monsanto. Its biggest deal was acquisition of a Belgian biotech company Devgen (closed in 2014) for USD 512,6m.

Pioneer Hi-Bred International was acquired by El DuPont de Nemours & Co in 1999. Since then this division manages the agriculture business of Dupont. By the end of 2014 the annual net sales figure of the division reached almost USD 11.3bn. Unlike its rivals, mostly Monsanto and Syngenta, Pioneer Hi-Bred was less acquisitive. We identified 11 deals where Pioneer was buyer of the seeds assets

[36] Jacob Bunge and Andrew Morse, Monsanto Makes Bid to go Big in Pesticides, Wall Street Journal, (8 May 2015), available at http://www.wsj.com/articles/syngenta-rejects-unsolicited-monsanto-acquisition-proposal-1431069142.

(Table 3). Most acquisitions were announced in 2008-2011 and completed in 2010-2014. Two of the acquisitions are software deals (Farms Technology,LLC which provides Internet-based procurement applications and Map Shots, Inc., which is active in precision agriculture software sales).

The majority of DuPont Pioneer's transactions (9 out of 11 deals) are acquisitions of seeds producers: two of them based in India, one in South Africa, and the rest were US incorporated seed companies. In 2008 DuPont launched the PROaccess platform which enables the company to sell its seeds to more growers through a network of distributors via special distribution agreements. Over the period 2008-2011, Pioneer acquired many of its partners of PROaccess platform including AgVenture, Hoegemeyer Hybrids, NuTech Seed, Seed Consultants, Terral Seed (all deal announced in 2010), and Doebler's Pennsylvania Hybrids (2011). No transaction data was disclosed on any of DuPont's deals.

Interestingly, Pioneer Hi-Bred was more involved in divestments than in acquisitions over the period under review. In 2014 the company sold pesticides business assets to its rivals such as Bayer, Sumimoto Chemicals, Mitsui, S&W Seed, and Syngenta. Over the last 5 years Pioneer continued to sell pesticides and chemical assets while acquiring mostly seeds companies.

This less active M&A strategy compared to Monsanto and Syngenta may be contrasted to the activity of DuPont Pioneer in filing patent applications. According to a recent study of Jefferson et al (2015), DuPont (together with its affiliates) is a global leader in plant-related IP rights portfolio (i.e., in utility patents for maize, rice and soybean plants), far exceeding the rest of the US industry, which includes small biotech companies, governmental research institutes, and universities, followed by Monsanto and other industry players[37].

Over the past six months two historic events for the agrichemical markets were announced. The first one relates to the merger between the Dow Chemical Company and DuPont, which was announced on December 11, 2015. According to the press-release, "the combined company will be named DowDuPont and have a combined market capitalization of approximately $130 billion at announcement…The

[37] Osmat A. Jefferson, Deniz Kollhofer, Thomas H. Ehrich & Richard A. Jeferson. The ownership question of plant gene and genome intellectual properties. Nature Biotechnology, Vol. 33, #11. November 2015

transaction is expected to deliver approximately $3 billion in cost synergies"[38]. Following the merger, the company will be separated into three independent, publicly traded companies, in agrichemicals, materials science, and speciality products. The new agrichemicals company will possess combined DuPont's and Dow's seeds and crop protection businesses with total revenues approximating USD 19 billion, and would sell about 41% of U.S. corn seeds and related genetics.[39]

Following the announcement of the DuPont Dow merger, another mega-deal was announced between Syngenta and ChemChina (on February 3, 2016 ChemChina made an offer to acquire Syngenta's shares). Headquartered in Beijing, ChemChina is the largest chemical corporation in China with net sales in excess of USD 39bn. Syngenta's sales figures exceeded USD 13.4bn in 2015. A combined company will have an estimated revenue of about USD 17bn (counting only seed and pesticides division), making it the second largest global player on the agricultural market. The DowDuPont Agriculture business spin-off would become the global leader[40]. The deal highlights China's ambition about food security and its dedication and persistence to get access to modern technologies. The merger has been viewed as a win-win transaction for Syngenta as well, given the great opportunities for the Swiss-based company arising from a growing demand in the food market in China.

Should these transactions close successfully, Monsanto, whose bid for Syngenta's acquisition was rejected by Syngenta's shareholders in 2015, will move from the leading position it currently holds to the third position in terms of revenue size.

This will bring down the number of major global companies producing crop seeds and pesticides from 6 to 4 and transform an already concentrated industry to a tight oligopoly on a global scale.

[38] Companies press-release, http://www.dow.com/news/press-releases/dupont%20and%20dow%20to%20combine%20in%20merger%20of%20equals

[39] Jacob Bunge et al., Dow Chemical Agree to Merge, the Break Up into Three Companies, Wall Street Journal, (11 December 2015), available at http://www.wsj.com/articles/dupont-dow-chemical-agree-to-merge-1449834739.

[40] http://www.bloomberg.com/news/articles/2016-02-03/chemchina-offers-to-purchase-syngenta-for-record-43-billion

B. Industry concentration

The analysis of the seed M&A activity the last 15 years provides a good sense of the magnitude of the consolidation trend in the seed industry.

High concentration in the food industry is not unusual. This phenomenon has been extensively studied over the last several years. Hoppe and Banker argue that 80 to 90 percent of US food production is produced by 10 to 20 percent of farmers[41]. The US food processing sector is also highly concentrated[42]: according to the Economic Research Service (ERS), 12 percent of plants with more than 100 employees ship 77 percent of all value of food in the US food manufacturing industry[43]. Macdonald and McBride indicate that the top four beef processing companies' share of the US slaughter market increased from 36 to 79 percent over the period 1980-2005[44].

Vertical integration is a key trend in many food chain subsectors when key players transform themselves through a series of strategic moves to diversify their business. A notable example is the US poultry industry which experienced vertical integration trends where few integrators (companies that own feeding, hatching, and processing poultry) have market power over poultry growers[45].

However the level of concentration of the seed industry is remarkable even considering traditionally high food sector concentration. Howard argues that the rapid consolidation of the seed industry led to global dominance by a few companies, with Monsanto, Syngenta and DuPont being the most powerful of them[46]. As a result, the four firm concentration ratio (CR4) in the crop seeds sector has reached 54 percent

[41] Robert A. Hoppe and David E. Banker, Structure and finances of U.S. farms – Family Farm Report, EIB-66. Washington, DC: U.S. Department of Agriculture, Economic Research Service, (2010).
[42] Malden M. Nesheim, Maria Oria and Peggy Tsai Yin (eds.), A Framework for Assessing Effects of the Food System. National Academy of Sciences (2015), available at http://nycfoodpolicy.org/wp-content/uploads/2014/05/A-Framework-for-Assessing-Effects-of-the-Food-System.pdf.
[43] Economic Research Service Manufacturing, (2014), available at http://www.ers.usda.gov/topics/food-markets-prices/processingmarketing/manufacturing.aspx#.Uvowa_vwv3t (accessed November 24, 2014).
[44] James M. MacDonald and William D. McBride, The transformation of U.S. livestock agriculture: Scale, efficiency and risks, (2009) U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin 43.
[45] Malden M. Nesheim, Maria Oria and Peggy Tsai Yin (eds.), A Framework for Assessing Effects of the Food System, National Academy of Sciences (2015), p. 53.
[46] Philip H. Howard, Visualizing consolidation in the global seed industry: 1996-2008, (2009) Sustainability 1(4):1266-1287; Philip H. Howard, Seed industry structure, (2014), available at https://msu.edu/~howardp/seedindustry.html.

according to a recent US National Academy of Sciences Report[47]. Fuglie et al. have demonstrated that few leaders in such industries as agricultural chemicals, farm machinery and animal breeding have more than 50% of the global market sales[48]. The latest estimates suggest that "the Big Six" (Monsanto, Syngenta, DuPont, BASF, Bayer, Dow) collectively control more than 75% of the global agrochemical market, 63% of the commercial seed market, and almost three quarters of R&D expenses in the seeds and pesticides sector (the combined R&D budget of the Big Six increased USDA crop science research budget more than 15 times in 2013)[49]. The same is true for the farm equipment sector where the top three companies (Deere & Co, CNH, AGCO) control 49% market share (2013[50]).

