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The "soy-ization" of Argentina: The dynamics of the "globalized" privatization regime in a peripheral context

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ABSTRACT

Based on extensive fieldwork conducted with actors from public, private and associative sectors, we explore the expansion of genetically modified soy in Argentina and we aim to figure out how the neoliberal "globalized privatization regime" unfolded in a peripheral location. Our case points at two inherent contradictions with such a regime's main tenets, namely that it needs a weak antitrust policy (thus leading to a market situation dominated by a monopoly of transnational companies) and a hyper-restrictive system of intellectual property. We highlight the participation of two groups of local actors in the regime. The first group is aligned with the globalized privatization regime agendas, while the second is involved in protest and regulatory actions focusing on the health, environment and safety issues related to the GM soy complex. To a different extent, both groups share a local agenda of resistance and an anti-imperialist imaginary. Both have national development objectives of Argentina in their ideological roots, although their conceptions of "development" are different (industrial development vs. protection of peasants' life and the environment). We conclude that it is not enough to postulate that the neoliberal globalized privatization regime will just expand to the South as it did in Northern countries. Rather, combined with the commercialization of science, peripherality creates protest, activism and local regulation.

1. Introduction

Biotechnology has been considered "the engine of a knowledge-based bioeconomy" [1–4], which refers to an economy based on industrial and economic sectors that "produce, administer and exploit biological resources and related services" [1]. It aligns with neoliberal proposals and narratives by renouncing to the passive notion of a *laissez-faire* economy in favor of an active approach to the spread and promotion of "free markets" [5, p. 661]. For Science and Technology Studies (STS) scholars, this turns biotechnology into a central site to "study up" [6, p. 225] and analyze current reconfigurations concerning corporate globalization, the increasing commodification of science, and rising social inequalities as a result of a weakening Welfare state. A renewed focus on "structural dimensions of power and the inequalities in knowledge policies" [7, p. 7] is required to analyze in which ways these dynamics are more profitable to some specific social groups. The commercialization of science, as has been discussed in STS by Mirowski and Sent [8, p. 665–662], addresses a "globalized privatization regime", characterized, among others, by the privatization of publicly funded research, commercial agreements eluding national controls and a general trend toward a commodification of scientific knowledge.

In those outstanding and timely critical STS contributions to a better understanding of how exactly the

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external political-economic forces of neoliberalism are transforming technoscience [5,9–13], what we often find missing are studies which go "beyond the charmed circle of Organization for Economic Cooperation and Development (OECD) countries" [14] to take into account the full texture of interesting developments that are taking place in other countries, for instance Latin American. The literature on the commercialization/privatization of science is no exception to this: the peripheral contexts and the international division of labor most of the times remain out of the scope of the STS analysis. In the 1970s and 1980s, the simple message was that core countries focus on higher skill, capital-intensive production, and the rest of the world focuses on low-skill, labor-intensive production and extraction of raw materials. In today's multipolar world, big countries like India or China, or middle-size countries like Brazil or Argentina show internal tensions and a blurring of the international division of labor: just like with other sectors such as ICT or media, agricultural biotechnology introduces new patterns.

In Argentina, genetically modified (GM) crops have turned into a central axis of the national economy. Indeed, GM soy, corn and cotton crops encompass 23 millions hectares of cultivated land, and the sector has generated enormous accumulated gross benefits over the last 15 years [15,16]. But how are these benefits distributed? Who gets the gains and who endures the risks and eventual impacts of the global expansion of GM crops? In her analysis of biotechnology in an age of imperialism and neoliberalism, Sheila Jasanoff [17, p. 288] doesn't seem to have any doubt about it as she argues: "GM crops are developed in the laboratory, usually in science-rich Western nations, tested in the field, and transported thence for commercial propagation in both naturally and socially variable environments. Monsanto, in this respect, is like the Kew Gardens of the nineteenth century: a metropolitan "center of calculation" from which standardized products flow out to take root in the world's economic and political peripheries". We find this quote all the more challenging as it captures what we want to test and scrutinize more closely in this article. We will review the case of GM soy in Argentina in order to explore what it tells us about the unfolding of a neoliberal "globalized privatization regime" [8]. Our starting hypothesis is that there are complexities that turn out to be neglected by Mirowski and Sent's characterization, which are linked to the impact of neoliberalism and bioeconomy in peripheral or semi-peripheral contexts.[2]

How has such a regime developed in Argentina? Can we point at trends that reflect the general pattern of commercialization of science, or do we see different dynamics, contradicting this general pattern to a certain extent? Are central (corporate and political) power and resources unevenly distributed at the expense of the periphery? To what extent has the peripheral character of Argentina influenced the process of biotechnology's expansion in this country? We have chosen to focus on GM soy for two reasons. On the one hand, with 19.5 million hectares planted, which represent half the total cultivated area, GM soy ranks first among crops cultivated in Argentina [15]. On the other hand, in contrast to neighboring countries such as Brazil, the development of the GM soy complex in Argentina has gone through a number of peculiar conditions that render it particularly interesting in order to explore the ambiguities, complexities and in-between situations that can take place when the neoliberal globalized privatization regime takes root in a semi-peripheral country.

