Biodiesel Mandate Laws in Argentina and Brazil:

An Estimation of Soybean Oil Foregone Export Revenues*

Matias G. Nardi**

Carlos E. Carpio

Todd D. Davis

and

William A. Ward

Abstract

Soybean oil foregone export revenues from the adoption of biodiesel incentive policies in Argentina and Brazil are estimated using a partial equilibrium displacement model. Two scenarios are modeled for each country, one based on the mandate laws and one based on phased biodiesel capacities according to planned investments.

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** Matias G. Nardi, Carlos E. Carpio, Todd D. Davis and William A. Ward are Graduate Student, Assistant Professor, Associate Professor and Professor, respectively, in the Department of Applied Economics and Statistics, Clemson University, Clemson, SC 29634-0313.

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Introduction[1]

Brazilian Federal Law 11,097, enacted on January 13, 2005, defined and established a legal mandate authorizing a 2% blend of biodiesel between 2006 and 2007, requiring a 2% blend of biodiesel starting in 2008 and increasing the requirement to a 5% blend starting in 2013. Similarly, Argentine Federal Law 26,093 was enacted on April 19, 2006 which established a legal mandate requiring a 5% blend of biodiesel in petroleum diesel starting in 2010. The biodiesel mandates in Argentina and Brazil were driven by the goals of reducing dependence on petroleum, adding value to the agricultural production and promoting a cleaner environment. This transfer of payments from the energy industry to the agriculture industry has also been adopted by other major agricultural nations, amid record-high energy prices and climate change environmental concerns from carbon dioxide emissions.

The diesel market in Brazil is 40 billion liters per year while in Argentina is 15 billion liters per year. The potential market for domestic biodiesel in Brazil for 2006 and 2007 was 840 million liters per year; however, biodiesel production was just 40 million liters at the end of 2005. The potential market for biodiesel in Brazil between 2008 and 2012 is 1 billion liters per year to comply with the legal mandate, and 2.4 billion liters for 2013 to comply with the 5% legal mandate. Biodiesel industrial capacity in Brazil is expected to reach 1.7 billion liters at the end of 2007 which is an increase from an estimated 730 million liters at the end of 2006. Because of overinvestment in biodiesel capacity thanks to generous tax incentives, the Brazilian Government is studying the possibility of raising the mandated biodiesel blend to

[1] The Introduction follows:
Serafim, Igly. "*Brazilian Biofuels Industry – September 2006*".
Joseph, Ken. "*2007 Argentina Biofuels Report – June 2006*". GAIN Report Number AR7016.
Barros, Sergio. "*2007 Brazil Biofuels Report – August 2007*". GAIN Report Number BR7012.

5% before 2013. In Argentina, the potential market for domestic biodiesel consumption for 2010 is of 750 million liters. However, the potential of Argentina's biodiesel production will be determined by the export market and the biodiesel production capacity, which is going to grow from 800 million liters in 2008 to an estimated 3 billion liters in 2014.

The Federal Law in Argentina and Brazil define biodiesel as any "renewable and biodegradable fuel for compression-ignition internal-combustion piston engines, derived from vegetable oils or animal fats, which can partially or fully replace diesel oil of fossil origin". Potential feedstocks in Brazil include soybean oil (*Glycine max*), castor oil (*Ricinus communis*), "pinhao-manso" (*Jathropa curcas*), palm oil and palm-kernel oil (*Elaeis guineensis*) while in Argentina include soybean oil, sunflower oil (*Helianthus annus*) and canola oil (*Brassica napus*). However, the most important vegetable oil produced in Argentina and Brazil is soybean oil. In 2007 Argentina was the largest soybean oil exporter with a 59.5% export share (USDA-FAS-PSD, 2008). Brazil was the second largest soybean oil exporter with a 20.4% export share (USDA-FAS-PSD, 2008). The main feedstock for biodiesel production in Argentina and Brazil is soybean oil but other vegetables oils and animal fats are also used to a lesser degree based on local feedstock availability and price.

Soybean oil domestic prices in Argentina (FAS) are lower than soybean oil export prices (FOB) because of differential export tariffs and rebates on exports. The export tariff for soybeans is currently set at 35% of the FOB price while for soybean oil and soybean meal are set at 31.5% of the FOB prices. Similarly, the export tariff on biodiesel is set on 5% of the FOB price. There are also rebates of 1.5% percent for soybean oil and soybean meal and 2.5% for biodiesel on the FOB prices. These tax measures favor the crushing of soybeans into its by-products: soybean oil and soybean meal. In contrast, soybean oil domestic prices in Brazil (FAS) are higher than soybean oil export prices (FOB). This is result of Brazil's

domestic fiscal policies. Domestic-bound soybean oil in Brazil has to pay both the ICMS[2] tax and COFINS[3] tax. ICMS is an interstate movement tax of 12% while COFINS is a social security tax of 9.25% on the soybean oil price. Export-bound soybean oil in Brazil does not have to pay these taxes. Therefore, the two taxes make soybean oil in the domestic market more expensive than soybean oil for the export market.

Because of the increased consumption of soybean oil for biodiesel in Argentina and Brazil, there is less available for the export market. Since this consumption is mandated and not market driven, the soybean oil could be exported at a greater value than that of the domestic market. This paper measures the foregone export revenues of soybean oil for Argentina and Brazil from both the mandate laws for domestic biodiesel consumption and from the phased capacity investments for the biodiesel exports. Policy makers and agribusinesses will have a better understanding of the effect of these policies on the welfare of the soybean value chain.

Methodology and Data

Argentine and Brazilian soybean oil foregone export revenues are estimated using a partial equilibrium displacement model that includes Argentina, Brazil and the Rest of the World. Two soybean oil export scenarios are modeled under the biodiesel mandate law for each country. The first scenario is based on the Argentine and Brazilian biodiesel mandate laws from 2008 until 2014 and assumes that biodiesel production will follow the legal mandate for 2008-2014. In Argentina this scenario represents 5% of the diesel market for 2010-2014 while in Brazil it represents 2% of the diesel market for 2008-2012 and 5% of the diesel market for 2013-2014. The second scenario assumes that biodiesel production will follow a phased capacity for 2007-2014 to represent the gradual growth of the industry. In

[2] *Imposto sobre operações relativas à Circulação de Mercadorias e sobre prestações de Serviços de transporte interestadual, intermunicipal e de comunicação, Lei Complementar 87 de 1996.*
[3] *Contribuição para Financiamento da Seguridade Social, Lei Complementar 70 de 1991.*

Argentina this scenario represents 2.5% for 2007, 5% for 2008, 7.5% for 2009, 10% for 2010, 12.5% for 2011, 15% for 2012, 17.5% for 2013 and 20% for 2014 of the diesel market, respectively. In Brazil, it represents 2% for 2007-2008, 3% for 2009-2010, 4% for 2011-2012 and 5% for 2013-2014 of the diesel market, respectively.

For both scenarios in each country, biodiesel production is assumed to be composed of 75% and 50% from soybean oil and 25% and 50% from other vegetable oils and animal fats, respectively. This sensitivity analysis reflects the substitute feedstock availability in each country. The diesel market is assumed to be 15 billion liters per year in Argentina and 40 billion liters per year in Brazil for 2007-2014 (). Biodiesel density used in the estimations is 0.880 metric ton per cubic meter (DIN 51606).

Both the biodiesel mandate and the biodiesel phased capacity scenarios can be viewed as a shock to the Argentine and Brazilian soybean oil markets, which is composed by both the domestic and export markets. The shock will affect both markets in the opposite direction. On one hand, the biodiesel mandate will produce an increase in domestic consumption of soybean oil due to biodiesel production, shifting the domestic demand curve out at a given price. On the other hand, this increased domestic consumption of soybean oil will decrease the quantity of soybean oil exported from Argentina and Brazil to the world market, shifting the soybean oil excess supply curve in at a given price. Since Argentina and Brazil both have an effect in the world market price for soybean oil, a reduction of soybean oil exports from Argentina and Brazil would produce an increase in the price of soybean oil in the world market. This price increase would reduce the quantity of soybean oil imported from importing countries. Soybean oil prices in the world market would be influenced according to the level of the price elasticities of demand and supply employed.

Argentine and Brazilian soybean oil foregone export revenues are the difference between export revenues without the biodiesel production shock and export revenues with the

biodiesel shock for the 2008-2014 period (biodiesel mandate scenario) and for the 2007-2014 period (biodiesel phased capacity scenario). Foregone export revenues will depend on the elasticities of supply and demand in the Argentine and Brazilian soybean oil export markets. If we assume that Argentine and Brazilian exports affect the world price, then the percent change in price will be as follows.

