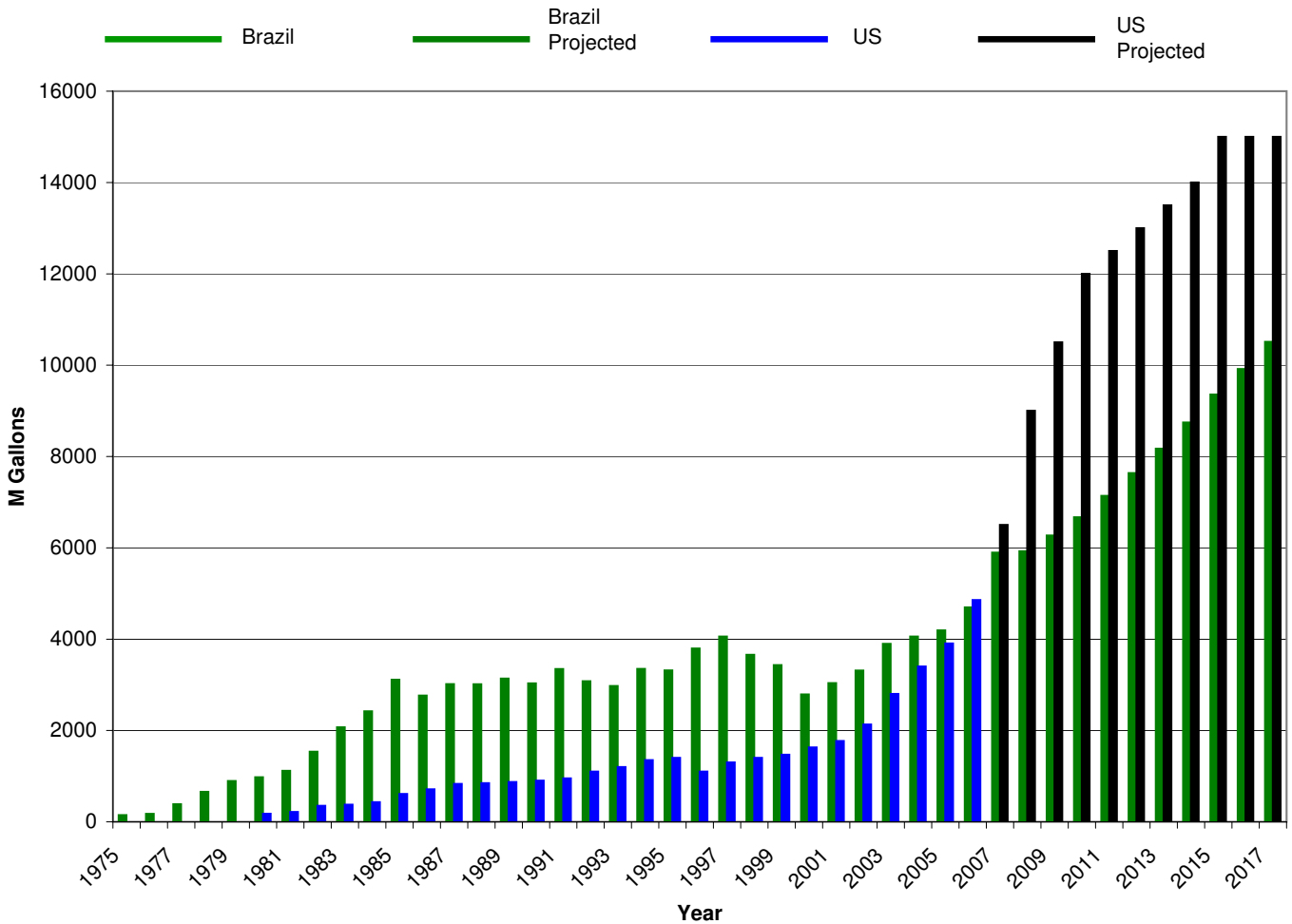
The Impact of Ethanol Policy on Social Welfare and GHG Emissions

Christine Lasco and Madhu Khanna
University of Illinois Urbana-Champaign

October 15, 2008
Farm Foundation Conference
St. Louis, MO

Trends in Ethanol Production



Background

- Concerns about energy security and climate change
  $\longrightarrow$ alternative energy sources

Background

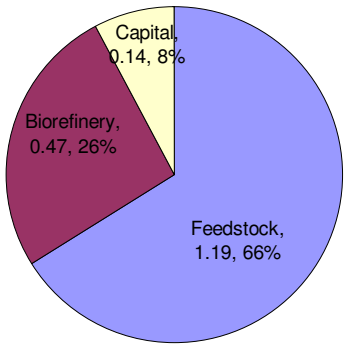
- Concerns about energy security and climate change
  $\longrightarrow$ alternative energy sources
- Ethanol is perceived to be a clean fuel that could help address energy and environmental concerns

Background

- Concerns about energy security and climate change
  $\longrightarrow$ alternative energy sources
- Ethanol is perceived to be a clean fuel that could help address energy and environmental concerns
- The government has put in place policies that encourage domestic ethanol production
  $\longrightarrow$ Subsidy ($ 0.51 per gallon, recently reduced to $ 0.45)
  $\longrightarrow$ Tariff ($ 0.54 per gallon and 2.5% of import price)
  $\longrightarrow$ Mandates (15 B gallons of corn ethanol, 21 B of cellulosic ethanol)