To inform our analysis, we rely on literature and secondary data analysis as well as on an extensive fieldwork that was conducted in the cities of Buenos Aires and Rosario during 2010 and 2011. A first stage involved 8 interviews to local experts in science, technology and innovation (STI) policies and institutions, and was aimed at understanding the institutional landscape, rules and arrangements that shape current science, technology and innovation developments in Argentina. The second stage included 31 semi-structured interviews to actors involved in the GM soy complex or that have had a saying in the public discussion around it (including members of the academia, public administration, seed and agricultural production, regulation, distribution sectors, and related civil society organizations). This stage was aimed at getting to know the opinions of a number of actors on the identification of stakeholders and the assessment of the biosafety and intellectual property rights regime, as well as on the socio-technical controversies around social and environmental impacts attributed to GM soy adoption—such as deforestation, the displacement of other crops and of cattle raising, soil degradation, and the increasing use of agrochemicals due to monoculture.

In the next sections we start with a brief outline of how GM soy was introduced in Argentina and significantly expanded in scope and impact. Then, we rely on the peculiarities of the case study to point at two inherent contradictions with the globalized commercialization of science's main tenets. This does not, however, lead us to deny the inclusion of Argentina in such a regime. Rather, we confirm the progression of a neoliberal "capture" of biotechnology in Argentina, with the active participation of local actors connected to international value chains and relying on the backing of national regulatory agencies that have harmonized regulation with that of importing countries and international agencies. Against this background, we also find local actors concerned with the impacts of what has been called by critics the 'soy-ization' or the 'Pampean-ization' of Argentina, since GM soy expansion has gone well beyond the Pampa's region, traditionally devoted to agriculture and cattle raising, reaching diverse settings in the North-Eastern and North-Western provinces

[2] We borrow these terms "peripheral" and "semi-peripheral" from world system analysis (WSA). WSA divides the world between core, semi-peripheral and peripheral countries. The core-periphery dichotomy is a relational concept: it lies on the inability of the periphery to develop an autonomous and dynamic process of technological innovation because the terms of trade are structurally favoring the center at the expense of the periphery. In theory, core countries try to maintain their privileged position in the world-system, while peripheral countries cannot do much to change their situation. Semi-peripheral countries, like Argentina, are comparatively more advantaged in the global economy but they are also in a most fragile position: they compete with other semi-peripheral countries to obtain the core status and to avoid to be demoted to the periphery.

of the country. These actors operate at the margins of the GM regulatory regime in Argentina: they are spokespersons of social movements and NGOs that are concerned with the impacts of the GM soy complex on public health, the environment and native communities, among other aspects. Although these issues have been overlooked by political and corporate elites since the introduction of GMOs in Argentina, recently they have gained visibility in the public agenda, and attracted the attention of academic, corporate and policy actors.

2. The embedding of GM soy in Argentina

After the early and fast adoption of glyphosate-tolerant GM soy in 1996, of which we are going to further explain the reasons below, Argentina has today become the world's second exporter (after the US and before Brazil) and world's third producer (after the US and Brazil) of GM crops. It is estimated that Argentina gathers 15% of the world's production of GM crops. As of 2012, local regulatory authorities have licensed 27 GM crops. In a decade, benefits derived from GM soy only have been estimated at US$ 20,000 million (77.4% received by producers, 9.2% by technology developers and 13.4% by the Argentinean government in export tariffs).[3] Unlike other key players in the GM production business such as Brazil and the US, which also rely on strong internal markets, Argentina exports almost all of its soy production—of which 98% is GM—to China and India (mainly as oil), and to Europe (mainly as flour for feed for a decade; and lately, also as biofuel). Thus, soy is not a mere commodity: it is being processed and added a value in Argentina, before being exported. Soy and soy products already represented more than a fifth of Argentinean exports in 2004: more than US$ 7100 million out of 31,491 million [20]. Today, this figure has increased to a 25% of the exports [21].

But this is not just a story of how GM technology was successfully introduced in Argentina. STS scholars have long demonstrated that technologies are "configurations that work" [22]. This is why "it makes little sense to conceive of, and to try and measure the performance of technology as artifacts in isolation. Artifacts certainly have potential to perform certain functions but they do nothing until they are linked and aligned with other social and technical elements to form a working configuration" [23]. In the case of GM soy, the configuration is very much in line with the commercialization of science narrative and the neoliberal emphasis on privatized and commodified knowledge. Since the 1980s, in Argentina like elsewhere in the world, the GM agriculture market has gone through a phase of consolidation and transnationalization, and became dominated by multinational companies, with only a small participation left to local/national companies as well as an abrupt drop in public funding [24, p. 115–116]. In the case of GM soy, corporate R&D conducted at the multinational Monsanto was aimed at developing more than a mere technological innovation: it led to the making up of a "technological package", commercialized in Argentina almost at the same time than in the US, the leading GM country, and then the rest of the world. This package includes the GM soy seeds specifically developed by Monsanto in order to be tolerant to its systemic, wide-spectrum herbicide glyphosate, sold under the commercial name of Roundup.

