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**AN EMPIRICAL INVESTIGATION OF THE PRODUCTION
EFFECTS OF ADOPTING GM SEED TECHNOLOGY: THE CASE
OF FARMERS IN ARGENTINA**

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**AN EMPIRICAL INVESTIGATION OF THE PRODUCTION EFFECTS
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OF FARMERS IN ARGENTINA**

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Introduction

During the 1990s, the market for biotechnology in the agricultural and pharmaceutical sectors became a major international economic force¹. One of the key factors influencing this market success is the investment in research and development (R&D) of new seed varieties². In the last decades investment in R&D switched from state-sponsored to private funding (Fernandez-Cornejo, 2004). At the same time, the market moved toward a strong concentration in a few multinational firms, which now control most of the biotechnological R&D around the world (RAFI, 1999 and Sirinivasan, 2003). These changes are happening at the same time that a revolution is advancing biotechnology within agricultural and pharmaceutical industries (Fernandez-Cornejo, 2004). In this new environment, with extensive private participation in the international market, the protection of intellectual property rights and its role in shaping the biotechnology market has been highly debated (Kesan, 2000; Kesan and Janis, 2001; Swanson and Goschl, 2000; Janis and Kesan, 2002; Goldsmith, Ramos and Steiger, 2002; Goldsmith, 2001; Lesser, 1998; Moschini, 2001; Moschini and Lapan, 1997; Rohrbach, Minde and Howard, 2003; Alston and Venner, 2002; Frisvold, Sullivan and Raneses, 2003; Graff, Rausser and Small, 2003 and Diez, 2002). Governments, international organizations, the private sector (firms and farmers), scholars and scientists are discussing how changes affect the market for seeds and how property rights should be defined and enforced to promote social welfare (Fernandez-Cornejo, 2004). To promote and protect their investments in companies abroad, developed countries have tried to enforce intellectual property rights over new seed varieties in developing countries. On the other hand,

¹ “The ISAAA projects that the global market value of transgenic crops will increase from between \$4.5 billion and \$4.7 billion in 2003, to \$5 billion or more in 2005. In 2002, the global market was estimated at \$4 billion, representing 15 percent of the \$31 billion global crop protection market and 13 percent of the \$30 billion global commercial seed market. The ISAAA says the estimated market value is based on the sale price of transgenic seed plus any technology fees that apply.” Doris de Guzman, Surge in US Biotech Crops Continues, Chemical Market Reporter, New York, V. 265, I. 15 April 12th 2004, at 13.

² The high cost of research and development is a limiting factor in emergence of biotechnology products: “Biotechnology is an expensive market to break into. Sources estimate that biotechnology research and development (R&D) costs more than \$200 million for just one product. . . . [G]etting a biotech drug to market is a difficult and expensive process. After years of laboratory research, hurdles consisting of clinical trials and governmental approval must be crossed before a drug can even make it to market.” Jay P. Kesan, Intellectual Property Protection and Agricultural Biotechnology: A Multidisciplinary Perspective, 44 AM. BEHAV. SCIENTIST 464, 465-66 (2000) (citation omitted).

developing countries have insisted on sustaining loose property rights systems in order to help their farmers and obtain new technologies at the lowest possible cost³.

In this article we will analyze the case of Argentina's property rights protection for genetically modified organisms. We analyze the case of Soybeans and use econometric techniques to understand both, the productivity impact of using genetically modified soybeans and why some farms, depending on their ownership structure, prefer to use these seeds, or not, given the uncertainty on property rights protection. We use a database of 3000 farms from the Province of Buenos Aires, provided by the Direccion Provincial de Estadisticas y Censo.

This article is organized as follows. The second section will provide a description of Argentina's corn and soybean markets. The fourth section will describe the evolution of intellectual property rights in Argentina. The fifth section will present empirical evidence using econometric techniques. Finally, we will present our conclusions.

Argentina in World Markets

Argentina and the United States are important actors in international agricultural markets. In Argentina, the market liberalization during the 1990s gave new impetus to agricultural production, and soybean was one of the crops that benefited the most.⁴ An intensified interest in new seed varieties and the introduction of genetically modified seeds in 1996 accompanied the impressive growth in grain exports.⁵

³ This seems to reflect a dichotomy between the Northern and Southern Hemispheres:

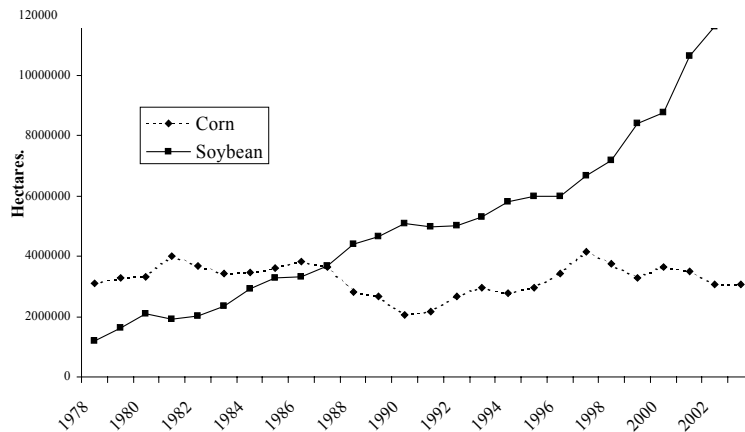
“The argument made by Northern countries is that while prices may rise in the short run, new technologies will be available over the long term and will, in turn, raise economic productivity. As the result of protected property rights, the South will gain from new investment. . . . For the net technology using countries (South) the significant short term costs may arise directly from an increase in the cost of the input due to the lack of complete substitutes and indirectly from the administrative and enforcement costs of a Northern style [intellectual property rights] IPR protection system. Adding to the complexity is the fact that welfare impacts are best understood in a dynamic context, as the short-term losses of strengthening the South's IPR regime are believed to be trumped by the long-term gain from economic growth.”

Goldsmith, Ramos & Steiger (2001), at 4.

⁴ See Randall D. Schnepf, Erik N. Dohlman & Christine Bolling, (2001).

⁵ See *id.* at 23.

