Analyzing the Impact of Changes in Trade and Domestic Policies: The Case of the Soybean Complex

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1. Introduction

The goal of the Doha Round of multilateral trade negotiations is to further address the issues of agricultural market access, export subsidies, and trade distorting domestic support. Trade policies and domestic support policies have been recognized as sources of market and trade distortions. Reducing trade distorting policies will help to achieve freer trade. A change in domestic policies has implications on overall trade performance because domestic and trade policies are interrelated. Change in one clearly has implications for accomplishing the goals of the other.

The primary objective of this study is to analyze and evaluate the impact of changes in domestic and trade policies on trade flows, demand and supply, and prices The analysis will focus on soybean complex (soybean, soybean meal, and soybean oil) using a *Stochastic Equilibrium Displacement Model* (SEDM). Different scenarios of changes in domestic and trade policies in the United States, Brazil and Argentina exercised under these three commodities will be investigated and the results will be discussed and analyzed. The focus of this study is to examine the impacts and interaction of likely changes in the U.S. soybean loan deficiency rate, Argentine soybean complex export taxes and transportation costs in Brazil.

The results of this study provide information for understanding the impact of policy changes; and therefore, can be used to assess and future directions of government policies.

This remainder of the paper is organized as follows. Section 2 provides an overview of the soybean industry and its related trade policies. Section 3 discusses the data and methodology. Section 4 provides estimation results. The main conclusions are summarized in section 5.

2. Overview of soybean industry and domestic and international trade barriers

2.1 Cost Competitiveness

The United States, Brazil, and Argentina are the major exporting countries for soybeans and soybean joint products. In 2006, total exports from these countries accounted for 90 percent, 88 percent, and 86 percent of total world exports for soybean, soyoil, and soybean meal, respectively (USDA, 2006).

As the world's largest exporter of soybeans, Brazil's competitiveness in the global market has suffered from its inadequate transportation infrastructure. Brazil has relatively higher transportation costs compared to the United States. Transportation cost is a natural barrier to free trade. In the past few decades, actions have been taken to improve the infrastructure. It is generally accepted that the improvement would consequently reduce soybean transportation costs and enhance the competitiveness of Brazil as a soybean export competitor in the international market. Major improvements include extension of railroads, construction of highways and inland waterways.

Table 1 shows the cost competitiveness for soybean among the three major exporting countries. As shown, Brazil and Argentina are more competitive on the production side than U.S. producers. The United States is more efficient than Brazil and Argentina in the variable costs aspects. On the other hand, the fixed costs in the U.S are extremely high compared to the South American counterparts, especially Brazil. Although the total production cost is less in Brazil and Argentina, the internal transportation costs are considerably higher when compared to the U.S. costs. The reason for such high transportation costs in Brazil can be explained by the farm-port distance, more than 1500kms on average, the lack of paved roads and navigable waterways, and small number of railroads. With adequate roads built, freight costs will be reduced and utilization of roads with offer less costly modes of transportation, such as waterways and railroads.

Table 1. Soybean production costs and export cost competitiveness: U.S., Brazil (Mato Grosso and Paraná), and Argentina (2003/04).

Cost Item	U.S. Heartland	Brazil		Argentina
		Mato Grosso	Paraná	
		US $ per acre		
Variable costs:				
Seed	28.67	12.79	10.54	18.57
Fertilizers	7.73	47.00	22.22	6.26
Chemicals	17.10	35.47	38.61	17.56
Machine Operation Repair	22.13	18.02	22.82	21.36
Interest on Capital	1.00	7.38	5.32	9.87
Hired Labor	1.26	1.46	5.59	6.08
Harvest	n/a	5.52	8.22	12.49
Miscellaneous	n/a	1.57	2.02	n/a
Total variable costs	**77.88**	**129.21**	**115.35**	**92.21**
Fixed Costs:				
Depreciation of machinery	51.36	16.83	18.96	22.14
Land costs (rental rate)	97.45	15.46	25.91	72.78
Taxes and insurance	5.92	2.81	4.63	n/a
Farm overhead	12.23	2.54	1.91	23.98
Total fixed Costs	**166.96**	**37.63**	**51.40**	**118.90**
Total production costs	**244.84**	**166.84**	**166.75**	**211.11**
Costs per bushel:	*US $ per bushel (percent of U.S. cost)*			
Yield (bushels/acre)	46.00	43.07	41.38	50.00
Variable costs per bushel	1.69	3.00	2.79	1.84
Fixed costs per bushel	3.63	0.87	1.24	2.38
Total costs per bushel	**5.32**	**3.87 (73)**	**4.03 (76)**	**4.22 (79)**
Internal trans. (US $/bu.)	0.48	1.80	0.81	0.72
Cost at border	**5.81**	**5.67 (98)**	**4.84 (83)**	**4.94 (85)**
Freight costs to Rotterdam	0.39	1.25	1.25	1.03
Price at Rotterdam	**6.20**	**6.92 (112)**	**6.09 (98)**	**5.97 (96)**