Combined with new agricultural techniques well adapted to Argentinean conditions, mostly no-till farming, RR soy has been by far the most rapid adoption of any seed variety in Argentina, including those introduced in the Green Revolution [25]. However, as we demonstrate in the next sections, the tremendous adoption of RR soy in Argentina cannot simply be explained as just one more achievement of the neoliberal globalized privatization regime. Actually, the Argentinean case even contradicts two main features of this regime, namely that it needs a weak antitrust policy (thus leading to a market situation dominated by a monopoly of transnational companies) and a hyper-restrictive system of intellectual property [8, p. 657]. Whereas an important element that has influenced international legislation is the intellectual property system based on patents, imposed by the US to protect their interests in the global economy [35], we will see it has not proven to be as successful in Argentina as in other countries. Rather, in the case of RR soy, one can speak of a technological package "free of patents", embedded in a permissive IP regime [36] as well as in a relatively open, non-monopolistic market dominated by private companies and not limited to multinationals, a fact due to exceptional circumstances more than to a strong antitrust policy of the government.

2.1. The expansion of a technological package "free of patents"

The seed market in Argentina is well divided in two: the autogamous and the hybridized crops. The Argentinean law, in line with the International Union for the Protection of New Varieties of Plants (the UPOV 1978 norms, which Argentina ratified in 1995), allows growers to replant their own seeds. This is particularly relevant in the case of autogamous crops like soy because the quality of the seed does not change from one generation to another, as it happens for corn hybrids, for instance. In the 1990s, replanting and a lack of controls facilitated the expansion of an illegal seed market, called "white bag" market ("de bolsa blanca"). According to some estimation of the Argentinean Association of Protection of Plant Varieties (ARPOV), in 2002 only 23% of planted soy seeds were certified. In addition, GM soy seeds from Argentina (also called "Maradona soy") were also imported illegally in Paraguay and Southern Brazil without significant impediments. In this market of autogamous crops, there are today a few multinational companies together with national ones. In the more profitable market of hybridized crops, the situation is much different: it is dominated by multinational companies. In terms of generating economic value, both markets

[3] This information comes from Ref. [15]. We draw the reader's attention to the fact that these indicators only consider the first ten years after the approval of GM soy in Argentina (1996–2006). However, some interviewees we met more recently pointed at a slight reduction of profit for producers, mostly but not solely to the benefit of the government: new figures are 75% for producers, 15% for the government and 10% for the technology developers [18,19].

are more or less equally rewarding, because even in spite of illegal activities, the autogamous market, dominated by soy, is substantially larger in volume.

A number of exceptional circumstances have been advanced to explain how GM soy expanded so rapidly in Argentina. We can start mentioning the fact that the patent of glyphosate had expired in 1991. This has been important because, as Ablin and Paz [37] note, in the 1980s glyphosate was more expensive in Latin American than in central countries (US$ 40 per liter), a situation which changed dramatically in the 1990s when the price dropped to US$ 10, and less than US$ 3 in 2001—less than one third of its price in the US. When RR soy was approved by Argentinean regulatory agencies in 1996, there were already 14 companies selling glyphosate-type herbicides; in 2001, there were 22 of them. Another circumstance is that a risk regulation system had been settled in 1991 (the first regulatory agency of the sub-continent, see Refs. [36] and [38]), thus five years before the first GM event's approval. In addition, there was an increase of the international demand for soy proteins, a phenomenon that is not deemed to weaken today with biofuels. A weak, unarticulated contestation also played a role in the rapid expansion of GM soy. More generally, the fact that the rapid introduction of GM crops did not provoke a full-blown controversy for many years in Argentina may be attributed to a series of reasons: its history as an agro-exporting country; the low involvement of consumers' associations, that were more concerned with other impacts of neoliberal policies; the active support of biotechnology by mainstream newspapers; and the fact that, in Argentina, scientists, public officials, firms and associations of producers actively promoted biotechnology in the name of their expertise in this domain and the country's long agricultural tradition [20 and Pellegrini 2011]. And as it was previously mentioned, the simultaneous integration of no-till farming techniques was important, too.

But above all, one additional key explanatory element of GM soy's expansion has been that the transnational company Monsanto could not patent the event in Argentina, contrarily to what happened in most other countries in the world, including Brazil [26]. This has had huge effects on the cost of the GM soy seeds, which was lower that what it would have been if the IP regime had been favorable to Monsanto's interests as it has been the case elsewhere with stronger IP regimes. No later than in early 2000s, some scholarly works were already highlighting the benefits that GM soy adoption represented to Argentine farmers. Meninato (2001) estimated that using RR soy instead of conventional soy permitted a cost decrease of US$ 27 per hectare. Penna and Lema [25] attributed the gross benefits of planting RR soy to the low cost of glyphosate. Qaim and Traxler [26] calculated a cost difference between RR and conventional soy of US$ 23 per hectare. Finally, Trigo and Cap [27] calculated that the cost reduction obtained by the use of RR soy in Argentina amounts to US$ 20/hectare and they have forwarded this as the major explanation for the advance of the crop in the country.

