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Potential Economic Impacts of Asynchronous Approvals of Biotech Crops on Latin American Countries

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Abstract

This regional case study examines Latin America, which is home to a large number of importers of agricultural commodities which trade with exporters in both North and Latin America. All major exporters in North and Latin America have extensively adopted biotech crops, while most of the Latin American importers generally have not. With major exporters and significant importers in close proximity, much of the trade of maize, soy and soybeans and processed products occurs through a dense network of exchanges crisscrossing the continent. While there have only been a few cases of trade disruption resulting from regulatory asynchronicity to date, the paper argues that the potential for such disruption is likely to increase, with significant economic implications. As new events are brought to market at an increasing rate, the divergent regulatory capacities of individual countries imply the chance for ongoing asynchronicities in the regulatory approvals of new biotech crops across the Americas.

The paper shows that smaller importing countries, whose trade can be more easily shifted across alternative suppliers, would likely experience 2-8% price increases as a result of trade disruptions, whereas larger importers would experience price increases of 9-20%.

Key Latin America Recommendations include:

- Since many Latin American countries with limited technical and scientific regulatory capacity and financial resources will confront a difficult reality upon more fully implementing their biosafety laws, they should first opt for ways to effectively evaluate the safety of new biotech events at a fast pace or risk costly trade disruptions.

- A pooling of regulatory resources, i.e through regional partnerships and common leveraging reviews and assessments undertaken by countries with well-developed regulatory capacity should be explored.

- Countries in the region are also advised to adopt a non-zero tolerance level for LLP in order to balance safety objectives with the practical realities of commodity trade.

1. Introduction

Since their initial commercialization in the mid-1990s, the introduction and adoption of new biotech crops has continued unabated. In 2010, 29 countries cultivated biotech crops on 148 million hectares (James 2010). The broad adoption has been driven by farm-level yield and efficiency gains which have translated into billions of dollars of economic gains every year (Brooks et al., 2010; Carpenter 2010; Falk-Zepeda et al. 2000; Konduru et al. 2008; Qaim, 2009; Sobolevsky et al. 2005).

Because major exporting countries have led their adoption, biotech crops represent a substantial share of key agricultural commodities (maize, soybeans, cotton and canola) which are broadly traded in international markets. Yet, as the biotech pipeline has accelerated and the trade of biotech crops has become more extensive, alerts about the chance for "regulatory asynchronicity" and ensuing trade disruptions have become more frequent (Krueger and Buanec 2008; EC DG AGRI 2007; Backus et al. 2008; Stein and Rodriguez-Cerezo, 2010).

Biotech crops are strictly regulated for food and environmental safety at a national level. To date, more than 120 biotech events and 24 biotech crops have been approved for use or cultivation in various countries. As the biotech pipeline has expanded, however, regulatory approvals of new biotech crops across different countries have become less synchronized. Under such conditions, a large and increasing number of new biotech crops has received regulatory approval for use and cultivation in one or more countries but is still unauthorized in others (Stein and Rodriguez-Cerezo, 2010). Since asynchronicity in regulatory approvals between producing and importing countries implies that some agricultural commodity trade flows may contain unauthorized material, it could lead to costly trade disruptions (EC DG AGRI 2007; Phillipides, 2009).

Latin America is home to major agricultural commodity exporting countries that have led in the adoption of biotech crops. It is also home to significant importers who have not been significant adopters of biotechnology. On a few occasions, trade in the continent has been interrupted as a result of regulatory asynchronicity of biotech crops among importers and exporters.[1] Yet, such events have, generally, been infrequent. In this paper, we are interested in the chance for sustained regulatory asynchronicity among importing and exporting countries in Latin America, the potential for ongoing trade disruptions and the relevant economic implications.

2. Volume and Importance of Agricultural Commodity Trade in Latin America

Because of geographic proximity and inherent market integration, trade patterns of agricultural commodities in the Latin America (LA) region are best understood when considering LA and North America (NA) together. The trade of maize and soybeans represent typical examples of agricultural commodity exchanges in these regions.[2]

The United States is by far the largest producer and exporter of maize in the world, while Argentina and Brazil are the second and third largest exporters and contribute significant amounts to the global trade of maize every year (table 1). Paraguay is a smaller but meaningful exporter of maize as well.

1 For instance, imports of soybean meal and soybean oil to Ecuador were stopped for several weeks by the Ministry of Agriculture in May 2005 causing great difficulties in local poultry, animal feed and tuna canning industries. These led the government of Ecuador to reverse its prior decision and permit the restart of the imports (USDA, FAS GAIN Report, 2011).

2 We review the trade of maize, soybeans and processed products here in some detail but note that the trade of other major agricultural commodities follows similar patterns.

Together these top four exporters accounted, on average, for 81% of global maize exports in the last five years. The United States and Brazil use a large share of their maize production to feed livestock (and in the case of the US to feed an expanding ethanol industry). Accordingly, exports comprised a relatively small portion of their total maize crop in the last five years–approximately 15%. In contrast, Argentina and Paraguay produce maize largely for international markets and as a result their exports accounted, respectively, for 69% and 80% of their annual crop over the same period (table 1).

Table 1. Maize Production, Use and Trade, Avg. 2007/08 -2011/2012 (1000MT)

	Domestic use	Exports	Imports	Production	Exports/ Production	Imports/ Dom. use
United States	275,007	49,539	442	320,895	15%	0%
Brazil	47,300	8,705	645	56,840	15%	1%
Argentina	6,960	15,121	7	22,063	69%	0%
Paraguay	300	1,460	12	1,834	80%	4%
% of world exports		82%				
Mexico	31,040	223	8,564	22,560	1%	28%
Canada	11,872	749	1,865	10,703	7%	16%
Colombia	5,140	1	3,497	1,580	0%	68%
Venezuela	3,250	-	1,487	1,749	0%	46%
Peru	3,180	9	1,576	1,627	1%	50%
Guatemala	1,840	9	654	1,190	1%	36%
El Salvador	1,350	3	496	851	0%	37%
Ecuador	1,310	16	414	946	2%	32%
Cuba	1,120	-	771	360	0%	69%
Dominican Republic	1,090	-	1,044	35	0%	96%
Honduras	990	1	383	603	0%	39%
Uruguay	720	117	405	440	27%	56%
Bolivia	700	13	15	699	2%	2%
Costa Rica	685	-	657	18	0%	96%
Nicaragua	570	5	129	440	1%	23%
Panama	455	-	365	82	0%	80%
Haiti	250	-	0	250	0%	0%
Jamaica	245	-	242	2	0%	99%
Trinidad and Tobago	110	-	103	5	0%	93%
Guyana	37	-	32	5	0%	86%
% of world imports			23%			
World	813,670	92,524	90,373	817,255	11%	11%

Source: USDA, PS&D Database

Most LA countries are net maize importers jointly accounting together for 23% of global imports over the 2007-2011 period. The largest maize importer is Mexico which, despite its significant domestic maize production, imported more than 8.5 MMT of maize per year in the last five years. Colombia, Venezuela, Peru and the Dominican Republic are also relatively large importers of maize. Most LA countries depend heavily on imports for their domestic needs as their share of imports to domestic use is rather high (table 1). For instance, the Dominican Republic, Costa Rica and Jamaica depend almost entirely on imports while Colombia, Venezuela, Peru and El Salvador have significant domestic production, but still depend on trade to satisfy 1/3 to 2/3 of their domestic consumption. Haiti and Bolivia have small domestic markets and are self-sufficient.