Source: ERS/USDA (2006), Schnepf et al., Rebolini (2005), Conab (2006) Paraná State Department of Agriculture (SEAB) (2006), CIF Rotterdam prices (FAS/USDA, 2006); U.S. FOB Gulf port prices (ASA, 2006); U.S. producer price (NASS/USDA, 2006); Argentinean internal transportation and marketing costs to port: Schnepf et al. and Lence; Brazil FOB prices are from Rio Grande (Safras and Mercado) and Paranagua (Reuters) (FAS/USDA, 2006).

2.2 Government Policy

The U.S. farm program supports the soybean industry with an income safety net through direct payments, marketing loans (loan deficiency payments) and counter-cyclical payments.

The farm bill affects the crop sector primarily through acreage and production changes. The marketing loan program allows producers to receive a loan at a specific loan rate per unit of production. It provides a LDP or marketing loan gain to producers when market prices are low. When market prices are below the loan rate, farmers are allowed to repay commodity loans at a loan repayment rate that is lower than the loan rate. Alternatively, loan program benefits can be taken directly as loan deficiency payments. Among the three programs, LDP has the greatest effect on production because it is directly coupled to producers' current production decision. Any change in LDP is expected to impact the U.S. domestic as well as international soybean industry.

The marketing loan rate was set at $5.00/bushel for soybean in the 2002 Farm Bill and remains in effect through 2007. For the 2007 Farm Bill, the American Soybean Association and National Barley Growers Association proposed a 0.2 percent increase of the loan rate for soybean to $5.01/bushel. However, the Administration proposed to set the loan rate at $4.92/bushel, which is equivalent to a two percent reduction. So far, a new farm bill has not been developed. Therefore, analysis of an increase and a decrease in the LDP is appropriate for this study.

Argentina is the world's largest exporter of soybean meal and oil. While Argentina has been engaged in improving its infrastructure in the past decade to spur competitiveness, its soybean and soybean byproducts are assessed an export tax of 23.5

and 20 percent, respectively. The internal price of soybeans is 23.5 percent less than the international price of soybeans due to the export tax. This revenue is managed by the Federal Government. The differential tax between soybeans and the products increases Argentina's competitiveness in exporting soybean meal and oil, by reducing the internal price of soybeans. Since Argentine farmers lose more than 23.5 percent of the commodity price off the top they have been forced to become more efficient. The following table shows how Argentine and U.S. costs compare.

Table 2. Soybean Cost Argentina vs. U.S.

Cost Item	*Argentina*	*U.S.*
Land Values	$5,000/Ha	$6,800/Ha /1
Rent	$200/Ha	$290/Ha /1
Operational Costs	600-800kg/Ha	935-985 kg/Ha /2
Average Farm Price 2004/05	$4.70/bu /3	$5.50/bu /4

/1 - ERS Corn Belt Land Prices from the Land Values and Cash Rents 2005 Summary
/2 - Based on ERS Prices converted from dollars/acre using a $5.50 price
/3 - Based on the average Rosario spot price for 2004/05 MY.
/4 - Based on USDA published price
Source: International Trade Report, USDA 2006

The Argentine soybean industry differs from the United States and Brazil in that a very small percentage of their soybeans are consumed domestically. Despite a growing poultry and swine industry, Argentina's soybean meal use still accounts for less than five percent of total soybean meal production. Soybean oil is in a similar situation in that the majority of soybean oil is exported as consumers prefer sunflower oil over soybean oil and there is no significant bio-diesel program at this time in Argentina. Since there is limited domestic demand for soybeans, about 95 percent of Argentina's soybeans and products are exports, with 70 percent going out as meal and oil and 25 percent as beans.