But how was it possible that Monsanto could not patent its technological innovation? This is due to various interrelated exceptional circumstances [16]. The story begins in the early 1990s, when Asgrow International, a company owned by UpJohn, signed an agreement with Monsanto to introduce the gene tolerant to glyphosate in its cultivars of soy. Little time after that, Upgrow sold its subsidiaries in Latin America. The multinational company Nidera bought Asgrow Argentina and, consequently, had a "natural" access to its developments, including the events tolerant to glyphosate. This is why it was Nidera (and not Monsanto) the company who asked for the regulatory approval of RR soy, which was granted by the regulatory agency (CONABIA) in 1996. In the mid-1990s, Monsanto bought the grain and oilseed business sector of Asgrow International. Then, Nidera lost the access to new biotechnology developments but it continued to enjoy the ones it had on previous biotechnologies, including RR soy. Thus, when Monsanto tried to patent the RR-tolerant soy in Argentina, it was told that event was already "liberated" [25–29].

A masterpiece in this story has been an Argentinean breeder, Rodolfo Rossi, a man many actors refer to as "the soy archetypal breeder" ("el hombre de la soja"). After obtaining his degree in Agronomic Engineering at the Universidad de Buenos Aires during the mid-1970s, Rossi joined the Argentinean subsidiary of the US company Asgrow, where he was a corn, sorghum and soy breeder from 1977 till 1987. He then became the Head of Asgrow's R&D division between 1987 and 1991. Asgrow Argentina was the first company to develop soy varieties adapted to Argentina's peculiar characteristics, from the early 1980s on. Later, in early 1990s, Rossi explains: "I was part of a group of four breeders, all working at Asgrow (the three others were from the US), with the explicit task to engineer the first varieties of soy tolerant to glyphosate and adapted to both tempered and tropical Latin American climates" [28]. In 1991, when Nidera bought Asgrow Argentina, Rossi became Nidera's Head of Research of the soy department, a position he still holds today. The first public acknowledgment of his role as "el hombre de la soja" has been the award of the Grain Stock Exchange in 1999. Another acknowledgment of his important role in developing transgenic varieties resistant to glyphosate and adapted to the Argentinean context has been his appointment, in 2004, as the President of the Argentinean Association for the Soy Chain, which aims at the promotion of this crop.

2.2. Monsanto's fight for royalties

Nevertheless, although during many years Monsanto was able to collect royalties from the seeds it sold, and local companies agreed to pay it a fee—mainly to have access to its future developments—it finally fought against the impossibility of patenting the RR soy event.[4] In mid-October 2003, the company announced it would put on hold a US$ 40 million investment in Argentina arguing "lack of a clear midterm strategy in the country and lack of adequate intellectual property protection policy," [30] according to a press account. After investing US$ 185 million in 5 years—of those, US$ 136 million in a new

[4] For a more detailed and complete analysis of the "battle for royalties", see Ref. [20].

glyphosate plant in Buenos Aires province—Monsanto had found that its revenues in Argentina had fallen 30% in 2003 due to the economic crisis. The same press account also mentioned Monsanto's concern about the black market of seeds, as well as the companies' expectations regarding the commercial approval of its RR corn.

This announcement was linked to the ambiguous position of Argentina's administration regarding the dumping case against Chinese glyphosate ingredients. "They're going after (royalties) a bit more aggressively now than perhaps they had in the past because they realize they may be losing some business on their chemical side," commented an international analyst [31]. Argentine experts also shared this interpretation [32]. However it is also difficult not to link Monsanto's renewed aggressive attitude with Brazilian government's second exceptional decree authorizing farmers to replant RR soybean seeds, which opened the door to a "transgenic Americas"—as Argentinean officials put it—and secured this technology position in the world market [20]. Indeed, one very important point to mention is how much Monsanto *benefited* from this permissive IP regime that, by allowing the massive expansion of illegal seed "white bag" market beyond the national borders of Argentina to Brazil and Paraguay, created a lock-in the technological package in the whole region[5] Once this lock-in was generated, the benefits Monsanto could expect from this permissive IP regime were close to zero; hence the company started a more aggressive strategy to obtain royalties.

But that was just the beginning of the final battle for RR soy royalties in Argentina. In January 2004, Monsanto made another announcement: it would stop selling soybean seeds, due to the increasing black market of seeds. According to trade estimations, Monsanto's revenues in Argentina had dropped from US$ 580 million in 2001 to US$ 300 million in 2002. Press accounts, while pointing at abolition of the seed regulator (INASE) in 2000 as "the root of the problem," also reported that Monsanto's decision was "widely seen" as an attempt to press Argentina's government into passing more stringent laws regarding seed commercialization [33]. At the international level, Monsanto sued the Argentinean government in Denmark and in the Netherlands, and even went to the European Court of Justice after its failed attempt to patent the RR soy. Before it finally lost the case, the company decided in 2004 to give up its corporate activities in Argentina.