The EU authorities are also increasingly concerned about the high concentration of the EU seed market. As argued by Mammana, contrary to the opinion that there are almost 7,000 seed companies operating on the EU seed market[51], there is considerable variation from country to country and market niche[52]. For instance, a single company controls 45 percent of the wheat market in the UK; while 5 companies control 95% of the EU vegetable seed market. The maize seed sector is a vital part of the EU seed market accounting for 26%. It is controlled by 5 companies whose collective market share amounts to 51.4%: the maize varieties of DuPont Pioneer accounting for a 12.2% market share, Syngenta for 11.5%, Limagrain for 9,7%, Monsanto for 8,95%, and KWS for 8,9%, from a total of 4 975 maize varieties registered in the European Common Catalogue[53]. According to the

[47] Malden M. Nesheim, Maria Oria and Peggy Tsai Yin (eds.), A Framework for Assessing Effects of the Food System, National Academy of Sciences (2015), p. 54.
[48] Keith Fuglie et al., Rising concentration in agricultural input industries influences new farm technologies, (2012) 10(4) Amber Waves 1-6, available at http://www.ers.usda.gov/amber-waves/2012-december/rising-concentration-in-agricultural-input-industries-influences-new-technologies.aspx#.VpYe1-9unct.
[49] ETC Group, Breaking Bad: Big Ag Mega-Mergers in Play, (December 2015), Communique 115, available at http://www.etcgroup.org/content/breaking-bad-big-ag-mega-mergers-play, p.4.
[50] Ibid., p. 8.
[51] Official controls: Impact on food business operators - seeds and plants, the European Seed Association's presentation to the European Parliament, 14 October 2013, http://www.europarl.europa.eu/meetdocs/2009_2014/documents/envi/dv/envi20131014_doc14_biloni_/envi20131014_doc14_biloni_en.pdf.
[52] Ivan Mammana, Concentration of Market Power in the EU Seed Market, (January 2014), Study commissioned by the Greens/EFA Group in the European Parliament.
[53] Ivan Mammana, Concentration of Market Power in the EU Seed Market, (January 2014), Study commissioned by the Greens/EFA Group in the European Parliament.

report of the European Parliament, EU farmers faced increases in prices of seeds and planting stock by 30% between 2000 and 2010[54].

IV. Competition dynamics in the seed industry

The significant transformation of the industry has led to the development of a different competitive interaction between the various players. We will examine the shift in the M&A activity of global seeds players, before commenting on their growth acceleration strategies that are essential in order to understand the new competitive game.

A. Global seeds players: a shift in strategy

The results of the conducted analysis of M&A activity show (notably with regard to Monsanto) a shift in strategy from seeds acquisitions to acquisitions in the biotech and IT sectors. In biotech, the companies are rapidly developing microbial products which can either become complementary to the existing products or serve as a replacement of traditional chemistry (i.e., pesticides products)[55]. The global pesticides industry accounts for USD 54,2bn (2013) and continues to grow steadily up to USD 75.9bn by 2019[56].

Microbial products are a new opportunity and potentially a game changer and a disrupting technology at the global scale. Although currently the industry is still in its infancy (less than USD 2bn of global sales in 2014), going forward it represents a huge potential, especially given the growing demand for organic farming globally.

Realizing this, in 2014 Monsanto announced an alliance known as BIOAG Alliance with Novozymes, one of leaders in biotech industry. Novozymes is responsible for the production of the microbial products while Monsanto serves as

[54] Report of the European Parliament on the farm input supply chain: structure and implications 2011/2114(INI), rapporteur José Bové, available at http://www.europarl.europa.eu/sides/getDoc.do?type=REPORT&reference=A7-2011-0421&language=EN

[55] Robb Fraley, Citi 2014 Basic Materials Conference, (3 December 2014), available at http://www.monsanto.com/investors/documents/2015/2014.12.03_citi_fraley.pdf.

[56] Christina Xie, Global Agrochemical Market will Continue to Maintain Steady Growth, (28 October 2014), available at http://news.agropages.com/News/NewsDetail---13349.htm.

the lead for field testing, registration, and commercialization for the Alliance's products[57].

A clear diversification move for global leaders is happening in the so-called "digital agriculture" market. Precision agriculture (or "precision farming") is a global trend that is rapidly growing. By precision farming experts understand a data analysis at the level of the square meter or even smaller to optimize the consumption of inputs (seeds, water, fertilizers, pesticides, etc.), and to monitor the actual process of production.[58] Precision agriculture, for instance, may use sensors to collect information from soil (various parameters such as the level of moisture, fertilizers and pesticides, soil organic matter, various soil properties such as bulk density, texture, compaction, etc.), and satellite images about crop growth progress. It then would combine all information and use big data algorithms to analyse it, applying sophisticated mathematical models to plan and adjust in real-time for needed inputs to maximize the eventual crop yield.

Precision agriculture is expected to revolutionize farming on a global scale within the next 10-15 years. The leading companies are rapidly enhancing this competency. A recent acquisition of the Climate Corporation by Monsanto is a bet to diversify beyond the traditional seeds and pesticides business model. The software developed by the Climate Corporation is aimed to become a powerful decision-support system and a crop progress monitoring tool for a typical farmer[59]. Combined with the existing product portfolio of Monsanto (seeds, traditional and bio-pesticides, etc.), the data analysis and recommendation tool of the Climate Corporation will enable Monsanto to become an ultimate one stop-shop opportunity for a farmer. Monsanto intends to sell subscription to the software as a stand-alone service on a global scale. The other "big six" of the seeds industry – Syngenta, DuPont Pioneer, Bayer, BASF, and Dow – are rapidly catching up by developing their own IT-platforms[60].

[57] BIOAG Alliance Fact Sheet, available at http://www.novozymes.com/en/about-us/brochures/Documents/BioAg-Alliance-factsheet.pdf.
[58] Boston Consulting Group, Crop farming 2030: the reinvention of the sector, (2015), available at https://www.bcgperspectives.com/content/articles/process-industries-innovation-crop-farming-2030-reinvention-sector/.
[59] David Friedberg, The Climate Corporation Platform Update (21 August 2014), available at http://www.monsanto.com/investors/documents/whistle%20stop%20tour%20vii%20aug%202014/the_climate_corporation_update.pdf.
[60] ETC Group, Breaking Bad: Big Ag Mega-Mergers in Play, (December 2015),Communique 115.

B. The growth accelerators of global seeds producers

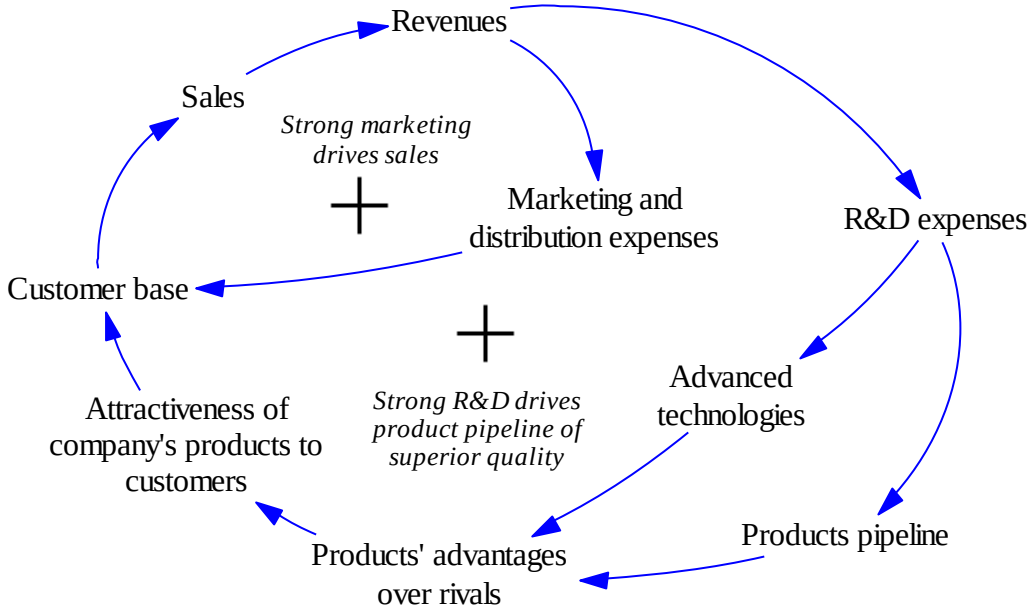
The growth engine of a corporation (how companies grow, what causes rapid growth) has long been one of the most fascinating topics for scholars studying corporate strategy and general management, although its lessons are still relatively unclear. One of the possible explanations of corporate growth engine worth studying was proposed by Achi et al. and is known as "growth cycles / accelerators"[61]. Achi et al. studied 9450 publicly listed companies to find 41 companies that have grown dramatically over the previous ten years (growth rates in excess of 20 percent). They suggested that increasing returns driven by positive feedback loops are at the core of successfully growing companies. A number of generic self-reinforcing feedback loops common to the companies that experienced superior growth rates over a long time period was identified. The authors suggested that corporate management needs to combine several growth accelerators to win market share, lock-in customers, and eventually to get sustainable performance over a long timescale. The topic of corporate growth mechanisms through feedback loops and its implications for strategic management was discussed in the works of Morecroft (1985)[62], Lyneis (1999)[63], Sterman (2000)[64], Warren (2004[65], 2008[66]), Casadesus-Masanell, and Ricart (2007[67]), among others.