The Americas are also home to the largest producers and exporters of soybeans and processed soy products in the world. The United States is the largest producer and exporter of soybeans followed closely by Brazil and Argentina (table 2). Both the US and Brazil export predominantly unprocessed soybeans and trade almost half of their production in international markets. Argentina exports only a quarter of its production and processes large amounts of soybeans in order to export value added products (e.g. meal, oil). Paraguay, Canada, Uruguay and Bolivia also contribute meaningful soybean exports to world markets every year. Together these seven countries accounted for 99% of global soybean exports in the 2007-2011 period (table 2).

Table 2. Soybean Production, Use and Trade, Avg. 2007/08 -2011/2012. (1000MT)

	Domestic use	Exports	Imports	Production	Exports/ Production	Imports/ Dom. use
United States	49,247	37,270	369	83,921	44%	1%
Brazil	37,153	30,062	89	67,360	45%	0%
Argentina	37,197	10,563	839	46,940	23%	2%
Paraguay	2,026	4,771	19	6,780	70%	1%
Canada	1,703	2,324	354	3,577	65%	21%
Uruguay	39	1,387	-	1,428	97%	0%
Bolivia	1,495	70	17	1,495	5%	1%
% of world exports		99%				
Mexico	3,659	-	3,553	111	0%	97%
Colombia	389	-	326	61	0%	84%
Costa Rica	231	-	231	-	0%	100%
Venezuela	145	-	74	71	0%	51%
Cuba	118	-	117	-	0%	99%
Peru	105	-	103	3	0%	98%
Chile	71	11	82	-	0%	100%
Ecuador	67	1	-	68	2%	0%
Guatemala	37	-	1	36	0%	3%
Barbados	23	-	23	-	0%	100%
Panama	5	-	5	-	0%	92%
Nicaragua	3	-	-	3	0%	0%
% of world imports			5%			
World	241,000	87,562	85,353	243,276	36%	35%

Source: USDA, PS&D Database

Beyond these large exporters, production of soybeans in LA countries almost non-existent. As a result, most LA countries must import soybeans for their consumption. There are only few countries in the region which import significant amounts of soybeans, however, and as a trade block LA countries accounted for only 5% of global soybean imports in the last five years. Since soybeans require processing prior to consumption, countries without processing capacity or the scale to support it import soybean meal and oil instead. Among LA countries, the largest importer of soybeans is Mexico followed by Colombia and Costa Rica.

Since most LA countries have no domestic soybean crushing capacity, they import large amounts of soybean meal and soybean oil. For instance, in the last five years, LA countries together imported 34% of all soybean meal traded in the world. The largest importer of soybean meal is Mexico, making it a major importer of both soybeans and meal. Other major importers include Canada, Peru, Venezuela and Colombia. When combining soybean and processed product imports, virtually all LA importers rely on imports for their domestic consumption.

Not surprisingly, almost all LA imports of value added soybean products originate in the Americas. The US is the largest producer of soybean meal and oil followed by Argentina and Brazil (table 3). As in the case of maize, the US and Brazil use a large share of their production domestically and export 1/4 - 1/2 of their soybean value added products. Argentina, Paraguay and Bolivia export virtually all the soybean meal they produce. As a result, Argentina is the largest exporter of soybean meal in the world, followed by Brazil and the US. These top five exporters of soybean meal together accounted for 89% of global exports over the 2007-2011 period (table 3).

Table 3. Soybean Meal Production, Use and Trade, Avg. 2007/08 -2011/2012 (1000MT)

	Domestic use	Exports	Imports	Production	Exports/ Production	Imports/ Dom. Use
United States	28,281	8,436	135	36,575	23%	0%
Argentina	685	26,915	2	27,789	97%	0%
Brazil	12,981	13,346	92	26,372	51%	1%
Paraguay	139	1,299	-	1,445	90%	0%
Bolivia	77	1,032	-	1,110	93%	0%
% of world exports		89%				
Mexico	4,278	7	1,426	2,856	0%	33%
Canada	2,112	139	1,198	1,051	13%	57%
Colombia	1,109	-	908	202	0%	82%
Venezuela	1,089	-	976	113	0%	90%
Peru	1,002	-	1,002	2	0%	100%
Chile	610	-	553	56	0%	91%
Ecuador	567	-	534	32	0%	94%
Dominican Republic	412	-	404	-	0%	98%
Cuba	367	-	274	92	0%	75%
Guatemala	285	-	285	-	0%	100%
Costa Rica	216	2	39	179	1%	18%
Panama	169	-	165	4	0%	97%
Uruguay	165	-	145	20	0%	88%
El Salvador	160	-	159	-	0%	99%
Honduras	147	0	145	-	0%	99%
Jamaica	105	-	104	-	0%	99%
Nicaragua	51	14	65	-	0%	100%
Trinidad and Tobago	44	0	44	-	0%	100%
Guyana	19	-	19	-	0%	100%
Barbados	18	-	-	18	0%	0%
% of world imports			15%			
World	164,735	57,112	55,000	167,036	34%	33%

Source: USDA, PS&D Database

3. Patterns of Trade Flows

With major exporters and significant importers in close proximity, much of the trade of maize, soybeans and processed products in the Americas occurs through a dense network of exchanges crisscrossing the continent. The US is by far the largest supplier of maize exports to LA, with a relatively large share shipped to Central America, Caribbean, and South America countries. For instance, over a typical four year period (2005-08), the US exported 37% of its maize to LA countries (table 4). A large share of these exports went to Mexico and Canada. However, Colombia, the Dominican Republic and other countries in Central America were meaningful markets. In fact, only a few countries (e.g. Chile and Peru) received more maize from other Latin American sources (Argentina) than from the US.

Table 4. Maize Trade Flows in the Americas: 2005-2008 (1000 MT)

Exporters / Importers	Argentina	Brazil	Canada	Mexico	Paraguay	USA	ROW	Am. % of Imports
Argentina	-	1	-	0	44	4	21	70%
Bahamas	0	-	-	-	-	1	0	100%
Barbados	-	-	0	-	-	36	0	100%
Belize	-	-	-	0	-	3	0	99%
Bermuda	-	-	0	-	-	0	-	100%
Bolivia	2	1	-	-	-	0	0	97%
Brazil	25	-	-	0	1,049	1	0	100%
Canada	0	-	-	0	0	2,623	16	99%
Cayman Isds	-	48	-	-	40	0	0	100%
Chile	1,335	20	0	0	4	325	4	100%
Colombia	177	89	-	0	-	3,170	18	99%
Costa Rica	0	-	0	32	-	702	2	100%
Cuba	5	-	-	0	-	778	0	100%
Dominica	-	-	0	-	-	1	0	99%
Dominican Rep.	13	-	-	-	-	1,205	0	100%
Ecuador	29	12	-	0	-	427	0	100%
El Salvador	0	-	-	89	-	521	12	98%
Grenada	-	-	0	-	-	12	0	100%
Guatemala	0	-	-	6	-	737	0	100%
Guyana	-	-	-	-	-	26	3	90%
Honduras	0	-	-	0	-	350	1	100%
Jamaica	-	-	0	-	-	259	0	100%
Mexico	2	1	-	-	-	9,535	27	100%
Nicaragua	-	-	-	0	-	137	1	100%
Panama	0	0	-	0	-	424	0	100%
Paraguay	2	11	-	-	-	0	0	100%
Peru	1,101	19	-	0	15	377	17	99%
Suriname	-	-	0	-	-	13	5	71%
Trinidad & Tobago	0	-	0	-	-	116	0	100%
USA	39	2	223	64	1	-	83	80%
Uruguay	69	0	-	-	347	0	0	100%
Venezuela	9	4	-	4	-	898	1	100%
ROW	13,140	9,588	395	0	196	39,138	-	
Am. % of Exports	18%	2%	36%	100%	88%	37%		

Source: GTIS, Global Trade Atlas

Argentina and Brazil typically trade a larger share of their maize crop to Europe, South East Asia and the Middle East. Because of this orientation, Argentina exported only 18% of its maize to LA countries over the 2005-08 period while Brazil exported only 2%. The majority of maize exports from Argentina were sent to neighbors in South America including Chile, Peru and Colombia. Other LA importers (e.g. Paraguay, Mexico and Canada) similarly trade mostly with adjacent countries (table 4).