GRAPH 1. Corn and Soybean Planted in Argentina⁶



Since the 1978-79 season the area planted with soybean in Argentina has steadily grown (Graph 1).⁷ The total growth from 1978 to 2003 reached 669%, while total production went from 2.5 million metric tons to 35 million in 2003. During the same period the area planted with corn declined 6.5%, but production increased 72.9% due to improvements in yield. The boom in soybean production has propelled Argentina into the spotlight in international markets. Total production of corn represented just 2.6% of total world production for the period 1999-2000 to 2001-2002. Nonetheless, total exports of coarse grains were 11.6% of total world exports (Table 2).

Argentina and the United States are among the largest exporters of grain and oilseeds (Tables 1 and 2). In the case of soybeans, the United States and Argentina represent 58.2% of total world exports, while Argentina is the main exporter of soybean oil and meal. The United States and Argentina are the leading exporters of coarse grains (Table 2). The United States also leads the world in wheat exports, and Argentina ranks fifth

⁶ For graph data, see Secretaria de Agricultura, Ganaderia Pesca y Alimentos (SAGPyA), Estimaciones Agrícolas, <http://www.sagpya.mecon.gov.ar/new/0-0/agricultura/otros/estimaciones/basestima.php> (last visited Mar. 18, 2006).

⁷ See *id.*

(Table 2). As a result, both countries play an important role in international agriculture markets. The strength of both countries in international markets is also reflected in the market for new seeds (Table 3). In this case, the United States is first in the consumption of new varieties, while Argentina is eighth. Finally, Argentina, following the United States, was one of the earliest adopters of genetically modified crops, especially soybean and corn.⁸ Since 1996, the Argentine government has approved the use of genetically modified seeds, and farmers have been adopting Roundup Ready soybean and Bt corn intensively.⁹ In the case of soybean, the area sown with genetically modified seeds rose from 6% in 1996 to 99.5% in 2002-03, while genetically modified corn increased from 0.25% to 40% during the same period; cotton went from 2.7% to 20%.¹⁰ Despite the impressive increase in new technological advances, there are important gaps in the amount of investment in research and development of new varieties, which are, in part, due to the investment gap between developed and developing countries.¹¹ Part of this gap also corresponds to the incentives offered by different regulatory regimes in each country.¹²

Given the important role the United States and Argentina play in international grain markets, an analysis of the differences in property rights legislation is meaningful to understand market behavior and the incentives producers face in each country.

TABLE 1. INTERNATIONAL EXPORTS IN SOYBEAN¹³

8 "In 2002 four countries accounted for 99% of total area sown with genetically modified crops: United States with 39.0 million hectares (66% of total), Argentina with 13.5 million hectares (23%), Canada with 3.5 million hectares (6% of total) and China with 2.1 million hectares (4% of total)." CARMEN VICIEN (2003)

9 See GAO (2000).

10 See DOMINGO (2003).

11 This gap is significant and may be growing:

In 1995 developed countries spent \$5.43 on public and private agricultural research and development for every one hundred dollars of agricultural output, compared with just sixty-six cents per one hundred dollars of output for developing countries. The eightfold difference in total research intensities illustrates the size of the technological gap in agriculture between rich and poor countries. Moreover, the situation is growing worse. The difference in public research intensity ratios was 3.5-fold in the 1970s, compared with 4.3-fold now. An even wider gap would have opened up if private spending was also factored in.

Pardey, Koo & Nottenburg (2004), at 218 (footnotes omitted).

12 See next sections.

13 For table data, see U.S. Dep't of Agric., Market and Trade Data, <http://www.fas.usda.gov/archive/asp> (last visited Mar. 18, 2006).

(Percentage of Total World Exports)			
	Soybean	Soybean Meal	Soybean Oil
Brazil	33.4	32.0	28.5
Argentina	13.7	42.8	50.3
Paraguay	4.4	1.8	1.9
Bolivia	0.5	2.2	2.6
United States	44.5	12.4	5.8
Canada	1.6	0.2	0.2
Asia	0.7	6.7	1.7
China	0.6	1.5	0.4
Rest of World	0.3	1.9	8.8

TABLE 2. INTERNATIONAL EXPORTS IN COARSE GRAINS AND WHEAT¹⁴
(Percentage of Total World Exports)

Coarse Grains		Wheat	
Argentina	11.6	Argentina	8.9
Australia	4.8	Australia	13.4
Canada	2.6	Canada	13.0
China	9.4	India	3.5
Brazil	3.6	Kazakhstan	3.9
Russia	2.2	Russia	6.4
South Africa	1.2	Syria	0.7
		Turkey	1.0
Ukraine	4.3	Ukraine	3.8
EU-25	5.9	EU-25	13.4
Others	4.5	Other Europe	1.1
		Others	5.7
United States	49.8	United States	25.1

Note: Coarse Grains include Corn, Barley, Sorghum, Rye and Oats

¹⁴ For table data, see U.S. Dep't of Agric., FASonline, <http://www.fas.usda.gov/oilseeds/circular/2006/06-02/toc.htm> (last visited Mar. 18, 2006).

TABLE 3. ESTIMATED VALUES OF COMMERCIAL SEED MARKETS¹⁵

Country	Internal Commercial Market (Million of Dollars)	
United States	5,700	23.2%
China	3,000	12.2%
Japan	2,500	10.2%
Commonwealth of Independent States	2,000	8.1%
France	1,370	5.6%
Brazil	1,200	4.9%
Germany	1,000	4.1%
Argentina	930	3.8%
India	900	3.7%
Italy	650	2.6%
United Kingdom	570	2.3%
Canada	550	2.2%
Poland	400	1.6%
Mexico	350	1.4%
Spain	300	1.2%
Netherlands	300	1.2%
Australia	280	1.1%
Hungary	200	0.8%
Denmark	200	0.8%
Sweden	200	0.8%
Other	1,967	8.0%
Total	24,567	

Seed Protection in Argentina: Evolution and Devolution of the Legal Protection

The legal framework in Argentina is far from the comprehensive protection provided for seed producers in the United States. Argentinean legislation has evolved over time, providing some timid increases in the protection of seed producers. In 1935 Congress enacted the first law regulating plant varieties.¹⁶ Although this legislation provided for the registration of new seeds and required government approval for new varieties to be introduced in the market, it did not provide any legal protection to

¹⁵ See FERNANDEZ-CORNEJO (2004), at 8.