Contrary to the WTO proposal to reduce trade distorting policies in order to achieve freer trade, the Economy Minister of Argentina announced an increase in the tax on exported soybeans from 23.5 percent to 27 percent and on exported soybean byproducts from 20 percent to 24 percent in January 2007. Argentina did this to mitigate the inflationary pressure and help those living in poverty. Therefore, both an increase and a decrease in the export tax will be analyzed for future policy impacts.

3. Methodology

To quantify the impacts of a change in the US LDP rate, a reduction in transportation costs through improvement in infrastructure in Brazil, and a change in Argentina's export tax, an economic model was specified to capture the basic linkages of soybean industry. A stochastic equilibrium displacement model was then developed to quantify such impacts on the oilseed and soybean joint products sectors.

3.1. Theoretical Considerations

Soybean oilseed and its joint products production, consumption, and trade are modeled on the basis of modern economic consumer and producer theory. Nonjointness of production is assumed[1]. If domestic and import soybean joint products are not perfectly substitutable, the following demand function can be defined:

$$OMD_D = OMD_D(POMD, POMD_M, PX, Y)$$

$$OMD_M = OMD_M(POMD, POMD_M, PX, Y)$$

where OMD_D and OMD_M are a country's domestic and import demand for soymeal and soyoil, respectively. POMD, $POMD_M$, and PX are price vectors of domestic soybean joint products, imported soybean joint products, and other goods, respectively, and Y is per capita income.

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[1] A multioutput industry's supply and demand has the same properties as a single output industry. According to Hall, the necessary and sufficient condition for nonjointness technology is that the total cost of producing all outputs is the sum of cost of producing each output separately:
$C(Y,W)=C^1(Y^1,W)+\ldots\ldots+C^n(Y^n,W)$ where $C(Y,W)$ is the total cost function, C^i is the cost function producing output I, Y^i is the ith output, and W is the vector of input prices. If the technology has constant returns to scale, the total cost function can further specified as $C(Y,W)=Y^1b^1(W)+\ldots..+Y^nb^n(W)$.

Given perfect competition, by Shepard's lemma, output supply and input demand were characterized as P = AC(W) and X = X(W, Z) where AC is average cost function, P is output price vector, W is the input price vector, X is input vector, and Z is output vector.

3.2. Analytical model

Based on considerations mentioned above, an economic model was specified to reflect the linkage of the oilseed and joint products. The world soybean industry is divided into six groups: (i) exporters – Brazil, U.S., and Argentina; and (ii) importers – EU, Asia (Japan and China), and Rest of the World (ROW). The model is specified below, where *i* stands for Brazil, the United States, and Argentina, *j* stands for EU, Asia, and ROW:

I. Soybean joint products (soymeal and soyoil)

Consumption

(1) $MD_j = MD_j\,(PMD_j, PMM_j)$

(2) $OD_j = OD_j\,(POD_j, POM_j)$

(3) $MM_j = MM_j\,(PMD_j, PMM_j)$

(4) $OM_j = OM_j\,(POD_j, POM_j)$

Production

(5) $PMD_j = AC\,(PB_j, PB_i)$

(6) $POD_j = AC\,(PB_j, PB_i)$

(7) $PMS_i = AC(PB_i)$

(8) $POS_i = AC(PB_i)$

II. Soybean

Demand

(9) $BD_i = BD_i\,(MS_i, OS_i, PB_i)$

(10) $BDM_j = BDM_j\,(MS_j, OS_j, PB_i, PB_j)$

Supply

(11) $BS_i = BS_i\,(PB_i, \alpha_i)$

III. Soybean export price determination

(12) $PBS = \Sigma(BS_i/BS)PB_i$

(13) $PMS = \Sigma(MS_i/MS)PMS_i$

(14) $POS = \Sigma(OS_i/OS)POS_i$

IV. Trade restrictions & equilibrium condition

(15) $PB_j = PBS\ (1 + T_j)$

(16) $PMS_i = PMS\ (1 + M_j)$

(19) $OD_j = OS_j$

(20) $BS_i = BD_i + \Sigma(BDM_j)$

(17) $POS_j = POS\ (1 + O_j)$

(18) $MD_j = MS_j$

(21) $MS_i = \Sigma MM_j$

(22) $OS_i = \Sigma OM_j$

Table 3. Variables and Their Definitions in the Model (in the sequence of the equations)

Variable	Definition
MD_j	demand for domestic soymeal in country j
PMD_j	domestic soymeal price in country j
PMM_j	soymeal import price in country j
OD_j	demand for domestic soyoil in country j
POD_j	domestic soyoil price in country j
POM_j	soyoil import price in country j
MM_j	import demand for soymeal in country j
OM_j	import demand for soyoil in country j
PB_j	soybean price in country j
PB_i	soybean price in country i
PMS_i	export supply price of soymeal from country i
POS_i	export supply price of soyoil from country i
BD_i	demand for soybean in country i
MS_i	domestic supply of soymeal in country i
OS_i	domestic supply of soyoil in country i
BDM_j	import demand for soybean in country j
MS_j	domestic supply of soymeal in country j
OS_j	domestic supply of soyoil in country j
BS_i	soybean supply in country i
PBS	world soybean export supply price
BS	world total soybean supply
PMS	world soymeal export supply price
MS	world total soymeal supply
POS	world soyoil export supply price
OS	world total soyoil supply
T_j, M_j, O_j	trade restriction variables in country j for all products
MDM_j	import demand for soymeal in country j from country i
ODM_j	import demand for soyoil in country j from country i
α_i	soybean export supply shifter in country i

3.3. Equilibrium Displacement Model

To investigate the impacts of exogenous shocks on different country groups, the total differential of each equation in the model was taken and expressed in the form of elasticities and relative changes ($\partial x / x = EX$) which is known as the equilibrium displacement model (EDM):

I. Soybean joint products

Consumption

(1) $EMD_j = \eta_j^M EPMD_j + \eta_j^M{}' EPMM_j$

(2) $EOD_j = \eta_j^O EPOD_j + \eta_j^O{}' EPOM_j$

(3) $EMM_j = \varepsilon_j^M EPMD_j + \varepsilon_j^M{}' EPMD_j$

(4) $EOM_j = \varepsilon_j^O EPOD_j + \varepsilon_j^O{}' EPOM_j$

Production

(5) $EPMD_j = cs_j^M EPB_j + \sum cs_i^M EPB_i$

(6) $EPOD_j = cs_j^O EPB_j + \sum cs_i^O EPB_i$

(7) $EPMS_i = cs_i^M EPB_i$

(8) $EPOS_i = cs_i^O EPB_i$

II. Soybean

Demand

(9) $EBD_i = os_i^M EMS_i + os_i^O EOS_i + \gamma_i^B EPB_i$

(10) $EBDM_j = os_j^M EMS_j + os_j^O EOS_j + \theta_j EPB_j + \sum \theta_i EPB_i$