Trade patterns in the soybean complex are complicated by the multitude of trade flows of soybeans, soybean meal and soybean oil which are determined by the relative capacity of soybean crushing across importers and exporters. To simplify the discussion of such trade flows, table 5 aggregates the trade of all three soybean commodities (in soybean equivalent terms) over the 2005-08 period.

The US is by far the largest exporter of soybeans and value added products to LA countries. 26% of its exports were bound for the Americas over the 2005-2008 period. The LA market represented 15%

of the total US soybean exports and 70% of its total value added product exports over that period. Mexico and Canada were the largest importers from the US with Canada importing mostly meal and Mexico mostly soybeans. Other larger importers included Colombia which imported both soybeans and meal, the Dominican Republic and Guatemala, both of which imported mostly meal.

Paraguay appeared as the second largest soy exporter to LA countries with 78% of its exports directed to the region in the 2005-08 period. However, much of that was exported to Brazil, Argentina and Uruguay from where it was typically re-exported to international markets. Because of Paraguay's lack of major export ports, Brazil, Argentina and Uruguay often serve as transshipment points.

Argentina and Brazil send a relatively small share of their total exports to LA (5% and 1% respectively). Argentina's largest destinations (predominantly meal) are: Peru, Chile, Colombia and Ecuador. Argentina and Brazil exports exceed those of the US only in Chile, Peru, Bolivia and Uruguay.

Table 5. Soybean, Soy Meal and Oil Trade Flows in the Americas:
Average of 2005-2008 in 1000 MT soybean equivalent

Exporters / Importers	Argentina	Brazil	Canada	Mexico	Paraguay	USA	ROW	Am. Share of Imports
Argentina	-	13	0	-	909	0	115	89%
Bahamas	-	-	-	-	-	3	7	27%
Barbados	0	-	0	-	-	29	0	99%
Belize	-	-	-	6	-	3	0	100%
Bermuda	-	-	0	-	-	0	-	100%
Bolivia	2	147	-	-	10	0	0	100%
Brazil	31	-	0	-	271	0	1	100%
Canada	1	0	-	-	0	2,032	10	100%
Cayman Isds	-	18	-	-	457	0	-	100%
Chile	495	22	0	-	185	65	56	93%
Colombia	450	41	0	0	13	649	292	80%
Costa Rica	35%	0	-	-	-	324	0	100%
Cuba	21	88	0	-	-	364	0	100%
Dominica	0	0	-	-	-	-	1	2%
Dominican Rep.	100	7	0	-	8	543	0	100%
Ecuador	397	1	-	-	31	89	17	97%
El Salvador	3	-	0	-	-	205	12	95%
Grenada	0	-	-	-	-	8	2	81%
Guatemala	36	8	0	0	5	368	0	100%
Guyana	0	1	-	-	-	24	7	78%
Honduras	0	0	0	0	-	204	2	99%
Jamaica	6	1	1	-	-	147	0	100%
Mexico	1	0	0	-	-	5,924	1	100%
Nicaragua	3	-	0	-	-	88	8	92%
Panama	14	0	0	-	-	194	8	97%
Paraguay	5	12	-	-	-	0	-	100%
Peru	501	4	0	-	255	72	136	86%
Suriname	2	1	0	-	-	7	6	62%
Trinidad & Tobago	5	2	0	-	-	72	1	99%
USA	21	3	292	1	4	-	77	81%
Uruguay	73	9	-	-	1,343	-	2	100%
Venezuela	114	61	-	0	114	432	640	53%
ROW	39,891	39,352	1,757	0	1,007	33,760	-	
Am. Share of Exports	5%	1%	14%	100%	78%	26%		

Source: GTIS, Global Trade Atlas

4. Biotech Use and Regulatory Approvals

Given the importance of maize, soybeans and other agricultural commodity trade for most countries in LA, trade disruptions could have significant impacts on supplies and prices. Since the presence of unapproved biotech events in the supplies of an exporter could trigger bilateral trade disruptions with one or more importers, it is of interest to examine the potential economic implications of such events for both importers and exporters in the region. In this context, the use of biotechnology in NA and LA countries is of interest.

All major exporters in the Americas have adopted biotech maize and soybean varieties quickly and extensively (table 6). In 2009, the last year for which adoption data is available for all relevant countries, soybean exporting countries in the Americas (the US, Brazil, Argentina, Canada, Paraguay, Uruguay, and Bolivia) cultivated 70-99% of their hectareage with biotech varieties. Only one importing country in the Americas, Mexico, cultivated biotech soybeans at a small scale (table 6).

Table 6. Maize and Soybean Hectareage and Biotech Adoption in the Americas in 2009

	Maize		Soybeans	
Country	Harvested Hectares	% biotech	Harvested Hectares	% biotech
USA	32,169,000	85%	30,907,000	92%
Brazil	12,925,000	36%	23,500,000	71%
Argentina	2,750,000	83%	18,600,000	99%
Canada	1,142,000	84%	1,380,000	72%
Paraguay	600,000	0%*	2,680,000	90%
Uruguay	96,000	82%	863,000	99%
Bolivia	310,000	0%	960,000	78%
Mexico	6,280,000	0%	70,000	25%
Honduras	362,000	4%	-	-
Colombia	550,000	0%**	32,000	0%

* biotech maize has not been approved in Paraguay; however, USDA FAS estimated that 90% of the 2009 hectareage was planted with biotech hybrids brought in from neighboring countries

** ISAAA reports that 35,000 hectares of maize were grown under a "controlled planting program"

Sources: ISAAA, USDA

Among the major maize exporters, the US and Argentina have led in the adoption of biotech maize with levels exceeding 80% of their harvested hectareage in 2009. Brazil approved and commercialized biotech maize for the first time in 2008 but it has since increased its adoption at a rapid rate and is expected to reach adoption levels similar to those in the US and Argentina in the next two years. Paraguay is the only maize exporter that has not approved and, officially, does not grow biotech maize. Nevertheless, the USDA has estimated that 90% of Paraguay's maize harvested hectares in 2009 were planted with biotech hybrids imported illegally from neighboring countries (USDA-FAS, GAINS Report, 2010). Among net maize importers, only Canada and Uruguay have adopted biotech maize extensively (over 80% of hectares). A small share of the maize hectares in Honduras were also planted with biotech hybrids in 2009 while a limited amount of hectares used biotech maize under a "controlled planting program" in Colombia during the same year (James, 2009).[3]

The adoption levels of biotech maize and soybeans in table 6 illustrate the divide in the use of biotechnology among exporting and importing countries in the Americas: Exporters have adopted the technology while importers have not. Yet, aggregate adoption levels, such as those reported in table 6, often obscure important differences in the varietal plantings among biotech adopters as well. As

3 Costa Rica and Chile also have a small number of hectares that grow biotech corn and soybean seeds for export markets.

the biotech pipeline has continued to evolve and grow over time, newer biotech traits and "stacks" of multiple traits have been introduced in some countries but not in others. As a result, adopters often use "different generations" of biotech crop technologies. Regulatory approvals across countries are typically good indicators of such potential differences.