Background

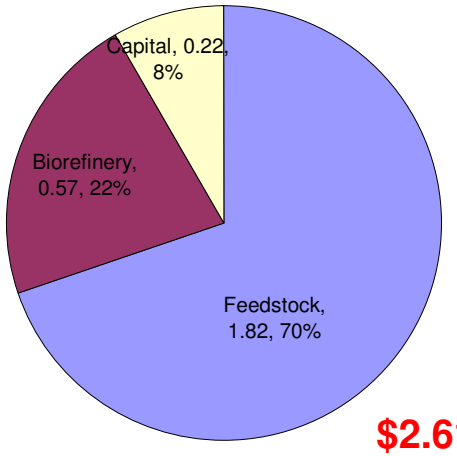
Brazil



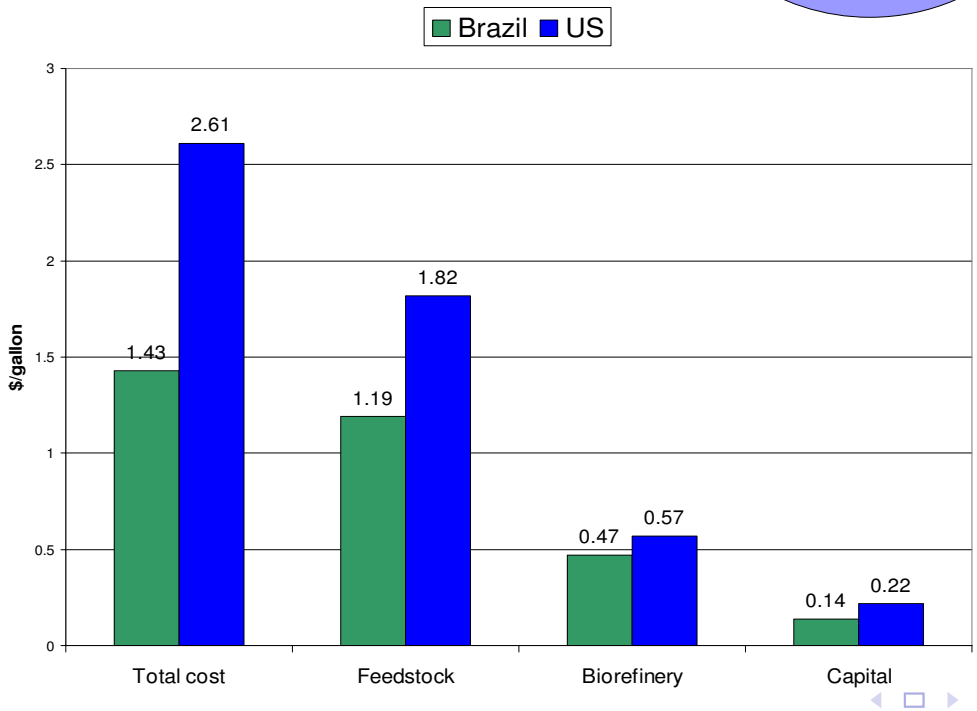
$1.43/ gallon

Brazil's production cost is 33% less than US cost

US



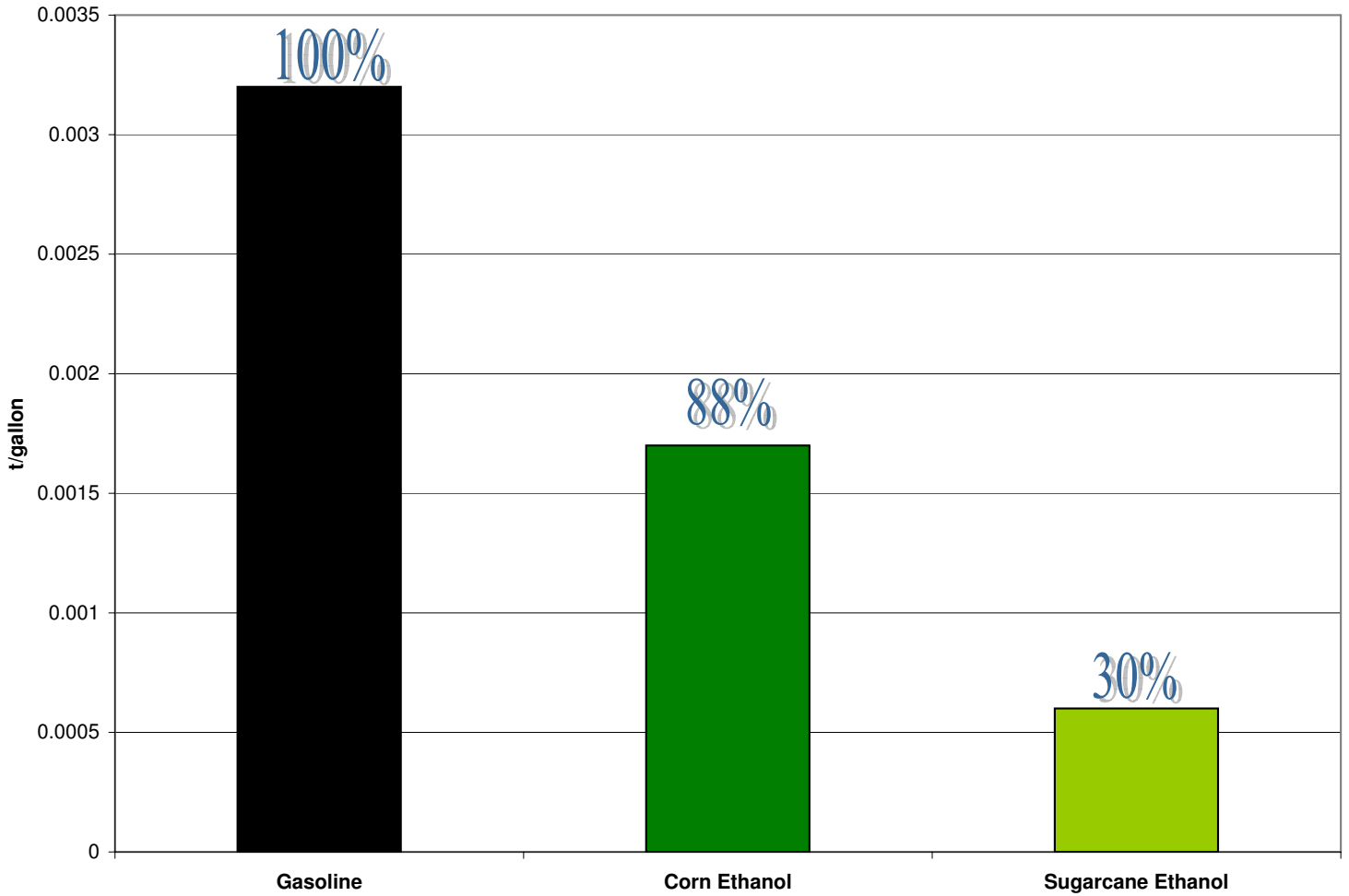
$2.61/ gallon



Life Cycle Analysis of GHG Emissions

Study	kg CO2-eq/gallon
BRAZIL	
Oliveira et al. (2005)	1.22
Smeets et al. (2008)	1.42 - 1.5
Macedo et al.(2008)	1.65
US	
Farrell et al. (2007)	6.02

Life Cycle Analysis of GHG Emissions



Paper Contribution

- Examine the welfare effect of biofuels policy taking into account greenhouse gas (GHG) emissions
  - Differentiate ethanol from US and Brazil based on GHG emissions