Supply

(11) $EBS_i = \delta_i EPB_i + \partial \alpha_i$

III. Soybean export price determination

(12) $EPBS = \sum \pi_i^B EPB_i$

(13) $EPMS = \sum \pi_i^M EPMS_i$

(14) $EPOS = \sum \pi_i^O EPOS_i$

IV. Trade restrictions & equilibrium conditions

(15) $EPB_j = EPBS + T_j/(1 + T_j)ET_j$

(16) $EPMM_j = EPMS + M_j/(1 + M_j)EM_j$

(17) $EPOM_j = EPOS + O_j/(1 + O_j)EO_j$

(18) $EMD_j = EMS_j$

(19) $EOD_j = EOS_j$

(20) $EBS_i = \varphi_i^B EBD_i + \sum \varphi_j^B EBDM_j$

(21) $EMS_i = \sum \varphi_j^M EMM_j$

(22) $EOS_i = \sum \varphi_j^O EOM_j$

where η is the own-price elasticity of domestic demand for soybean joint product (M = meal and O = oil), η' is the cross-price elasticity of domestic demand for soybean joint product, ε is the cross-price elasticity of import demand for soybean joint product, ε' is the own-price elasticity of import demand for soybean joint product, *cs* is the cost share, *os* is output share, γ price elasticity of input demand, θ is elasticity of input demand from domestic and non-domestic sources, δ is the soybean supply elasticity, π is the soybean export market share, and φ is the market share of demand for exports of soybean and the joint products.

3.4. Parameter Values Specification

In an EDM, the accuracy of parameters has direct impact on the simulation results. Assuming that they are known with certainty is a drawback of EDM because with this practice, the values might be biased. As developed by Davis and Espinoza, this study extends the common practice by imposing certain probability distributions for selected parameters in the model instead of adopting only one value for them and conducting sensitivity analysis later. Therefore, final results for all endogenous variables are stochastic. The definition, value, and sources for the elasticities are presented in Table 4. The cost, output, and market shares were estimated with data obtained from PS&D/USDA, Companhia Brasileira de Abastecimento (CONAB), and Secretaria Argentina de Pecuaria y Agricultura (SAGPyA).

Table 4. Elasticities and other parameters: Definition, Value, and Source

Item	Value	Source
Soymeal domestic demand		
Own-price elasticity (η)		
- Asia	~ GRKS (-0.60, -0.38, -0.20)	(1)
- EU	~ GRKS (-0.16, -0.10, -0.04)	(1)
Cross-price elasticity (η')		
- Asia	0.14	Author
- EU	0.23	Author
Soyoil domestic demand		
Own-price elasticity (η)		
- Asia	~ GRKS (-0.54, -0.33, -0.20)	(1)
- EU	-0.07	(1)
Cross-price elasticity (η')		
- Asia	0.036	Author
- EU	0.024	Author
Soymeal import demand		
Cross-price elasticity (ε)		
- Asia	~ GRKS (0.77,0.80,0.82)	Author
- EU	0.045	Author
Own-price elasticity (ε')		
- Asia	-0.01	Author
- EU	-0.64	Author
Soyoil import demand		
Cross-price elasticity (ε)		
- Asia	1.88	Author
- EU	~ GRKS (0.22,0.39,0.49)	Author
Own-price elasticity (ε')		
- Asia	-0.06	Author
- EU	-0.31	Author
Soybean demand(γ)		
- Brazil	-0.10	(2)
- U.S.	~ GRKS (-0.87,-0.44,-0.16)	(1), (3), and (4)
- Argentina	~ GRKS (-0.40,-0.37,-0.34)	(2) and (3)
Domestic Soybean Input demand (θj)		
- Asia	~ GRKS (0.28,0.34,0.40)	Author
- EU	0.02	Author
Import Soybean Input demand (θi)		
Asia - Brazil	-0.15	Author
- U.S.	-0.12	Author
- Argentina	-0.15	Author
EU - Brazil	-0.015	Author
- U.S.	-0.031	Author
- Argentina	-0.017	Author
Soybean supply(δ)		
- Brazil	~ GRKS (0.20,0.43,0.55)	(1) and (5)
- U.S.	~ GRKS (0.14,0.55,0.87)	(1) and (3)
- Argentina	~ GRKS (0.03,0.28,0.60)	(1), (2), and (3)

(1) Piggott et al. (2) Fuller et al. (3) Qaim and Traxler. (4) Mattson et al. (5) Williams and Thompson.

4. Scenarios and Results

Five scenarios are analyzed and simulated. All results presented are in 90 percent probability interval.

Scenario 1: 20 percent reduction in transportation costs due to improvement in infrastructure in Brazil. All infrastructure improvements are assumed to happen at one time upon completion.