Tables 7 and 8 list the regulatory approvals of new biotech maize and soybean events for use and planting which have been granted over time by countries in NA and LA.[4] From these tables, it is readily apparent that even among the countries that have broadly adopted biotechnology, there are significant differences. The US and Canada have reviewed and approved new biotech events on an ongoing basis and as a result they have had access to the newest biotech crops available. Argentina and Brazil have reviewed and approved significantly fewer new biotech events, though Brazil has greatly accelerated its deregulations in the last three years. Mexico, and to a lesser extent Colombia, has approved a large number of new biotech events but mostly for use as food or feed, or for further processing, and not for planting. As a result, Mexico and Colombia have continued to import and consume biotech soybean and maize but they have not grown them much. All other adopters have approved and used a limited part of the biotech maize and soybean pipeline.

Table 7. Approvals of Biotech Maize Events for Use and (Planting) in the Americas*

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
US	3(7)	10(3)	1(3)	2(2)	(1)	2(1)	3(2)	0	1(1)	5(2)	1(1)	4(2)	7(4)	2(1)	5(4)	7(1)	(2)	53(37)
Canada	1	4(7)	6(3)	1(1)	0	0	2(2)	1(1)	2(1)	3(1)	3(3)	6(6)	3(2)	2(2)	4(2)	6(2)	0	44(33)
Argentina	0	(1)	0	4(3)	0	0	1(1)	0	0	1(1)	4(3)	0	1(1)	1	1	5(4)	(2)	18(16)
Brazil	0	0	0	0	0	0	0	0	0	0	0	0	2(1)	5(6)	8(7)	2(3)	1(1)	18(18)
Colombia	0	0	0	0	0	0	0	0	1	1	1	1(1)	1	5(3)	1	4	0	15(4)
Mexico	0	0	0	0	0	0	0	4	1	4	0	4	8	5	1	9	0	36
Paraguay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uruguay	0	0	0	0	0	0	0	0	1(1)	1(1)	0	0	0	0	0	0	(4)	2(6)
Costa Rica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Honduras	0	0	0	0	0	0	0	1(1)	0	0	0	0	0	1(1)	1(1)	0	0	3(3)
Bolivia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chile	0	0	0	0	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0(1)
El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3

*Use approvals consist of the earliest Food, Feed, Import or Processing approval for an individual event

Source: ISAAA, GM Approval Database. http://www.isaaa.org/gmapprovaldatabase/default.asp

4 Approvals for new biotech events are generally granted for food use, feed use, processing, importation and planting. Individual countries may use particular approvals and not others. For example, some countries grant food and feed approvals, while others require an importation approval when food and feed safety for imports is necessary. Countries grant planting approvals when permission to grow a new biotech event is sought. In tables 7 and 8, food, feed, processing and importation approvals are summarily presented as "Use" approvals, implying that a new biotech event (imported or otherwise) can be placed on the market for consumption. Planting approvals (placed in parenthesis) are separately indicated.

Table 8. Approvals of Biotech Soybean Events for Use and (Planting) in the Americas*

	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005	2007	2008	2009	2010	2011	Total
US	1(1)	0	(2)	1(1)	4(2)	0	0	0	0	0	2(1)	(1)	1	1(1)	1	11(5)
Canada	0	1(1)	0	0	0	(1)	3(2)	0	0	0	1(1)	0	3(2)	1(1)	0	9(8)
Argentina	0	0	1(1)	0	0	0	0	0	0	0	0	1	0	0	1(2)	3(3)
Brazil	0	0	0	0	1(1)	0	0	0	0	0	0	0	1(1)	4(4)	0	6(6)
Colombia	0	0	0	0	0	0	0	0	0	1	0	0	0	2(1)	0	3(1)
Mexico	0	0	0	0	1(1)	0	0	3	0	0	0	2	1	1	0	8(1)
Paraguay	0	0	0	0	0	0	0	0	1(1)	0	0	0	0	0	0	1(1)
Uruguay	0	0	0	1(1)	0	0	0	0	0	0	0	0	0	(2)	0	1(3)
Costa Rica	0	0	0	0	0	0	0	0	0	0	0	(1)	(1)	0	0	0(2)
Honduras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bolivia	0	0	0	0	0	0	0	0	0	0	0	1(1)	0	0	0	1(1)
Chile	0	0	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0(1)
El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Use approvals consist of the earliest Food, Feed, Import or Processing approval for an individual event

Source: ISAAA, GM Approval Database. http://www.isaaa.org/gmapprovaldatabase/default.asp

While there are significant differences in the regulatory approvals and use of new biotechnologies among adopters, there are even larger discrepancies among the countries that are not listed in tables 7 and 8. Indeed, some LA countries have no biosafety regulatory framework at all (e.g. Dominican Republic and Panama). Others have been developing their biosafety regulations (e.g. El Salvador, Venezuela, and Chile) but it is unclear when they might be able to complete them. And there are other LA countries that use ministerial decisions, decrees and other executive decisions to manage regulatory approvals for field trials or importation on an “as needed” basis (e.g. Guatemala and Paraguay).

A number of factors contribute to this wide diversity in the stage of development of regulatory approvals and use of biotechnology, chief among them: (a) an accelerating pipeline; (b) diverse national priorities, government policies and demands by various stakeholder groups; and (c) national differences in technical capacity and financial resources needed to support a robust regulatory system. The factors can explain, at least in part, the significant differences in the portion of the biotech pipeline that has been deregulated in the different NA and LA countries. But they also serve to highlight an emerging problem: As new events are brought to market at an increasing rate, the divergent regulatory capacities of individual countries imply the chance for ongoing (structural) asynchronicities in the regulatory approvals of new biotech crops across the Americas. As such, the possibility of exporting biotech commodities that have not been authorized in one or more LA importing countries will be high in the future.

5. Asynchronicity, LLP and Potential Economic Impacts of Trade Disruption: An Empirical Investigation

If asynchronicity in the regulatory approvals of new biotech crops among exporting and importing countries in the Americas were to lead to disruptions in bilateral trade flows, importers would need to identify alternative supplies and exporters would need to find alternative markets for their products. We are interested in the economic consequences of such potential disruptions on importers and exporters alike. Because only the trade flows between specific importers and exporters may be affected, a model that explains bilateral trade flows must be used for quantitative analysis. Here, we use a spatial equilibrium framework to examine the economic impact of disruptions in bilateral trade flows of maize among importers and exporters in NA and LA.[5]

Modern spatial equilibrium concepts were first developed by Enke (1951) and Samuelson (1952) and were later formalized by Takayama and Judge (1971) as quadratic programming problems. Spatial equilibrium models have been used in studies of commodity markets to examine the potential price impacts from changes in trade due to improvements in infrastructure (roads, canals, lock and dam systems, ports, etc); country-specific tariffs and/or quotas; country-specific trade bans or embargoes; trade restrictions associated with disease outbreaks or epidemics, phytosanitary concerns; and other related issues.