¹⁶ Law No. 12253, called "Ley de Granos," was passed by Congress in October 1935. See Instituto Nacional de la Semilla (INASE), *Evolucion del fitomejoramiento y la produccion de semillas en nuestro pais. Estructuras oficiales y su marco regulatorio desde comienzos de siglo (1998)* [hereinafter *Evolucion*], available at <http://www.dpi.bioetica.org/ovnotas1.htm>.

intellectual property rights for the new seeds.¹⁷ In the following decades, succeeding governments created diverse agencies in charge of managing the regulatory system.¹⁸ In 1973, the Military Government passed the Law No. 20247 — the “Law of Seeds.”¹⁹ This was the first piece of legislation giving commercialization rights to the inventors of new seed varieties.²⁰ Although this law was a step forward in protecting intellectual property rights, it was not immediately enacted and had to wait until 1978 for its regimentation.²¹ Law No. 20247 provided for the creation of the National Seed Commission (Comision Nacional de Semillas, CONASE), in charge of advising and evaluating government policies regarding the regulatory regime.²² Second, it created a national registry and a property registry for new varieties, providing exclusive commercialization rights to the owners for a term between ten and twenty years, depending on the type of seed.²³ This system of varieties registration implied a two-step procedure: the inventor of a new variety should register the variety in the National Variety Registry²⁴ and then apply for a property certificate to be included in the National Registry of Property of Varieties.²⁵ Third, the law provided for the recognition of foreign seeds, but it established that the country of origin should provide similar protection for Argentine researchers. Furthermore, the term of the property rights was limited to the number of years left in the original certification of property granted in the country of origin of the variety.²⁶ Fourth, the Executive Power could declare a new variety to be of

17 *See id.*

18 *See id.*

19 *See* Law No. 20247, Mar. 30, 1973, B.O., *available at* www.sagpya.mecon.gov.ar/new/0-0/inase/pdf/Normativa/LEY-20.247.PDF.

20 Article 22 of the law states: “The property right of a variety will be given for a period no less than 10 and no more than 20 years, according to the type of plant and the regulations.” *Id.*

21 *See* Decree No. 1995/78, 1978, B.O.

22 The law provides:

The Commission will be formed by ten members designed by the Ministry of Agriculture and Livestock. . . . Five of the members will be State representatives, two from the National Agency of Agriculture Control and Commercialization (Direccion Nacional de Fiscalizacion y Comercializacion), two from the National Institute of Agriculture Technology (Instituto Nacional de Tecnologia Agropecuaria) and one from the National Grain Board (Junta Nacional de Granos). Five other members will represent the private sector, one from the seeders, two from the seed traders and production and two from the seed users. The Ministry of Agriculture and Livestock will name the president and vice-president from the members of the Commission.

Law No. 20247, Mar. 30, 1973, [volume] B.O. art. 5, *available at* www.sagpya.mecon.gov.ar/new/0-0/inase/pdf/Normativa/LEY-20.247.PDF.

23 *See id.*

24 Chapter IV of Law No. 20247 provides the regulations for the registration of new varieties in the Registry. *See id.*

25 Chapter V of Law No. 20247 provides the regulations for requesting the property of a new variety and its registration in the National Registry. *See id.*

26 Article 26 states:

“restricted public use,” implying that the owner of the variety should be compensated by the state and that the ownership should be transferred to the Ministry of Agriculture.²⁷ Finally, the law recognized farmers’ rights to the use of seeds saved from a previous crop and researchers’ rights to use one variety of a seed to develop a new variety.²⁸ As a result, the first legal registration of new varieties in the country began in 1978, after the law was enacted by the Executive Power Decree No. 1995 of 1978.²⁹ This Decree was proposed by the CONASE³⁰ and slightly modified by Decree No. 50/89.³¹ Nonetheless, this legislation did not provide enough protection and enforcement of intellectual property rights for new seed varieties, since its regulations are similar to the PVPA certificates in the United States.

A modification to the 1978 Decree was enacted in 1991, introducing important changes to the regulatory regime and updating the legislation according to international standards. The Executive Power issued Decree No. 2183/1991 on October 21, 1991.³² The modification to the Law No. 20247 originated not only from the need for modernization of property rights legislation, but also from the political pressure exerted by some associations of seeders and other interest groups inside CONASE, such as the Argentine Seed Association (ASA) and Association for the Protection of Plant Breeders (ARPOV).³³ There were several significant modifications. First, CONASE continued to

The property title requested for a foreign variety should be done by its inventor or legally authorized representative established in Argentina, and it will be granted only if the country of origin of the variety has similar property right protection for Argentine invented varieties. In such cases, the term of the property will be up to the term that is left in the country of origin for the same variety.

Id. at art. 26

²⁷ See *id.* at art. 28. Article 29 limited the use of such right to two years, although the Executive Power could extend it for another two years. See *id.* at art. 28.

²⁸ Article 25 states: “The property of a variety does not prevent that other persons could use the variety for the creation of a new variety, which could be claimed by its creator without the consent of the owner of the original variety used in the process of creation. . . .” *Id.* at art. 25. Article 27 provides that: “The property right of a variety is not affected if the seed is given by authorization of the owner, or somebody saves and sow seeds for his/her own use, or use or sell as primary product or feeding the seed obtained from the crop of the variety.” *Id.* at art. 27.

²⁹ See Decree No. 1995/78, date, [volume] B.O. page, available at www.mecon.gov.ar.

³⁰ See CASEM, Camara Argentina de Semilleros Multiplicadores, 1er Congreso Nacional de Multiplicadores de Semillas, Circular Interna No. 066 (Oct. 15, 1999), <http://www.cedasaba.com.ar/CircularesInternas/CircInt066.htm>.

³¹ See Decree No. 50/89 Poder Ejecutivo Nacional, June 11 1989, B.O. No. 26672, 13.

³² See Decree No. 2183/91, Poder Ejecutivo Nacional, November 1, 1991, B.O. No., 27254. available at <http://www.sagpya.mecon.gov.ar/new/0-0/inase/pdf/Normativa/DECR-2183-91.PDF>.

