An overview of the appropriability mechanisms used in plant biotechnology industry

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Abstract

This paper aims to discuss the main appropriability mechanisms used by biotech firms to avoid imitation and appropriate the economic benefits from crop innovations. To this end, we analyze the strategic links between the technological development of genetically modified organisms (GMO) and the ownership rights over plant transformation technologies. We also discuss a key case study - the legal battle between Monsanto and Syngenta by the control of the GMO crops derived from the GA21 gene. Our findings show that a system of blocking patents has been built basically through strategies relating to intellectual property mechanisms. As result, Monsanto's efforts to sue competitors for patent infringement have proved to be a successful barrier to entry in plant biotechnology industry.

Keywords: genetically modified organisms; innovation; blocking patents; barrier to entry.

1. Introduction.

The development of agricultural biotechnologies began in the 1980s with the use of recombinant DNA technology in cultivated plants. These research efforts gave rise to the first generation of genetically modified organisms[1] (GMO), popularly termed as transgenic seeds. The development of GMO requires several crop transformation methods and a good relationship with the "plant breeders" (Qaim & Traxler, 2005). In the subsequent stages, related to the commercialization of transgenic seeds, it is also necessary to establish relationships with users, competitors and suppliers, characterizing a huge mobilization of complementary assets (Graff, Rausser, & Small, 2003).

[1]A GMO is a plant whose genotype was altered by genetic engineering techniques (Qaim, 2009).

Thus, crop genetic engineering makes room for commercial strategies carried out largely by companies linked to the seed industry (Silveira & Borges, 2012). However, for many decades, the large multinational companies feared the weak appropriability conditions in agriculture. This skepticism drove away private investments in crop markets.

Until 1977, the patents over living organisms were not accepted in any country, including the United States. In that year, the US courts ruled that natural products could not be patented per se, but only if they presented some modification due to the human intellect intervention. In 1980, as a result of the Diamond vs. Chakrabarty Case, the US Supreme Court decided to grant the first genetically modified bacteria patent. These two decisions have removed the main legal obstacles to the patenting of genes and GMO.

The strengthening of the intellectual property (IP) regime contributed to reduce the uncertainties over the plant breeding programs, especially the concerns regarding the appropriability of the profits from innovation (Rausser, 1999). As result, the top 3 agrochemical companies – Monsanto, Dupont and Syngenta – were attracted to the seed industry during the 90s and the 2000s. Since then, the market value of these firms is highly dependent on the development of plant biotechnologies and on their protection through IP rights.

Considering this context, this paper aims to discuss the main appropriability mechanisms used by biotech firms to avoid imitation and retain the economic benefits from GMO crop innovations. To this end, we study the strategic links between the technological development and the ownership rights over plant transformation technologies. We also discuss a key case study - the legal battle between Monsanto and Syngenta by the control of the GMOs derived from the GA21 gene. Our findings show that, in contrast with the models based on Kenneth Arrow's perspective, a system of blocking patents has been built basically through strategies relating to IP mechanisms.

The remainder of the article can be broken down into the following sections: Section 2 presents a theoretical framework to analyze appropriability strategies while Section 3 brings the discussion to the context of plant biotechnology. Subsequently, Section 4 highlights the IP mechanisms that were effectively used by Monsanto to deter its rivals and Section 5 presents the final remarks.

2. Theoretical framework: Appropriability of technical innovations.

The ability of a firm to appropriate the economic results from innovation is crucial to building and sustaining a competitive advantage (Laursen & Salter, 2014). Several studies have pointed out that firms use several appropriability mechanisms simultaneously to protect their innovations rents against imitators (Arundel, 2001; Cohen, Nelson, & Walsh, 2000; Levin et al., 1987). Among those mechanisms, the authors emphasize: i) patents and other legal mechanisms; ii) complementary assets, including sales, manufacturing and marketing capabilities; iii) product and process secrecy; v) quick market entry to capture first mover advantages against rivals.

The survey conducted by Cohen, Nelson, & Walsh (2000) reveals that in most sectors the complementary assets and the industrial secrecies tend to be the appropriability mechanisms most used by firms while patent documents occupies a secondary position in corporate strategies for capturing the profits from innovation. The chemical industry, especially the pharmaceutical sector, is an exception. In these industries,

patents have played historically a central and effective role in protecting innovations and, consequently, the licensing practices have been widely disseminated (Arora, 1997).