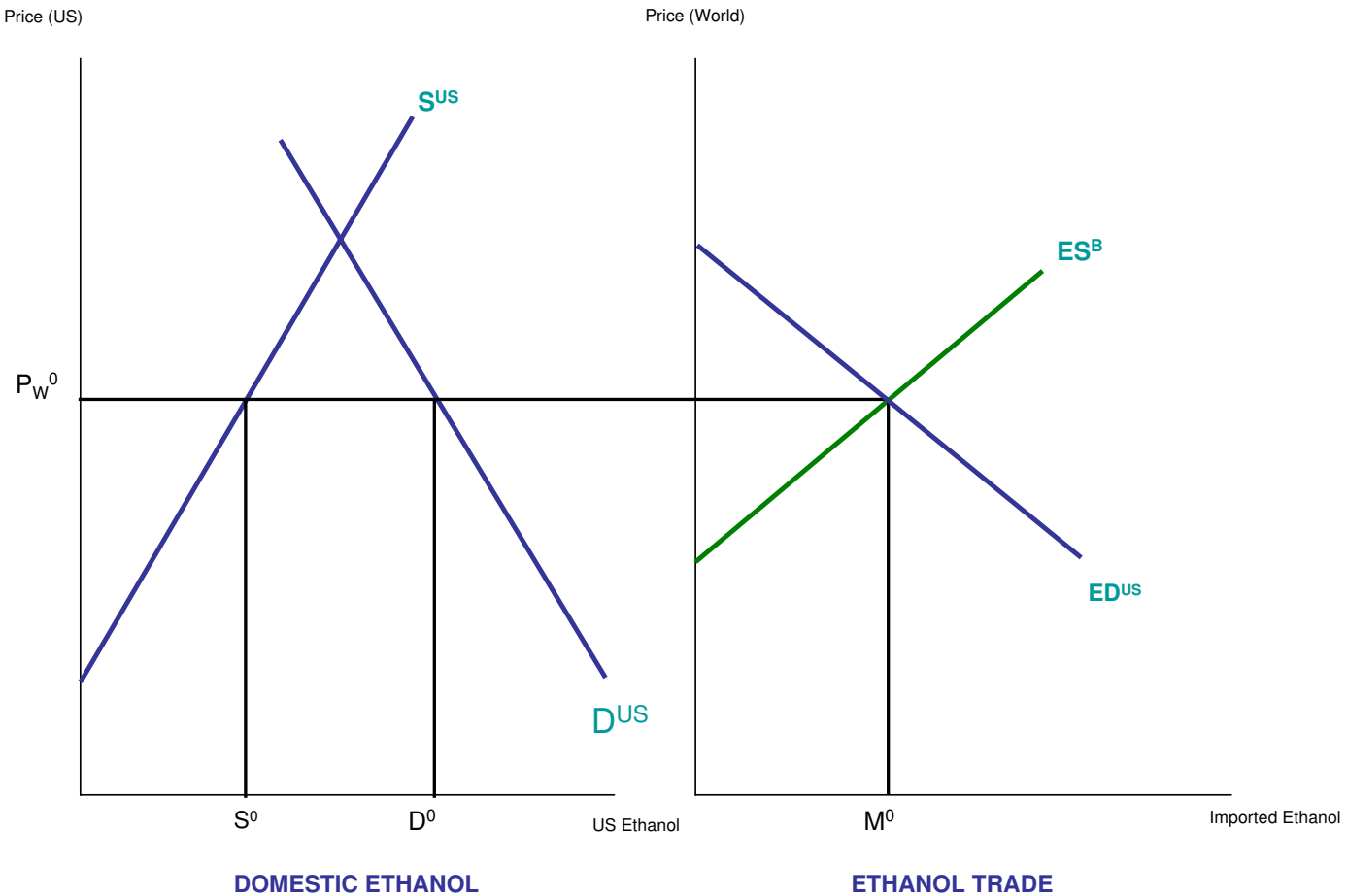
Paper Contribution

- Examine the welfare effect of biofuels policy taking into account greenhouse gas (GHG) emissions
  - Differentiate ethanol from US and Brazil based on GHG emissions
- Specify a miles production function where gasoline and ethanol are imperfect substitutes
  - Most papers assume that ethanol and gasoline are perfect substitutes or complements
  - Substitutes: E85, FFVs