³³ At a symposium on Intellectual Property Rights in Plant Biotechnology, Oscar Domingo presented the relevant legal framework in Argentina:

“ASA, which has been in operation for 54 years and groups together the 67 main seed companies, and ARPOV, set up more recently, are the bodies which deal with sectoral union activity and work for the technological development and protection of phytogenetic creations. ASA, which is member of CONABIA, since it was set up 11 years ago, has played a major role in the discussion of the

be an advisory committee to the Secretary of Agriculture³⁴ and other specific agencies created by this Decree.³⁵ Second, a new agency, the National Seed Service (Servicio Nacional de Semillas, SENASE) was created to be in charge of managing and enforcing the regulatory regime for new varieties.³⁶ As a result, all the activities concerned with the management of the system were concentrated in a specific government agency instead of being dispersed among different secretaries inside the Secretary of Agriculture. Accordingly, this change would allow the government to focus on enforcement and the definition of norms for the market of new varieties. Third, the Decree defined the specific steps and requirements for registration of a new variety and the granting of property rights.³⁷ Fourth, the Decree defined the different types of plants that could be registered, including seeds or germ and phylogenetic breeding varieties.³⁸ Fifth, the special “restricted public use” right of the Executive Power was preserved.³⁹ Finally, the use of saved seed was restricted only for research purposes and farmer’s privilege.⁴⁰ Nonetheless, Decree No. 2817 of December 30, 1991, created the National Seed Institute (Instituto Nacional de Semillas, INASE), which replaced the SENASE in the management of Law No. 20247.⁴¹ This agency is in charge of the national registry for varieties and property of seeds, the enactment of rules regarding the management of the system, and the enforcement of the regulations of the law.⁴² By creating this new agency,

regulations which Argentina now possesses for the commercial release of a transgenic event.

Three years ago, the Association of Agricultural Technology Chambers (ACTA) was set up and groups together the sectors providing technological material for agricultural production, seeds (ASA), agrochemicals and fertilizers (Chamber of Plant Health and Fertilizers – CASAFE), veterinary products (Chamber of Veterinary Producers – CAPROVE) and agricultural machinery (Association of Tractor Manufacturers – AFAT), which has been acquiring major importance in agro-industrial production activities, and is the most important in Argentina.

As a result of the work of those institutions, Argentina acceded to the 1978 Act of the UPOV Convention and discussions regarding accession to the 1991 Act of the UPOV Convention are very advanced.”

Domingo, (2003), at 11.

34 In this text, “Secretary of Agriculture” and “Ministry of Agriculture” are the same, since the Ministry of Agriculture was renamed to Secretary of Agriculture in the early 1990s. Its role in the government continues to be the same.

35 Chapter II of the Decree established the role of the CONASE. Decree No. 2183/91, *supra* note 62.

36 Chapter III of the Decree No. 2183/91 established the main activities for the Servicio Nacional de Semillas. *See id.*

37 Chapters V to VII of the Decree No. 2183/91 describe the procedures for registration of new varieties. *See id.*

38 *See id.*

39 *See id.*

40 Article 41 of the Decree No. 2183/91 establishes the different cases in which authorization from the owner of the variety is needed. *See id.*

41 *See* Decree No. 2817/91 Poder Ejecutivo Nacional, April 6, 1992, B.O. No. 27363, at 3. *available at* <http://infoleg.mecon.gov.ar/infolegInternet/anexos/5000-9999/8052/texact.htm>.

42 *See id.*

the government sought to improve enforcement and control of property rights in new varieties:

One of the main achievements of the process, initiated in 1990 and completed and consolidated with the creation of INASE, was to make more transparent the commerce of self-pollinating seed species, particularly soybean and wheat, where the legal market for these species reached just 25% of the total demand of seeds. This meant that most of the market for seeds had no guarantee of identity and quality, there was a high degree of tax evasion and there was no recognition of the property rights of the inventors of varieties registered in property giving as a result a disincentive to invest in new varieties⁴³ However, this kind of property rights protection has not been useful in protecting the soybean seed market from brown-bagging and stealing.⁴⁴

In contrast to the CONASE, the INASE's only role is the management and enforcement of the different issues concerning commercial rights on seeds, although the same constituencies that formed the CONASE were represented in this Agency.⁴⁵

With respect to the farmer's privilege, the INASE issued Norm 35/96 INASE in February 1996 to define the limits and scope of this privilege, broadly established in the Law No. 20247.⁴⁶ Under Norm 35/96 INASE tried to limit the application of the farmer's privilege to specific cases in which the farmer actually saves some seed for the next crop, limiting the scope of saved seed established by Article 27 of Law No. 20247, which allowed other uses for saved seed.⁴⁷ It established specific rules for saved seeds to be considered under this privilege. For example, the main criteria for being considered under this rule are that first, the solicitor should be a farmer. Then, the farmer should

43 Evolucion, *supra* note 16, at 15.

44 Discussing the depression of soybean seed prices by the black-market sale of seeds in Argentina, the U.S. General Accounting Office found:

A group of Argentine seed companies and breeders, called the Argentine Association for the Protection of Plant Varieties, in cooperation with the government, have had an effort under way since 1990 to enforce the law and limit the sale of uncertified seed on the black market. The effort helped reduce black market sales from about three-quarters of all soybean seed sales in 1992 to about half in 1994. However, according to Argentine industry officials, black market sales subsequently increased in response to higher prices for commercial seeds following the initial marketing of Roundup Ready soybean seeds in 1996.

U.S. Gen. Accounting Office (2000), at 15-16.

45 See Decree No. 2817/91, *supra* note, 71.

46 See Secretaria de Agricultura Ganaderia y Pesca [SAGyP], Resolucion INASE No. 35/96 (Feb. 28, 1996), available at http://www.inase.gov.ar/tikiwiki/tiki-list_file_gallery.php?galleryId=2&offset=0&sort_mode=description_desc.

47 See *id.* at art. 1; Law No. 20247, Mar. 30, 1973, [volume] B.O. art. 27, available at www.sagpya.mecon.gov.ar/new/0-0/inase/pdf/Normativa/LEY-20.247.PDF.

prove that the original seed was legally bought, and the saved seed was obtained from the original, legally bought seed. Next, the saved seed should be specifically set aside and distinguished from other varieties. Finally, the farmer must show the purpose of use, noting the prohibition on any transfer or sale of the saved seeds.⁴⁸ The Norm increased the difficulty for farmers to save seed for other purposes, as it tried to control the trade of non-legal varieties.