Argentine and Brazilian soybean oil domestic quantity demanded is a function of the price.

$$Qd_i = f(P_i) \tag{1}$$

Argentine and Brazilian soybean oil quantity supplied is a function of the price.

$$Qs_i = g(P_i) \tag{2}$$

Argentine and Brazilian soybean oil quantity traded in the world market is a function of the price.

$$Qt_i = h(P_i) \tag{3}$$

Argentine and Brazilian soybean oil quantity traded in the world market can also be written as the difference between the quantity supplied and the quantity demanded in the domestic market.

$$Qt_i = Qs_i - Qd_i \tag{4}$$

We totally differentiate (1), (2), (3) and (4) and we use $\frac{dx}{x} = d\ln x$ to show the partial changes.

$$\frac{dQt_i}{Qs_i} \times \frac{Qt_i}{Qt_i} = \frac{dQs_i}{Qs_i} - \left(\frac{dQd_i}{Qs_i} x \frac{Qd_i}{Qd_i}\right) \tag{5}$$

The percent change in quantity demanded in the domestic market equals the soybean oil own price elasticity of demand times the percent change in price.

$$d\ln Qd_i = \eta_{di} \times d\ln P_i \tag{6}$$

Any exogenous shock in the quantity demanded in the domestic market can be modeled by adding the shock γ to Equation (6) giving $d\ln Qd_i = \eta_{di} \times d\ln P_i + \gamma_i$.

The percent change in quantity supplied equals the soybean oil own price elasticity of supply times the percent change in price.

$$d\ln Qs_i = \eta_{si} \times d\ln P_i \tag{7}$$

The percent change in quantity traded in the world market equals the soybean oil own price elasticity of export demand times the percent change in price.

$$d\ln Qt_i = \eta_{ei} \times d\ln P_i \tag{8}$$

The percent change in the quantity of Argentine and Brazilian soybean oil traded in the world market times the share of Argentine and Brazilian soybean oil exported (W_{TS}), equals the change in quantity supplied less the percent change in quantity demanded in the domestic market times the share of Argentine and Brazilian soybean oil used domestically (W_{DS}).

$$d\ln Qt_i \times W_{TSi} = d\ln Qs_i - (d\ln Qd_i \times W_{DSi}) \tag{9}$$

In Equation (10) we replace $d \ln Qt$ by $(\eta_e \times d \ln P)$ from equation (8), $d \ln Qs$ by $(\eta_s \times d \ln P)$ from equation (7) and $d \ln Qd$ by $((\eta_d \times d \ln P) + \gamma)$ from equation (6).

$$W_{TS} \times (\eta_e \times d \ln P) = (\eta_s \times d \ln P) - [W_{DS} \times ((\eta_d \times d \ln P) + \gamma)] \quad (10)$$

The Argentine and Brazilian soybean oil export price will change according to the change in the shock γ and the values of the elasticities (η_{di} , η_{ei} and η_{si}) and the shares of export demand and domestic demand (W_{TSi} and W_{DSi}).

$$d \ln P_i = \frac{-W_{DSi} \times \gamma_t}{[(W_{TSi} \times \eta_{ei}) - (\eta_{si}) + (W_{DSi} \times \eta_{di})]} \quad (11)$$

Data was obtained from SAGPyA[4] and from ABIOVE[5] websites publish monthly data for soybeans, soybean oil and soybean meal beginning and ending stocks, domestic consumption, exports, crushing and domestic and export prices for the three commodities for Argentina and Brazil, respectively. Monthly US$/AR$ and US$/BR$ exchange rate were obtained from USDA-ERS historical exchange rate dataset. Since the IBGE[6] does not publish export price indexes for selected categories of goods or six-digit harmonized system, soybeans, soybean oil export prices were deflated by the Argentine Export Price Indexes (1993=100) for vegetable oils as published quarterly by the INDEC[7]. Export price indexes were also available from the United States' BLS[8] but Argentine export price indexes were selected as Brazil's export matrix is more similar to that of Argentina than the United States.

Argentine and Brazilian soybean oil quarterly export and prices data between 2003 and 2006 were used as the baseline for the model. Soybean oil prices and soybean oil quantities for each quarter were averaged between 2003 and 2006 and were assumed to be the baseline for both the biodiesel mandate scenario (2008-2014) and biodiesel phased capacity scenario (2007-2014). Soybean oil domestic shares (W_{DS}) were 0.057 and 0.548 while soybean oil export shares (W_{TS}) were 0.943 and 0.452 for Argentina and Brazil, respectively for 2003-2006.

[4] *Argentine Secretary of Agriculture, Livestock, Fisheries and Food.*
[5] *Brazilian Association of Vegetable Oil Industries.*
[6] *Brazilian Institute of Geography and Statistics.*
[7] *Argentine National Institute of Statistics and Census.*
[8] *Bureau of Labor and Statistics.*

Elasticity values were obtained from different sources on supply and demand for soybean oil in Argentina and Brazil. Since most of the elasticities found in the literature were estimated during different time periods and included different assumptions, these elasticities were averaged in order to have a value within the range of elasticities found in the various sources. Soybean oil elasticity of domestic demand (η_d) were -0.18 and -0.175, soybean oil elasticity of export demand (η_e) were -1.31 and -1.3635, and soybean oil supply (η_S) were 0.25 and 0.4175, for Argentina and Brazil respectively. Soybean oil elasticity of total demand (η_o) is estimated to be -0.48 for Argentina and -0.71 for Brazil. According to Equation (12) (Piggott and Wohlgenant, 2002), (η_o) for Argentina and Brazil equals the sum of the elasticity of domestic demand (η_d = -0.18 and -0.175) times the domestic share (W_{DS} = 0.057 and 0.548), plus the elasticity of price transmission (η_{pt} assumed to be 1 for both countries) times the export share (W_{TS} = 0.943 and 0.452) times the soybean oil elasticity of export demand (η_e = -1.31 and -1.3635).

$$\eta_{oi} = (W_{DSi} \times \eta_{di}) + (\eta_{pti} \times W_{TSi} \times \eta_{ei}) \qquad (12)$$

Results: Change in Quantities and Prices

The quantity of soybean oil used for biodiesel production varies according to the assumptions listed above for each scenario and each country (Figures 1a and 1b). The quarterly soybean oil demand shock (γ) is the percentage difference between the baseline soybean oil export quantity and the simulated soybean oil export quantity. This is, the baseline less the soybean oil diverted for biodiesel production under the two scenarios divided the baseline (Figures 2a and 2b). The quarterly percent change in soybean oil export price ($d \ln P$) is estimated through Equation (10) for each scenario and depends on the quarterly soybean oil export quantity percent change (γ). The higher percent change in exported quantities (γ) occur at the end of both scenarios, where quantities of soybean oil

employed in biodiesel are higher for both scenarios and for both shares of soybean oil assumed for each country (Figures 2a and 2b).

In the case of Argentina, for both scenarios, the relative drop in soybean oil exports is lower given that the size of exports is larger than in Brazil and the domestic size of diesel market is smaller (Figure 2a). In the case of Brazil, with a soybean oil share of 75% in biodiesel production, the drop in soybean oil exports is 64.5% in the last two years (2013-2014) for both scenarios, up from 25.7% from the first two years (2008-2009 and 2007-2008 for each scenario, respectively) with respect to the soybean oil baseline quarterly exports (Figure 2b).

When we take into account a soybean oil share of 50% in biodiesel production, the percent change in export quantities (γ) are lower for both Argentina and Brazil (Figures 2a and 2b). In the case of Brazil, in the last two years (2013-2014), the drop in soybean oil exports is 42.8%, while in the two first years is 17.1% (2008-2009 and 2007-2008 for each scenario, respectively) with respect to the soybean oil baseline quarterly exports (Figure 2b). For Argentina, the percent change in export quantities (γ) are smaller than Brazil as stated above (Figure 2a). These are the higher values within the corresponding years, since there is seasonality of exports within each year (Figure 2). Therefore, the percent change in soybean oil quantity exported (γ) follows this pattern of exports as biodiesel production per quarter is assumed to be constant throughout the year.