These findings seem to support the Teece's (1986) statement that the private value of an innovation depends heavily on the complementary assets of the firm that intends to exploit it. The same studies also highlight the firms' intensive efforts to control the communication flows between their workers and the external environment in order to ensure that trade secrets are retained by the firm.

In most industries patents have been a fragile incentive to foster innovations (Marengo, Pasquali, Valente, & Dosi, 2012). However, in recent years, patent applications have grown strongly in all economic sectors. These ambiguous facts suggest that – in parallel to the protection of the inovation profits and to the collection of royalties – the IP efforts can involve other corporative motivations. Firms use patents not only to avoid other companies from copying their technology but also to block other competitors from entering their markets (Reitzig, 2004).

The literature has identified two kinds of blocking patents able of hinder market entry conditions and the emergence of new firms. In the case of industries where the patenting of substitute inventions (i.e. inventions functionally quite like each other) is possible, firms tend to focus their efforts in building patents fences around a core invention. This concept refers to the patenting of products and/or processes that may replace the original invention (Arora, 1997; Reitzig, 2004).

Another kind of patenting strategy emerges in complex industries. The development of complex products requires sequential innovations that combine several previous inventions. Patent laws sometimes assure to the holders of upstream inventions some ownership right over subsequent downstream innovations. This set of overlapping IP rights is called patent thickets (Shapiro, 2000). Because of these overlapping patents, an infringing inventor may have to pay royalties to multiple right holders. Due to patent thickets, companies have less incentive to development new complex technologies (Chu, 2009; Heller & Eisenberg, 1998).

3. Biotechnology, agriculture and intellectual property

According to Goeschl & Swanson (2003), the presence of a typical phenomenon of life science sectors (human and animal health, as well as plant biotechnology) leads to much less R&D investment than what would be allocated if the researches were conducted by a central planner. The reason is what the authors term "adaptive destruction", which is the loss of the economic value of a biotech product due to the evolution process of pests, which can eventually occur over a period shorter than the patents lifetime.

As pest resistance to biotechnological solutions get stronger and faster, the gap between the private investment in R&D and the socially desirable value tends to increase. This market failure is not corrected by the patenting system (Yerokhin & Moschini, 2008).

The propositions put forward by Goeschl & Swanson (2003) run counter to the evidence of a period of intense patenting of plant biotechnologies after the start of GMO cultivation in 1996. The seed industry faced many uncertainties in the second half of the 1990s, which coincided with an intense patenting effort in this sector. Therefore, IP rights, especially, but not only, biotech patents, helped to sustain huge plant breeding programs and firms' appropriability strategies (Marco & Rausser, 2008).

Heller & Eisenberg (1998), as well as Wilson (2007), stressed that the multiplication of patent thickets (see

Section 2 above) in biotech sectors could generate a new type of market failure. The famous "tragedy of the commons" refers to problems of overutilization of the resources due to the absence of property rights. The increase of blocking patents leads to an opposite market failure called “tragedy of the anti-commons”. The development of a new GMO integrates different types of biotechnological tools (e.g. vectors, markers, promoters, etc.). It is observed, therefore, the emergence of numerous right holders able to charge royalty fees over these intermediary technologies. As result, these overlapping charges tend to reduce the usage of the biotechnological tools themselves.

On the other hand, several authors have pointed out the crucial role of mergers and acquisitions (M&A) for mitigating the problems caused by blocking patents (Marco & Rausser, 2008; Shapiro, 2000). In a similar vein, Fulton & Giannakas (2001) argue that the M&A can reinforce the complementary assets required for protecting knowledge assets. According to the last authors, the top biotech companies usually combine complementary assets and patent rights with the aim of deterring new entrants and gaining market share.

4. Case study: the legal battle between Monsanto and Syngenta.

The development of a new GMO needs to integrate multiple scientific knowledges and several complex technologies. Graff, Rausser, & Small (2003) identified three groups of assets that must be used to accomplish this task: i) the DNA fragments responsible for encoding new agronomic traits in plants; ii) enabling technologies , i.e., the genetic engineering techniques used for inserting these genetic sequences into plants or for regulating the gene expression process; iii) the agronomic cultivars selected to receive the exogenous genes. The IP lawsuits presented below primarily encompass enabling technologies patents.