In 1994, Law No. 24376, enacted on September 21, modified the Law No. 20247 and its Decrees,⁴⁹ bringing the legislation up to the guidelines set by the International Agreement for the Protection of the Vegetal Obtentions (UPOV/78), approved in Paris, France in 1961 and modified in Geneva, Switzerland in 1972 and 1978.⁵⁰ Law No. 24376 approved the UPOV agreement and established that the clauses of this agreement should prevail over the regulations of Law No. 20247 and its regulatory decrees.⁵¹ The changes with respect to the previous legislation are not too relevant, except for the political decision to be a part of the UPOV international agreement.⁵² That said, the adoption of the UPOV 1978 guidelines is a limited gesture since the UPOV 1978 guidelines are not as thorough as the more recent UPOV 1991 agreement, which has not yet been adopted in Argentina.⁵³

Due to the economic crisis in 2000, the Executive Power ordered the Secretary of Agriculture to close the INASE, leaving the regulatory regime for new varieties without any management.⁵⁴ The Institute was reopened in 2004⁵⁵ by Law No. 25845.⁵⁶ The

48 See Secretaria de Agricultura Ganaderia y Pesca [SAGyP], Resolucion INASE No. 35/96 art. 1 (Feb. 28, 1996), available at http://www.inase.gov.ar/tikiwiki/tiki-list_file_gallery.php?galleryId=2&offset=0&sort_mode=description_desc.

49 See Law No. 24376, Oct. 20, 1994, Honorable Congreso de la Nacion Argentina, October 25, 1994, B.O. No. 28003, available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/0-4999/768/norma.htm>.

50 See International Union for the Protection of New Varieties of Plants, The UPOV System of Plant Variety Protection, http://www.upov.int/en/about/upov_system.htm (last visited Feb. 24, 2006) (describing the UPOV system of plant protection).

51 See Law No. 24376, Oct. 20, 1994, *supra* note 79

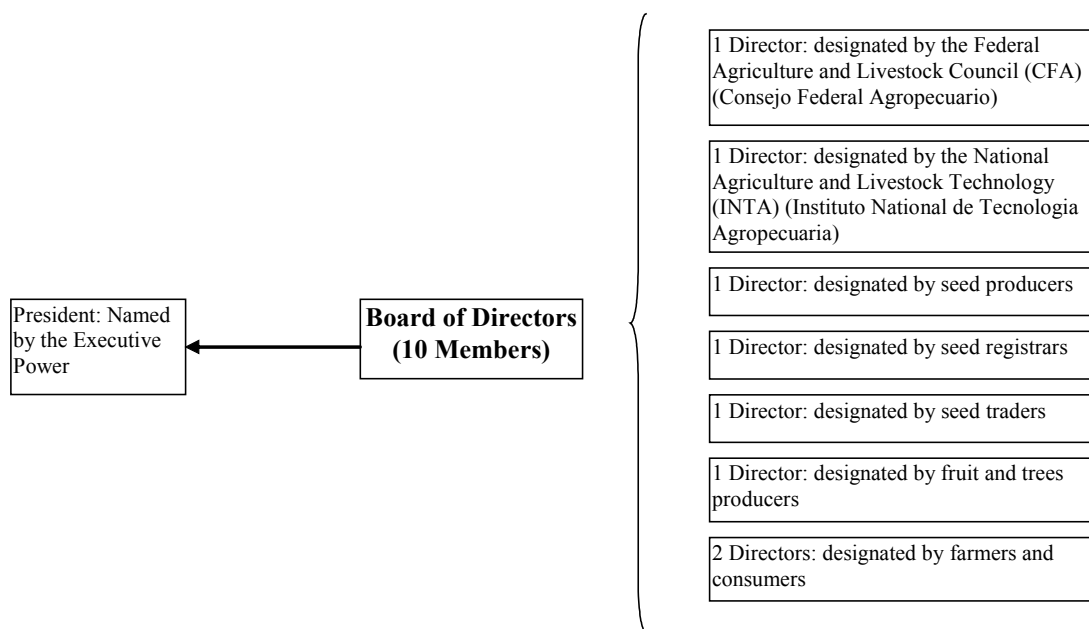
52 See *id.*

53 See <http://www.sagpya.mecon.gov.ar/> (documenting the evolution of legislation and the adoption of the UPOV 78 treaty); see also Proteccion Legal De Obtenciones Vegetales, http://www.proyectonacion.entupc.com/proyectosart/proteccion_legas_obteccion_vegetales.htm (last visited Feb. 24, 2006) (describing a bill presented this year in Congress by Congressmen Eduardo Di Cola proposing the adoption of UPOV 91).

54 See FRANCISCO PIROVANO, U.S. DEP'T OF AGRIC., GAIN REPORT AR4022: ARGENTINA PLANTING SEEDS ANNUAL 2004 4 (2004) (noting that although the INASE was dissolved in 2000 due to a lack of budget, it was reactivated on January 6, 2004 "to assure quality and proper identification of the seed to be marketed, to promote the supply of improved varieties through the protection of their property rights, to foster production and marketing of planting seeds as a way to improve crop production in Argentina").

Board of the INASE represents the different economic stakeholders in the regulatory framework of agricultural seeds (Figure 1).⁵⁷

FIGURE 1. STRUCTURE OF INASE⁵⁸



The evolution of the legislation in Argentina has focused on the development and improvement of a Plant Variety Protection type of property rights without any advance in the field of patenting new varieties.

Genetically Modified Seed and the Quest for Patent Protection

The Argentine government was one of the first, together with the United States, to allow the use of genetically modified crops. In 1991, the Secretary of Agriculture created

55 *See id.*

56 The law states:

Article 1: the Decree 1104/200, which dissolved the Instituto Nacional de Semillas (INASE), is derogated.

Article 2: By the present law we ratify the validity of the Decree 2817/91, restoring the Instituto Nacional de Semillas (INASE) the functions, missions and structures regulated by the Law 20247, the Decree 2183/91 and the Administrative Decision 489/96.

Law No. 25845, Jan. 6, 2004, Honorable Congreso de la Nación Argentina, January 7, 2004, B.O. No. 30312, at 2. *available at* <http://infoleg.mecon.gov.ar/infolegInternet/anexos/90000-94999/91549/norma.htm>.

57 *See id.* The Consejo Federal Agropecuario was created by Law No. 23843 of 1990 and is a Council comprised of representatives of the rural sector from the different regions of the country. The director of the Secretary of Agriculture, Livestock and Fishing of the Nation presides over this council. Law No. 23843, Sept. 26, 1990, Honorable Congreso de la Nación Argentina, October 19, 1990, B.O. No. 26992. *available at* <http://www.carbap.org/root/MostrarDocumento.asp?id=614&accion=4>.

