Economic Evalutation of the Impact of Implementing the Biosafety Protocol (BSP) and The International Agricultural Biotechnology Institutional Framework

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ABSTRACT

The Biosafety Protocol entered into force in 2003 as part of Convetion on Biological Diversity (CDB) with the main objective to contribute to the safe transfer across countries of Live Modified Organisms (LMOs), which will be released into the environment and could affect the conservation and sustainability of biological diversity. Its importance is related to the fact that the use of agricultural biotechnology has spread rapidly since 1996, and the acreage under GM crops now exceeds 100 million hectares. However, the process of building an institutional framework to deal with the diffusion of transgenic crops is progressing at a slow pace, due to conflicts between countries, generate by the different views of the participants, on the role of biosafety to biotechnology adoption process.

The aim of this paper is to present an economic impact evaluation of three different institutional alternatives to implement the Biosafety Protocol, regarding USA, Argentine, Brazil, China and EU positions on The Meeting of the Parties –3 occured last March in Brazil (Silveira at al., 2006). It shows that documentation options of shipments of soybean and maize varieties have a significant impact on agriculture production of different countries, with impact on trade and even on biotechnology diffusion process. The results raise some evidences of the key role of transaction costs on biotechnology development, in the process of building its international institutional framework.

Key words: Biosafety Protocol; Economic Impacts; Agricultural Trade, Biotechnology Institutions

1. INTRODUCTION

The Cartagena Protocol on Biosafety (CPB) was the first attempt to create a global agreement establishing rules for trade, transport and consumption of genetically modified organisms. The CPB is a supplement to the Convention on Biological Diversity (CBD) adopted at the United Nations Conference on Environment and Development held at Rio de Janeiro in 1992. Article 19.3 of the CBD called for the establishment of an environmental agreement to regulate the use of living modified organisms (LMOs):

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> "The Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity."

The agreement called for by this provision of the CBD was finalized in 2000 as the Cartagena Protocol on Biosafety, which came into force in September 2003. In Brazil the CPB was ratified by Congress that same year. The CPB is one of the available instruments for implementation of the CBD and the first international agreement designed to establish rules for the safe handling, transfer and use of LMOs.

The overall objective of the CPB is to "to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements"(CIB, 2006).[1] The specific aims of the CPB are as follows:

- creation of an online Biosafety Clearing-House for countries to exchange information regarding authorizations to grow and import LMOs for direct use as food or feed or for processing, and to act as a database providing access to all Parties' national laws, regulations and guidelines on biosafety;

- creation of an Advanced Informed Agreement (AIA) procedure so that importer countries can decide to what extent imported LMOs will be introduced into the environment as seeds for planting, animals for sale or microorganisms for bioremediation;.

- promoting and facilitating public awareness, education and participation concerning the safe transfer, handling and use of LMOs in relation to the conservation and sustainable use of biodiversity;

- development of human resources and institutional capacities in biosafety and biotechnology in all Parties but especially developing-country Parties.

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[1] The main controversy relates to handling, transfer., packaging and identification of grain shipments, to use the CPB's jargon. See CIB (2006).

At three Meetings of the Parties (COP-MOP) held between 2004 and 2006,[2] the signatories adopted by consensus procedures for implementation of the CPB. The first (COP-MOP.1) took place at Kuala Lumpur in Malaysia in February 2004 and was attended by representatives of 160 countries. The talks focused on operational and institutional aspects of the CPB's implementation. The second (COP-MOP.2) was held in May-June 2005 at Montreal, Canada, with representatives of more than 100 countries attending. The main topics discussed were as follows: "detailed information requirements in the documentation accompanying shipments of LMOs intended for direct use as food or feed, or for processing as required in Article 18.2 (a); assessment of the possibility of creating a system of liability and redress (Article 27); implementation of the Biosafety Clearing-House (Article 20); and physical and human capacity building for the effective implementation of the Protocol (Article 22)" (CIB, 2006).