In our opinion, this is a useful methodology for the analysis of the emergence of the global seed leaders over the last three decades. We think that considering the active mergers and acquisitions policy conducted by the "Big Six" as the only explanation of their rapid development is *insufficient*. Top factors that shaped the seed industry include: (1) consolidation, (2) R&D spending, (3) early adoption of the use of new promising genetics technology (i.e., RNA inhibition allowing selective control and the expression of individual genes), (4) vertical integration, (5) network

[61] Zafer Achi et al., The Paradox of Fast Growth Tigers, McKinsey Quarterly, (1995) 3.
[62] John Morecroft, The Feedback View of Business Policy and Strategy, (1985) 1(1) System Dynamics Review 4-19.
[63] James M. Lyneis, System dynamics for business strategy: a phased approach, (1999) 15 System Dynamics Review 37-70.
[64] John Sterman, Business Dynamics: Systems Thinking and Modelling for Complex World (McGraw Hill, 2000).
[65] Kim Warren, Why has Feedback Systems Thinking Struggled to Influence Strategy and Policy?, (2004) 21 Systems Research and Behavioral Science 1-17.
[66] Kim Warren, Strategic Management Dynamics (Wiley, 2008).
[67] Ramon Casadesus-Masanell and J.E. Ricart, Competing Through Business Models, (November, 2007) IESE Business School Working Paper No. 713, available at http://ssrn.com/abstract=1115201.

externalities (sale of complementary products in addition to seeds – i.e., Monsanto's corn seeds and "Roundup Ready"), (6) economies of scale from market expansion, and (7) product differentiation (seeds, pesticides, IT cloud-based decision support systems). Such factors are the core growth accelerators based on reinforcing feedback loops. Other accelerators fuelling the corporate engine of global seed and agriculture chemistry producers include IP rights protection, patent alliances to swap traits, market power resulting from increasing lobbying opportunities, etc.

A mechanism of gaining a competitive advantage through key growth accelerators is examined in more detail below (Pictures 1-3) using a methodology of casual loops diagrams of system dynamics[68].

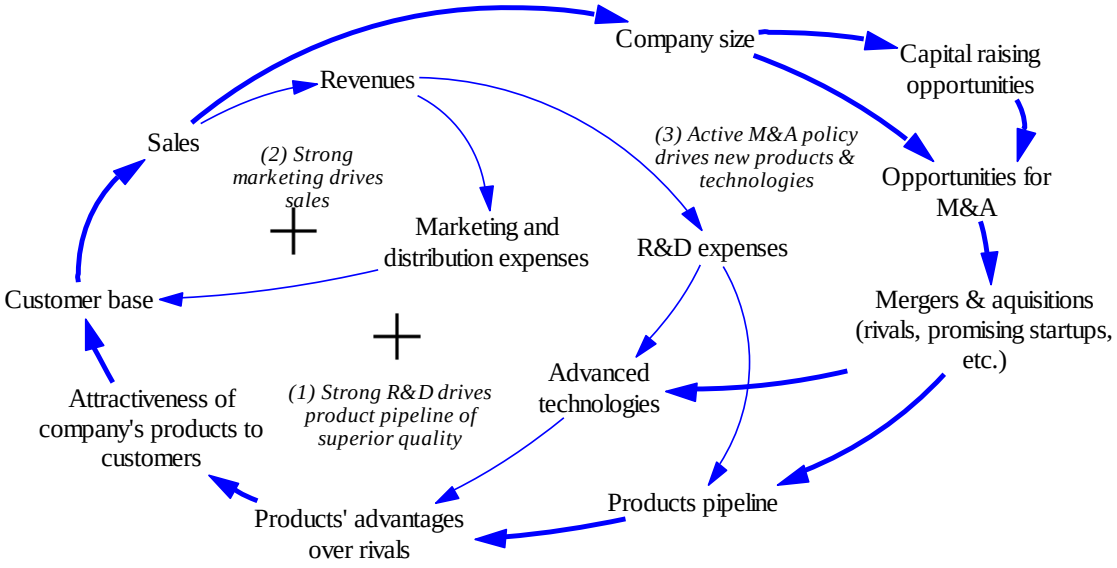


Picture 1.

The most common growth accelerators for leading seed companies come from state-of-the-art research and development efforts resulting in advanced technologies (i.e., RNA inhibition, etc.), and products with a superior quality over competitors (i.e., seeds with higher yields or advanced resistance to insects), as well as substantial spending on marketing & distribution channels (Picture 1). A diversified pipeline of high quality products increases the attractiveness of a company's products to customers, thus increasing customer base, driving sales and revenues. Higher

[68] Eric F. Wolstenholme, Qualitative vs quantitative modelling: the evolving balance, (1999) 50 Journal of Operational Research Society, 422-428.

revenues allow strong R&D and marketing budgets, thus forming a powerful feedback loop based on the economic concept of increasing returns.



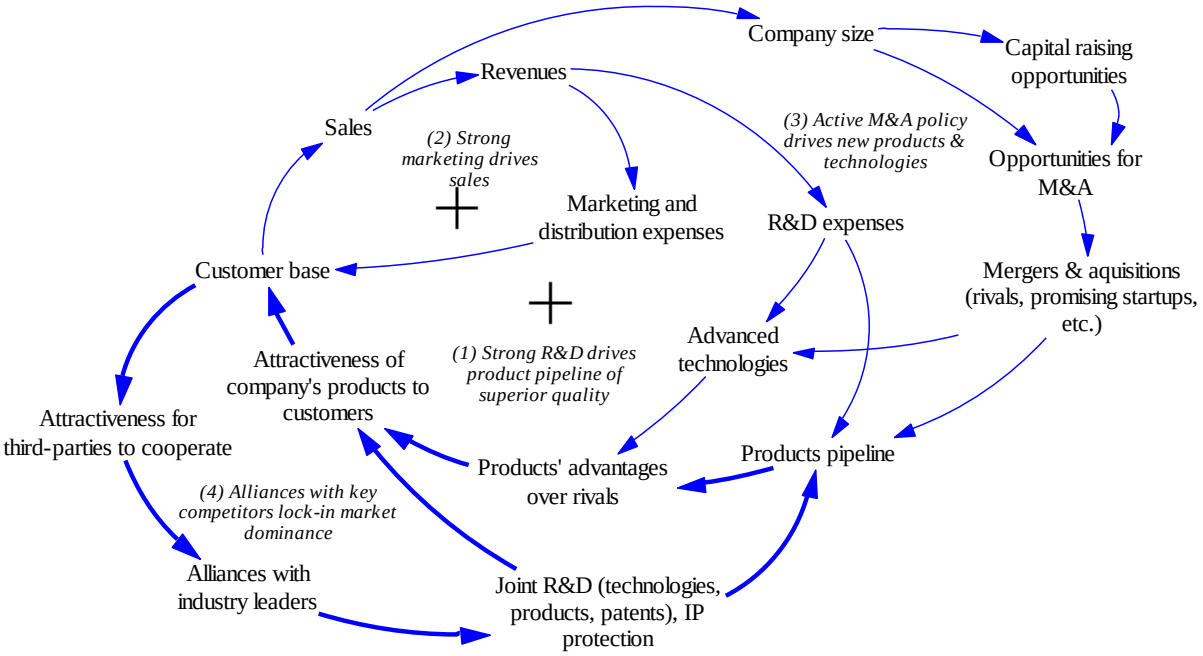
Picture 2.