The roots of the conflict between Monsanto and Syngenta date back to the joint research agreements signed by the companies Calgene, Aventis and Dekalb in the early 90s. In this period, Aventis and Dekalb had the ownership of the main biotechnologies necessary to create herbicide-tolerant maize plants. The research efforts performed by Aventis improved the genes discovered by Calgene in the 1980s. On the other hand, Dekalb patented the bombardment techniques able to introduce these genes into cells. Under the 1991 agreement, Calgene and Aventis agreed to license their genes to Dekalb, which become responsible for performing the crop transformation. The GA21 gene was development through these joint research efforts. In 1994, the original agreement was reformulated. During these negotiations, Dekalb omitted some key information about the field tests conducted on its GMO crops. The company was accused by Aventis of violating the previous agreements. The lawsuit was won by Aventis and, as a result, Dekalb lost all its property rights over the GA21. The court also reinstated Aventis’s exclusive rights in regard the transgenic seeds derived from this gene. Bayer acquired the GA21 from Aventis in 2002 and, then, sold it to Syngenta. Furthermore, the takeover of Dekalb by Monsanto occurred in 1998.

Monsanto has opted for developing herbicide-tolerant seeds through the insertion of the CP4 gene. Despite its preference for this gene, the company tried hard to avoid the emergence of another GMO derived from the GA21. In mid-2006, when Syngenta finished the tests conducted on Maize Agrisure™, Monsanto filed two lawsuits accusing the Swiss company of patent infringement.

The first case was judged by the United States Court of Appeals. Syngenta was accused of infringing the bombardment techniques claimed by patents No. US5538880 and US6013863. The Federal Court

presented several evidences that the insertion of the GA21 gene into maize plants through the particle bombardment method was first performed by Dekalb in 1993. Therefore, Syngenta did not perform, directly, this process, since the company legally purchased (from Bayer) the GMO containing the GA21 gene. Consequently, the Federal Court ruled that Syngenta did not infringe the patents No. US5538880 and US6013863.

Monsanto and Syngenta had a second legal altercation over the scope of the patent No. US5554798. This document demands legal protection for plant promoters used for developing fertile transgenic maize plants. Syngenta denied that its products have violated any kind of property rights. According to the Swiss company, the patent No. US5554798 did not specify the type of promoter used by Monsanto. Under this perspective, the legal document cannot cover the "rice actin" promoter that was incorporated into the Maize Agrisure ™.

Monsanto replied that the biotechnological tool termed promoter concerns the DNA construct that instructs the cells to start the biochemical processes that will result in the proteins synthesis. Therefore, the patent No. US5554798 covers all types of plant promoters. Unlike the previous lawsuit, the verdict promulgated in 2007 by the Missouri Court was favorable to Monsanto. One year after this sentence, the Swiss company negotiated an agreement with Monsanto that aimed to dismiss all the lawsuits between them.

5. Conclusion

As the case study analysis illustrated, Monsanto's appropriability strategies have been strongly grounded on patent enforcement rights. The ownership rights to exclude competitors from using some key biotechnological tools have acted as a strong barrier to entry able of slowing down rival companies. In this sense, the paper adheres consistently to the classic idea that patents are an important appropriability mechanism in certain industries, some of which are created by innovation itself, as the plant biotechnology sector (Arora, 1997; Marco & Rausser, 2008). Moreover, our findings are also consistent with those of Heller & Eisenberg (1998), for whom the patenting of enabling technologies could generate blocking patents, in such way that the outcome of this IP strategy is sometimes socially undesirable.

Backing to Section 3, it is admissible that pests are now more resistant to GMO products, as shown by the appearance of new glyphosate-resistant weeds. However, at no point in our study was it clear that the decline of R&D efforts in plant biotechnologies occurred due to this biological adaptation process, as argued by Goeschl & Swanson (2003). Instead, we highlighted some key IP strategies to raise entry barriers and to guarantee a significant market share that, at the same time, could have discouraged new researchers from coming to seed industry.

6. References

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