Between 2004 and mid-2012, there were no Monsanto's seeds sold in Argentina. However, the situation has recently changed, with the approval of a stacked event: RR2 PRO, a GM soy that is tolerant to glyphosate and resistant to insects, which has been presented as the avant-garde of a new generation of events, although it is the first stacked event approved in Argentina [33bis]. During those years, however, Monsanto was able to collect important benefits from the sales of its Roundup herbicide (these sales account for 40% of the glyphosate-type herbicides market, which is shared with 53 other brands than Roundup [18,19]) as well as from the sale of its GM corn and cotton seeds. Actually, in this latter case, private regulatory efforts on the part of Monsanto have been more successful than the seed regulator (re-established in 2003 under the law 25.845) at intervening in the configuration of the informal seed production and delivery system, albeit motivated by the firm's loss of income from the extensive trade in uncertified seed rather than in ensuring that seed quality is improved (see Ref. [23] who discuss the GM cotton case). This now also holds true for soy: indeed, Monsanto has signed private agreements with local companies, granting them access to its newly introduced events, in exchange for a fee. Since the soy germoplasm best adapted to Argentina is not in Monsanto's hands, these agreements actually expand Monsanto's reach, while at the same time let other companies—notably, Nidera as well as the local company Don Mario, which jointly dominate the soy seed market—continue making profits out of Monsanto's biotechnology developments.

In the future, the IP regime could shift toward a distribution of benefits more favorable to technology developers, who have consistently claimed they do not receive a fair return on their investments in technological innovations [18,19,27]. Technology developers and seed growers associations have been lobbying for a new seed law for a long time, and it occurs that the Ministry of Agriculture is currently assessing the various possibilities to establish a new, stricter IP regime, more able to protect the rights and to ensure royalties for technology developers' products by restricting the right to replant one's own seeds [21, 33bis]. However, there is more at stake than securing the private companies' benefits: the new IP regime should not suppress the right for small-scale, poor family farmers to replant their own seeds. Nevertheless, this does not apply for soy as it does for cotton [23,34], because the soy requires large-scale commercial farming and is not suitable for family farming. As Pellegrini [21] notes, this project to reform the IP regime would imply a profit transfer from the local agrarian *bourgeoisie* to private multinational companies. Interestingly enough, it does not seem to generate much conflict, which makes a striking difference with the former attempt of the government to dispute those profits (the "resolucion 125" case, see Ref. [39]).

While intellectual property has played an important role in the shift to a privatization of science regime, Mirowski and Sent [8, p. 661] recall that IP should not be confused with the *cause* of the modern privatization of science, which was instead attributable to the larger shift in the nexus of science management and funding. Regulatory agencies, which we want to briefly address in the next section, have been integral part of such a larger shift: by providing an institutional structure in line with the commercialization of science's agenda, they contributed to create lock-ins and irreversibility [40] on the privatization's path. Indeed, as we will see, they provided the regulatory practices of corporate power and delineated the risks to be considered as legitimate before the release and commercialization of a GM event in a way that advances—or at least is compatible with—transnational companies' interests.

[5] This situation was due to the fact that the US, Brazil and Argentina dominate the global market of soy. Since the US and Argentina had already adopted GM varieties, once Brazil also did it, the world supply of soy would sooner or later became mainly GM.

2.3. The GM regulatory landscape

Regulatory agencies were established across the developing world in the 1990s "during a period when linked agendas of privatization and liberalization were dominant. As part of the so-called Washington Consensus, regulatory agencies reflected these agendas [41, p. 267]. As Dubash and Morgan [41] observe, the result is often an incomplete engagement with and insufficient embedding of regulatory agencies within local political and institutional context. Argentina was no exception to this: it took the decision to create the first regulatory agency in Latin America in 1991, thus 5 years before the first GM event to be approved, in the aftermath of a scandal that involved French and US labs in an experiment with a recombinant vaccine against rabies illegally introduced to Argentina [38,42]. The historical roots and detailed functioning of the regulatory agencies are explained elsewhere [34,36,38], so what we will just highlight for our purpose here is that the risk regulation landscape in Argentina is composed of three institutions/agencies: CONABIA, looking at environmental risks, SENASA, looking at health risks, and the market Direction looking at commercial risks. What is clear from this landscape is that it addresses specific risks—those related to health, environment and trade—but also overlooks other risks—e.g. more local impacts such as those related to small producers, like social consequences of restricting their use of their own seeds for replanting or their inability to compete with the large-scale commercial farming sector. As a matter of fact, along with the progress of the globalized privatization regime, biotechnology regulation has known a trend toward global harmonization of increasingly severe and complex testing [24,34,43]. In the case of Argentina, as many actors acknowledge, it was often in order to comply with the export destinations' (often European) standards of acceptability [18,19,28,29,44–48].