Although spatial equilibrium models have been applied to a wide range of economic problems, the segment of the spatial equilibrium literature that examines the economic impacts of bilateral trade disruptions is relatively small. Much of the modern empirical and theoretical literature on such trade disruptions was initially motivated by several trade embargoes in the world markets for petroleum and other commodities in the 1970s as well as the 1980 grain embargo imposed by the US on the Soviet Union (e.g. see USDA ERS Report 564, 1986).

Since the group of grain embargo studies was published in the 1980s, there have been some more recent applications of the Takayama-Judge spatial equilibrium models to studies of trade disruptions in international agricultural markets. Recent examples include the study of the world rice market by Chen, McCarl, and Chang (2006) and the study of bans on genetically modified products in the international soy complex by Sobolevsky, Moschini, and Lapan (2005). Although much of the most recent empirical research on international trade issues is now based on other types of models (e.g., computable general equilibrium (CGE) or Armington-type models), the Takayama-Judge spatial equilibrium models have certain advantages in analyzing the impact of trade disruptions. For instance, Armington-type models are based on constant elasticity of substitution (CES) specifications, which imply that the trade flows of countries that do not normally trade will remain zero under any type of disruption and change in global trade. This is limiting when the potential redistribution of trade in response to disruptions of traditional trade flows is of interest.

Conceptual Model

The spatial equilibrium model developed for this analysis represents the global maize sector, and the basic model structure is based on the general approach for multi-region trade that is described by Takayama and Judge (1971). The objective of the spatial equilibrium model is to maximize net social welfare (consumer and producer surplus minus transportation costs and import and export tariffs) by choosing the bilateral trade flows subject to relevant behavioral constraints (i.e., market equilibrium and no-arbitrage constraints).

Notation

The market quantities and prices for maize are the market equilibrium levels that are derived from the excess supply-demand functions for maize in each country. We use linear quantity-dependent supply and demand specifications

(1) Supply: $Q_i^S = \delta_{1i} + \delta_{2i} p_i^S$ Demand: $Q_i^D = \gamma_{1i} - \gamma_{2i} p_i^D$

where p_i^S is the supply price of maize in country i, p_i^D is the demand price in country i, Q_j^S is the

5 While we present empirical results for maize trade here, similar results have been derived from the empirical analysis of trade in soybeans and processed products in NA and LA.

aggregate quantity of maize supplied in country j, Q_i^D is the aggregate quantity of maize demanded in county i, and all of the model parameters are positive values. We allow the aggregate quantity demanded to differ from the aggregate quantity supplied so that individual countries may be net importers or exporters of maize, but the market equilibrium is imposed in each market by restricting the supply and demand prices to be equal ($p_i^S = p_i^D$). Accordingly, we can form the linear aggregate excess demand function

(2) $$Q_i^D - Q_i^S = (\gamma_{1i} - \delta_{1i}) - (\gamma_{2i} + \delta_{2i}) p_i = \beta_{1i} - \beta_{2i} p_i$$

for country i. To determine the market equilibrium outcomes, we calibrate the excess demand functions by using observed price and import or export quantity data for each country. For example, the slope of the excess demand equation in (2) is computed from excess demand elasticity estimates taken from prior studies, and the intercept coefficient is calibrated from the observed price and quantity data.

Given these linear excess demand equations, the net social welfare values may be computed for country i as

(3) $$\sum_i \beta_{1i} p_i - \sum_i \beta_{2i} p_i^2 / 2$$

The objective of this formulation for the spatial equilibrium problem is to choose the trade flows (imports or exports) that maximize the net social welfare expression in (3) subject to the behavioral constraints. The market equilibrium relationships for each country are expressed in (2), and we also require that international price differences may not be subject to arbitrage. In particular, the price differences between any two markets should not exceed the per-unit transport costs between the markets. Further, the no-arbitrage conditions should account for the possibility that countries may impose import or export tariffs on their trade volumes. If a country imposes a specific (per-unit) import tariff (t_{ij}^M) or export tariff (t_{ij}^X) on maize, the tariff is added to or subtracted from the associated transportation rate for maize flowing to or from the country. To represent a spatial equilibrium such that no arbitrage between the countries is possible, we also impose the following constraints on the prices

(4) $$\left| p_i - p_j \right| \leq w_{ij} + \left(t_{ij}^X + t_{ij}^M \right) p_i$$

Here, the absolute price differences between countries i and j are less than or equal to the transportation and per-unit import and export tariff rates.The solution values from the spatial equilibrium models include the aggregate excess supply and demand quantities and the market-clearing prices for maize in each country. These values are used as the baseline for our trade scenario analysis.

Imposing potential bilateral trade restrictions

If trade between countries h and k is restricted, then the no-arbitrage constraint on the price difference between these markets (e.g., (4)) does not have to hold at the spatial equilibrium. To remove these constraints from the optimization problem, we may increase the constraint bound in (4), which may be interpreted as imposing a prohibitively large per-unit cost of trade between the parties. However, the other no-arbitrage constraints between these countries and all third parties are still imposed, so the price difference between countries h and k under these trade restrictions cannot become implausibly large as long as there are other willing trading partners with available stocks to exchange (i.e., an interior solution exists for each country). In such cases, the price changes in countries h and k largely reflect the additional costs of reallocating the displaced quantities to other markets. Under extreme trade disruptions in which alternative trading partners may have limited ability to make up for the displaced quantities, the no-arbitrage constraints may no longer hold between countries h and k and all third parties due to corner solutions. In such cases, the no-arbitrage constraints are removed for all interactions involving countries h or k, but the no-arbitrage constraints are retained for all relationships among the third parties. Thus, the price changes resulting from the trade disruption may be large in countries h and k.

Empirical Analysis

Data

In order to operationalize the spatial equilibrium model set out in the previous section, detailed data on production, consumption, trade flows, prices and freight rates, as well as tariffs and quotas for maize in selected countries and groups of countries were collected or constructed. Trade flow data was derived from the United Nations Comtrade database and this data set was validated and augmented by additional information on trade flows taken from Global Trade Atlas of Global Trade Information Services as well as from FAOSTAT-TRADESTAT. Each of these data sets is based on national customs data collected by origin and and/or destination countries. In particular, the maize trade flows were collected for HS Code 100500.

Detailed annual bilateral trade flow data for maize in various countries was collected for individual countries and some selected country groupings. Initially, the data was collected for all available trading partners and where one dataset omitted a potential trading partner it was complemented with data from the other data sources to ensure that relevant trade flows were not excluded. Trade flow data was aggregated into 38 countries and country groupings yielding a symmetric 38x38 matrix of bilateral trade flows (Table 9).

As the data reported by origin countries and destination countries did not always match, the maximum value of the two reporting countries was taken for the final trade flow. Trade flow data was available in both volume and value. Although volume was of primary interest for the analysis, value data allowed the calculation of implied per-unit costs for various trades which were, in turn, used in the validation of global trade prices (discussed below).