Table 5. Results of 20 percent reduction in transportation costs in Brazil

Variables	% - Change
Asia Soybean import demand	(1.99, 6.57)
Asia Soymeal import demand	(-12.24, -5.79)
Asia Soyoil import demand	(-6.28, -3.03)
EU Soybean import demand	(0.43, 2.72)
EU Soymeal import demand	(1.34, 2.84)
EU Soyoil import demand	(-0.76, 1.05)
Brazil Soybean Supply	(0.87, 2.99)
Argentina soybean supply	(0.08, 0.58)
US soybean supply	(-0.46, 0.02)
Brazil Soymeal supply	(0.66, 1.42)
Argentina Soymeal supply	(0.26, 0.57)
US soymeal supply	(-2.45, -1.15)
Brazil soyoil supply	(-2.09, -0.87)
Argentina soyoil supply	(-2.39, -1.04)
US soyoil supply	(-1.44, -0.47)
Brazil Soybean export price	(-29.44, -14.48)
Brazil soymeal export price	(-9.77, -4.81)
Brazil soyoil export price	(-6.28, -3.09)

Under this scenario, the results suggested an increase in soybean supply between 0.87 and 2.99 percent. Such increases in supply explain the decrease in soybean prices (-29, -14.5). Meanwhile, the export prices for soymeal and oil have also decreased, (-9.8, -4.8) and (-6.3, -3.1), respectively. Since the increase in soybean supply in Brazil put a downward pressure on the global soybean prices, the United States and Argentina experienced a decrease in soybean prices as well. However, this decrease is smaller than that in Brazil. Brazil will likely become more export competitive compared to the U.S. and Argentina. For the importing countries, both Asia and EU had an increase in soybean imports (1.99, 6.6) and (0.43, 2.72) percent, respectively. This increase in soybean imports from Asia and EU might be generated by Brazil's increase in supply and less expensive soybeans since the changes in soybean supply for the United States and Argentina were minimal.

For soybean joint products, the results displayed opposite effects on soymeal supply (increase between 0.66 and 1.42 percent) and soyoil supply (decrease between 2.09 and 0.87) from Brazil. Significant changes were observed for soymeal and soyoil export prices with a decrease of (9.77, 4.8) and (6.28, 3.1) percent interval, respectively. A possible explanation for such reduction is that less costly oilseeds are used as an input for domestic processing, which will enhance the competitiveness of Brazil in soybean joint products market. While EU maintained a steady increase of soymeal and soyoil imports, Asia had a significant decrease in imports of soymeal and soyoil due to higher soybean imports and greater domestic soymeal and oil outputs.

Scenario 2: 5 percent reduction in Loan Deficiency Payment rate in the U.S.

Table 6. Results of 5 percent reduction of LDP in the U.S.

Variables	% -Change
Asia Soybean import demand	(-0.96, 0.07)
Asia Soymeal import demand	(1.19, 3.24)
Asia Soyoil import demand	(0.63, 1.73)
EU Soybean import demand	(-0.31, -0.09)
EU Soymeal import demand	(-0.4, -0.15)
EU Soyoil import demand	(-0.1, 0.06)
Brazil Soybean Supply	(-0.04, 0.05)
Argentina soybean supply	(0.03, 0.16)
US soybean supply	(-2.87, -0.49)
Brazil Soymeal supply	(0.04, 0.12)
Argentina Soymeal supply	(0.16, 0.45)
US soymeal supply	(0.55, 1.53)
Brazil soyoil supply	(0.38, 1.08)
Argentina soyoil supply	(0.41, 1.14)
US soyoil supply	(0.35, 1.0)
US soybean export price	(4.3, 11.83)
US soymeal export price	(1.91, 5.24)
US soyoil export price	(1.08, 2.98)

The results indicated a loss of competitiveness of U.S. soybean industry should the LDP rate decreases. Under this scenario, US soybean export prices increased between (-4.3, -11.8) percent and so did the export price for the joint products although not as large. Total soybean supply decreased between (-2.87, -0.49) percent due to partial withdrawal of price support in farm bill. More soybeans were retained domestically for crushing, which leads to the increase of soymeal and soyoil exports from the U.S., between (0.55, 1.53) and (0.35, 1) percent, respectively. Since this is a domestic policy, it did not have noticeable impact on Brazil or Argentine soybean supplies. However, a slight increase was observed for soymeal and soyoil supply from Brazil and Argentina.