As a company grows in size, it gets access to favorable capital raising options, thus enhancing opportunities for M&A (Picture 2). Through acquisitions of promising start-ups or rivals with high potential products or advanced technologies the company adds to the existing product pipeline, driving further sales and revenues. This is another self-reinforcing growth cycle that was successfully employed by global seed and agrochemical companies over the last 20 years.

The market power of the "Big Six" is further enhanced by the cross-licencing agreements for genetically modified seed traits between Monsanto, Syngenta, Bayer, DuPont, BASF and Dow[69]. This enables them to create additional barriers to entry for new market players by enhancing intellectual property and trait licensing agreements (i.e, swap of traits, generic trait agreement to manage regulatory regime after expiration of patents) between them as well as litigating the expiration of patents (i.e., peaceful resolution of patent litigation between Monsanto and DuPont in 2013). The results obtained by Vergote and Grandjean[70] suggest that in some

[69] Philip H. Howard, Intellectual Property and Consolidation in the Seed Industry, (2015) 55(6) Crop Science 1-7, available at http://www.apbrebes.org/files/seeds/files/Howard_seed_industry_patents_concentration_2015.pdf.
[70] Woulter Vergote and Gilles J. Grandjean, Network formation among rivals, (2015) CEREC Working Papers 2014/9.

cases such cooperation between rivals may lead to increased barriers to entry for those who are not part of the network. An example of such a case has been documented by Bekkers et al.[71] through the analysis of Motorola's successful attempt to create a group of dominant players in the GSM industry in 1980s through cross-licencing agreements.



Picture 3.

An established customer base serves as an attractiveness anchor for third-parties (i.e., competitors, leading NGOs, etc.) to cooperate (Picture 3). The companies become engaged in alliances and networks for joint R&D opportunities (research for new technologies, products – a good example is Monsanto-Novozymes alliance), IP-protection issues (cross-licensing agreements, joint patents, competitive framework after patent expiration policy, etc.), or major industry initiatives (i.e., construction of Svalbard Global Seed Vault).

As the area under GMO plants continues to expand,[72] the area under biotech crops increased every year from 1996 to 2014 and accounted for more than 180

[71] Rudi Bekakers, Geert Duysters, and Bart Verspagen, Intellectual property rights, strategic technology agreements and market structure: the case of GSM, (2002) 31(7) Research Policy 1141-1161.
[72] Clive James, Global Status of Biotech/GM Crops, (Ithaca, NY, 2014) ISAAA Brief No. 49.

million hectares in 2014, leading seed production companies increasingly to gain market power. Eventually, a combination of several powerful positive feedback loops helps industry leaders to *de facto lock-in sustainable competitive advantage* and *market dominance*. Lobbying opportunities as well as sponsoring of NGOs, various interest groups, and the scientific community helps to shape a positive corporate image and to sustain market power, thus further maintaining the status quo. Combined altogether, the self-reinforcing feedback loops that drive growth accelerators for global seed industry leaders help them to create *a superior competitive advantage* over other industry rivals.

V. Implications for competition law and policy

From this perspective, focusing on the level of concentration on a particular segment of the market, or ignoring the various sources of market power that the above competitive strategies highlight, leads to a myopic competition law and policy. The usual competition law tools have not been systematically used in order to deal with the resulting bottlenecks, as the competitive dynamics of the development of the industry and the consolidation of some key global seeds companies have not been clearly understood, and the role of IP rights in these competitive dynamics understated.

Traditionally, competition law has dealt with such unbalances of power by reinforcing the bargaining power of farmers so as counter-balance that of other segments of the food value chain, downstream but also upstream, by enabling them to form agricultural cooperatives. These specific exceptions/regimes have nevertheless been under attack lately, as a result of the rise of a specific view of the consumer welfare paradigm in competition law.

A. Challenges for competition law enforcement in the seeds industry

Competition law enforcement may engage with the IP practices of seed companies, mergers in this area, and different forms of agreements linking the seed producers with farmers.

As explained above, IP rights play an increasing role in the competitive dynamics of the seed industry. The owners and developers of patented seed traits

may exert considerable market power through cross-licensing agreements with firms that want to include the patented technology, in most cases Monsanto traits, in their seed products. These cross-licensing agreements between Monsanto and its competitors in the seeds market enable the latter to exercise control over the way its competitors use the traits.

Furthermore, Monsanto licensing agreements with farmers typically prohibit the traditional practice of saving seeds from harvested crops to plant the next season, thus limiting competition from seeds developed by farmers, and eventually leveraging their IP right in order to create or enhance market power in markets other than that covered by the IP right. Farmers dispose of three sources of buying seed: (i) obtain new seeds from seed companies, public institutes and dealers, (ii) save part of their own harvest for seeds, and (iii) trade part of their harvest for seed from grain dealers[73]. By signing restrictive licensing agreements seed companies reduce farmers' options and are thus able to raise licensing fees and seed prices for all farmers.

Other possible anticompetitive practices include exclusionary practices, such as exclusive dealing arrangements, requiring licensees not to deal with competing technology providers, anti-stacking restrictions, and loyalty rebates to seed distributors limiting the sales of competing seeds.

Seed companies also actively implement their IP rights and combat "seed piracy", filing a considerable number of patent infringement cases, even if the farmer's field was only inadvertently contaminated by neighbouring genetically modified crops. It is always possible to attach a competition law counterclaim to the patent infringement claims brought by the seed company, invoking illegal bundling or tying, de facto exclusive dealing, refusal to access to essential facilities doctrine, input foreclosure, restrictions to innovation, in particular for restrictions included in cross-licensing agreements on the way rival seed companies may stack the protected traits with their own traits[74]. It was, however, noted that these counterclaims have been generally unsuccessful[75].

[73] Jitendra P. Srivastava and Steven Jaffee, Best Practices for Moving Seed Technology: New Approaches to Doing Business, (Washington D.C.: The World Bank, 1993) World Bank Technical Paper No. 213.
[74] Diana L. Moss, Competition, Intellectual Property Rights, and Transgenic Seed, (2013) 58 South Dakota Law Review 543-559, p. 546.
[75] Ibid.

In *Bowman v. Monsanto,* the US Supreme Court has also reduced the scope of the patent exhaustion doctrine in this industry by holding that the sale of one generation of seed does not exhaust rights on later generations. A farmer who purchased seed to grow could not sow a new crop using the seeds produced by the fist crop - as that, the Court held, would constitute *making* the patented product and not *reusing* or *selling* the seed that had been purchased[76]. Bowman was found to infringe two of Monsanto's patents because he "made" replicas of Monsanto's genetically modified, herbicide-resistant soybean seeds, by simply planting, cultivating, harvesting, saving, and then re-planting the patented seeds. IP rights on self-replicated seeds are thus not exhausted by the first authorized sale to a farmer.

Monsanto's Roundup and Roundup Ready technology has since entered the public domain, as the patent expired in 2015, thus enabling competitors to introduce a generic version of the trait. However, Monsanto has patented the Genuity™ Roundup Ready 2 Yield trait technology, these seeds being protected by a different utility patent which will not expire until the end of the next decade. The speed of the entry of generics in this market will depend on the access generic seed companies may have to Monsanto's data packages allowing them an advanced development and testing. This may raise equivalent competition issues than those routinely involved in the competition law enforcement in the pharma sector that led to jurisprudence such as *FTC v. Actavis* in the U.S.,[77] and *Astra Zeneca* in the E.U with regard to strategies by incumbent IP holders to block the entry of generics, following the expiration of their IP rights[78].

Competition authorities have been marginally more active in the seeds industry in the context of merger control. The US DOJ Antitrust Division extracted remedies concerning the possible anticompetitive effects of licensing, in a series of mergers involving Monsanto acquiring the corn seed company DeKalb or the cotton seed companies Delta and Pine Land, where they imposed the condition that Monsanto removes anti-stacking restrictions to its licensees, provides wide access

[76] *Bowman v. Monsanto Co*., 133 S. Ct. 1761 (2013).
[77] *Federal Trade Commission v. Actavis*, 133 S.Ct. 2223 (2013).
[78] Case C-457/10 P, *AstraZeneca AB and AstraZeneca plc v European Commission*, ECLI:EU:C:2012:770.

through licensing to its germplasm, and divests some of its assets in germplasm and seeds[79].