Domestic supply and demand data came from FAOSTAT and was validated with USDA PS&D data. FAOSTAT data is reported on a calendar year basis and was used to indicate each country's excess supply and demand conditions. The composition of domestic demand (feed, food, industrial demand) was used in applying and weighting the appropriate elasticities to the trade model. Demand and supply elasticities were obtained from the CAPRI model. Where data was unavailable, comparable elasticities were taken from FAPRI and WATSIM.

Freight rates for all possible routes implied in the constructed 38x38 trade matrix used in the analysis were estimated through regression analysis. Actual freight rates reported for maize were obtained from Maritime Research. These rates were regressed against the distance covered in each individual trade as well as against selected indexes of bunker and fixtures for panamax and handy size vessels typically used in dry bulk commodity trade. The regression equation was then used to estimate freight rates for all routes and years in the analysis.

Cash port prices reported by USA, Brazil, Argentina and the EU for the dominant trading ports were the basis of the global trade prices used in the model. Using each country's share of trade with these four countries an average FOB price was constructed for the port of origin. A per-unit weighted average of transportation cost and tariff was added to the FOB price to derive a CIF price for each importer. These prices were validated by the implied per-unit import costs calculated from GTIS trade data to ensure consistency.

Annual import tariff data was collected from the WTO tariff database using the country's average applied tariff. This data was validated with tariff rates maintained by FAPRI. All export tariffs used were from FAPRI. Tariffs were calculated for country aggregates by weighting the volume of imports (or exports) and average tariff paid for each country.

Table 9. Countries and Country Groupings

Acronym	Description
EU25	European Union 25
BRA	Brazil
ARG	Argentina
USA	United States of America
CHN	China
PAR	Paraguay
CAN	Canada
MEX	Mexico
BUR	Bulgaria & Romania
WBA	Western Balkans
REU	Rest of Europe
RUB	Russia & Belarus
UKR	Ukraine
CAM	Central America
VEN	Venezuela
CHL	Chile
URU	Uruguay
BOL	Bolivia
NWSA	NW countries in South America (Colombia, Ecuador and Peru)
IND	India
JAP	Japan
TLD	Thailand
SKR	South Korea
INDO	Indonesia
MLAY	Malaysia
PHIL	Philippines
ANZ	Australia & New Zealand
MOR	Morocco
TUN	Tunisia
ALG	Algeria
EGY	Egypt
TUR	Turkey
ISR	Israel
LDC	Least Developed Countries
AFR	Non-LDC African Countries in the ACP
C&P	Non-LDC Caribbean & Pacific Island countries in ACP
MIDE	Middle East (Syria, Iran, Iraq, Saudi Arabia, UAE)
ROW	Rest of World

Baseline Development and Model Validation

The spatial equilibrium model developed here is a simplified representation of world trade in maize. The model is not a forecasting tool and should not be understood as such. Still, it must effectively represent the direction and magnitude of changes that might occur in response to a given disruption of bilateral trade. In this context, an effective representation of observed supply, demand and trade by the model for the countries of interest is important. Hence, the model must be validated for its effectiveness to approximate observed demand, supply and trade conditions in any particular year.

The maize model was calibrated with GTIS trade data from the respective calendar years. Solving the model provides estimates of supply and demand as well as imports and exports for all 38 countries/ country groups in the analysis. These baseline estimates can be compared with observed data in order to evaluate the adequacy of the empirical model. Deviations of model-derived baseline estimates from actual excess demand and supply figures for maize --expressed as (baseline-actual)/ actual-- ranged from -29% to 12% for all countries and years in the analysis. The average deviations were much smaller than the extreme values -under 5%- with the relevant deviations for the world market at 3.6% for 2005 and 2.3% for 2007, the two years for which the model was calibrated.[6] Similarly, calculated trade flows for all large importers and exporters closely matched observed trade flows. Small volume trades were not represented as effectively, which is typical in spatial equilibrium models using annual data. Such trades typically represent opportunistic transactions within a year and are difficult to represent through annual averages. In all, the baseline model runs were considered effective.

Empirical Results

With an effective baseline in hand, the impact of potential bilateral trade disruptions for selected countries or regions in LA could be examined through scenario analysis as outlined in the modeling section above. Two scenarios were considered and each scenario has two components. Scenario 1 involves the disruption of bilateral trade between a single large importer (Mexico) and (1) its main supplier (US) or (2) its major supplier and another large exporter (US and Argentina). Scenario 2 involves the disruption of trade for a block of smaller importers (Colombia, Ecuador, and Peru) located in northwest South American (NWSA) and (1) their main supplier (US) and (2) their main supplier and another large exporter (US and Argentina).[7] Note that the importer and its major supplier are neighboring countries in Scenario 1, and alternative supplies have to be procured from farther away when bilateral trade is disrupted. In contrast, the importer and the primary suppliers are more distant from one another in Scenario 2 and alternative suppliers to NWSA are closer. Finally, both scenarios are examined under two distinct types of markets situations as represented by 2007 and 2005 (i.e. the baseline years) reflecting above and below average global supply conditions.

Scenario 1

Mexico normally gets nearly all of its maize imports from the United States. For example, Mexico imported more than 8 million metric tons of maize in 2007, and the US supplied all but roughly 80 thousand metric tons of this amount. The reasons for this strong trade relationship include proximity as well as the size and dependability of the US market and the convenient and inexpensive freight access through various modes of transport (i.e., rail and ocean vessels).

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6 2005 was chosen as a baseline year because it was representative of a short global maize crop and hence of tight market conditions. 2007 was chosen as an alternative baseline year since global production was above average and hence it was representative of a well-supplied global maize market. The two alternative baselines are used to envelop "normal" market conditions.

7 The importing countries in scenarios 1 and 2 were chosen in order to provide effective examples of differential size in imports and relative proximity to suppliers.

If regulatory asynchronicity could lead to finding material in the US maize supply chain that were unauthorized in Mexico for consumption, trade disruptions could ensue. As such, Mexico would seek maize imports from alternative suppliers. Under this scenario, US maize exports would be consumed domestically or delivered to other importers. Due to the larger distances involved in finding alternative markets for both the US and Mexico, we expect that freight costs would significantly increase for both countries. In particular, the domestic price of maize in Mexico should rise, and the domestic price of maize in the US should fall as the trade volumes shift to other partners. The maize price should rise in the countries that increase exports to Mexico (e.g., Argentina), and the price should decline in those countries that attract new imports from the US. If the scenario is extended to include bilateral trade disruptions in maize trade between Mexico and one of the alternative suppliers (Argentina), we should expect the maize price in Mexico to increase even more, and the prices of maize in the US and Argentina to decline.

Scenario 1 results for 2005 are presented in table 10 and in table 11 for 2007. In both tables, the leftmost columns present the results for the US-only trade disruption, and the impact of a disruption in the bilateral trade between Mexico the US and Argentina appears in the rightmost columns of the tables. For 2005, the unavailability of US imports increase the price of maize in Mexico by about 15.3 percent. As expected, the maize price in alternative suppliers to Mexico (e.g., Argentina, Brazil, Paraguay, and Venezuela) increase, and the price in countries that import maize from the US (e.g., Canada and Central America) decline. The US price declines by 1.2% as a result of the trade disruption. The same general pattern is observed under the 2007 data, though the relative price impacts are smaller than in 2005 due to the presence of more plentiful global maize supplies in 2007. In particular, the increase in the Mexico maize price is about 9.3 percent under the 2007 situation.