  - Complements: E10

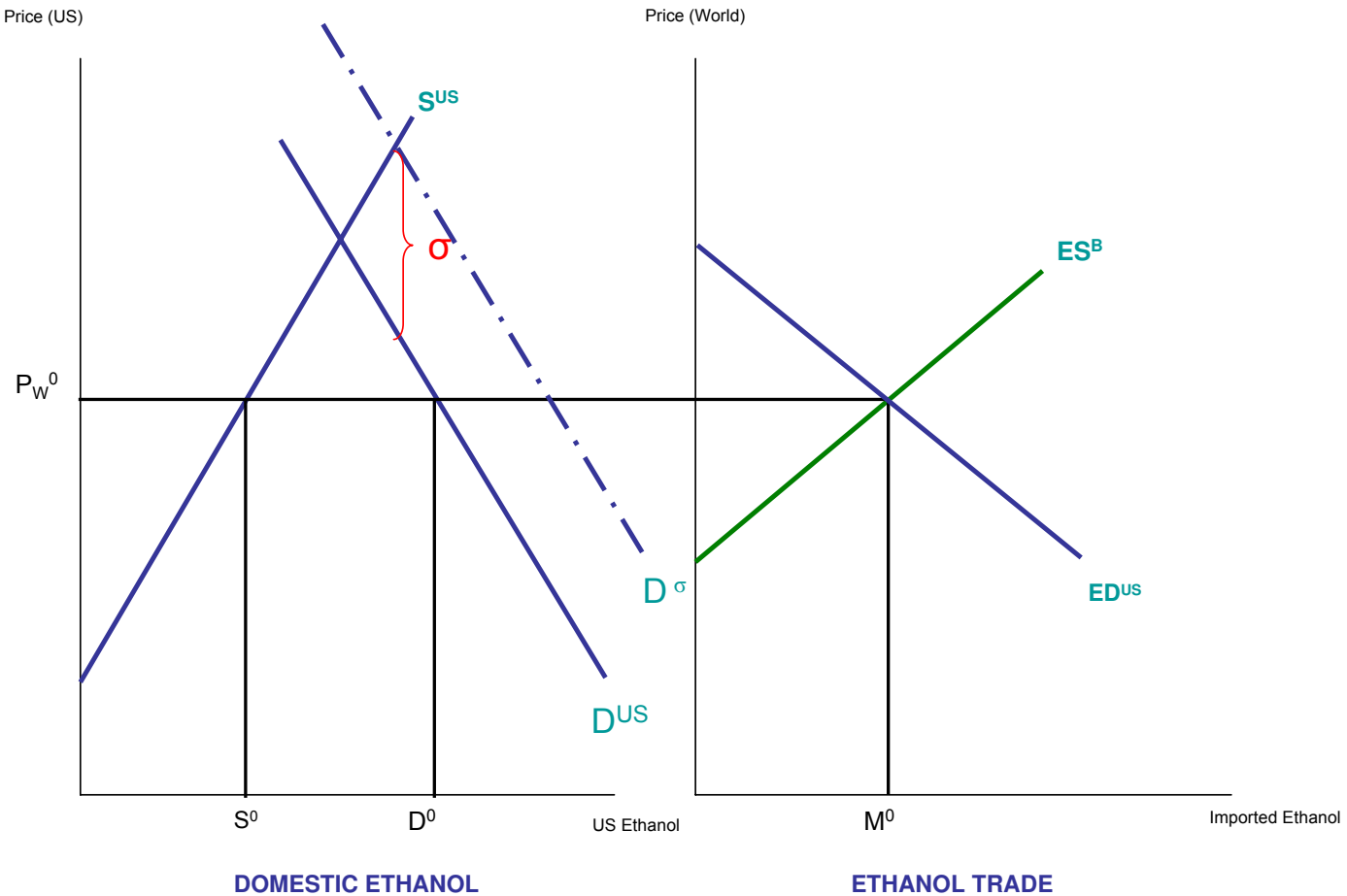
Assumptions

- Consumers benefit from the consumption of miles
- Miles are produced using fuels like gasoline and ethanol (from corn and sugarcane)
- Gasoline and ethanol are imperfect substitutes, sugarcane and corn ethanol are perfect substitutes
- The use of fuels causes GHG emissions
- Miles cause congestion, air pollution and traffic accidents