The European Commission has been relatively less active, with only one seeds merger case since 2006, Syngenta's acquisition of Monsanto's sunflower seed business, being subject to remedial conditions. The Commission raised concerns over the possible effects of the merger, which would have removed a considerable competitor in the market for the commercialisation of sunflower seeds in Spain and Hungary. It also expressed concerns with regard to the exchange and licensing of sunflower varieties, insofar as the merging parties would be in a position to restrict the access of competitors to inputs necessary for the commercialisation of sunflower seeds. These would have led to the reduction of innovation, the foreclosure of competitors in the markets for the commercialization of sunflower seeds, and the reduction of the choice of sunflower seed hybrids for customers. To address these concerns, Monsanto agreed to divest its sunflower hybrids as well as the parental lines used in the creation of those hybrids, or those currently under development for the creation of hybrids for Spain and Hungary[80].

Taking into account the intense M&A activity in this market during the last twenty years, this lack of intervention appears intriguing[81]. This may be due to the fact that the existing turnover thresholds in Article 1 of the EU Merger Regulation may not catch merger activity in this highly evolving sector, as acquisitions of companies that did not achieve high turnover in the past are excluded from

[79] Diana L. Moss, Competition, Intellectual Property Rights, and Transgenic Seed, (2013) 58 South Dakota Law Review 543-559, p. 546.
[80] Case No COMP/M.5675-Syngenta/Monsanto's Sunflower Seed Business, C(2010) 7929 final.
[81] See our analysis above Section III(A).

consideration[82], even if the potential anti-competitive effect of such merger may be significant[83] and in our view has to be subjected to competition law scrutiny *ex ante*.

The economic potential of these merger transactions in terms of the possibilities of exercising market power in the future is probably better reflected by the purchase price (the transaction value) of these mergers, which is rather high as indicated above in view of the turnover made by the acquired targets. Article 22 of the EU Merger Regulation establishes a referral system ensuring that Member States may refer to the Commission those transactions that fall short of satisfying the jurisdictional criteria[84]. It is noteworthy that the 2006 Syngenta's acquisition of Monsanto's sunflower seed business, which is the only EU seed merger case we identified post 2004, was referred to the Commission following a request from Spain and Hungary, pursuant to Article 22 of the EU Merger Regulation.

It is also surprising that out of the 180 cases investigated by National Competition Authorities in Europe in the food supply chain between 2004 and 2011, the overwhelming majority of those concerned the processing, retail, and manufacturing level, only a handful concerned the seed industry[85]. The factors of

[82] According to Article 1 of the Council Regulation (EC) No 139/2004 Merger Regulation, [2004] OJ L L 24/1, a concentration is subject to the Commission's merger jurisdiction if: "a) the combined aggregate worldwide turnover of all the undertakings concerned is more than 5000 million €; and (b) the aggregate Community-wide turnover of each of at least two of the undertakings concerned is more than 250 million €, unless each of the undertakings concerned achieves more than two-thirds of its aggregate Community-wide turnover within one and the same Member State", or if "(a) the combined aggregate worldwide turnover of all the undertakings concerned is more than 2500 million €; (b) in each of at least three Member States, the combined aggregate turnover of all the undertakings concerned is more than 100 million €; (c) in each of at least three Member States included for the purpose of point (b), the aggregate turnover of each of at least two of the undertakings concerned is more than 25 million €; and (d) the aggregate Community-wide turnover of each of at least two of the undertakings concerned is more than 100 million €, unless each of the undertakings concerned achieves more than two-thirds of its aggregate Community-wide turnover within one and the same Member State".

[83] The merger threshold operates as a proxy for an analysis of the effects of the merger. See Green Paper on the review of the Merger Regulation COM(96) 19 final, OJ [1996] C 58, para. 31.

[84] Article 4(5) of the EU Merger Regulation also provides for another possibility of referral. According to this provision, a concentration which does not have a Community dimension within the meaning of Article 1 of the EU Merger Regulation and which is capable of being reviewed under the national competition laws of at least three Member States may be referred to the Commission if none of the Member States involved has expressed its disagreement. The merger will thus be deemed to have a Community dimension and shall be notified to the Commission.

[85] ECN Activities in the Food Sector – Report on competition law enforcement and market monitoring activities by European Competition Authorities in the food sector, ECN Subgroup (May 2012), available at http://ec.europa.eu/competition/ecn/food_report_en.pdf (noting a case in Portugal concerning tomato seeds, where the food processor Sugalidal had used contractual clauses which made the purchase of tomatoes conditional upon the seller buying tomato seeds from Sugalidal's subsidiary; a case in Bulgaria regarding a cartel for price agreements in the sectors of production and distribution of sunflower seeds, processing of seeds, and production and trade of sunflower oil; a case in Spain, closed with a commitments decision, on the obligation imposed on farmers to acquire

production portion of the food supply chain are barely examined in publications by Commission officials in charge of competition law enforcement initiatives in the food supply chain[86].

Monsanto's licensing contracts have been found in some jurisdictions to provide the company the possibility to influence strategic decisions of licensee companies, thus transcending the object of the agreement. By significantly affecting the independence between the parties, these contracts were considered as a structural change that could be analysed under merger control rules[87].

For instance, the Brazilian Administrative Council for Economic Defence (CADE) approved with restrictions four operations involving licensing agreements through which *Monsanto do Brasil Ltda* authorized other companies to develop, produce and sell, in Brazil, soybean seeds with Intact RR2 PROTM technology, owned by Monsanto. CADE conditioned the approval of the transactions to the change of clauses that gave Monsanto the possibility to influence the strategic decisions of the licensee companies. This influence did not only reach seed production with Intact technology but also extended to the total production of the licensee companies.

The contractual provisions established a compensation mechanism for the licensee companies, based on sales of the Intact product and on the sales of certified seeds of Monsanto's competitors. Had a licensee company chosen to expand its production by also using a patent from a competing product, the compensation from what had been produced with Intact technology would have been reduced accordingly. Monsanto's competitor should have then counterbalanced the offer by paying for the correspondent profit reduction.

The rise of this "contract agriculture"[88], the farmers entering into "take it or leave it" long-term exchanges with only a few companies controlling germplasm lead

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sunflower seeds from the companies to whom they sold the final sunflower production; and a sector enquiry in Bulgaria on the competitive environment of the markets for production and trade of sunflower seeds and oil).

[86] Philippe Chauve, Antonia Parera and An Renckens, Agriculture, Food and Competition Law: Moving the Borders, (2014) 5(5) Journal of European Competition Law & Practice 304-313.

[87] On this case, see Vinicius Marques de Carvallo, Agreements and Competition Enforcement: The Choice between Preventive and Repressive Channels, in Barry Hawk (ed.), *Annual Proceedings of the Fordham Corporate Law Institute* (Juris, 2014) 37-47, pp. 41-42.

[88] Neil E. Hart, The Age of Contract Agriculture: Consequences of concentration in Input Supply, (2000) 18(1) Journal of Agribusiness 115-127; James MacDonald et al., Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities, (2004) Agricultural Economic Report No. 837 9, available at http://www.ers.usda.gov/media/284610/aer837_1_.pdf .

to a smaller share of the revenue from production going to the farmer, the lion's share of the revenue ending up with the global seed companies holding the rights to the technology involved. One may also note that the effect of these strategies is reinforced by the increasing financialisation of agricultural commodities trade, financial speculation on agricultural commodities being facilitated by the creation of new financial devices with the aim to establish private insurance markets through forward trading that would substitute for existing public price-control mechanisms set in order to protect farmers from market price fluctuations. However, the development of such commodity futures trade triggers price fluctuations through self-reinforcing speculation, thus putting the farmers at the mercy of big market actors, in particular global seed companies, which develop one-stop shop solution businesses providing farmers insurance with regard to their yields[89].

The development of quasi-integrated vertical platforms, through contractual licensing restrictions constitutes a significant development in the industry. It has been noted that

> "[…] the organization of the transgenic seed industry has shifted fundamentally over the past two decades from separate ownership of agricultural biotechnology and seed assets to integrated platforms. These platforms comprise three major levels: (1) innovation involving genetic transformation technologies and genomics; (2) genetic traits that are expressed in plant agronomics, including insect resistance (Bt) and herbicide tolerance (Ht); and (3) state-of-the-art seeds containing genetic traits, for which seed companies are the major distribution channel for ultimate sales to farmers. Most current-generation transgenic seeds contain multiple or "stacked" genetic trait"[90].