At the moment, because this landscape created certain irreversibility, it seems to be very unlikely that the Argentinean regulatory landscape would shift much. This is a key factor to our analysis, because unlike previous sections highlighting features contradictory to the globalized privatization regime's thrust, like the technological package "free of patents", the (globally harmonized) regulatory agencies evidence the advance of such a regime. Ironically, whereas at the beginning it was a claim from anti-GMOs stakeholders [49], the multinational companies were never against increasing the severity and complexity of risk regulation procedures before a GM event was approved for commercialization. The side effect has been that today only a small range of powerful private corporations can afford those costly and long processes of risk assessment. Public scientists, either at universities, CONICET (the national research funding agency) or INTA (the national institute for agricultural technologies), in spite of their long experience with working with GM crops,[6] find it difficult not to be dependent on multinational companies [50,51]. Nonetheless, new public-private partnerships today also emerge, as the recent joint venture between the private companies Arcadia Biosciences and Bioceres,[7] CONICET and the Universidad Nacional del Litoral in order to develop soy, wheat and corn crops tolerant to drought and salinity attests [48,50].[8]

3. Discussion: a local agenda for resistance and regulation

Argentina's peripheral location in the world-system encouraged the emergence of actors different from those raised Mirowski and Sent, but also pertaining to the configuration of this new phase of the commercialization of science. We especially think of two types of groups of actors.

The first group is made of actors that support public-private R&D partnership in biotechnology and claim the importance of a national strategic perspective, as the alliance of CONICET and the company Bioceres for a drought-tolerant event epitomizes. Unlike NGOs, this group of actors accepts the general terms of an overall privatization regime, but attempt to incorporate perspectives that take advantage from the strategic situation of Argentina. At the same time, they acknowledge the country's peripheral position, that forced its companies to enter into alliances with multinational corporations in order to put their developments in the market, like the example we gave with the US company Arcadia.

The second group is mainly composed of national NGOs (peasants movements like MOCASE Via Campesina or Rural Reflection Group) and scientists (see below) who combine a critical look at biotechnology, emphasizing anti-imperialism and food sovereignty.[9] During some protest actions, they have been joined by international NGOs such as Greenpeace, Friends of the Earth or WWF, although one could argue that those organizations are somehow part of imperialism too. The worldwide activist movements against genetically modified food provides an example of how social movements challenge scientific knowledge and emergent technologies, particularly around issues of risk and safety. However, activists and advocacy social movements also go beyond the risk and safety frameworks. For example, they frequently frame the debate and protest events around concerns with globalization and US food hegemony [59]. In the case of RR soy, the social activists and concerned stakeholders consider that the technological package also dramatically affect public health and the environment. They are especially worried about the impacts of what has been coined as a "soy-ization" or a

[6] Before turning to the dominant crops in the international scientific agendas—GM soy, corn or cotton—these scientists were focusing on more locally relevant crops, like GM potato (Pellegrini, 2011).

[7] Arcadia Biosciences is an agricultural technology company focused on developing technologies and products that benefit the environment and human health, and Bioceres, an agricultural investment and development company owned by more than 230 of South America's largest soybean growers. Together the two companies form Verdeca, a 50–50 joint venture. For more information see http://www.arcadiabio.com/news/press-release/arcadia-biosciences-and-bioceres-form-verdeca-agricultural-technology-joint-ventu.

[8] http://www.indear.com/web-esp/prensa-y-publicaciones/amplia-repercusion-de-la-patente-que-obtuvo-bioceres-en-argentina/.

[9] There we can situate the comparison between Monsanto and the Kew Gardens portrayed by Jasanoff [17] in the introduction.

"Pampeanization" of Argentina. The former term relates to a tendency, mainly in the Pampas, to grow soy instead of any other crops (or instead of cattle raising), because soy is more profitable and easier to handle. This had led to a lack of rotations between the crops and to a too intensive agriculture as well as an overuse of agrochemicals and fertilizers, thus decreasing the soil quality and favoring its erosion. The latter term, "Pampeanization", refers to the tendency to introduce agro-industrial crops such as soy in other provinces than the ones usually corresponding to such activities (the provinces of Santa Fe, Cordoba, Entre Rios, La Pampa or Buenos Aires), for instance in the north of the country (like the province of Salta). This has a number of consequences, first because it affects the soil's fertility and, second, it disrupts the ecosystems of those regions, by displacing indigenous population and by leading to deforestation. This situation has been the target of repeated campaigns from international NGOs like Greenpeace [49] or Friends of the Earth, denouncing monocultures and deforestation, and invoking some "scandalous" cases like when protected forests zones were sold for soy culture [20,49,55,56].