Welfare Effect of a Subsidy and a Tariff

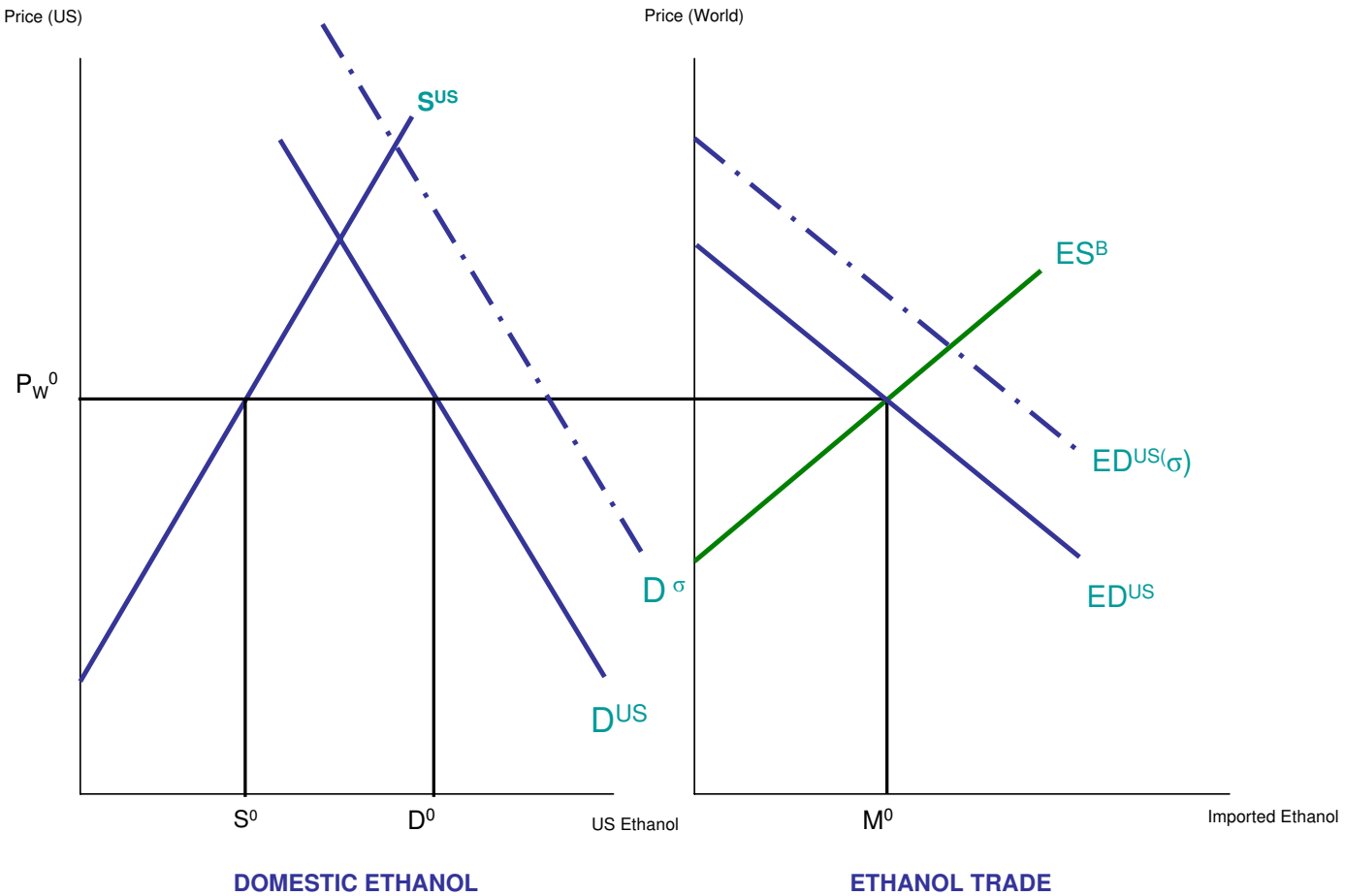


Welfare Effect of a Subsidy and a Tariff

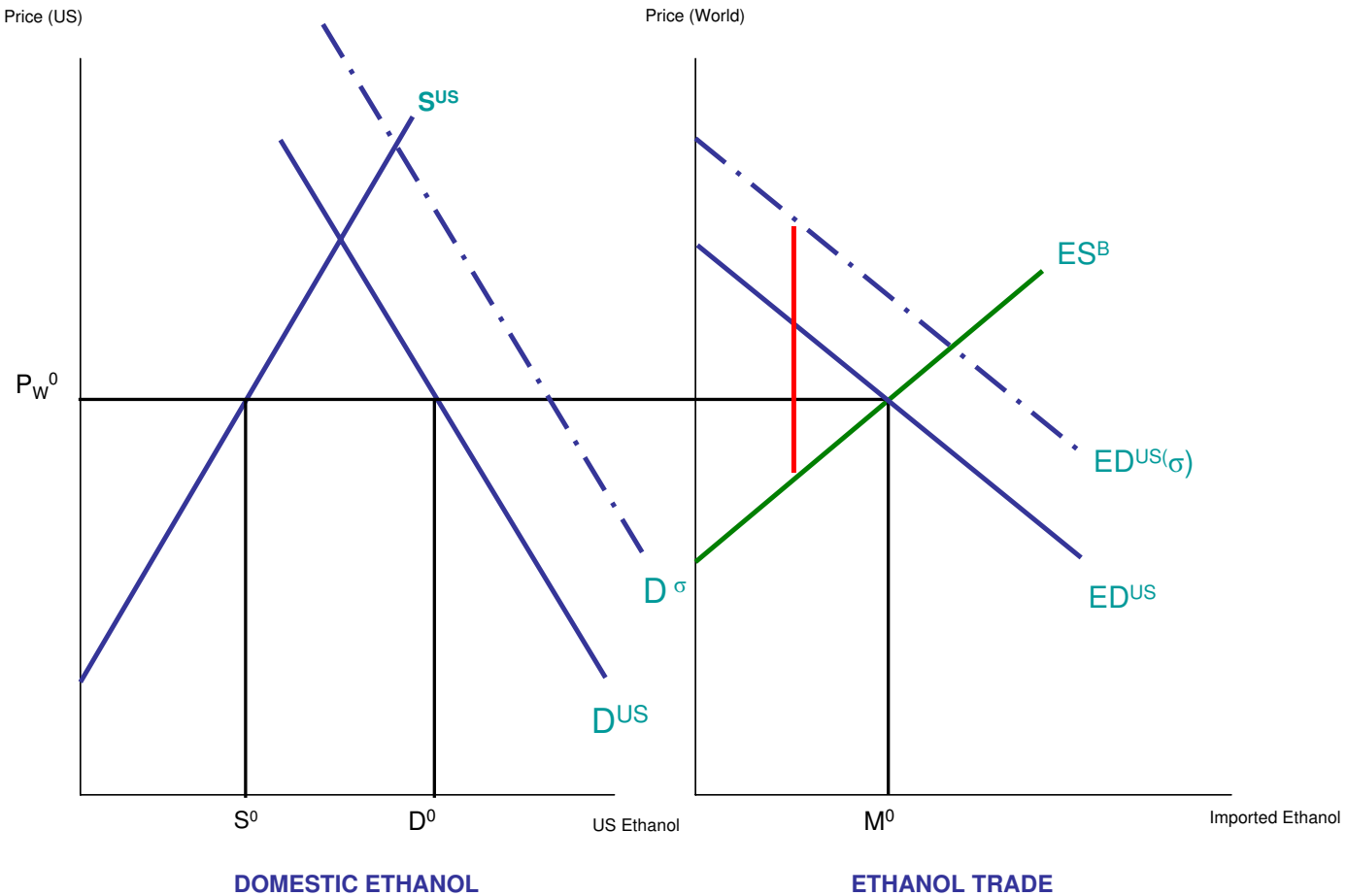