These seed platforms may be established for benign reasons, for instance the prospect of economies of coordination that potentially arise from complementarities between complex research and development. However, seed platforms may also result from a strategy to create or enhance market power through control of patented technology and distribution channels for delivering transgenic seeds to farmers[91].

[89] Jayati Ghosh, The Unnatural Coupling: Food and Global Finance, (2010) Journal of Agrarian Change 10 (1) 72–86.
[90] Diana L. Moss, Transgenic Seed Platforms: Competition Between a Rock and a Hard Place?, (23 October 2009) AAI Submission, p. 2.
[91] Ibid.

This has occurred partly because of the expansion of IP rights in this sector, as instead of negotiating for the rights to a competitor's technology, it was simpler, cheaper, or more advantageous to acquire the competitor outright.

There is also a variety of competition models characterizing the industry. As it is reported by Diana Moss,

> "[…] two non-mutually exclusive models of competition characterize rivalry in transgenic seed--inter-platform and intra-platform competition. In the first case, rivalry is between transgenic seed platforms. Seed containing traits that are exclusive to a single firm are the product of such platforms. Intra-platform competition involves rivalry within platforms whereby firms develop new transgenic seed products, in part, by obtaining access to [] patented traits [within the platform]. […] What model of competition is likely to produce the greatest benefits for competition and consumers poses key a question for antitrust enforcement"[92].

Some have argued that these different forms of competition should be reflected in the definition of the relevant market, the market for patented traits being defined as a separate market than that for traited seed, "when those rights are marketed separately from the products in which they are used"[93].

Firms have the choice to either opt for an open system in which different complementary assets (such as genetic traits and seed germplasm) interoperate well with rival technology, or to develop "closed" platforms. This choice involves "fundamental decisions to promote open source versus proprietary technologies, "plug-and-play" versus non-standardized components, and tactics that are designed to frustrate rivals' access to needed technology"[94]. Competition in this context may occur between platforms and within platforms.

Competition authorities should make efforts to promote inter-platform competition, but also intra-platform competition. This is important in view of the consolidation of the industry and the significant competitive position of some global seeds companies which control, through ownership or through a great number of cross-licensing or joint-venture agreements, large, totally closed platforms in

[92] Ibid., p.12.
[93] Daryl Lim, Living with Monsanto, (2015) Michigan State Law Review 559, 649, also noting that high production costs and technological "irrelevance" may not make conventional or organic seeds substitutable to traited seeds.
[94] Diana L. Moss, Transgenic Seed Platforms: Competition Between a Rock and a Hard Place?, (23 October 2009) AAI Submission, p.12.

transgenic seed that may be challenged only by the unlikely emergence of rival platforms. This may lead to single-firm dominance and the foreclosure of competitors from the access to technology that is critical for intra-platform competition. A combination of a more active competition law enforcement *ex ante* (through merger control) as well as *ex post* (abuse of dominance, anticompetitive agreements) in this sector and more government funding for research might promote alternative platforms. Furthermore, the development of global commons for germ plasm and traits may further develop innovation, while promoting a more competitive market structure[95].

Diana Moss explains that as the dominant player in the market for genetic trait, Monsanto acquired numerous independent seed companies between the mid-1990s to late 2000s, beefing up its presence in downstream markets for traited seed with the effect that it has been to create vertically integrated platforms of genetic traits and traited seed. In order to stack traits, a developer must combine its own traits with those of Monsanto or another rival. In view of Monsanto's important share in genetic traits, the number of possible traits combinations that could be created between non-Monsanto developers is limited, with the result that the majority of stacked trait combinations contain a Monsanto trait[96].

The possibility of generic competition in transgenic seed, following the end of some Monsanto patents is also limited, without the development of an institutional structure for promoting and managing generic competition and incentives for the

[95] On the need and strategies to develop global commons for germ plasm and traits, see *inter alia* M. Halewood, I. López ega & S. Louafi (eds.), Crop Genetic Resources as a Global Commons 9Routledge, 2013); W.P. Falcon & C. Fowler, Carving up the commons—emergence of a new international regime for germplasm development and transfer, (2002) 27 Food Policy 197–222. Possible solutions may be inspired by the emergence of global commons for other natural resources, such as microbial commons: see, T. Dedeurwaerdere, Global microbial commons: institutional challenges for the global exchange and distribution of microorganisms in the life sciences (2010) 161 Research in Microbiology 414-421; E. Brousseau, T. Dedeurwaerdere, P.-A. Jouvet and M. Willinger (eds), Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms (Oxford University Press, 2012). This trend towards the formation of global commons will become even more pronounced following the implementation of the Nagoya protocol on Access to Genetic Resources, a supplementary agreement to the Convention on Biological Diversity, adopted in 2010 (and which entered into force in 2014). See, T. Dedeurwaerdere, P. Melindi-Ghidi & A. Broggiato, Global scientific research commons under the Nagoya Protocol: Towards a collaborative economy model for the sharing of basic research assets (2016) 55(1) Environmental Science & Policy 1-10.

[96] Daryl Lim, Living with Monsanto, (2015) Michigan State Law Review 559, 636, notes that Monsanto's Roundup Ready technology "has become an industry standard or de facto standard essential patent," opening the possibility of compulsory access to the Roundup Ready under either the essential facilities doctrine or the patent misuse doctrine.

dominant player in this market to facilitate the development of generic products[97]. According to Diana Moss, "(a) myriad of adverse effects potentially flow from this, including reduced or lower quality innovation in transgenic seed, higher seed prices to farmers (i.e., "technology fees"), fewer transgenic seed choices, and higher commodity prices than what would have prevailed under competitive market conditions"[98].

Finally, one may add the transformation of farmers from risk-taking entrepreneurs that dispose of important incentives to innovate to agents, or simply labor, for seed companies, receiving fixed compensation and not incurring any significant risks. This reduces the overall incentives to innovate of a significant number of economic operators in this economic sector and eventually limits the possibility of applying some competition law provisions to these vertical relations. Farmers and seed companies may be considered, in some circumstances, forming a "single undertaking", for instance when seed companies hold ownership of the product with the producer under contract.

B. Farmers: Antitrust's Fallen Heroes?

It is not yet clear whether such level of penetration into the typical farming business is sustainable for farmers as independent economic entities. Considering the recent trend of global agrochemical players to build IT-platforms to sell decision-making services to farmers complementary to their already existing product portfolios these companies will have access to information that has never been collected and shared before. The farmer becomes critically dependent on the product mix from a single provider or a limited number of providers. This may result in a shrinking choice for farmers of seeds cultivars. A recent study by Hilbeck et al. of farmers' choice of seeds in four EU countries with different levels of GM crop adoption, showed that in Spain, which has adopted GM maize, the seed market appeared to be more concentrated with fewer differentiated cultivars[99].

[97] Diana L. Moss, Transgenic Seed. The High Technology Test for Antitrust?, (Spring 2010) Competition Policy International, Competition Policy International, 10(2).
[98] Diana L. Moss, Transgenic Seed Platforms: Competition Between a Rock and a Hard Place?, (23 October 2009) AAI Submission, p.12.
[99] Angelika Hilbeck et al., Farmer's choice of seeds in four EU countries under different levels of GM crop adoption, (2013) 25(1) Environmental Sciences Europe 12, available at http://www.enveurope.com/content/25/1/12.

Another study conducted by Benbrook found that contrary to the argument of biotech crop proponents that genetically-engineered crops reduce pesticides use, "the spread of glyphosate-resistant weeds in herbicide-resistant weed management systems has brought about substantial increases in the number and volume of herbicides applied"[100]. The study documented that farmers had to increase pesticides use in the United States over the period of 1996-2011 by 7% (equivalent of roughly 183 million kgs).

In some sense, farming as an industry becomes increasingly *commoditisized*, meaning that farmers are finding themselves outsourcing more and more critical inputs (i.e., seeds) and decisions (through IT decision-support systems) to global agriculture solutions providers. The farmer's only value added is his labor, by which we mean actual efforts spent on growing the harvest. The farmers are increasingly losing control of seed materials (this decision in turn defines the mix of crop protection products and other inputs), and very soon they will outsource other decision-making capabilities. In the long run, to stay competitive farmers will be forced to use high quality seeds supplied to them from a limited number of global players, and an associated array of complementary products to these seeds from the same number of providers. Also, they will be using relatively the same agriculture machinery from the other limited group of global equipment providers such as John Deere, CNH, AGCO, Claas, etc.