The quarterly percent change in soybean oil export price ($d \ln P$) follows a trend similar to the trend described for the soybean oil percent change in quantity exported (γ) (Figures 2a and 2b). The higher percent change in soybean oil export prices ($d \ln P$) occur at the end of both scenarios, when quantities of soybean oil employed in biodiesel are higher for both scenarios and for both shares of soybean oil used (Figures 2a and 2b). In the case of Brazil, with a soybean oil share of 75% in biodiesel production, the percent increase in

soybean oil export price is 31% in the last two years (2013-2014) for both scenarios, up from 12% from the first two years (2008-2009 and 2007-2008 for each scenario, respectively) with respect to the soybean oil baseline quarterly price (Figure 2b). However, in the case of Argentina, the percent increase in soybean oil export price is almost insignificant given the decrease in exports and the elasticity of soybean oil export demand values (Figure 2a).

When we take into account a soybean oil share of 50% in biodiesel production, the percent change in soybean oil export price ($d \ln P$) are lower (Figures 2a and 2b). In the case of Brazil, in the last two years (2013-2014), the percent increase in soybean oil export price is 21%, while in the two first years is 8% (2008-2009 and 2007-2008 for each scenario, respectively) with respect to the soybean oil baseline quarterly price (Figure 2b) while in the case of Argentina is minimal (Figure 2a). Again, these are the higher values within the corresponding years, since there is seasonality of soybean oil export prices within each year (Figures 4a and 4b). Therefore, the percent change in soybean oil export price ($d \ln P$) follows this pattern of exports as biodiesel production per quarter is assumed to be constant throughout the year.

Results: Foregone Export Revenues

Quarterly simulated revenues for each scenario and each country were calculated as the multiplication of the simulated price times the simulated quantity. The simulated price was the quarterly baseline price times the quarterly percent soybean oil export price change ($1+ d \ln P$) for each scenario. The simulated quantity was the quarterly baseline quantity less the quarterly quantity diverted for biodiesel for each scenario. The summations of the quarterly simulated revenues for each scenario were contrasted with the summation of the quarterly baseline revenues to estimate the foregone export revenues for Argentina and Brazil for each scenario.

The Argentine and Brazilian biodiesel mandate laws and the biodiesel planned capacity decrease the quantity of soybean oil exported for both scenarios and produce an increase in the soybean oil export price according to the assumptions described above (Figures 3a, 3b, 4a and 4b). The increase in the soybean oil export price in the world market from the increased domestic consumption of soybean oil for biodiesel production in Argentina and Brazil does not offset the decrease in soybean oil revenue from lower soybean oil export quantities for each scenario (Figures 3a, 3b, 4a and 4b). Therefore, Argentine and Brazilian soybean oil export revenues are lower than the baseline for both the biodiesel mandate (2008-2014) and biodiesel phased capacity (2007-2014) scenarios and for both the assumptions of 75% and 50% share of soybean oil in biodiesel production (Figures 3a, 3b, 4a and 4b).

Argentine and Brazilian soybean oil estimated foregone export revenues for the biodiesel blend mandate (2008 to 2014 period) are US$ (1993) 714.71 and 990.69 million (50% soybean oil share) and US$ (1993) 1,072.86 and 1,626.63 million (75% soybean oil share), respectively (Tables 1a and 1b). Argentine and Brazilian soybean oil foregone export revenues for the biodiesel phased capacity are US$ (1993) 2,579.95 and 1,413.74 million (50% soybean oil share) to 3,878.02 and 2,337 million (75% soybean oil share), respectively (Tables 1a and 1b). The estimated US$ (1993) 714.71 to 3,878.02 millions for Argentina and US$ (1993) 990.69 to 2,337.53 million for Brazil of soybean oil foregone export revenues provides a tangible measure of the opportunity cost of implementing the biodiesel mandate law in each country (Tables 1a and 1b).

Conclusions

The soybean oil foregone export revenues from the biodiesel mandate law represents a transfer payment from the energy industry to the agriculture industry in both Argentina and

Brazil. This transfer of income is going to boost agricultural production in Argentina and Brazil thanks to higher commodity prices. Increased commodity prices will bring new land into production from more distant regions or with lower fertility, or both. Soybean planted area has increased from 10.67 to 20.64 million hectares while soybean output has increased from 23.2 to 58.1 million metric tons between 1995/96 and 2006/07 crop years in Brazil (USDA-FAS-PSD, 2008). Argentina has followed the pace and soybean planted area has increased from 5.98 to 15.90 million hectares while output has increased from 12.48 to 47.20 million metric tons during the same period of time (USDA-FAS-PSD, 2008). Soybean planted area and soybean output growth rates will be further increased under the new Energy Paradigm in both Argentina and Brazil.

This analysis does not take into account foregone export revenues from soybeans and soybean meal which are the raw product and the co-product of soybean oil, respectively. This analysis also does not take into account foreign exchange gains from diesel import substitution and income transfer to the rural sector in Argentina and Brazil. Finally, this study does not take into account the efficiency and environmental costs of the biodiesel policy. Presumably, there would be a deadweight loss, both from the efficiency of implementing the policy and from the environmental impact of the policy. The efficiency loss would come from implementation, regulation and enforcement of the policy. The environmental loss would come as a consequence of deforestation in the Amazonas and grassland loss in the *Cerrados* Region in Brazil and from the *Chaco* Region in Argentina which will have an impact on soil and water quality as well as in agriculture sustainability in the long term in both Argentina and Brazil.

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Tables and Figures

TABLE 1a: *Baseline, Simulated and Foregone Export Revenues (US$ millions) for Argentina for two Assumed Scenarios: Biodiesel Mandate (2008-2014) and Biodiesel Phased Capacity (2007-2014); and two Assumed Soybean Oil Shares in Biodiesel Production: 50% and 75%.*

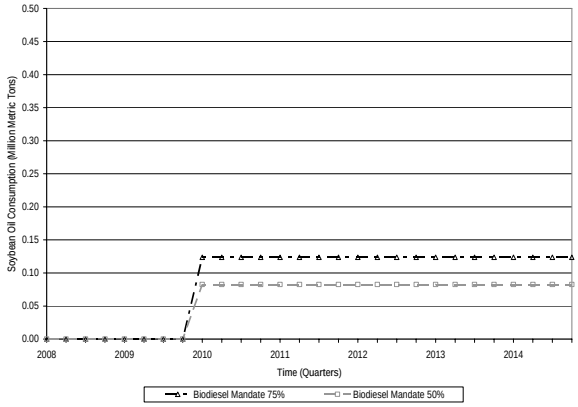
Scenarios	***1***	***2***	***3***	***4***
Biodiesel Production According To	***Biodiesel Mandate (2008-2014)***		***Biodiesel Phased Capacity (2007-2014)***	
Soybean Oil Share in Biodiesel Production	*75%*	*50%*	*75%*	*50%*
Units	*(US$ millions)*	*(US$ millions)*	*(US$ millions)*	*(US$ millions)*
Baseline Revenues	$15,543.14	$15,543.14	$17,763.59	$17,763.59
Simulated Revenues	$14,470,28	$14,828.43	$13,885.57	$15,183.64
Foregone Revenues	**$1,072.86**	**$714.71**	**$3,878.02**	**$2,579.95**

TABLE 1b: *Baseline, Simulated and Foregone Export Revenues (US$ millions) for Brazil for two Assumed Scenarios: Biodiesel Mandate (2008-2014) and Biodiesel Phased Capacity (2007-2014); and two Assumed Soybean Oil Shares in Biodiesel Production: 50% and 75%.*

Scenarios	***1***	***2***	***3***	***4***
Biodiesel Production According To	***Biodiesel Mandate (2008-2014)***		***Biodiesel Phased Capacity (2007-2014)***	
Soybean Oil Share in Biodiesel Production	*75%*	*50%*	*75%*	*50%*
Units	*(US$ millions)*	*(US$ millions)*	*(US$ millions)*	*(US$ millions)*
Baseline Revenues	$7,891.28	$7,891.28	$9,018.60	$9,018.60
Simulated Revenues	$6,264.65	$6,900.59	$6,681.06	$7,604.86
Foregone Revenues	**$1,626.62**	**$990.68**	**$2,337.53**	**$1,413.74**

FIGURE 1a: *Quarterly Soybean Oil (Metric Tons) Diverted for Biodiesel Production in Argentina for the Different Assumed Scenarios.*

Scenarios 1 and 3: Biodiesel Mandate 2008-2014 with 75% and 50% of Soybean Oil share in Biodiesel Production, respectively.



Scenarios 2 and 4: Biodiesel Capacity 2007-2014 with 75% and 50% of Soybean Oil share in Biodiesel Production, respectively.