58 For figure data, see Law No. 25845, *supra* note 86.

the Advisory National Commission for Rural Biotechnology (CONABIA, Comisión Nacional Asesora de Biotecnología Agropecuaria).⁵⁹ This advisory group, composed of representatives from the government and the private sector, helped the government to develop a regulatory framework for the application and commercialization of biotechnology in agriculture.⁶⁰ As a consequence, in 1992 the CONABIA recommended that the Secretary of Agriculture, Livestock and Fishing enact a set of rules and requirements for the approval of experimentation with genetically modified seeds. The Secretary responded with Resolution 656/92 for Genetically Modified Microorganisms.⁶¹ Accordingly, the CONABIA is in charge of reviewing all the applications for the use of genetically modified organisms and recommending the approval or denial of each application to the Secretary of Agriculture, Livestock and Fishing.⁶² This resolution was improved with further regulations for the trials in each crop by Resolution 226/97, also recommended by the CONABIA.⁶³ The regulation of these permits was enacted by Resolution 289/97, complemented by Resolution 131/98, and replaced by Resolution 39/03.⁶⁴ From 1991 to 2004, the Secretary gave 788 permits for experimentation with genetically modified organisms.⁶⁵

59 See Secretaría de Agricultura Ganadería y Pesca [SAGyP], Resolución No. 124/91 (Oct. 24, 1991), available at http://www.senasa.gov.ar/marcolegal/Res_RY/ry_124_91.htm.

60 Resolution 328/97 establishes that

The Commission is composed of two representatives from INTA (National Institute of Agriculture and Livestock Technology), two from the National University of Buenos Aires (UBA), two from the Argentine Forum of Biotechnology, two from the Asociación de Semilleros Argentinos (Argentine Seed Producers Association), two from the private livestock sector, two from the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), two from INASE, four from the National Service of Agricultural and Food Safety and Quality (SENASA) and some directors of specific government agencies, two professionals on issues of livestock safety and quality, two professionals on issues of plant safety and quality, and other directors from specific government agencies.

Secretaría de Agricultura Ganadería y Pesca [SAGyP], Resolución No. 328/97 (May 28, 1997), available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/40000-44999/43548/norma.htm>. The composition of the CONABIA was modified in part by the Resolution 244/04:

The Commission is composed of two representatives from INTA (National Agriculture and Livestock Technology Institute), two from the National University of Buenos Aires (UBA), two from the Argentine Forum of Biotechnology, two from the Asociación de Semilleros Argentinos (Argentine Seed Producers Association), two from the private livestock sector, two from the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) and some directors of specific government agencies.

Secretaría de Agricultura Ganadería y Pesca [SAGyP], Resolución No. 244/04 (Feb. 18, 2004), available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/90000-94999/93050/norma.htm>.

61 See OFICINA DE BIOTECNOLOGÍA, SECRETARÍA DE AGRICULTURA, GANADERÍA, PESCA Y ALIMENTOS, MARCO REGULADOR DE LA BIOTECNOLOGÍA AGROPECUARIA EN LA REPÚBLICA ARGENTINA 234 (2005).

62 See Secretaría de Agricultura, Ganadería, Pesca y Alimentos, Bioseguridad Agropecuaria: La Experiencia de la CONABIA [hereinafter CONABIA Experience], http://www.sagpya.mecon.gov.ar/new/0-0/programas/conabia/bioseguridad_agropecuaria2.php (last visited Feb. 27, 2006).

63 See *id.*

64 See *id.*

65 See *id.*

The procedure for obtaining a permit consists of two stages. First, the CONABIA evaluates the application and grants or denies a permit for experimentation. The second stage, which allows for extensive use of experimentation, consists of determining whether the use of the genetically modified organism will have an impact on the environment similar to the one produced by a similar non-genetically modified organism.⁶⁶ Only eleven applications passed the second stage (Table 5).

TABLE 5. PERMITS GRANTED BY CONABIA⁶⁷

Seed	Characteristic	Resolution – Date	Company
Soybean	Tolerance to Glifosato	SAPyA 115, 3-7-96	Nidera S.A.
Corn	Resistance to Lepidopteros	SAPyA 458, 8-2-96	Ciba-Geigy
Corn	Tolerance Glufosinato de Ammonia	SAGPyA 77 2-11-98	AgrEvo S.A.
Corn	Resistance Lepidopteros	SAGPyA 289 3-29-98	Monsanto
Cotton	Resistance Lepidopteros	SAGPyA 290 5-29-98	Monsanto
Corn	Tolerance to Glifosato	SAGPyA 79 10-8-98	Monsanto
Cotton	Tolerance to Glifosato	SAGPyA 721 11-11-99	Monsanto
Corn	Resistance Lepidopteros	SAGPyA 442 8-16-00	Novartis
Soybean	Tolerance Glufosinato de Ammonia	SAGPyA 47 5-7-01	Hoechst Schering AgrEvo S.A.
Corn	Tolerance to Glifosato	SAGPyA 361 5-2-03	Monsanto
Corn	Resistance Lepidopteros and Tolerance Glufosinato de Ammonia	SAGPyA 209 9-1-03	Dow AgroSciences S.A. and Pioneer Argentina S.A.

After obtaining this permit, companies need to obtain another authorization to commercialize the genetically modified variety. Ten of the varieties listed in Table 4

⁶⁶ See *id.*

⁶⁷ See *id.*

obtained this authorization.⁶⁸ To obtain this last authorization from the Secretary and CONABIA takes at least three years.⁶⁹

Given the increased interest in genetically modified organisms and the high number of registrations of new varieties that are genetically modified (Table 5), the government decided to create a special agency in charge of advising on biotechnology policy. By Resolution 219/2001, the Secretary created the National Advisory Commission for Agricultural Biotechnology,⁷⁰ and by Resolution 362/2003 made the Biotechnology Area independent from the Sub-Secretary of Agricultural and Food Policy.⁷¹ Finally, by Resolution 244/04, the Secretary eliminated these two agencies and created the Office of Biotechnology (Oficina de Biotecnología), which is in charge of advising and managing all issues related to the biotechnology policy of the country.⁷² Pursuant to this change, the CONABIA depends directly on the Office of Biotechnology. As we can see, the regulatory framework for biotechnological discoveries in agriculture is in constant flux, with different agencies in charge and changes to the structure of the management system. This differs from the more stable and well-defined system in place in the United States.