Farmers' labor commoditization means that the only available choice to compete will be cost reduction. As a result, one might expect a further trend of small and mid-sized farmers to exit the market, further expansion of the big farms and vertically integrated agriculture holdings. In some countries where agriculture industry to a significant extent consists of small and mid-sized farmers – i.e., India, Brazil, China, selected Latin-American and African countries – this may be a rather painful process.

Ultimately, consumers will probably benefit from these trends by getting agriculture products at cheaper prices. However, this will be largely at the expense of the farming industry. One may also argue that a measure of consumers' welfare should also include a quality dimension, including sustainability and quality of food

[100] Charles M. Benbrook, Impacts of genetically engineered crops on pesticide use in the U.S. – the first sixteen years, (2012) 24 Environmental Sciences Europe 24, available at http://www.enveurope.com/content/24/1/24.

(in terms of nutrient value), or that, at least in order to include these dimensions in competition law and policy, mergers (and at least horizontal cooperation agreements) in the food sector should be assessed under broader public interest standards.

Ironically, the interests of farmers and consumers were considered as largely compatible in the formative years of the Sherman Act. The role of the Granger movement and their revolt against the monopoly power of railways in the passage of the Sherman Act has long being highlighted[101]. Some agricultural cooperatives were excluded from the scope of the Sherman Act with Section 6 of the Clayton Act 1914, which also provided an exemption for labor unions. According to this provision, the antitrust laws should not be construed to prohibit the existence and operation of agricultural organizations instituted for purposes of mutual help and allowing individual members of such organizations to carry out these "legitimate objects", the "labor of a human being […] not [being] a commodity or article of commerce".

Passed in 1922, the Copper-Volstead Act further provides for an exemption from antitrust liability to allow farmers to join together on collectively marketing or processing commodities they produce. The statute is implemented by the USDA which may file complaints against cooperatives that engage in a monopoly or a restriction of trade to such an extent that the price of the commodity is "unduly enhanced"[102]. Christine Varney observed how "the Capper-Volstead Act's proponents viewed cooperatives as a bulwark against 'middlemen' and 'speculators' that unfairly preyed on both farmers and consumers", these firms "collecting [their] tribute from both the farmer and the consumer"[103]. The scope of the exemption was however narrowly construed by US courts[104].

EU competition law also includes derogations for producer organizations, on the basis of the Common Agricultural Policy (CAP) provisions of the EU Treaties and

[101] Hans Thorelli, The Federal Antitrust Policy (Baltimore: John Hopkins, 1955), p. 143. See, however, the criticism on the influence of the agrarian movement in the passage of the Sherman Act by George Stigler, The Origins of the Sherman Act, (August 1983) Working Paper No. 27, available at http://www.chicagobooth.edu/assests/stigler/27.pdf.
[102] 7 USC § 292.
[103] Christine Varney, The Capper-Volstead Act, Agricultural Cooperatives, and Antitrust Immunity, (2010) The Antitrust Source 1-9, pp. 2-3.
[104] See, Christine Varney, op. cit.; Peter Carstensen, Agricultural Cooperatives and the Law: Obsolete Statutes in a Dynamic Economy, (2013) 58 South Dakota Law Review 462-498; John M. Connor, Antitrust Developments in Food and Pharma, (February 2015), available at SSRN: http://ssrn.com/abstract=2616799 or http://dx.doi.org/10.2139/ssrn.2616799.

related secondary legislation[105]. It is worthy of note that the extent of such specific regimes of immunity for agricultural cooperatives have been expanding in the EU while they have been shrinking in the U.S. It is remarkable that these exemptions aim to protect farmers from the superior bargaining power of retailers downstream[106]. The recent draft Commission guidelines on the specific competition rules for common market organisations (including agricultural cooperatives) active, for instance, in the arable crop sector, however, omit any reference to the important power exercised by the upstream input of production suppliers, in particular global seed companies.

From a political economy perspective, it may make sense for emergent and developing jurisdictions to take into account the inter-country distribution of the total surplus value of the global food value chain when designing their competition law interventions in this area. The high concentration in food supply chains, in particular in the factors of production level including seeds, and the bargaining power that ensues have been examined by a briefing note of the UN special rapporteur on the right to food, which is of particular interest for our study, in view of the emphasis put on the "direct link between the ability of competition regimes to address abuses of buyer power in supply chains and the enjoyment of the right to adequate food"[107].

The report highlights concerns over the strategies of input suppliers and their bargaining power vis-à-vis farmers. Faced with a reality of decreasing revenues, small farmers are pressed to produce even more agricultural commodities in order to earn short-term income in an attempt to meet daily expenses, which leads to oversupply and the vicious circle of further depression of prices, sometimes even below the average cost of production. This has particularly devastating consequences in the developing world and emerging economies, these effects not being alleviated through a high level of state subsidies, as it is the case in Europe, for instance. The special rapporteur recommends that "competition law regimes should be improved to comport with general human rights principles of equality and

[105] See Articles 169, 170 and 171 of the CMO Regulation and the recent Draft Commission Notice, Guidelines on the Application of the Specific Rules Set out in Articles 169, 170 and 181 of the CMO Regulation for the Olive Oil, beef and veal and arable crops sectors, (2015), available at http://ec.europa.eu/competition/consultations/2015_cmo_regulation/draft_guidelines%20_en.pdf.
[106] See, Ioannis Lianos and Claudio Lombardi, Superior bargaining power and the global food value chain: The wuthering heights of holistic competition law?, Concurrences I-2016, pp. 22-35.
[107] Olivier de Schutter, Addressing Concentration in Food Supply Chains, (December 2010) Briefing Note 03, available at http://www.srfood.org/en/briefing-note-addressing-concentration-in-food-supply-chains, p. 1.

non-discrimination, and to facilitate the realization of human rights, including among others the right to food, the right to work, and the right to development"[108].

More concretely, this implies that countries exporting agricultural commodities should not adopt "competition laws focused on consumer welfare on the model proposed by the OECD," but should instead seek to "ensure that, in the competition law regime that they set up, they offer a sufficient high level of protection of their producers against abuses of dominant positions by commodity buyers, food processors or retailers, as part of their obligation to protect the right to food under their jurisdiction"[109].

For the special rapporteur, "substantive competition laws should recognize that consumer harms arising from excessive buyer concentration are incipient and therefore indeterminate in character, but that this indeterminacy should not be a reason for failing to control such conduct", a "more enriched conception of consumer welfare" being needed, "one that takes account of consumers' interests in sustainability – rather than focusing purely upon short-term price changes"[110].

In view of the inability of major developed countries' competition authorities to control excessive buyer power, because of the remoteness of the effects of such power on their consumers, according to the effects doctrine,[111] developing

[108] Ibid., p. 4.
[109] Ibid., p. 5.
[110] Ibid.
[111] The rapporteur notes that Section 6(a) of the Foreign Trade Antitrust Improvements Act (FTAIA) provides that jurisdiction of the US Sherman Act can be established only where extraterritorial conduct has "direct, substantial and reasonably foreseeable effect" on trade or commerce in the US, these concepts being interpreted restrictively by the US courts. Hence, conduct by large buyers that has remote effects on consumers may escape the scope of the Sherman Act. He gives the example of a 9th Circuit court of appeals case in *U.S. v. LSL Biotechnologies*, 379 F.3d 672 (9th Cir. 1945), in which the defendant, a US corporation, had imposed a foreign supplier-developer of tomato seeds, a contractual clause preventing it from supplying any other buyer in the U.S. According to the US DOJ, Antitrust Division, such clause would have made less likely innovations from the foreign supplier-developer in the creation of heartier tomato seeds that would have allowed consumers to enjoy higher quality, better tasting winter tomatoes. The judge dismissed these arguments noting that the "delay of possible innovations does not have a direct effect on American commerce". The special rapporteur notes that the EU effects doctrine may catch this type of behavior as the EU courts have interpreted the requirement of the immediate and substantial effect in the EU broadly "to pertain not so much to economic effects, but to the structure of the market".

With regard to the US, it is well known that the 9th circuit in earlier cases had adopted a strict standard for directness of the effect on American commerce, as the effect must follow from "an immediate consequence of the defendant's activity." *US v LSL Biotechnologies*, 379 F.3d 672 (9th Cir. 2004).