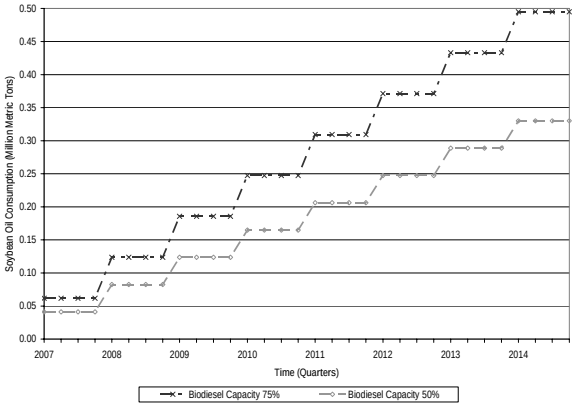
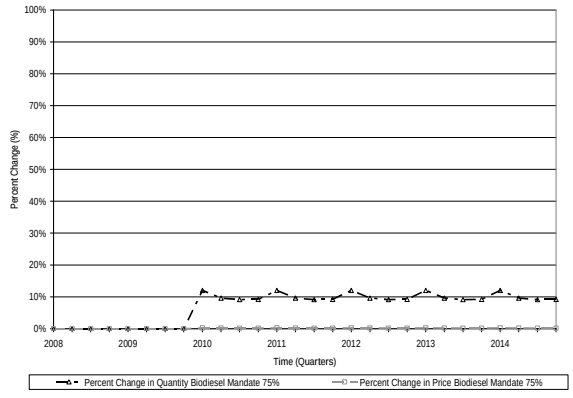
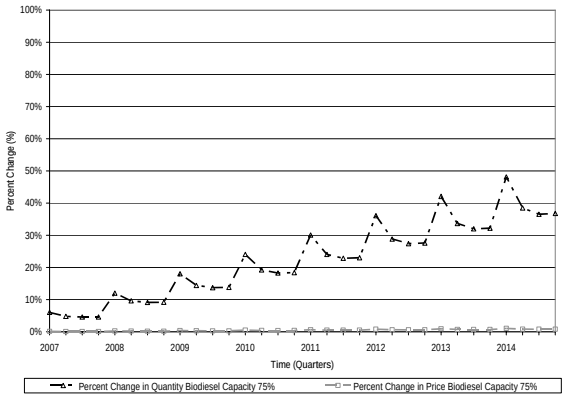


FIGURE 2a: *Quarterly Soybean Oil Quantity Exported Percent Change* (γ) *and Quarterly Soybean Oil Export Price Change (* $d \ln P$ *) for each Scenario and Soybean Oil share with respect to the Baseline in Argentina.*

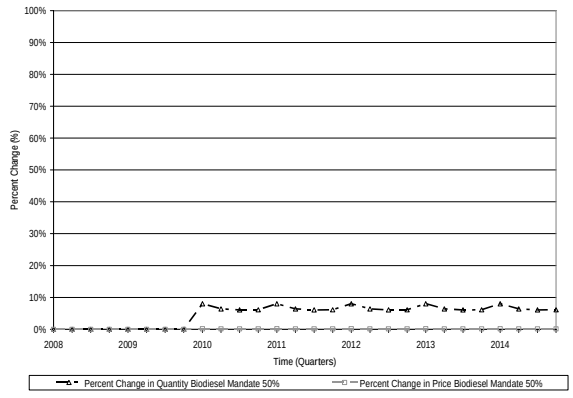
Scenario 1: Biodiesel Mandate 2008-2014 and 75% of Soybean Oil share in Biodiesel Production.



Scenario 3: Biodiesel Capacity 2007-2014 and 75% of Soybean Oil share in Biodiesel Production.



Scenario 2: Biodiesel Mandate 2008-2014 and 50% of Soybean Oil share in Biodiesel Production.



Scenario 4: Biodiesel Capacity 2007-2014 and 50% of Soybean Oil share in Biodiesel Production.

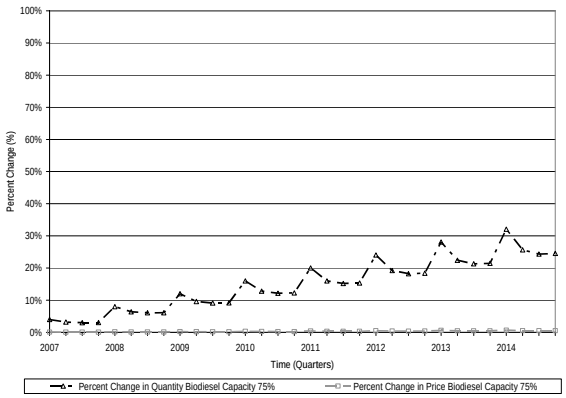


FIGURE 3a: *Quarterly Soybean Oil Baseline and Estimated Export Revenue (million US$), Baseline and Estimated Export Quantity (Metric Tons) and Average Baseline and Estimated Implicit Real FOB Price (US$ / Metric Ton) for Argentina for two Assumed Scenarios: Biodiesel Mandate and Biodiesel Capacity; and 75% of Soybean Oil share in Biodiesel Production.*

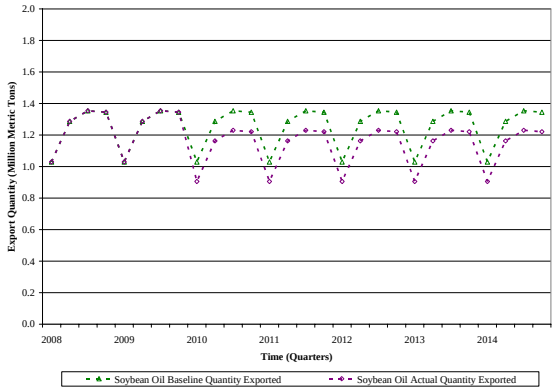
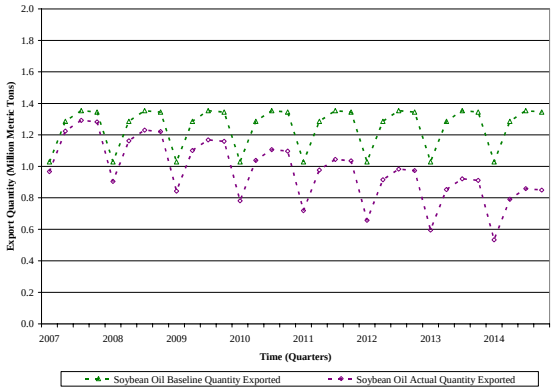
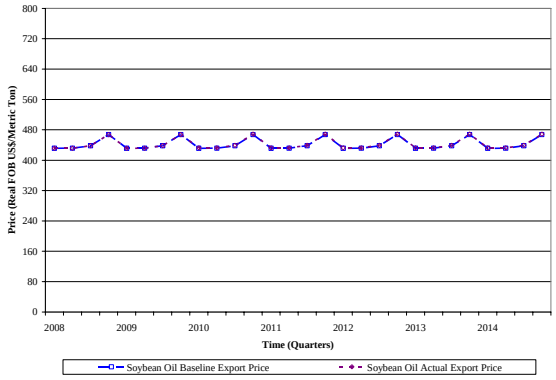
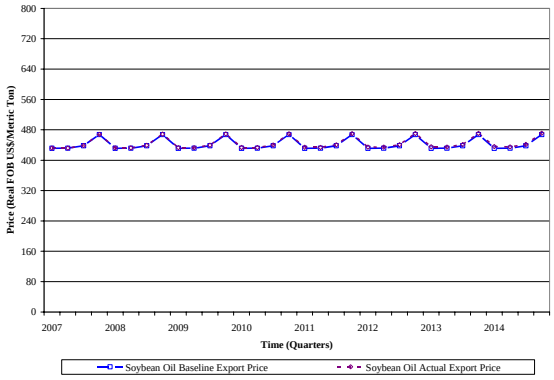
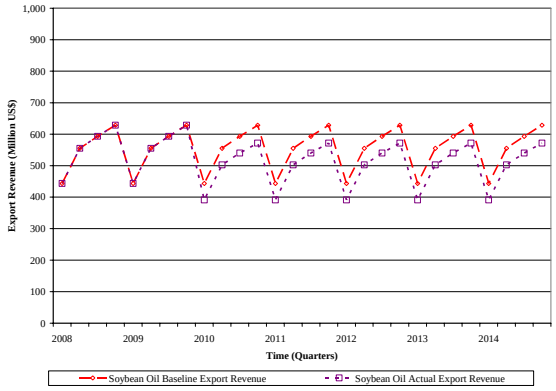
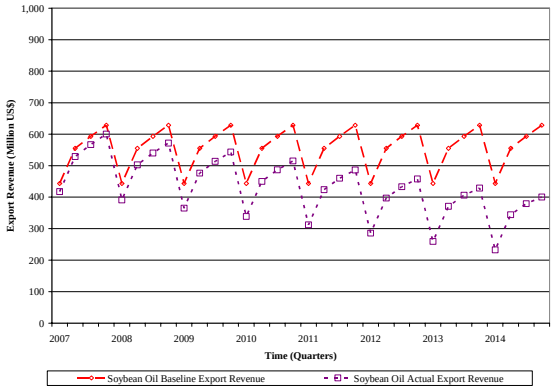
Scenario 1: Biodiesel Mandate 2008-2014 and 75% of Soybean Oil share in Biodiesel Production.	***Scenario 3: Biodiesel Capacity 2007-2014 and 75% of Soybean Oil share in Biodiesel Production.***
	