The third and most important meeting (COP-MOP.3) was held in March 2006 at Curitiba in Brazil. The talks focused on issues relating to the development of standards for identification, handling, packaging and transport practices for transboundary movements of LMOs. Noting that the expression "may contain LMOs" in the original text of the Protocol does not require a detailed listing of LMOs in the shipment, a large proportion of countries that import agricultural commodities argued for identification using the expression "contains LMOs". For exporter countries the identification method is fundamental because it may incur additional costs. Adoption of the expression "contains LMOs", as advocated by importer countries, would entail highly detailed identification and require the performance of sophisticated tests, thus substantially increasing the costs incurred by exporter countries.

Before COP-MOP.3 began, Brazil was allied only with New Zealand in defending the expression "may contain LMOs". As the date of the meeting approached, Mexico and Central American countries, along with some small producers of soybeans such as Paraguay, changed their

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[2] Formally termed "Meetings of the Conference of the Parties to the Convention serving as the meeting of the Parties to the Protocol (COP-MOP)".

minds when they realized that depending on the precise rules adopted the expression “contains LMOs” could prevent them from participating in international trade.

It should be noted that although the methodology used in these meetings involved separate analysis of each article, the Parties acknowledged a link between the issue of shipment identification in Article 18.2 (a) and that of liability and redress in Article 27. This is because a liability and redress regime must be supported by segregation and traceability methods capable of indicating the origin of a problem, in the event that it originates in agriculture and not in handling errors in the country of destination. The choice between a system of objective liability or “fault-based liability”, therefore, would condition the decision on handling, transfer, packaging and identification of LMOs.[3] However, this discussion was deferred until the next COP-MOP, scheduled for 2008, since the Parties acknowledged that they lacked the necessary knowledge to address the issue at the Curitiba meeting.

2. SCOPE OF THE PROTOCOL

The CPB sets out to regulate crossborder trade in LMOs. International trade in genetically modified grains will therefore be affected, albeit not their byproducts. Large-scale production of GM crops began in 1996 in the United States and since then their rate of diffusion in the U.S. and other countries has been fast compared with other farm technologies. Plantings of GM crops worldwide are estimated to have risen from 2.8 million hectares in 1996 to 102 million hectares in 2006 (JAMES, 2006). The fast pace of GM crop diffusion relates to the following advantages of using transgenic cultivars: a) lower production costs, estimated to be in the range of 5%-10% by several assessment studies (SILVEIRA, BORGES & BUAINAIN, 2005); b) less application of pesticides, especially insecticides in the case of insect-resistant cultivars; c) enhanced planning of agricultural activities, including a tighter fit between weed and pest control and no-tillage practices.

[3] In our view opting for an objective liability regime would amount to imposing a moratorium on biotechnology research. Radical anti-GM environmentalists advocate such a regime, which is opposed by researchers and seed and biotech companies. For example, anyone receiving a shipment of LMOs for processing and illegally diverting a lot for planting inside that country would be liable in a “fault-based” regime for any losses caused to biodiversity, whereas the objective liability regime would require the research centre that created the transgene to redress any damage caused, whether or not the error had been made there or far away by another player in the supply chain. See Amâncio, *apud* CIB (2006).

GM crop diffusion has hitherto been concentrated in “platform products”, i.e. groups of commodities with a large volume of world trade. According to James (2006), the 102 million hectares of GM crops are divided into four groups of commodities: soybeans, corn or maize (Zea mays L.), cotton, and canola. Soybeans and maize account together for 84% of the total area planted with GM crops worldwide. Thus the use of GMOs in agriculture is concentrated in the production of a few types of grain, with the four major grain crops – rice, maize, soybeans and wheat – occupying about 50% of all the world’s arable land (FAOSTAT, 2006).