In 2012 the Seventh Circuit took a different approach in *Minn-Chem Inc. v. Agrium Inc*., 683 F.3d 845 (7th Cir. 2012), where it introduced the " 'reasonably proximate causal nexus" standard, which enables a more expansive interpretation of Section 6(a) of the Foreign Trade Antitrust Improvements Act (FTAIA). This more expansive view was confirmed in the recent Motorola II judgment of the Seventh Circuit, *Motorola Mobility v. AU Optronics Corp*., 773 F.3d 826 (7th Cir.

jurisdictions, in which the majority of impoverished farmers are located, should set up "credible competition authorities of their own". The special rapporteur concludes that

> "[…] developed countries, especially those where dominant agribusiness buyers are domiciled, should be more active in addressing the creation, maintenance and abuse of such buyer power, with a view not only to protecting the suppliers, particularly in developing countries, from the impacts of abuses of dominant positions, but also to ensur[e] the longer term stability of supply for consumers.
>
> Developing countries where food insecurity is widespread in the rural areas and where violations of the right to adequate food of small-scale farmers are common, may wish to create competition regimes that impose on buyers specific duties, or subject them to specific types of control, in certain supply chains or for certain commodities that are particularly important to the revenues of small-scale farmers, with a view to preventing types of conduct which result in harm[] to the welfare of producers"[112].

VI. Conclusion

The rising levels of consolidation of the seeds market globally, because of the expansive M&A strategies of the various players and the dense network of cross-licensing arrangements and IP pools, leads to the emergence of a tighter oligopoly in this important segment of the global food value chain. This may raise interesting issues as to the need of such consolidation for a more intensive R&D effort, and

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2014), petition for cert. filed, 83 U.S.L.W. 3745 (U.S. March 16, 2015), where the Seventh Circuit revisited a more restrictive interpretation of Section 6(a). In Motorola I, *Motorola Mobility v. AU Optronics Corp*., 746 F.3d 842 (7th Cir. 2014), the Court rejected the existence of a "direct" effect on U.S. commerce because of the fact that the anti-competitive behaviour was affecting intermediary and not final products.

The Second Circuit also adopted the more expansive "reasonably proximate causal nexus" standard in *Lotes Co. v. Hon Hai Precision Indus. Co*., 753 F.3d 395 (2d Cir. 2014) (conduct was considered as within the scope even if it affected intermediary products).

In a recent judgment the Ninth Circuit nevertheless insisted on the restrictive approach of "the immediate consequence test," *US v. Hui Hsiung*, 778 F.3d 738 (9th Cir. 2015), petition for cert. filed, 83 U.S.L.W. 3745 (U.S. March 16, 2015).

[112] Olivier de Schutter, Addressing Concentration in Food Supply Chains, (December 2010) Briefing Note 03, p.6.

more generally, on the allocation of the total surplus among the various segments of the global food value chain.

At the same time, farmers relinquish functions, such as risk management, in favour of integrators, thus leading to an informal quasi-vertical integration at the global scale of the production segment of the global food value chain, which also has broader social implications that are not usually examined in competition law assessment.

One may advocate the consideration of value chains, or more generally the overall value of transactions,[113] in assessing the thresholds for merger control, as the turnover of past business years does not necessarily represent the competitive significance of the transaction, in terms of the likely reduction of potential competition.

It is also possible to think of assessing mergers and other transactions leading to consolidation of the seeds market from a public interest perspective, in view of the broader concerns animating public policy in this context and the existence of a nexus of international commitments as to biodiversity, sustainability, the right to food etc[114].

[113] This type of threshold has also been suggested for the review of mergers in digital markets that present similar problems of under-inclusiveness for the current turnover thresholds, in view of the highly evolving nature of this market and the impact of merger activity on potential competition. See, Monopolkommission, Wettbewerbspolitik: Herausforderung digitale Märkte, Sondergutachten der Monopolkommission gemäß § 44 Abs. 1 Satz 4 GWB (June 2015), available at http://www.monopolkommission.de/index.php/de/homepage/84-pressemitteilungen/286-wettbewerbspolitik-herausforderung-digitale-maerkte .

[114] Biological diversity is protected at the international level by the Convention on Biological Diversity adopted in 1992. The aim to guarantee a fair and equitable sharing of benefits arising from genetic resources is further implemented by the Nagoya Protocol on Access to Genetic Resources, a supplementary agreement to the Convention on Biological Diversity, adopted in 2010 (and which entered into force in 2014).

The Nagoya Protocol sets out core obligations for States contracting parties, including domestic-level access measures with the aim to create conditions to promote and encourage research contributing to biodiversity conservation and sustainable use and benefit-sharing obligations for the benefits arising from the utilization of genetic resources as well as subsequent applications and commercialization, subject to mutually agreed terms (monetary or non-monetary). According to the Protocol, "(e)ach Party shall take legislative, administrative or policy measures, as appropriate, with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities, in accordance with domestic legislation regarding the established rights of these indigenous and local communities over these genetic resources, are shared in a fair and equitable way with the communities concerned, based on mutually agreed terms" (Article 5 of the Nagoya Protocol).

Legal obligations arising out of environmental protection laws and sustainability norms included in international treaties and national constitutions also frame public action relating to the preservation of competition in the context of the food value chain. For instance, the EU treaties include a general integration clause at Article 7 TFEU, according to which "(t)he Union shall ensure consistency between its policies and activities, taking all of its objectives into account and in accordance with the principle of conferral of powers". Sustainable development constitutes a fundamental objective pursued by the European Union, according to the Treaty of Lisbon. With regard

The role of public authorities, including competition authorities, in supporting the development of commons for germ plasm and traits, as well as in putting in place a vibrant generic biotech crops market, constitute additional strategies in order to open up access to the seeds market and loosen the pressure that input suppliers, in particular global seed companies, exercise on farmer's revenues.

This raises important questions as to the sociological categories protected by competition law (consumers, farmers, small & medium undertakings), and the explicit consideration of the distributive implications of competition law enforcement, also at the level of a specific jurisdiction. Although there is important work on the effects of IP rights and IP strategies on innovation in agricultural biotechnology, there is little analysis over the distribution of the value brought by the innovations introduced throughout the various segments (and actors) of the food value chain[115].

Concerns over inequality and the role competition law may play in this context[116] may justify claims for a "fairer" distribution of the total surplus value resulting from innovation, and for an increasing focus of competition law enforcement on the way the total value is allocated between the various segments of the chain, but also among the various jurisdictions in which economic actors are involved in this value creation. These important challenges may justify the rethinking of some of the core concepts of competition law enforcement and the rehabilitation of concepts that have been long excluded from mainstream antitrust law jargon, following the shift from the era of populist antitrust to the current neoclassical price theory driven theoretical framework[117]. This may prove crucial for developing jurisdictions that are

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to environmental protection, Article 11 TFEU provides that "(e)nvironmental protection requirements *must* be integrated into the definition and implementation of the Union's policies and activities" (emphasis added) .

The inclusion of these provisions will inevitably lead the Commission and arguably the Courts to grant more importance to broader public interest concerns in some circumstances. See, I. Lianos, Some Reflections on the Question of the Goals of EU Competition Law, in *Handbook in EU Competition Law: Substantive Aspects*, I. Lianos and D. Geradin (eds.), (Edward Elgar, 2013), 1-84.

[115] Of particular interest may be some recent studies on the distribution of financial value from innovation in the global supply chains of iPods and notebook computers and the role of bargaining power in this context. See, J. Dedrick, Who profits from innovation in global value chains?: a study of the iPod and notebook PCs, (2010) 19(1) Industrial and Corporate Change, 81-116.

[116] Anthony Atkinson, Inequality: What can be done? (Harvard University Press, 2015), in particular his Proposal 2(a) that **"**Public policy should aim at a proper balance of power among stakeholders, and to this end should (a) introduce an explicitly distributional dimension into competition policy […]".

[117] For instance, one may think of the need to rehabilitate the concept of superior bargaining power, or more generally, relational market power, although not the populist antitrust version of it, but one that may rely on recent economic thinking, including non-cooperative game theory, behavioural economics etc. For a discussion, see Ioannis Lianos & Claudio Lombardi, Superior bargaining power and the

concerned by the way they may maintain or improve ("upgrade") their position in the various global value chains[118].

global food value chain: The wuthering heights of holistic competition law?, Concurrences I-2016, pp. 22-35.

[118] United Nations Conference on Trade and Development, *Global Value Chains and Development: Investment and Value Added Trade in the Global Economy*, UN Doc UNCTAD/DIAE/2013/1 (2013).