If maize trade between Mexico and the US and Argentina was interrupted due to regulatory asynchronicity and the presence of unapproved biotech events in the supplies of these exporters, the price of maize in Mexico would increase by 20.3 percent under the 2005 situation and by 12.6 percent under the 2007 situation. Maize prices in both the US and Argentina would decline by 0.5%-1.4% and 0.2%-0.5%, respectively. As before, the relative magnitudes of the price changes are more pronounced under the short-supply situation in 2005 than in 2007. Overall, we find that the maize price in Mexico would increase by about 9 to 20 percent under the various situations in this study, and the relative impacts on maize prices in the relevant trading partners are considerably smaller (i.e., less than 2 percent across all cases).

Scenario 2

Like Mexico, the small countries in NWSA (Colombia, Ecuador, and Peru) import much of their maize from the US. However, these countries are more distant from the US than Mexico, and they are closer to other sources of maize imports (e.g., Argentina, Brazil, and Paraguay). Moreover, these countries are smaller trading partners, and should find it easier to replace the disrupted trade quantities. Thus, we expect that the price impacts of the trade disruptions in these markets should be smaller than in Scenario 1.

The Scenario 2 results for 2005 are presented in Table 12. Here, the disruption of US imports increases the maize price by 2.4 percent in the importing countries and decreases the US price by less than 1 percent. Potential suppliers to NWSA (Argentina, Brazil, Paraguay, and other South American countries) see slightly higher maize prices, and the maize prices in other markets that buy US exports (e.g., Canada and Mexico) decline by small amounts. When both US and Argentine maize imports are interrupted, the price in NWSA increases by 8.2 percent, the prices in the US and Argentina decline by small amounts, and the prices in other maize-producing nations of South America increase slightly. Finally, the 2007 outcomes are uniformly smaller in magnitude (as illustrated in the Scenario

1 results). Overall, we find that bilateral trade disruptions between smaller countries like those in NWSA and the US and Argentina cause modest (2 to 8 percent) increases in the domestic maize price of the importing countries.

Table 10. Price and Supply Impacts (% changes against baseline)
Scenario 1 -- 2005 baseline

	No imports from the US			No imports from the US & Argentina		
	Price	Exports	Imports	Price	Exports	Imports
		-%change-			-%change-	
EU27	-0.9	0.0	0.0	-1.0	0.0	0.0
BRA	0.4	0.0	0.0	3.3	1.3	0.0
ARG	0.4	0.3	0.0	-0.5	-1.6	0.0
USA	-1.2	-0.3	0.0	-1.4	-0.5	0.0
CHN	-0.2	0.0	0.0	-1.0	0.0	0.0
PAR	2.8	1.1	0.0	7.7	13.5	0.0
CAN	-1.0	0.0	0.1	-1.2	0.0	0.1
MEX	15.3	0.0	-3.4	20.3	0.0	-6.5
BUR	0.3	0.0	0.0	-1.2	0.0	0.1
WBA	2.0	0.1	0.0	1.0	0.1	0.0
REU	2.5	3.5	0.0	13.4	23.0	0.0
RUB	2.2	0.0	-1.1	2.4	0.0	-1.3
UKR	0.3	0.1	0.0	-1.3	-0.9	0.0
CAM	-1.0	0.0	0.7	-1.2	0.0	0.9
VEN	8.7	0.0	0.0	6.4	0.0	0.0
CHL	0.3	0.0	-0.3	-0.4	0.0	0.4
URU	0.4	0.0	0.0	-0.4	0.0	0.1
BOL	-0.4	0.0	0.0	1.1	0.0	0.0
NWSA	-1.0	0.0	0.9	-0.4	0.0	0.4
IND	-1.0	0.0	0.0	-0.7	0.0	0.0
JAP	-0.7	0.0	0.7	-0.9	0.0	0.8
TLD	2.1	0.0	0.0	-3.3	-0.1	0.0
SKR	-0.8	0.0	2.3	-0.9	0.0	2.1
INDO	0.3	0.0	0.0	-0.3	0.0	0.0
MLAY	0.3	0.0	-0.9	-0.3	0.0	0.9
PHIL	5.8	0.2	0.0	-0.3	0.0	0.0
ANZ	0.3	0.0	0.0	-0.3	0.0	0.0
MOR	0.3	0.0	-1.1	-1.1	0.0	3.1
TUN	0.3	0.0	-2.4	-1.0	0.0	5.3
ALG	0.3	0.0	-1.3	-1.0	0.0	3.4
EGY	0.3	0.0	-0.4	-1.2	0.0	2.0
TUR	0.3	0.0	0.0	-1.2	0.0	0.0
ISR	0.3	0.0	-1.8	-1.2	0.0	5.0
LDC	0.3	0.0	-0.1	-0.3	0.0	0.1
AFR	0.3	0.0	0.0	-0.4	0.0	0.0
C&P	-1.0	0.0	2.2	-1.1	0.0	2.3
MIDE	0.3	0.0	-0.4	-0.3	0.0	0.5
ROW	0.3	0.0	0.0	-0.3	0.0	0.0

Table 11. Price and Supply Impacts (% changes against baseline)
Scenario 1 - 2007 baseline

	No imports from the US			No imports from the US & Argentina		
	Price	Exports	Imports	Price	Exports	Imports
		-%change-			-%change-	
EU27	-0.45	0.00	0.40	-0.32	0.00	0.14
BRA	0.20	0.13	0.00	0.68	0.29	0.00
ARG	0.05	0.05	0.00	-0.20	-0.20	0.00
USA	-0.54	-0.14	0.00	-0.59	-0.20	0.00
CHN	-0.46	-0.02	0.00	-0.39	-0.02	0.00
PAR	0.16	0.76	0.00	0.83	1.05	0.00
CAN	-0.50	0.00	0.04	-0.17	0.00	0.02
MEX	9.28	0.00	-2.12	12.62	0.00	-2.88
BUR	0.04	0.00	-0.05	-0.16	0.00	0.23
WBA	0.04	0.00	-0.01	-0.16	0.00	0.05
REU	0.04	0.00	-0.05	-0.16	0.00	0.21
RUB	-0.04	0.00	0.01	-0.15	0.00	0.02
UKR	0.04	0.01	0.00	-0.16	-0.03	0.00
CAM	-0.48	0.00	0.36	-0.17	0.00	0.12
VEN	-0.49	0.00	0.16	-0.17	0.00	0.06
CHL	0.04	0.00	-0.06	-0.17	0.00	0.27
URU	0.04	0.00	-0.01	-0.18	0.00	0.04
BOL	1.57	0.03	0.00	2.44	0.05	0.00
NWSA	0.04	0.00	-0.05	0.59	0.00	-0.69
IND	0.14	0.02	0.00	0.13	0.02	0.00
JAP	-0.42	0.00	0.33	-0.36	0.00	0.28
TLD	0.65	0.09	0.00	0.31	0.04	0.00
SKR	-0.43	0.00	0.35	-0.36	0.00	0.30
INDO	0.04	0.00	0.00	-0.13	0.00	0.01
MLAY	0.03	0.00	-0.10	-0.15	0.00	0.43
PHIL	-0.21	-0.03	0.00	-0.39	-0.06	0.00
ANZ	0.04	0.00	0.00	-0.16	0.00	0.01
MOR	0.04	0.00	-0.09	-0.16	0.00	0.39
TUN	0.04	0.00	-0.12	-0.16	0.00	0.53
ALG	0.04	0.00	-0.11	-0.16	0.00	0.49
EGY	0.04	0.00	-0.05	-0.16	0.00	0.22
TUR	0.04	0.00	-0.02	-0.15	0.00	0.08
ISR	0.04	0.00	-0.15	-0.15	0.00	0.62
LDC	0.03	0.00	0.00	-0.15	0.00	0.02
AFR	0.04	0.00	0.00	-0.16	0.00	0.02
C&P	-0.48	0.00	0.98	-0.17	0.00	0.34
MIDE	0.03	0.00	-0.08	-0.15	0.00	0.33
ROW	0.03	0.00	-0.01	-0.15	0.00	0.05