	
	

FIGURE 4b: *Quarterly Soybean Oil Baseline and Estimated Export Revenue (million US$), Baseline and Estimated Export Quantity (Metric Tons) and Average Baseline and Estimated Implicit Real FOB Price (US$ / Metric Ton) for Argentina for two Assumed Scenarios: Biodiesel Mandate and Biodiesel Capacity; and 50% of Soybean Oil share in Biodiesel Production.*

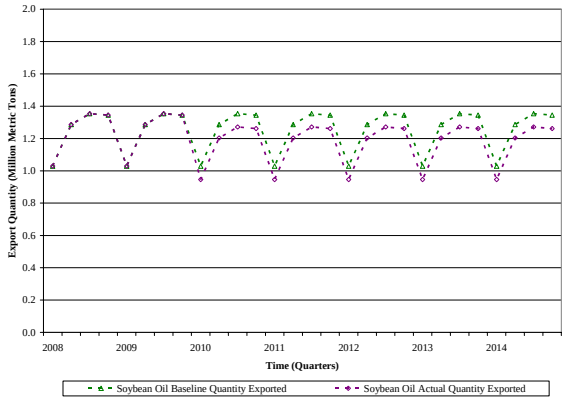
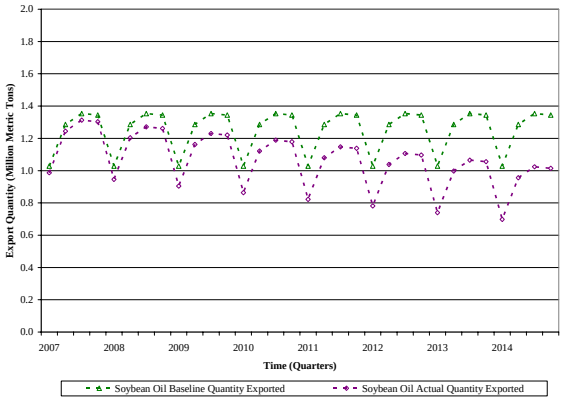
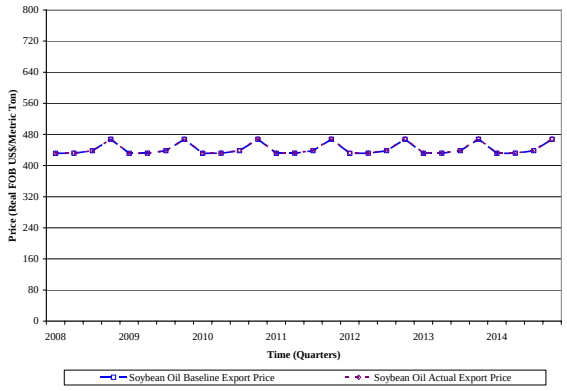
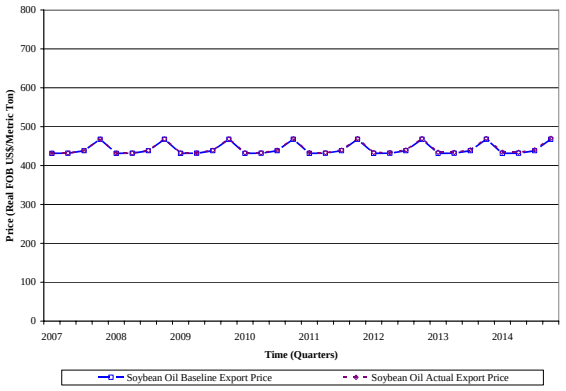
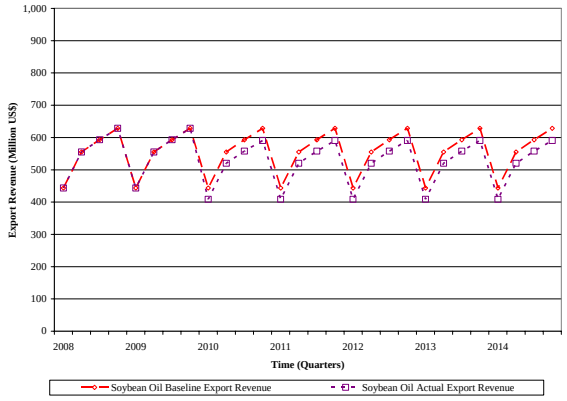
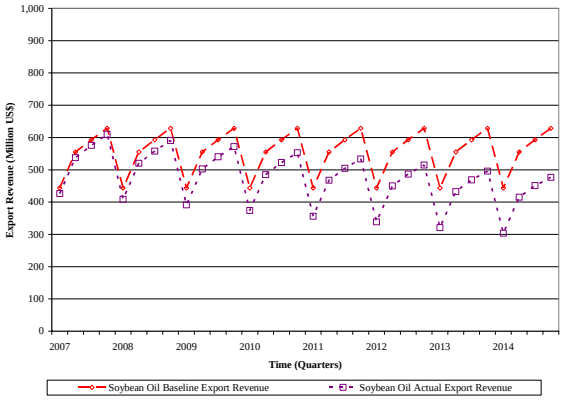
Scenario 2: Biodiesel Mandate 2008-2014 and 50% of Soybean Oil share in Biodiesel Production.	***Scenario 4: Biodiesel Capacity 2007-2014 and 50% of Soybean Oil share in Biodiesel Production.***
	
	
	

FIGURE 1b: *Quarterly Soybean Oil (Metric Tons) Diverted for Biodiesel Production in Brazil for the Different Assumed Scenarios.*

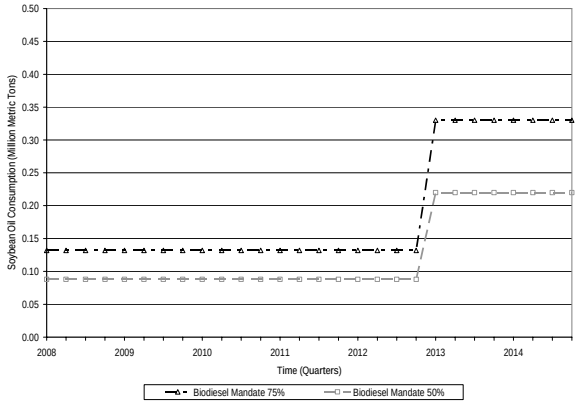
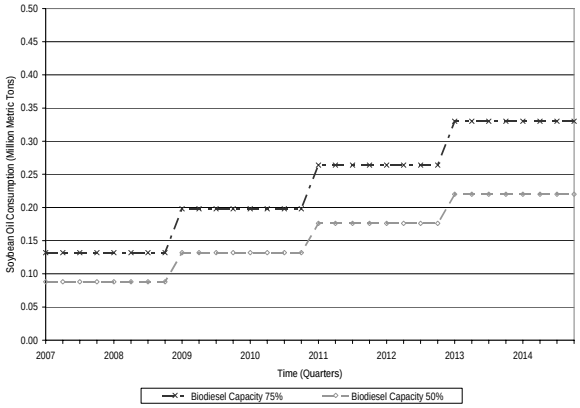
Scenarios 1 and 3: Biodiesel Mandate 2008-2014 with 75% and 50% of Soybean Oil share in Biodiesel Production, respectively.	***Scenarios 2 and 4: Biodiesel Capacity 2007-2014 with 75% and 50% of Soybean Oil share in Biodiesel Production, respectively.***
	

FIGURE 2b: *Quarterly Soybean Oil Quantity Exported Percent Change* (γ) *and Quarterly Soybean Oil Export Price Change* $(d \ln P)$ *for each Scenario and Soybean Oil share with respect to the Baseline in Brazil.*