The most intense immediate effect of the CPB would be on soybean and maize, which account for a large share of world agricultural production. The volume of soybeans produced worldwide rose from 31 million metric tons in 1965 to 209.5 million in 2005. Although growth was constant in the period, after 1975 the rate of growth declined until 1995 and then accelerated again in 1995-2005, during which period the main producers began to plant GM soybeans. Between 1995 and 2005, world output of soybeans increased 65%. In the case of maize, production also grew sharply between 1965 and 2005. Maize production rose more than that of any other grain crop in the period, increasing its share of world grain output from 22% in 1965 to 32% in 2005. (FAOSTAT, 2006).

This vigorous growth in grain and cereal production in the last 40 years is explained by rising demand for food, which in turn is explained by population growth and economic development. In the specific case of soybeans and maize, production growth relates to rising demand for meat, since a large proportion of these two crops is used as animal feed. In the case of maize, for example, some 70% of world output is used for feed. Technological gains – moderate ones per unit of production, it is true — multiplied by a high coefficient of transgenic cultivar adoption in crops of significant importance to international trade assure the relevance of technological innovation from the economic standpoint. At the same time, the growth in acreage has aroused increasing opposition from environmentalists, consumer advocates and some representatives of public health organizations, by order of activism. In 2005 GM crops were grown in all the main exporters of agricultural commodities: the U.S., Argentina, Brazil and Canada, alongside the European Union and China (James, 2006).

A survey of international plant biotechnology research by Runge & Ryan (2004) shows that transgenics can be used in other segments besides grain production. The transgenics research and experiments cover an increasingly wide array of crops and countries. The 2004 survey identified 57 plants as undergoing biotech research and divided them into four groups: field crops, vegetables, fruits, and other plants, including agricultural commodities of major importance to world trade such as coffee, rice, wheat, sugarcane and oranges.

The evolution of agricultural biotechnology is expected to drive diffusion of transgenic cultivars in volume, acreage and the number of distinct events contained in commercialized grains.[4] Where small volumes of GM crops with few events are involved, the CPB embodies uncertainty and excessive use of the "precautionary principle" in the definition of rules for the identification of LMOs for export. This tends to lead to situations of conflict, as outlined in the following section.

3. IMPACT OF THE CPB ON WORLD AGRICULTURAL TRADE

The economic impact of the CPB will depend on compliance costs, which correspond to the cost of the resources necessary to comply with the legal requirements established by the Parties. Summarizing the points mentioned in Section 2, compliance costs depend on:

- the type of LMO identification required
- the country's position in the world market for agricultural commodities, i.e. whether it is a producer, exporter or importer of GM crops
- the internal conditions in each country, such as logistics and technical capacity to perform tests reliably and at low cost.

As noted above, use of the expression "contains LMOs" will require more complex, expensive and time-consuming tests, affecting mainly transport logistics.

[4] An event corresponds to insertion of a gene for a specific trait into a cultivar. A cultivar may contain more than one event, as is already the case with transgenic varieties of maize, soybean and cotton. The more samples in a lot, the higher the cost of quantification testing required to identify export shipments (see below).

3.1 LMO identification and its impact on costs

Studies produced in Brazil, Argentina and the U.S. show that the cost of LMO testing increases with the number of samples analyzed; the type of analysis required by the CPB (simple identification using a protein test, qualitative assessment, quantitative assessment); the number of events to be tested for; and the number of crops to be assessed (SILVEIRA et al., 2006; KALAITZANDONAKES, 2005).