Scenario 3: 17 percent export tax increase in Argentina

Table 7. Results of 17 percent export tax increase in Argentina

Variables	% - Change
Asia Soybean import demand	(-1.08, -0.48)
Asia Soymeal import demand	(0.29, 0.72)
Asia Soyoil import demand	(0.11, 0.33)
EU Soybean import demand	(0.08, 0.2)
EU Soymeal import demand	(-1.01, -0.46)
EU Soyoil import demand	(-1.08, -0.41)
Brazil Soybean Supply	(-0.49, -0.22)
Argentina soybean supply	(-3.33, -1.57)
US soybean supply	(-0.28, -0.1)
Brazil Soymeal supply	(-0.5, -0.17)
Argentina Soymeal supply	(1.77, 3.9)
US soymeal supply	(-0.33, -0.09)
Brazil soyoil supply	(-0.3, -0.11)
Argentina soyoil supply	(1.20, 2.65)
US soyoil supply	(-0.19, -0.05)
Argentina Soybean export price	(4.47, 9.85)
Argentina Soymeal export price	(1.17, 3.90)
Argentina Soyoil export price	(1.2, 2.65)

Upon Argentina's announcement of a four percentage point (17 percent) increase in the export tax of both soybean and soybean byproducts in January 2007, the internal price of soybean has dropped even further. Argentina kept more soybeans domestically for further processing and less soybeans were exported. Soybean export supply fell between (-3.33, -1.57) percent interval, which caused the soybean export price to rise between (4.5, 9.9) percent interval. Because more soybeans were crushed domestically, more soybeans and soyoil were exported; the increase was between (1.77, 3.9) and (1.20, 2.65) percent interval. Higher prices of soybeans from Argentina increase the overall soybean price in the international market and make soybeans more costly for importing countries. Fewer soybeans were imported by Asia and therefore fewer soybeans were available for domestic crushing. To satisfy the demand, Asia increased its import of soymeal and soyoil, between (0.3, 0.72) and (0.11, 0.33) percent interval.

Scenario 4: 50 percent reduction of export tax in Argentina

Table 8. Results of 50 percent reduction of export tax in Argentina

Variables	Change
Asia Soybean import demand	(1.13, 2.57)
Asia Soymeal import demand	(-2.72, -0.68)
Asia Soyoil import demand	(-0.79, -0.27)
EU Soybean import demand	(-0.46, -0.20)
EU Soymeal import demand	(1.09, 2.41)
EU Soyoil import demand	(0.97, 2.58)
Brazil Soybean Supply	(0.53, 1.18)
Argentina soybean supply	(3.74, 7.91)
US soybean supply	(0.23, 0.67)
Brazil Soymeal supply	(0.88, 1.96)
Argentina Soymeal supply	(0.76, 1.70)
US soymeal supply	(0.34, 0.76)
Brazil soyoil supply	(0.21, 0.82)
Argentina soyoil supply	(0.14, 0.71)
US soyoil supply	(0.28, 1.05)
Argentina Soybean Export price	(-23.38, -10.62)
Argentina Soymeal export price	(-9.46, -4.20)
Argentina Soyoil export price	(-6.3, -2.86)

Despite of the increase in export taxes in Argentina, an analysis of export tax elimination in the future was conducted.

With 50 percent of the export tax eliminated, Argentina soybean export price decreased dramatically, between (-23.4, -10.6) percent interval and so did the soymeal and soyoil export prices although not to the same degree. Along with this, Argentina became more competitive in the global market and fewer soybeans were used for domestic crushing. This led to an increase in Argentine soybean exports, between (3.74, 7.91) percent. Slightly higher exports of both soymeal and soyoil from Argentina were expected. The lower prices of soybeans in Argentina led to an overall price decline in the global market and stimulated the import demand and export supply of the United States and Brazil. Asia increased its imports of soybean, which was between (1.13, 2.57) percent.