68 See CONABIA Experience, *supra* note 62.

69 See *id.*

70 See Secretaria de Agricultura Ganaderia y Pesca [SAGyP], Resolucion No. 219/2001 (Sept. 10, 2001), available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/65000-69999/68853/norma.htm>.

71 See Secretaria de Agricultura Ganaderia y Pesca [SAGyP], Resolucion No. 362/2003 (May 2, 2003), available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/80000-84999/84847/norma.htm>.

72 See Secretaria de Agricultura Ganaderia y Pesca [SAGyP], Resolucion No. 244/04 (Feb. 18, 2004), available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/90000-94999/93050/norma.htm>.

TABLE 6. NEW TRANSGENIC VARIETIES REGISTERED IN ARGENTINA (1995-2003)⁷³

Year	Soybean				Corn				
	Transgenic	Non transgenic	Total	Transgenic as % of Total	Total	Conventional	IMI (Non-GMO)	Transgenic	Transgenic as % of Total
1995	-	8	8	0.0	34	33	1	0	0.0
1996	5	11	16	31.3	33	32	1	0	0.0
1997	12	23	35	34.3	47	46	1	0	0.0
1998	18	18	36	50.0	42	32	2	8	19.0
1999	28	13	41	68.3	58	39	10	9	15.5
2000	19	7	26	73.1	49	31	3	15	30.6
2001	32	3	35	91.4	82	51	1	30	36.6
2002	13	2	15	86.7	55	36	2	17	30.9
2003	9	-	9	100.0	39	24	1	14	35.9

In contrast to the situation in the United States, companies in Argentina cannot look for patent protection for new varieties or genetically modified organisms. Despite the many changes to the law and the demand for new technologies in genetics, the new legal framework does not allow for strict property rights protection via a patent system; new genetically modified varieties must resort to the same weak protection as other varieties.

From 1864 to 1995, the patent system in Argentina was regulated by Law 111.⁷⁴ This law did not specify any particular regulation with respect to plants, but during this period there were no patent applications for a new variety. Furthermore, all the matters with regard to plant varieties were derived from the regulations of Law No. 20247⁷⁵ and, later, Law No. 24376.⁷⁶ In 1995, Congress enacted new patent laws modifying Law No. 111 (Law Nos. 24481 and 24572).⁷⁷ According to the new regulatory framework, the patenting of new plants is expressly prohibited, although it does not specify new plant varieties.⁷⁸ Furthermore, patenting of new varieties is not legally possible, as the law of 1994 adhered to UPOV 1978, which prohibited a regulatory system of double protection.

⁷³ See Domingo (2003), at 9.

⁷⁴ See Rapela (2000).

⁷⁵ See Law No. 20247 (Mar. 30, 1973), Poder Ejecutivo Nacional, April 16, 1973, B.O. No. 22648. available at <http://infoleg.mecon.gov.ar/infolegInternet/anexos/30000-34999/34822/norma.htm>.

⁷⁶ See Law No. 24376 (Oct. 20, 1994), *supra* note 79.

⁷⁷ See RAPELA (2000), at 74.

⁷⁸ “Since the Patent law in Argentina prohibits the patenting of plants, in fact prohibits the patenting of varieties since, even though not all plants can be labeled as plant varieties, all plant varieties are composed by plants without exception.” See *id.* at 151. (author translation from the original: “[L]a ley de patentes de Argentina al prohibir taxativamente el patentamiento de plantas esta, de hecho, prohibiendo el patentamiento de variedades ya que, si bien no todas las plantas pueden ser categorizadas como variedades vegetales, todas las variedades vegetales estan compuestas por plantas sin excepcion alguna.”).

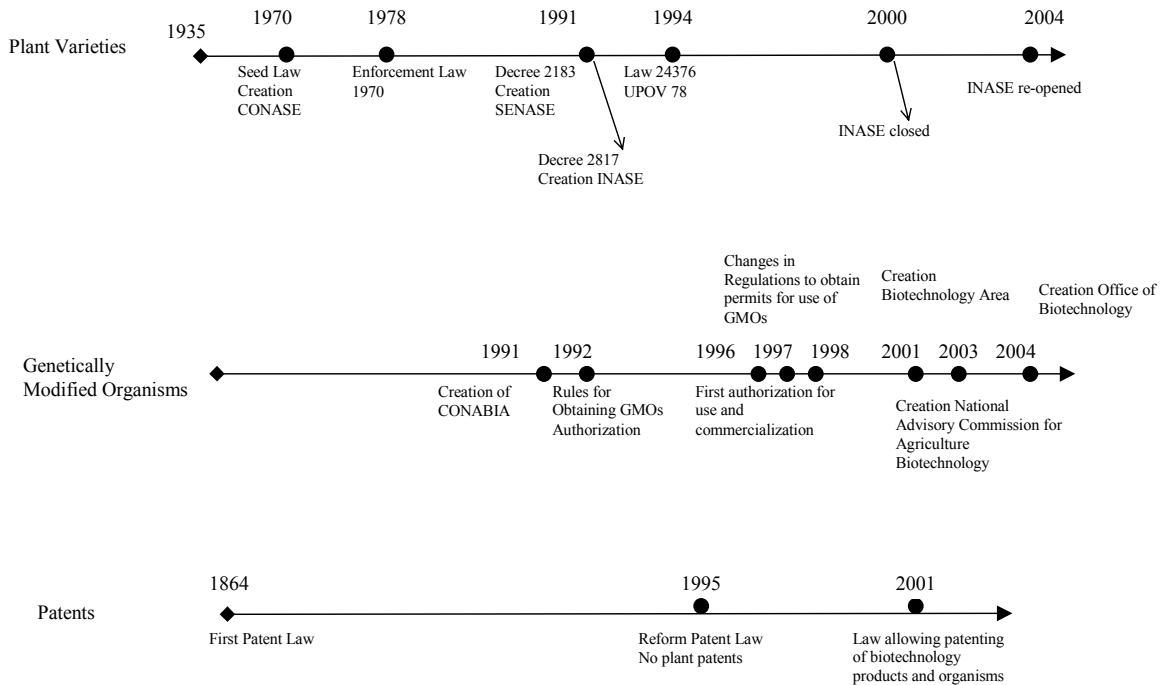
There is already, moreover, a government agency that grants Plant Variety Protection certificates,⁷⁹ and new laws passed in 2000, Laws Nos. 24481 and 24575, allow the patenting of biotechnology products and organisms, including pharmaceutical products.⁸⁰ Apparently, these laws could provide a legal vehicle for patenting plant varieties, but the prohibitions of the Patent Law of 1995, the UPOV 78, and the Decree 260/96, which all prohibit the patenting of plant varieties, generate uncertainty over the ability to obtain a patent.⁸¹ Congress has been dealing with some pressure from seed producers to approve a new law with the UPOV 1991 guidelines, which support the existence of multiple systems for property rights protection (Figure 2). Nonetheless, even if this legislation has passed, the courts will have to interpret the patent law and decide if the prohibition of patenting plants can be extended to plant varieties. As a consequence, the legal framework is far from creating sweeping changes in the way property rights are regulated and enforced.