The existence of two events and six different varieties could result in a high cost of identifying and quantifying the events concerned. Table 1 shows estimates for U.S. maize exports in 2004, based on 3,575 non-containerized bulk cargoes exported annually by ocean vessel, for a total of 71.5 million metric tons per year.[5]

The results show that compliance costs would significantly increase if events had to be identified and quantified. The estimates by Kalaitzandonakes (2005) contrast a case in which only one sample is analyzed at the port, using DNA methods, with a case in which 20 samples are analyzed as a lot moves through the grain trade system. Although economies of scale may exist when a larger number of assessments is performed, the estimates suggest that solely to determine whether a lot does or does not contain GM cultivars – without identifying them, let alone quantifying them – the cost could be as high as some US$20 million per year, or about 0.1% of the value of the entire U.S. maize crop. At the other extreme, the estimated cost of quantifying all the LMOs in a lot rises to US$87 million, or about 0.5% of the U.S. crop.

It is important to note that these estimates for the U.S. do not take into account the additional cost of identifying grain cargoes for export. The author was apparently unaware that detailed identification using the quantitative PCR method would be of little use unless it was accompanied by cargo segregation and the use of at least four samples to identify the origin of possible contamination capable of constituting a hazard to biodiversity and/or human health (i.e. the crop to which a specific LMO is applied).

[5] Each vessel holds about 20,000 metric tons of maize on average, so the number of vessels involved is large. A Panamax bulk carrier can hold up to 70,000 mt. See SILVEIRA et al., 2006.

Table 1. Cost of compliance with the Cartagena Protocol on Biosafety: U.S. maize production

No. of samples tested	Cargoes tested	Simple identification (US$)	Event identification (US$)	Event quantification (US$)
1	3,575	936,650 (100)	2,343,900	4,356,900
20		18,733,000 (100)	46,848,000	87,138,000

Source: Kalaitzandonakes, 2005.

Although no detailed studies have been performed hitherto for the U.S., the data from a study by FAO/SAGPyA (2006) presented below show the significant impact in terms of the internal reorganization of transport and storage logistics, even in a country such as Argentina with favourable conditions to apply the methods required. Brazil would be less favourably positioned because the estimated average time to complete export procedures is 29 days. Any action that involved implementing segregation and traceability systems would lengthen these procedures (SILVEIRA et al., 2006).

3.2 Position in the world market: the CPB's impact on international trade

As noted above, being or not being a Party to the CPB is less important than being a grain exporter as far as the impacts of the Protocol's implementation are concerned.

A group of countries that can be grouped together in the category "major exporters" of grains and have not ratified and implemented the CPB, such as the U.S., Argentina, Australia and Canada, are key to the game of chess that continues after COP-MOP.3. Theoretically the fact that they have not ratified the Protocol does not exempt them from following the rules established by the Parties for trade between a non-Party (origin) and a Party (destination).

This is because the framers of the Protocol, inspired by the instruments created to regulate the donation of pesticides by FAO (SILVEIRA, 1994), wanted it to be "self-executing" in the sense that its rules would be enforceable even for non-Parties by virtue of the requirements for importer Parties. However, this reasoning overlooks the power of bilateral agreements, whereby Parties to the Protocol can downgrade their requirements and hence the potential economic impact of enforcing the CPB.

As for the expected impacts, in the short term implementation would affect the principal segments of world agricultural trade and the main exporters of agricultural commodities, which are also the main producers of GM crops.

The medium- and long-term effects may be twofold: on one hand, the expanding scope of agricultural biotech suggests an increase in the acreage and number of GM crops, alongside increased complexity due to more events per export lot; on the other hand, the short-term impacts may lead to a reduced volume of trade in GM crops as well as a reduction in the volume of grain exports in proportion to exports of processed products.

This "trade diversion" (SILVEIRA et al., 2006) would drive up the cost of raw material if production shifted to countries which had been major importers prior to CPB implementation, such as China and the EU), or act as an incentive to export semi-manufactured goods such as soybean meal and even finished manufactures such as feed.[6]

A third possibility would derive from the fact that implementation of the Protocol as far as identifying LMOs for export is concerned imposes a fixed cost on participants in the grain crop and byproduct supply chain. In situations such as Brazil's today, in which low prices are coupled with an overvalued exchange rate, the imposition of additional costs relating to identity preservation (IP) could lead to the slow abandonment of transgenic cultivars or, on the contrary, to the disappearance of non-transgenic cultivars and recognition via documented IP techniques that Brazil's entire production is transgenic.