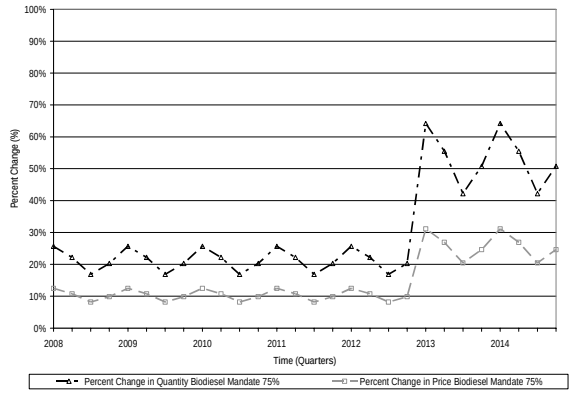
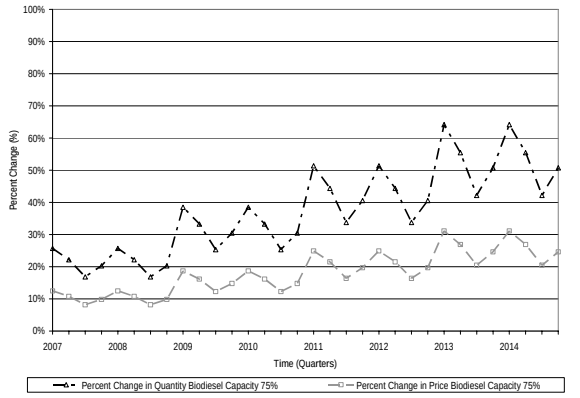
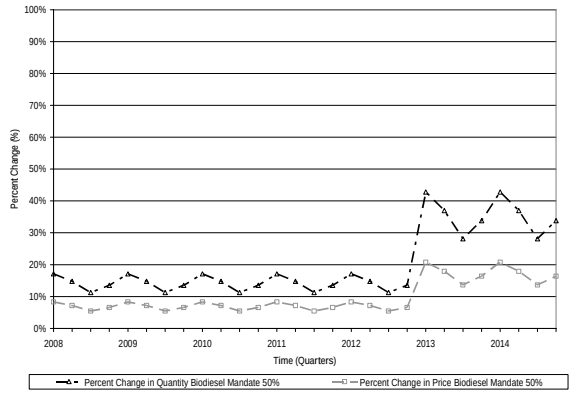
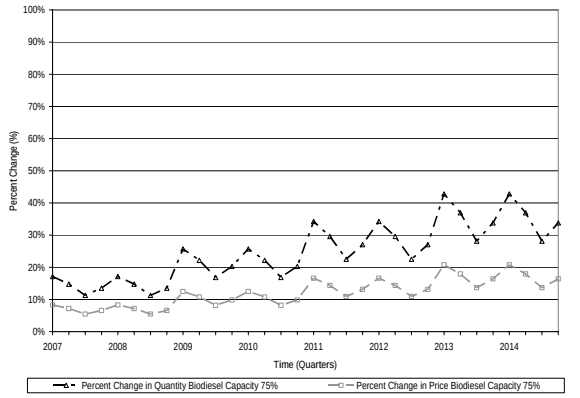
Scenario 1: Biodiesel Mandate 2008-2014 and 75% of Soybean Oil share in Biodiesel Production.	*Scenario 3: Biodiesel Capacity 2007-2014 and 75% of Soybean Oil share in Biodiesel Production.*
	
Scenario 2: Biodiesel Mandate 2008-2014 and 50% of Soybean Oil share in Biodiesel Production.	*Scenario 4: Biodiesel Capacity 2007-2014 and 50% of Soybean Oil share in Biodiesel Production.*
	

FIGURE 3b: *Quarterly Soybean Oil Baseline and Estimated Export Revenue (million US$), Baseline and Estimated Export Quantity (Metric Tons) and Average Baseline and Estimated Implicit Real FOB Price (US$ / Metric Ton) for Brazil for two Assumed Scenarios: Biodiesel Mandate and Biodiesel Capacity; and 75% of Soybean Oil share in Biodiesel Production.*