Another controversial issue concerns glyphosate and its side effects. Indeed, there are today a growing number of actors and movements from national and international NGOs, academia and sometimes even industry who are engaged in discussing the impact of glyphosate use and misuse on public health and the environment [42,45,47,49,52]. Some of them are industry and technology developers' associations, who consider that glyphosate is less toxic than herbicides previously widely used and they question toxicological classifications from the World Health Organization. The message they convey is that glyphosate may be too widely used or at least that it is sometimes used without the most basic safety precautions, and thus it would require more preventive measures, like information campaigns, to be taken by public authorities. Other actors, like environmental movements or some scientists [49,54–56], argue that the level of uncertainty regarding glyphosate safety is too high, pointing at the increasing number of cancer and malformation cases in areas close to fumigated fields, and even calling to its banning [[57], and [58] for a recent and as controversial European study].

These conflicting debates and worldviews, we argue, are not context but integral part of the neoliberal governance of biotechnologies and, as such, can be analyzed in terms of their resulting from, and indirect effects on the commercialization of science. Social, "risk movements" associated with emerging technologies and grassroots support organizations targeting science or the industry have always been of interest for STS scholars [59, p. 493]. To understand the phenomenon of the commercialization of science in Argentina, we find them very important. Indeed, *"at the margin"*[10] *of GM regulation*, there is a number of socio-technical controversies, which have aimed at various regulatory initiatives supported by social and environmental advocacy movements and some local scientists. Most often, private companies, local politicians and some other scientists in line with the commercialization of science challenge and oppose these actions. These alliances and protestation actions have led to the recent emergence of a complementary regulatory framework. This regulation at the margin results from compromises and is sometimes just in the course of solidification. We call this an "impressionist regulation" because like in painting it includes relatively small, thin, yet already visible "brush strokes" for the one who takes a step back and looks at the broader soy complex from a different (peripheral) angle. While this can be seen as just a number of disconnected, even informal additional measures, analytically they can be taken together in relation with the solid heart of the transgenic model and the way it is regulated because their spokesmen or representatives are engaged in similar issues—social, health, environment and safety issues related to the GM soy complex, that are overlooked by political and corporate elites—and they all face a resurgence of policy, corporate and academic interest.[11] What we thus see at the margin of the GM soy regulation is abundant examples of several laws, knowledge claims, protest and regulatory activities *around* the GM soy complex, which attest to the existence of a soft, impressionist regulation of GMOs in Argentina and complement as much as it challenges the risk regulation landscape as illustrated above.

For instance, with regard to limiting the deforestation activities (mainly in the North-Eastern and North-Western provinces), a "forest law" was approved by the Argentinean Parliament (law 26.331). It still fails to be applied because it depends on the provinces (sub-federal entities) but it is nevertheless presented by environmental activists as a success, since it may signal the end of soy expansion in the Northern provinces [49,55,56].

Concerning the impacts due to herbicide spraying, a number of lawsuits (especially in Formosa, Cordoba, Chaco and Salta provinces) concern the inappropriate use of glyphosate: they address the related side effects for health and the environment and prescribe stricter regulation for the use of agrochemicals in populated areas. Much scientific evidence it is referred to at those lawsuits has been produced by a national scientist, Andres Carrasco (Director of a laboratory in embryology at the Universidad de Buenos Aires and a former President of the CONICET), who is actively involved together with other activists — national and international NGOs, indigenous movements — in current efforts for limiting, reducing or even banning the use of glyphosate in the name of the precautionary principle (on those cases of social activism, see Ref. [52]. See also [53] for the Carrasco case).

[10] We borrow this expression from Rebecca Lave, who presented a communication entitled: "Neoliberalism and knowledge from the margins", Society for Society Studies of Science (4S) Annual Meeting, Cleveland 2011.

[11] This point is similar to what Rebecca Lave [60] analyses with the different types of environmental knowledge held by extramural science producers (like indigenous people or amateur scientists). She argues that those are surprisingly central to neoliberalism and that it is worth considering them as deeply interconnected if this is to see the fine-grained picture of neoliberalism and its effects on knowledge production.

Other laws can be mentioned too, like the 23.302 "indigenous law", which often fails to be applied but that aims at protecting the rights of indigenous people, in order, among other things, to protect them from being displaced as long as GM crops progress all over the country; and the 26.737 "land law", recently voted among other purposes to limit the capacity of foreigners to buy lands in Argentina. Related to this point, there are also heated debates about concentration of land use and the international investments in agricultural trusts called "pooles de siembra". "Pool de siembra" is the name given in Argentina to an agricultural production system characterized by the organization of a financial enterprise system that assumes temporary control of agricultural production, by leasing large tracts of land, and hiring seeding equipment, herbicide spraying, harvesting and transport, in order to generate economies of scale and high yields. After the harvest, profits made out of agricultural sales are distributed among the investors. The system plays a key role in the production of soy in Argentina today. "Pooles de siembra" were installed as one of the leading and most profitable business in the 2000s, accounting for a large part of the total area sown by soy [45].