Table 2 lists countries accounting for 90% of world agricultural trade. Among major net exporters only Brazil, India and New Zealand are Parties to the Biosafety Protocol. The other major net exporters – Argentina, Australia, Canada and the U.S. – are not signatories. However, as noted above, in theory this should not exempt them from complying with the Protocol because importer countries can require LMO identification. In the case of soybeans, for example, Brazil is the only Party to the CPB among the top three exporters. The other two, Argentina and the U.S., are not

Parties but will probably have to comply because the main importers – China, the EU, Japan and Mexico – are signatories and entitled to require identification in accordance with CPB rules.

Table 2. World Agricultural Trade Balance in 2005: Selected Countries

Country	Agricultural Products	Soy	Maize	Position Regarding CPB
Brazil	23,616,930	5,321,123	561,409	Signatory
Australia	16,400,465	795	4,121	Non Signatory
Argentina	14,953,141	1,591,601	1,189,258	Non Signatory
New Zealand	8,241,267	-483	-1,519	Signatory
Canada	5,379,636	144,447	-192,918	Non Signatory
United States	4,019,016	6,630,602	5,997,216	Non Signatory
India	1,950,114	761	155,229	Signatory
European Union (25)	-3,240,871	-4,503,595	-713,014	Signatory
Mexico	-3,559,357	-1,106,310	-737,707	Signatory
China	-15,556,970	-7,535,482	-494,347	Signatory
Japan	-39,604,945	-1,774,405	-2,931,825	Signatory

Source: FAOSTAT, 2006.

Table 3 shows the effects of the CPB on price levels in different markets according to a simulation by HUANG et al.. (2006). As expected, international prices of soybeans and maize would increase after CPB implementation.[7] Depending on the LMO identification scenario, the increase would be in the range of 0.07%-0.11% for soybeans and 0.31%-1.07% for maize, according to Table 3. The higher increase for maize reflects higher relative costs per ton and more complex testing. Domestic prices would rise in step with the international market in China but fall in the NAFTA countries[8] and South and Central America.

[6] It is worth recalling that countries such as India and China charge high tariffs (about 30%) on imports of semi-manufactured products from Brazil, and that these act as an incentive to grain exports. Thus the CPB could drastically change the composition of international trade in grains.

[7] The impact of increased costs due to the CPB on the Chinese market has been measured by the Global Trade Analysis Project (GTAP), which also estimates of the cost of testing by samples and by ton of imports. All hypotheses and data sources are specified in HUANG et al. (2006).

[8] The United States, Canada and Mexico. NAFTA is the North American Free Trade Association.

Table 3. Estimated impact of CPB implementation on domestic and international prices of soybeans and maize according to three alternative scenarios, in percent – 2010

Region	Soybeans			Maize		
	May contain	Identification	Quantification	May contain	Identification	Quantification
International prices	0.07	0.1	0.11	0.31	0.56	1.07
Domestic prices						
China	0.06	0.08	0.1	0.09	0.17	0.33
NAFTA	-0.03	-0.05	-0.07	-0.05	-0.09	-0.17
South & Central America	-0.02	-0.03	-0.04	-0.04	-0.07	-0.13

Source: HUANG *et. al.* (2006)

An analysis of the impact on production, as summarized in Table 4, shows a drop in production in NAFTA and in South and Central America. In the case of China, domestic production would increase. Rising domestic prices in China would stimulate the soybean and maize markets, leading to an increase in production under all three scenarios considered. The higher the domestic price increase due to CPB implementation, the more producers would respond by raising production as they sought to benefit from higher prices. Conversely, in regions where prices fell this would act as a disincentive to the entry of new producers into the market and hence to any increase in production.