- The subsidy (σ) increases the domestic demand for ethanol

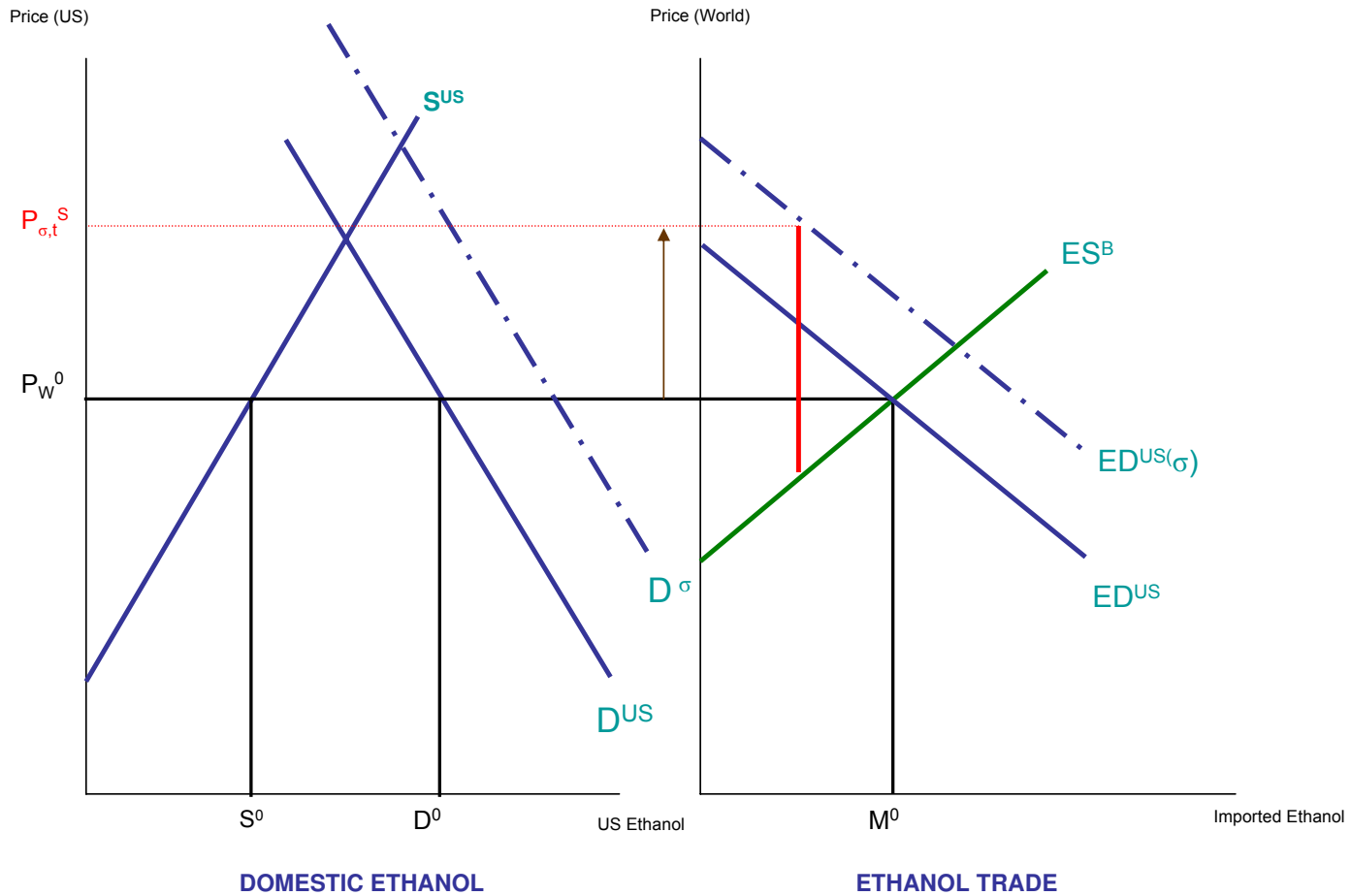
Welfare Effect of a Subsidy and a Tariff