Initially consisted exclusively of farmers seeking to gain scale, pools were gradually adopting an independent and open financial modality aimed at attracting capital from any source. Pools temporary lease lands and services for planting, spraying and harvesting GM soy. It is estimated by technology developers' associations that approximately 60% of the total planted areas are leased [18,19]. The pools have been criticized by various sectors, arguing that they favor the concentration of land use, tend to abuse their market power, displace small and medium producers, and increase environmental impacts by looking for short-term profits [49,54–56,61]. By contrast those who are in favor of "pooles de siembra" argue that they have allowed investors to join farming, while production costs have been reduced, multi-risk insurance business were introduced, as well as modern techniques in the management of land [18,19,27–29,44,45,48].

4. Conclusion

If we take a step back and summarize our findings, we see that the globalized privatization regime certainly applies to Argentina too, but due to the country's peripheral position it happens in a nuanced and contrasted way: Monsanto's inability to patent the RR soy in Argentina renders our case strikingly different from the situation in other neighboring countries, like Brazil. The "permissive IP regime" [36] "determined the low cost and ample adoption of the technological package, "free of patents". This permitted to access the GM technology at a lower price than in the US and led to significant economic benefits for the government due to export taxes, and for producers due to a better and more simple weed control. Concerning technology developers, the peculiarities of the Argentinean situation have facilitated the access of a number of private actors to the seed market, mostly transnational companies (e.g. Pioneer Hi-Bred, Dekalb, Nidera, Bayer Crop Science) but also national ones (e.g. Don Mario Relmó and La Tijereta). The low cost of the technological package (both the GM seed and the herbicide), the higher crop security for growers, and the ever-increasing international demand for soy (either for proteins or for biofuels), all these features contributed to the development and further expansion of soy far beyond the region of the Pampas, traditionally devoted to agriculture. Although the IP regime was more permissive than in other countries, the regulatory landscape has favored corporate interests at the expense of public research institutions.

In parallel, in addition to a group of local actors aligned with the globalized privatization regime agendas, we pointed at seemingly disconnected protest and regulatory actions highlighting the health, environment and safety issues related to the GM soy complex. Those actions today have a shared status as the product of targeted appropriation by policy, media and corporate actors. As such, this indicates that they gained in visibility, and possibly in credibility and respect, but this does not automatically equates with a greater social and environmental justice [60]. Interestingly, both groups have national development objectives of Argentina in their ideological roots, although their conceptions of "development" are different (industrial development vs. protection of peasants' life and the environment).

By contrast, the other actors of the transnational companies (Monsanto, Nidera, etc.) are key players in the global bioeconomy, but they see Argentina as a market from which to extract profits, rather than a country that should be developed. In this sense, from different perspectives, the two local resisting groups mentioned above may share an anti-imperialist imaginary [62],[12] while Monsanto *represents* that very imperialism. Monsanto's recurrence in some of our interviewees' discourses has been extremely high (for example [50,56]). Monsanto takes on the role of the usual suspect and, when criticizing "Monsanto" or its embodiments, some actors are criticizing at the same time multinational companies, the unlimited accumulation of capital growth as an indicator of well being, neo-colonialist attitudes of central countries, and the exploitation of Latin American resources by those countries.

When analyzing the dynamics of the commercialization of science beyond the charmed circle of OECD countries [14], we conclude that it is not enough to postulate that the neoliberal globalized privatization regime will just unfold and progressively expand to more countries at the expense of most Southern actors at the periphery. Rather, combined with the commercialization of science, "*peripherality*" [63] creates protest, activism and regulation at the margin. Thus, further research should devote time to address the joint and complex progression of both neoliberalism and its externalities in Southern countries.

Another important point comes from the peripheral position of Argentina, a country historically devoted to

[12] However, a difference lies in the fact that the interest of local actors supporting R&D in biotechnology might overlap with Monsanto's agenda to require a stronger system of IPR protection (this could not be the case of national NGOs). So there is an "economic cluster", which aims at stimulating a certain pathway of development by turning agricultural biotechnologies as a central axis of the national economy.

agricultural export, as a result of an international division of labor that dates from the late nineteenth century. In a semi-peripheral country as Argentina, the agenda of resistance to GMOs is very different from what is generated in the core countries. In Argentina, the most important issues are herbicide spraying, deforestation, monoculture, etc., but not risks linked to human consumption of GMOs. Those concerns have to do with Argentina as a producer rather than consumer of GMOs and that is related to its peripheral inclusion in the international division of labor.

This local agenda of resistance leads to the emergence of a more local regulatory landscape, linked to enforcement of a forest law, in search of a new law on agrochemicals, and addressing the toxicity of glyphosate. We think in this sense that the "impressionist" framework cannot be global regulation. On the contrary, it is different in the periphery than in the core because regulatory measures taken at the periphery do not necessarily apply to the core. By contrast, the majority of regulatory measures that originate in the core countries to facilitate trade are applied in peripheral contexts (standard biosafety regulation is used although consumption is not an issue considered as important locally: it is used because it facilitates international trade, not to protect consumers in the first place). Our results attest to a more complex relational concept of center-periphery. Centers and peripheries do not strictly correspond anymore to geographical characteristics; they also depend on the participation of actors situated in various locations, and speaking from various standpoints in a "globalized privatization regime".

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