Table 4. Estimated impact of CPB implementation on production of soybeans and maize according to three alternative scenarios, in millions of US dollars – 2010

Region	Soybeans			Maize		
	May contain	Identification	Quantification	May contain	Identification	Quantification
World	3.1	4.2	4.6	8.5	17.3	33.4
China	4.1	5.4	5.9	10.8	21.7	41
NAFTA	-7.4	-9.6	-9.8	-20.6	-41.2	-77.3
South & Central America	-6.9	-9.7	-11.6	-7.5	-14.9	-27.7

Source: HUANG *et. al.* (2006)

This situation would occur because the entire burden of paying for CPB implementation would have to be shouldered by countries that export soybeans and maize to China. This explains why China has now ratified and implemented the CPB and advocates compulsory LMO identification, with quantification of the presence of GM grains in all imported lots. If the cost of testing is borne by exporter countries, the rise in international prices will lead to an increase in domestic production. These outcomes are associated with the fact that China is a major importer of soybeans and maize and not an exporter, at least in the case of soybeans.

It is important to note that that the results of the simulation show an effect similar to the application of a tax – yet another one in the Brazilian case – that reduces the price received by producer and exporter regions and raises the price paid in consumer countries, with a self-evident loss of well-being for the entire economic system. The conclusion must be not only that care should be taken in implementing the Protocol but that the precautionary principle should be applied to the regulatory process itself, since there can be no good reason for enforcing an excessively rigorous system for LMO identification without taking into account the evidence furnished by risk assessments on a case-by-case basis.

3.3 Conditions within exporter countries

The impact of the Protocol will vary significantly even among exporter countries. These differences will reflect logistical conditions, the infrastructure for identification testing, and the share of exports in total production. Cost differences among exporter countries may affect their competitiveness and cause trade diversion.

A study of the Brazilian case and specifically of the CPB's impact on soybean production (SILVEIRA et al., 2006) highlights the stark differences among the main soybean exporters in terms of transport efficiency. A key factor in Argentina's competitiveness, for example, is the relatively short distance from soybean growing areas to ports (less than 250 km on average), which favours road transport (82%), an agile mode albeit costlier than the alternatives. In the U.S. the distances travelled by cargoes are longer but this country has the advantage of transporting 61% of the total by waterway, which not only costs less but reduces the number of transhipments and thus reduces the number of cargo identification tests. Brazil remains at a disadvantage compared with its two main competitors because of the relatively large average distance between producer areas and ports (over 1000 km); the significant dependence on road transport, which accounts for 60% of the total transported according to estimates by ABIOVE, the national association of vegetable oil producers (cited in SILVEIRA et al., 2006); and the excessive number of transhipments (three or more before reaching the port).

There is a close correlation between grain transport and storage conditions and the estimated impact of the CPB. The greater the distance between producer areas and ports, the more transhipments are needed in the export process. Studies by FAO/SAGPyA (2006), in discussing “propitious zones” for segregation at levels compatible with labelling thresholds (0.9%, 1%), show the limits to the introduction of identity preservation processes in areas located more than 350 km from a port.

The existence of intermediate storage facilities, private or owned by co-ops, also hinders the identification process. These facilities have substantial capacities ranging from 30,000 to 60,000 metric tons. Such volumes are not compatible with certification programmes based on low levels of adventitious presence, according to FAO/SAGPyA (2006).

In the specific case of Brazil, although road transport predominates, its combination with rail and, to a lesser extent, waterways entails the formation of “lots” with far larger volumes than the recommended volume for identifying adventitious presence above the desired threshold. The quality of Brazil’s roads, its rural storage capacity deficit, the existence of intermediate storage facilities and the seasonal nature of exports lead companies to pursue optimization along the route travelled by cargoes. For almost all cargoes exported, these practices are not compatible with segregation processes. In the case of soybeans, producer areas display differences in distances to ports, modes of transport and storage conditions. These differences would entail differentiated costs to implement segregation. As shown in Table 5, the total cost of segregation would reach 8% of the price of soybeans in the southeast of Mato Grosso and only 0.2% in Rio Grande do Sul.