Welfare Effect of a Subsidy and a Tariff

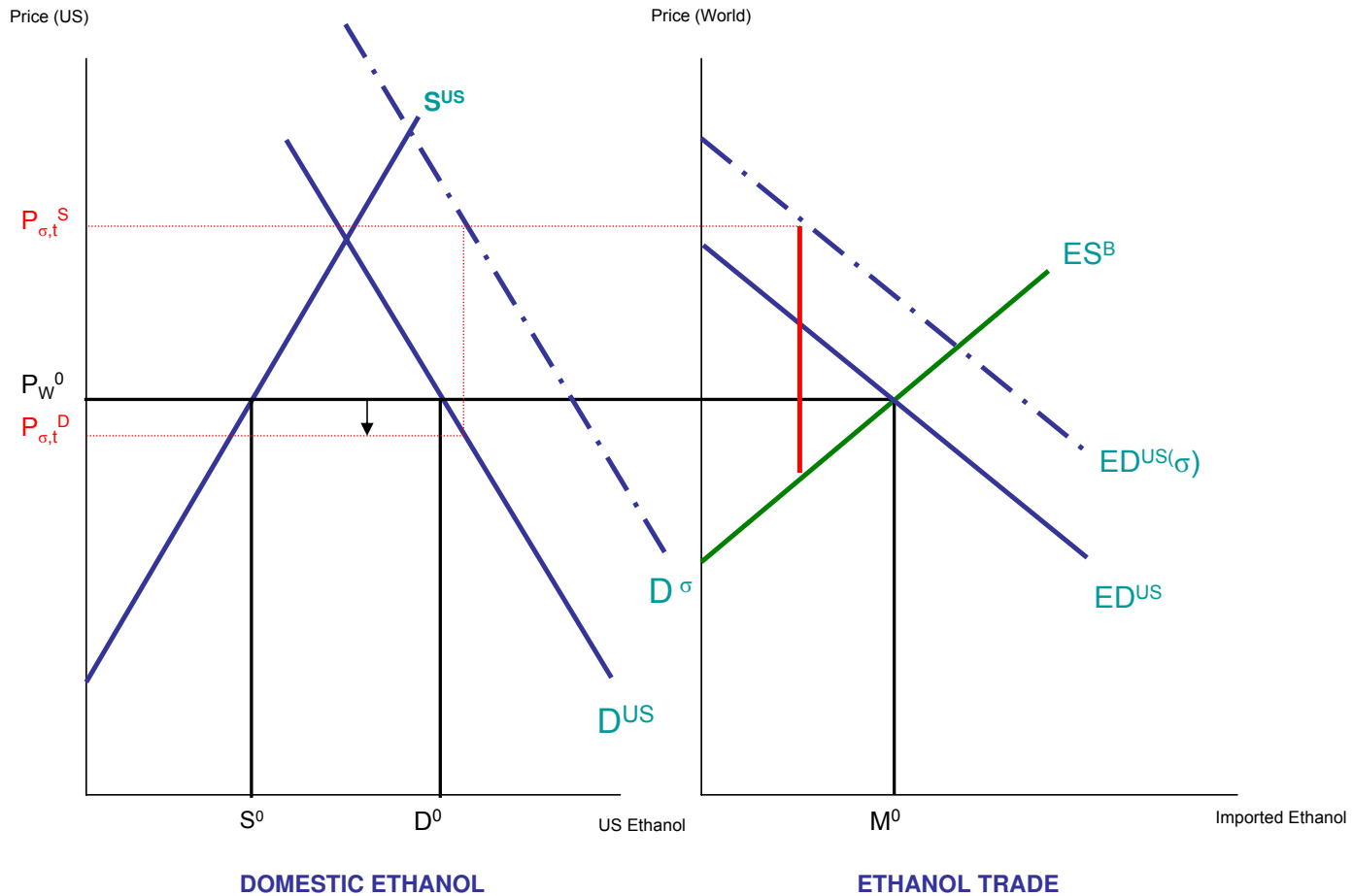


Welfare Effect of a Subsidy and a Tariff