Scenario 5: 20 percent transportation cost reduction in Brazil, 5 percent decrease in U.S. LDP, and 50 percent decrease in export tax in Argentina

Table 9. Results of the combination of the three scenarios

Variables	% - Change
Asia Soybean import demand	(3.57, 7.29)
Asia Soymeal import demand	(-10.63, -4.38)
Asia Soyoil import demand	(-5.42, -2.17)
EU Soybean import demand	(-0.05, 1.90)
EU Soymeal import demand	(2.53, 4.33)
EU Soyoil import demand	(0.46, 3.21)
Brazil Soybean Supply	(1.65, 3.69)
Argentina soybean supply	(4.33, 8.01)
US soybean supply	(-2.87, -0.17)
Brazil Soymeal supply	(1.83, 3.01)
Argentina Soymeal supply	(1.38, 2.10)
US soymeal supply	(0.89, 0.65)
Brazil soyoil supply	(-0.92, 0.56)
Argentina soyoil supply	(-1.26, 0.33)
US soyoil supply	(-0.41, 1.28)
US soybean price	(4.69, 13.14)
US soymeal price	(2.08, 5.82)
US soyoil price	(1.18, 3.31)

When all three scenarios happen at the same time, U.S. competitiveness declined the most. US soybean prices increased between (4.7, 13.14) percent interval, along with soymeal and soyoil prices. The export prices of soybean and joint products in Brazil and Argentina decreased dramatically, between (-21.6, -9.7) and (-34.3, -16.78) percent, which resulted in greater exports from both countries. Due to the drop in overall prices of soybeans and strong import demand, U.S. soybean export supply increased. Brazil and Argentina gained market share by exporting more soybeans and soymeal. The increase of soybean exports from Argentina was between (4.3, 8) percent, a larger increase compared to Scenario 4. Asia experienced the greatest import increase in soybeans, between (3.6, 7.3) percent interval. Its import decrease in soymeal and soyoil were significant as well, between (-10.6, -4.4) and (-5.4, -2.2) percent interval, respectively.

5. Conclusions

This study assessed changes in soy complex in terms of trade volumes, demand, supply, and prices under five different scenarios. Six groups of countries were classified as exporting and importing countries. A stochastic equilibrium model (SEDM) was developed and solved by incorporating self estimated parameters. The overall results suggest that the reduction of U.S. Loan Deficiency Payment rate will raise U.S. soybean prices. The United States becomes less competitive in the global market and fewer soybeans are exported. Consequently, more soymeal and soyoil will be produced and higher prices follow due to more costly soybeans.

The reduction in transportation costs due to the infrastructure improvements in Brazil dramatically enhances its competitiveness by increasing soybean supply, and decreasing export prices of soybean, soymeal and soyoil. Due to lower prices, Asia imports more soybeans and therefore imports less soymeal and soyoil.

Argentina has announced a four percent increase in its export tax for both soybean and its byproducts which further suppresses soybean exports while increasing soymeal and soyoil production and exports. If Argentina gradually phases out the export tax, fewer soybeans will be retained domestically for crushing and more soybeans are exported. Exports of soymeal and soyoil increase as well, although less than compared to soybeans.

The United States experiences the greatest loss in competitiveness if the LDP rate reduction and changes in Brazil and Argentina happen simultaneously. The U.S. prices of soybean, soymeal and soyoil increase significantly and exports decrease. Brazil and Argentina gain market share by exporting more soybean, soymeal and soyoil with cheaper export prices. If the United States maintains a constant LDP rate at $5.00/bushel, there is a slight increase in U.S. soybean supply (less than 1 percent) and prices of U.S. joint soybean products remain stable. This occurs due to the surge of increased supplies in Brazil and Argentina. In the mean time, Asia experiences the largest increase in soybean imports and decrease in soymeal and soyoil imports. The EU also increase soymeal and soyoil imports; however, its soybean demand remains fairly steady.

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