Table 5. Estimated increase in logistical cost of soybean production with segregation and certification for major growing areas in Brazil, compared with average price of soybeans by region (R$ per metric tons)

Region	Main routes	Cost increase (R$/metric ton)				Price (R$/metric ton)	Total cost (% price)
		Transport	Storage	Testing	Total		
Southeast Mato Grosso	Rondonópolis-Paranaguá	30.5	13.4	1.2	45.1	523.3	8.6%
	Rondonópolis-Alto Taquari-Santos	24.4	10.7	1.5	36.6	523.3	7.0%
	Rondonópolis-Uberlândia-Vitória	24.4	10.7	1.5	36.6	523.3	7.0%
	Rondonópolis-Santos	24.4	10.7	1.2	36.3	523.3	6.9%
	Rondonópolis-Porto Velho-Itacoatiara	18.3	8	1.9	28.2	523.3	5.4%
Rio Grande do Sul	Passo Fundo-Rio Grande	0	0	1.2	1.2	616.7	0.2%
	Passo Fundo-Rio Grande	0	0	1.2	1.2	616.7	0.2%
	Passo Fundo-Rio Grande	0	0	1.5	1.5	616.7	0.2%

Source: Author's calculations

The predominance of public terminals at the main Brazilian ports, their configuration and the lack of adequate parking conditions for trucks would entail the use of private terminals specifically built or leased for products certified as non-LMO for not more than 20% of total export volume in the case of grains. Port reorganization on this scale would incur very high costs that can be estimated only with great difficulty (SILVEIRA et al., 2006).

4. CONCLUSION

The principal purpose of this paper is to show the crucial influence of biosafety regulation on technology adoption and trade in products, benefiting some countries and harming others. It is a duty of regulators, especially those concerned with science and technology issues, to pay close attention to the use made by certain players in the regulatory game – those protected by international protocols – of their privileged position in the process with a view to creating "technical barriers" to trade.

For LMO-exporting countries adoption of the "contains LMOs" principle, with identification and quantification of events, would cause an unnecessary increase in costs, since biosafety is assured not by identification testing but by analysis of each product before its release for commercial production. This type of identification entails a need to test every shipment "without direct benefits for biodiversity conservation, since the products concerned are not destined for release into the environment, and if they have been authorized by the exporter country their safety is assured by risk assessments".

A significant proportion of the agreements involving regulation of crossborder commodity flows interact with free-trade provisions regulated by agreements concluded under the aegis of the World Trade Organization (WTO). Advocacy of environmental protection therefore cannot overlook the economic implications of decisions taken in this regard without creating trade diversions that interfere substantively in national development.

Chart 1. Synthesis of soybean exporter positions regarding the CPB

Soybean exporters	Insertion in world market		Logistical conditions		CPB signatory	Cost of compliance with CPB
	Grain exports	Grain byproduct exports	Ave. distance between production & port	Ave. no. of transhipments		
Argentina	31%	69%	200 km	2	No	Low
Brazil	57%	43%	> 1000 km	3-4	Yes	High
United States	81%	19%	> 1000 km	2	No	Low

Source: Author's calculations

Chart 1 synthesizes the effect of CPB compliance on the three main soybean exporter countries including Brazil, considering a medium standard of compulsory testing and a certain degree of cargo segregation.

A lesser but still far from negligible effect noted in the paper would be the incentive for grain production in less competitive countries or regions, such as China and the European Union. One important suggestion is that implementation of the Cartagena Biosafety Protocol should be accompanied by measures to reduce the tariffs charged by importer countries, such as India and China, on exports of semi-processed products, especially meal for animal feed, to attenuate the impact of CPB implementation, since these exports have nothing to do with biosafety.

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