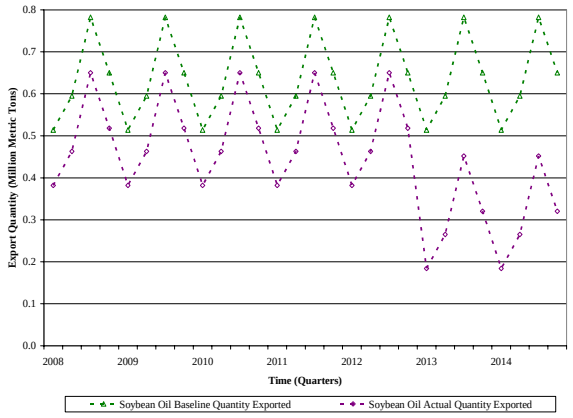
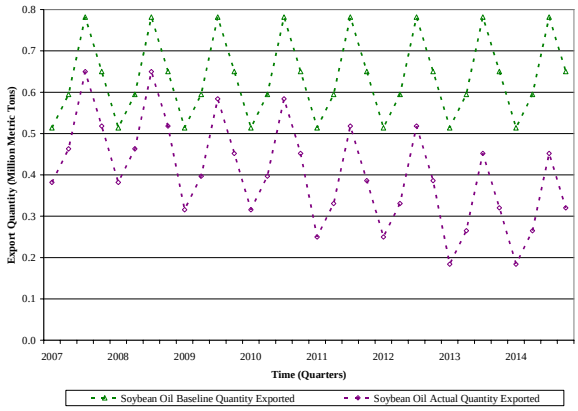
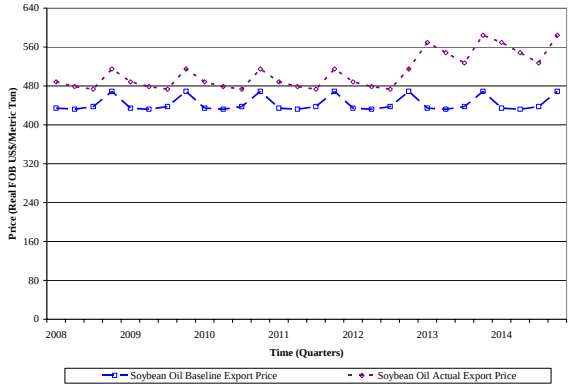
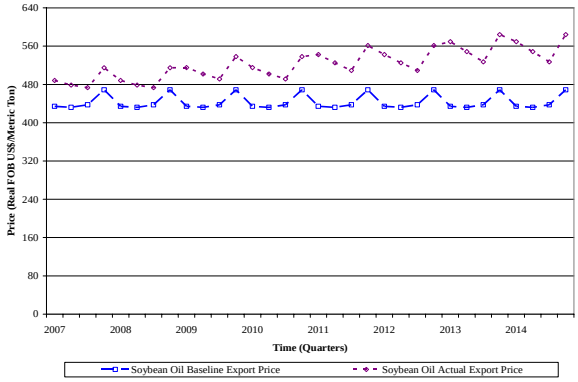
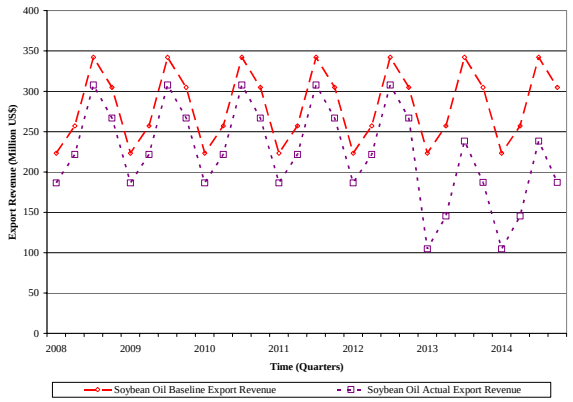
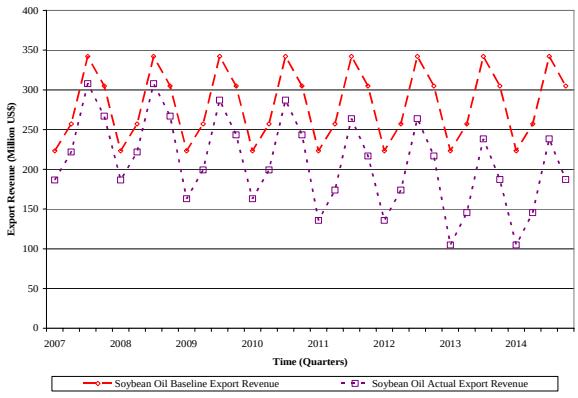
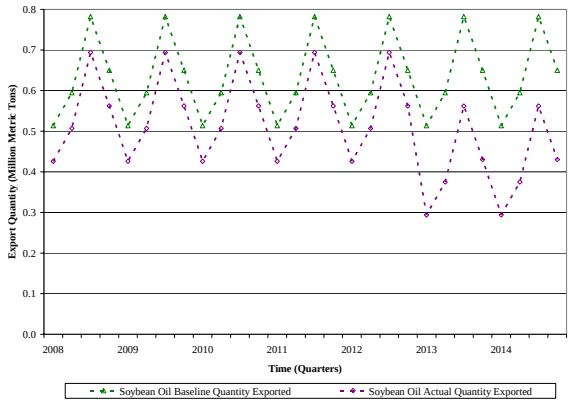
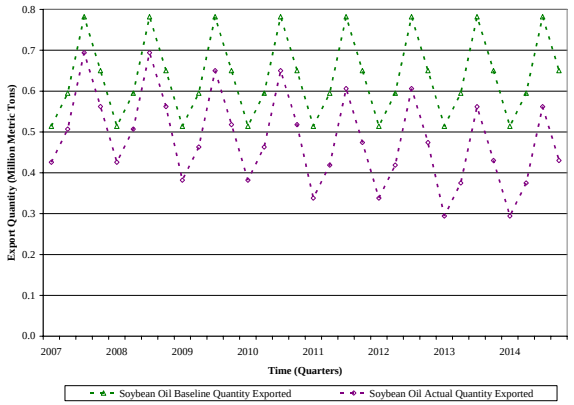
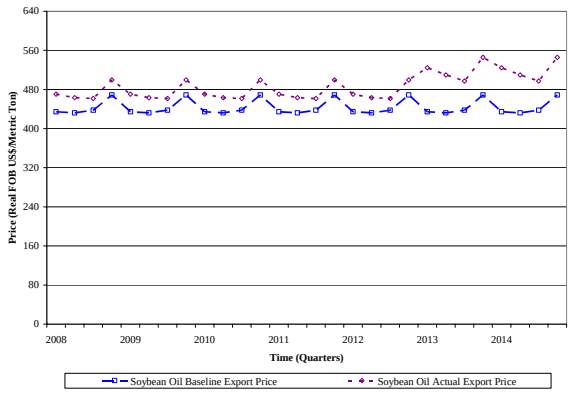
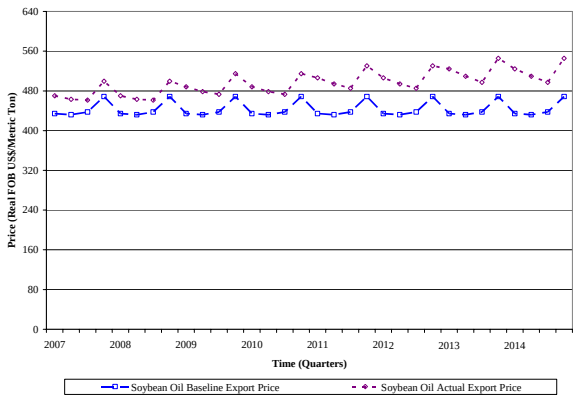
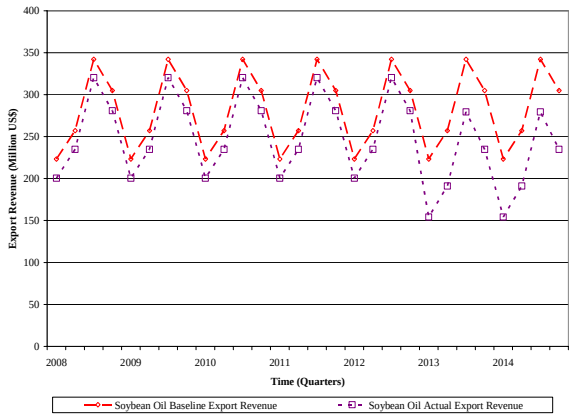
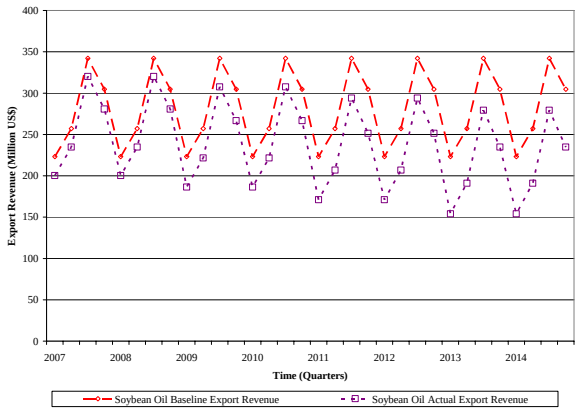
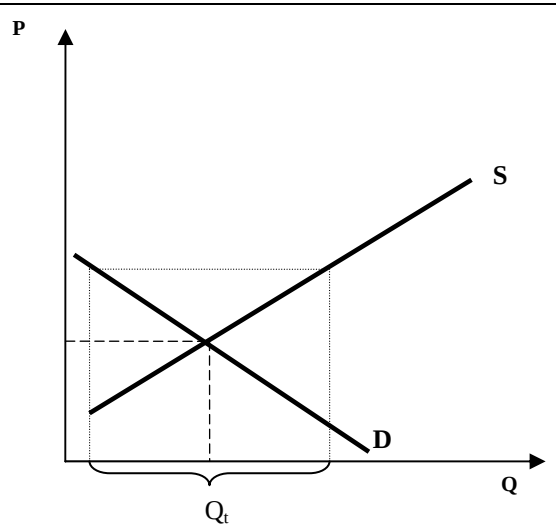
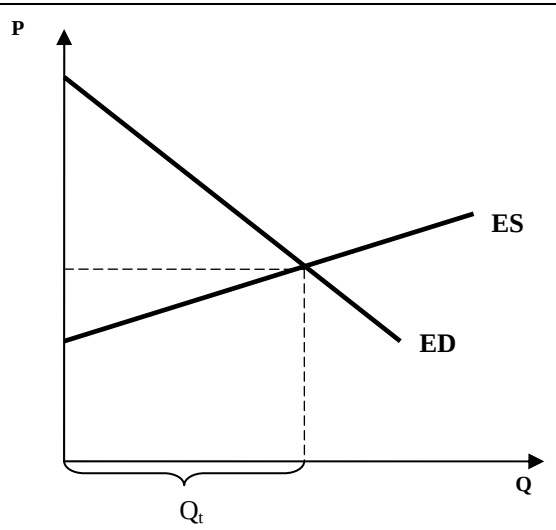
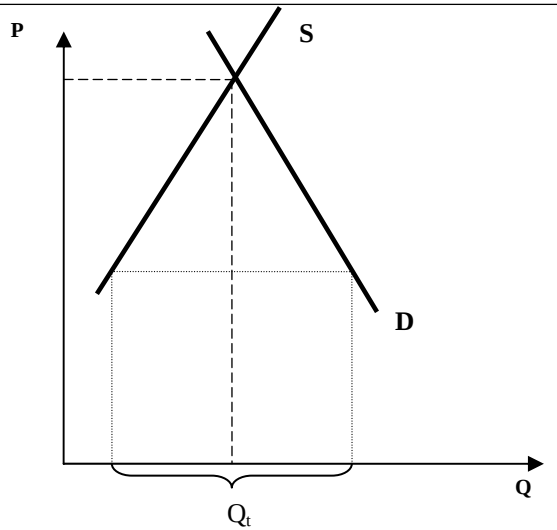
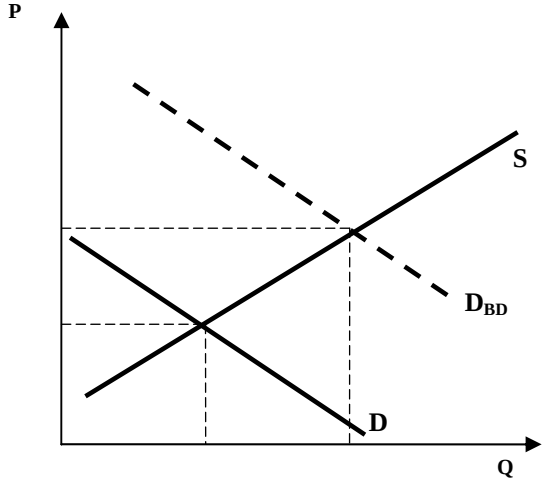
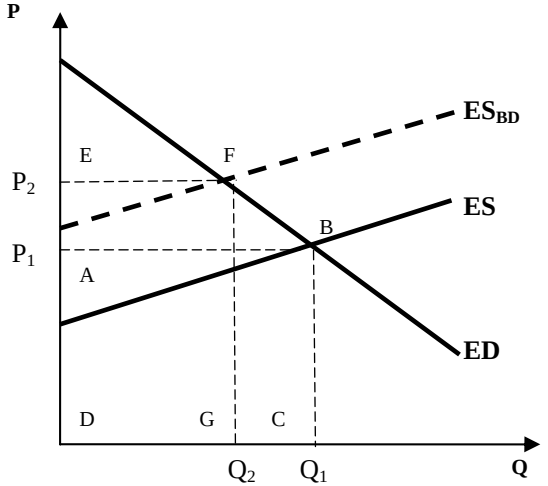
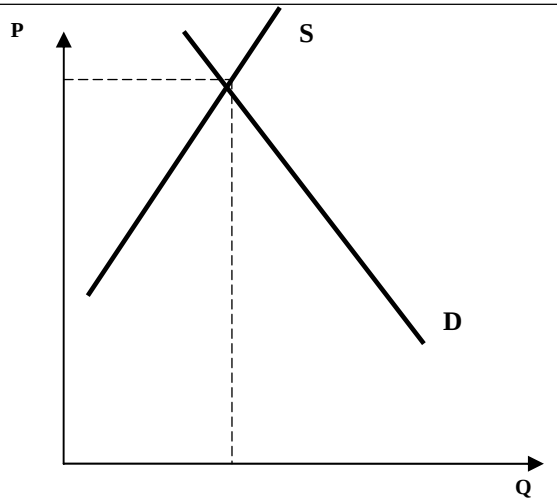
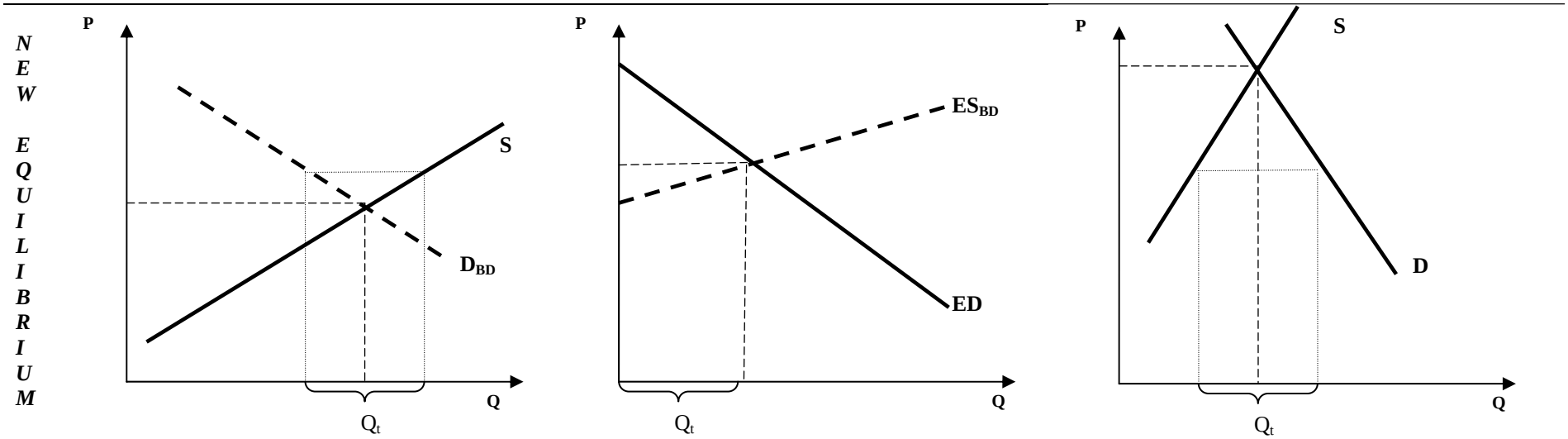
Scenario 1: Biodiesel Mandate 2008-2014 and 75% of Soybean Oil share in Biodiesel Production.	***Scenario 3: Biodiesel Capacity 2007-2014 and 75% of Soybean Oil share in Biodiesel Production.***
	