79 *See id.*

80 *See VICIEN (2003)*, at 19.

81 *See id.*

FIGURE 2. TIMELINE OF ARGENTINE LEGISLATION⁸²



As Figure 2 shows, the legal framework for plant varieties, both genetically and non-genetically modified is diffuse, complex, and rapidly changing, producing complaints and hesitation from seed producers. This particular system has been widely criticized by international seed producers. For example, Monsanto decided to stop selling soybean seeds in Argentina because its Roundup Ready soybean variety was being widely used by farmers who did not pay royalties or user rights of any kind.⁸³ As a consequence, they decided to stop the commercialization of any soybean varieties in the country, given the lack of protection. The government has tried to find a solution without having to change the legal framework—a daunting task given the economic interests at stake—by proposing the creation of a tax.⁸⁴

⁸² For figure data, see generally <http://www.sagpya.mecon.gov.ar> (last visited Mar. 18, 2006).

⁸³ See Tony Smith, *Argentine Soy Exports Are up, but Monsanto Is Not Amused*, N.Y. TIMES, Jan. 21, 2004, at W1.

⁸⁴ See *Argentina to Propose New Royalty Payment Rules for GM Seed*, SEEDQUEST, Jan. 27, 2005,

Use of Genetically Modified Soybean and Productivity

Despite the discussion regarding the legal problems seed producers face in the Argentine market, most researchers work under the assumption that the adoption of genetically modified seeds is always good for farmers, and that developing countries' government do not want to protect companies' property rights to favor farmers. However, there are not many comprehensive analysis of the impact of the use of genetically modified soybean in developing countries. In this case we use a database from 3000 Argentine farms, in the Province of Buenos Aires for the year 2001⁸⁵. The uniqueness of this database is that one of the questions ask farmers if the soybean they are using is genetically modified or not. As a result, we use this survey to analyze the productive impact of using genetically modified soybeans. Furthermore, the results will help to support, or not, the heated debate among government and companies with respect to regulation. In this respect, if government pushes for more lax regulation because farmers are benefitting from it, but farmers are not getting big gains, then why to pursue such a policy. On the other hand, if the benefits are too big, seed companies can show that farmers can pay for the use of the better seeds, given the important effect in their yields.

Accordindgly, we want to test the following model:

$$Y_i = \alpha_0 + \beta_1 Soy_i + \beta_2 GMO_i + \beta_3 Farmer_i + \beta_4 Soc_i + \beta_5 Corp_i + e_i$$

Where Y is the yield of soybean crop in each farm;

Soy: is the area planted with soybean

GMO is a dummy variable equal to 1 if the soybean seed is genetically modified

Farmer: is a dummy variable that represents farms owned by an individual farmer

Soc: is a dummy variable that represents farms owned by a group of farmers

(informal societies)

Corp: are the farms owned by corporations

<http://www.seedquest.com/News/releases/2005/january/11144.htm>.

⁸⁵ This database was collected by the Direccion Provincial de Estadistica de la Provincia de Buenos Aires.

The result show that there is a strong impact of the use of GMO soybean on yields (Table 7). That result represents an increase on yields of 13% due to the use of genetically modified soybean seed. As a result, this evidence shows that there is strong support to the claim that genetically modified seeds represent an important improvement for farmers.

Table 7: Econometric Model. Dependent Variable Yield	
Soy	0.0977 *** (0.00874)
GMO	0.1264 ** (0.04943)
Farmer	0.0581 (0.04021)
Soc	0.1008 ** (0.04375)
Corp	0.0255 (0.04294)
Constant	-0.04857 (0.03797)
Number of obs = 1753	
F(5, 1747) = 292.30	
Prob > F= 0.0000	
R-squared = 0.4965	

Given the legal setup in Argentina, we would like to investigate which farms use genetically modified soybeans. As a result we run the following logit model,

$$Pr ob(Y_i = 1) = f(Farmer, Soc, Corp, Soy, Emp)$$

Where the new variable Emp is the total numbe of employees in the farm. The results in Table 8 show that corporations tend to use less genetically modified soybean than indifidual farmers and informal societies. This result can be an indication that, given the legal uncertainty in Argentina, corporations seem to be more reluctant to use genetically modified soybean than other farmers, despite the productive incentives to do so. As a result, the weak enforcement and unclear regulation can induce different strategies in the adoption of new technologies.

Table 87: Econometric Model. Dependent Variable GMO	
Soy	3.992 *** (0.26849)
Emp	0.943 (0.06836)
Farmer	0.734 (0.21286)
Soc	0.643 (0.24285)
Corp	-0.180 *** (0.06465)
Number of obs = 1377	
Wald chi2(5) = 452.19	
Prob > chi2 = 0.0000	
Log pseudolikelihood = -238.9142	
Pseudo R2 = 0.7378	

Conclusion

Today, the effects of property rights definition and enforcement on biotechnology in agricultural markets is one of the main issues under debate. Scholars and policymakers debate the pros and cons of different regimes. According to existing literature, the effective protection of property rights offers adequate incentives for R&D in a biotechnology market controlled by private firms. This kind of protection was not needed decades ago, when most of the research was in the hands of governmental or non-profit institutions. However, in the last few decades, the growth of private research and the consolidation of the private sector in multinational corporations have brought the issue of property rights to the international arena. This article uses the case study of Argentina to understand the complexity of property rights definitions in developing countries. It uses econometric techniques to evaluate the effect of using genetically modified seeds in soybeans and the decision making of farmers. This paper finds that, even though the gains from using genetically modified soybean are apparent, corporation farms will not be as willing to use them as individual farms and informal societies. This result can be a direct consequence of the uncertain definition of property rights in the market for seeds, and the higher exposure of corporations to this kind of regulation.

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