Table 12. Price and Supply Impacts (% changes against baseline) – Scenario 2 - 2005 baseline

	No imports from the US			No imports from the US & Argentina		
	Price	Exports	Imports	Price	Exports	Imports
		-%change-			-%change-	
EU27	-0.15	0.00	0.01	0.49	0.00	-0.01
BRA	0.41	0.06	0.00	2.32	2.43	0.00
ARG	1.25	1.66	0.00	-0.94	-1.27	0.00
USA	-0.46	-0.18	0.00	-0.05	-0.02	0.00
CHN	0.35	0.00	0.00	-0.59	0.15	0.00
PAR	0.62	0.47	0.00	8.97	8.83	0.00
CAN	-0.41	0.00	0.04	-0.59	0.00	0.06
MEX	-0.41	0.00	0.13	0.37	0.00	-0.12
BUR	-0.35	0.00	0.02	-0.97	0.00	0.06
WBA	-0.38	-0.03	0.00	-1.05	-0.08	0.00
REU	0.58	1.00	0.00	1.88	3.22	0.00
RUB	0.50	0.00	-0.28	1.62	0.00	-0.89
UKR	-0.38	-0.26	0.00	-1.06	-0.72	0.00
CAM	-0.39	0.00	0.30	0.43	0.00	0.01
VEN	-0.39	0.00	0.02	-0.60	0.00	0.03
CHL	0.39	0.00	-0.45	-0.29	0.00	0.34
URU	0.42	0.00	-0.08	-0.32	0.00	0.06
BOL	0.52	0.00	0.00	-0.17	0.00	0.00
NWSA	2.38	0.00	-0.81	8.15	0.00	-9.07
IND	0.48	0.01	0.00	-0.19	0.00	0.00
JAP	-0.31	0.00	0.26	-0.52	0.00	0.43
TLD	0.48	0.02	0.00	0.65	0.13	0.00
SKR	-0.32	0.00	0.72	-0.54	0.00	1.24
INDO	0.32	0.00	-0.01	0.26	0.00	-0.61
MLAY	0.32	0.00	-0.92	0.25	0.00	-0.16
PHIL	0.37	0.02	0.00	-0.28	-0.01	0.00
ANZ	0.35	0.00	-0.01	-0.24	0.00	0.00
MOR	-0.36	0.00	1.05	-0.56	0.00	1.65
TUN	-0.34	0.00	1.80	-0.57	0.00	2.97
ALG	-0.35	0.00	1.16	-0.57	0.00	1.91
EGY	-0.34	0.00	0.56	-0.94	0.00	1.57
TUR	-0.34	0.00	0.01	-0.96	0.00	0.03
ISR	-0.33	0.00	1.46	-0.93	0.00	4.06
LDC	0.33	0.00	-0.09	-0.25	0.00	0.07
AFR	0.37	0.00	-0.03	-0.28	0.00	0.02
C&P	-0.39	0.00	0.79	-0.63	0.00	1.28
MIDE	0.32	0.00	-0.56	-0.25	0.00	0.42
ROW	0.33	0.00	0.00	-0.25	0.00	0.00

6. Summary and Concluding Comments

LA is home to large number of agricultural commodity importers that depend heavily on imports for their consumption. Almost all of these agricultural commodity imports are procured from major exporters in the Americas. All exporting countries in the Americas have adopted biotech crops extensively while Latin America importers generally have not. The degree to which biotech crops have been regulated in these countries has also been quite variable.

Some exporting countries have been approving new biotech crops for use and planting on an ongoing basis. As a result, these exporting countries have had access to the full biotech pipeline over time. Other exporting countries have approved and planted fewer new biotech crops. Importers have also deregulated new biotech crops at variable speeds. A few importers have approved a large number of new biotech crops for consumption but not for planting, but most importing countries in LA have approved few, if any. As a result, structural asynchronicity in the regulatory approvals of biotech crops among importing countries in LA and their suppliers has been ongoing and it is likely to worsen as the biotech pipeline continues to expand.

In the past, regulatory asynchronicity has led to few trade disruptions. However, that could change in the near future as new biosafety laws take effect in many LA importing countries. Other countries with existing biosafety laws may also see their regulatory capacity tested by the increasing flow of new biotech crops and face, at least temporary, asynchronicity with their trade partners. Under these conditions, LA countries that import large amounts of agricultural commodities may benefit from the adoption of national LLP policies, including the use of the CODEX Annex, which could resolve short term pressures from asynchronicity and LLP of unauthorized material in their imports. A more significant and long-lasting problem, however, for many importing LA countries could be structural asynchronicity from limited regulatory capacity.

Many Latin American importing countries with limited technical and scientific regulatory capacity and financial resources will confront a difficult reality as they implement more fully their biosafety laws. They will have to find ways to effectively evaluate the safety of new biotech crops at a fast pace or risk costly trade disruptions with trade partners. Pooling regulatory resources through regional partnerships and leveraging reviews and assessments from countries with well-developed regulatory capacity may be some options among others.

Trade disruptions are an unpalatable alternative as they can be costly. In our empirical analysis of maize trade in LA, we estimated that for smaller importing countries whose trade can be more easily shifted across alternative suppliers, prices would increase 2-8% depending on the supply conditions in the global market. Even such modest price increases translate into significant outlays, however. Applying, for instance, these increases on the 2005-2009 maize import spending of Colombia, Ecuador and Peru would result, on average, in $20-$80 million higher outlays per year. For larger importers, like Mexico, the estimated price increases were higher, 9-20% depending on the supply conditions of the global market. Applying, these price increases on the 2005-2009 maize import spending of Mexico would result, on average, in $130-$294 million higher outlays per year.

These increased outlays do not reflect additional costs from foregone value added activity, potential short term supply disruptions, quality differences in alternative supplies, and added transaction costs. They also do not reflect the tighter supply conditions experienced in international markets in more recent years. For instance, in the last two years, China has turned from a modest net exporter of maize to a meaningful net importer, a trend expected to strengthen in the future. Similarly, the US has continued to increase the amount of maize retained for its growing ethanol industry. Tighter supply conditions would only worsen potential price increases from trade disruptions. The number of alternative exporters could also dwindle. In our scenario analysis, trade from up to two major exporters was restricted leaving ample alternative supplies for trade substitution. In the face of structural asynchronicity, however, this may not be the case leading to larger and more abrupt price changes. Finally, adding such potential economic costs across all relevant commodities provides a full scope of the problem in hand.

Amid renewed interest in food security in the face of escalating commodity prices and tight global supplies of agricultural commodities, trade will continue to play an important moderating role. A predictable and effective regulatory environment that minimizes the structural asynchronicity of regulatory approvals in LA importing countries and their suppliers is desirable in order to keep trade options open and agricultural commodity prices in check.

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