	
	

FIGURE 4b: *Quarterly Soybean Oil Baseline and Estimated Export Revenue (million US$), Baseline and Estimated Export Quantity (Metric Tons) and Average Baseline and Estimated Implicit Real FOB Price (US$ / Metric Ton) for Brazil for two Assumed Scenarios: Biodiesel Mandate and Biodiesel Capacity; and 50% of Soybean Oil share in Biodiesel Production.*

Scenario 2: Biodiesel Mandate 2008-2014 and 50% of Soybean Oil share in Biodiesel Production.	***Scenario 4: Biodiesel Capacity 2007-2014 and 50% of Soybean Oil share in Biodiesel Production.***
	
	
	

Appendix 1: *Graphical representation of soybean oil trade between Argentina/Brazil and the Rest of the World before, during and after the mandate law on biodiesel.*

	ARGENTINA/BRAZIL	***TRADE***	***REST OF THE WORLD***
OLD EQUILIBRIUM			
TRANSITION			



Where:

Q_i = soybean oil quantity supplied for country $_i$
P_i = soybean oil price for country $_i$
S_i = soybean oil supply for country $_i$
D_i = soybean oil demand for country $_i$
D_{BDi} = soybean oil demand after the biodiesel adoption for country $_i$
ES_i = Soybean oil excess supply for country $_i$
$ES_{BD\,i}$ = Soybean oil excess supply after the biodiesel adoption for country $_i$
ED_i = Rest of the World soybean oil excess demand for country $_i$
$Q_{t\,i}$ = Soybean oil traded in the world market for country $_i$

Quantities and Prices in the Old Equilibrium:

$P_{1\,i}$ = soybean oil implicit export price (*FOB*) based on 2003-2006 quarterly averages for country $_i$
$Q_{1\,i}$ = soybean oil export quantities (*Metric Ton*) based on 2003-2006 quarterly averages for country $_i$

Quantities and Prices in the New Equilibrium:

$P_{2\,i}$ = soybean oil implicit export price (*FOB*) after the shock for country $_i$
$Q_{2\,i}$ = soybean oil export quantities (*Metric Ton*) after the shock for country $_i$

Soybean Oil Export Revenues:

ABCD = soybean oil export revenues with no biodiesel adoption for country $_i = P_{1\,i} \times Q_{1\,i}$
EFGD = soybean oil export revenues with biodiesel adoption for country $_i = P_{2\,i} \times Q_{2\,i}$
ABCD - EFGD = change in soybean oil export revenues from the adoption of biodiesel for country $_i = (P_{1\,i} \times Q_{1\,i}) - (P_{2\,i} \times Q_{2\,i})$

Appendix 2: *Estimation of the Baseline, Estimated and Foregone Soybean Oil Export Revenues for each Assumed Scenarios for Argentina and Brazil.*

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Biodiesel Assumption	*Production of biodiesel follows the Legal Mandate (2008-2014)*		*Production of biodiesel follows the Phased Capacity (2007-2014)*	
Soybean Oil Assumption	*Soybean oil share in biodiesel production is 75%*	*Soybean oil share in biodiesel production is 50%*	*Soybean oil share in biodiesel production is 75%*	*Soybean oil share in biodiesel production is 50%*
Argentina	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel production to comply with the legal mandate (0% of diesel consumption for 2008-2009 and 5% for 2010-2014). Soybean oil is 75% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel production to comply with the legal mandate (0% of diesel consumption for 2008-2009 and 5% for 2010-2014). Soybean oil is 50% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel phased capacity (2.5% of diesel consumption for 2007 increasing to 20% by 2014). Soybean oil is 75% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel phased capacity (2.5% of diesel consumption for 2007 increasing to 20% by 2014). Soybean oil is 50% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.
Brazil	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel production to comply with the legal mandate (2% of diesel consumption for 2008-2012 and 5% for 2013-2014). Soybean oil is 75% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel production to comply with the legal mandate (2% of diesel consumption for 2008-2012 and 5% for 2013-2014). Soybean oil is 50% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel phased capacity (2% of diesel consumption for 2007-08 increasing to 5% by 2013-2014). Soybean oil is 75% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.	*Baseline Revenues*: 2003-2006 quarterly averages for Q_1 and P_1. *Estimated Revenues*: Q_2: Soybean oil domestic consumption increases according to biodiesel phased capacity (2% of diesel consumption for 2007-08 increasing to 5% by 2013-2014). Soybean oil is 50% of the feedstock used for biodiesel production. P_2: Equation (11). *Foregone Revenues*: difference between the baseline and the estimated revenues.