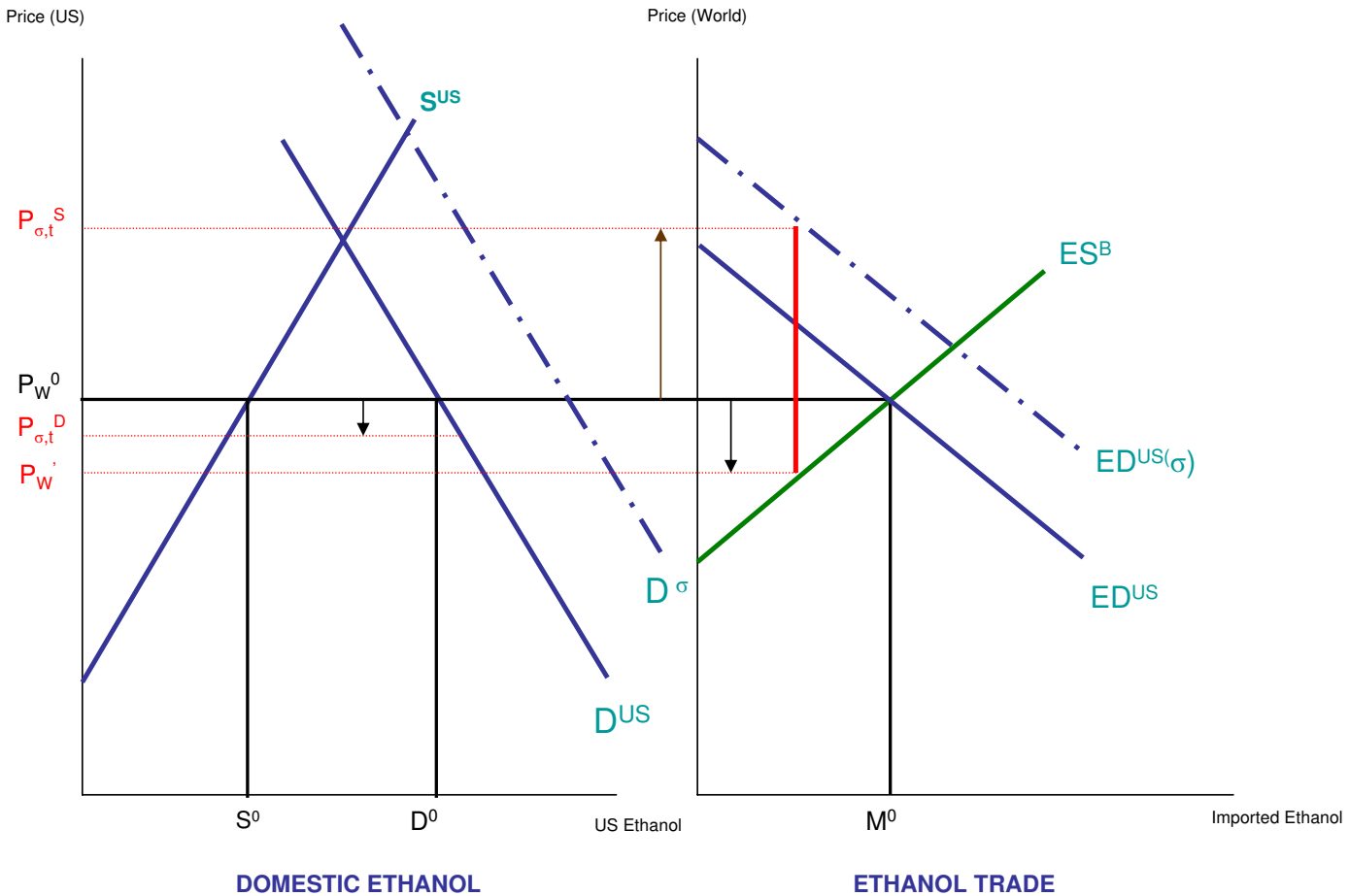
- The tariff increases the domestic price of ethanol to $(P_{\sigma,t}^{S})$

Welfare Effect of a Subsidy and a Tariff



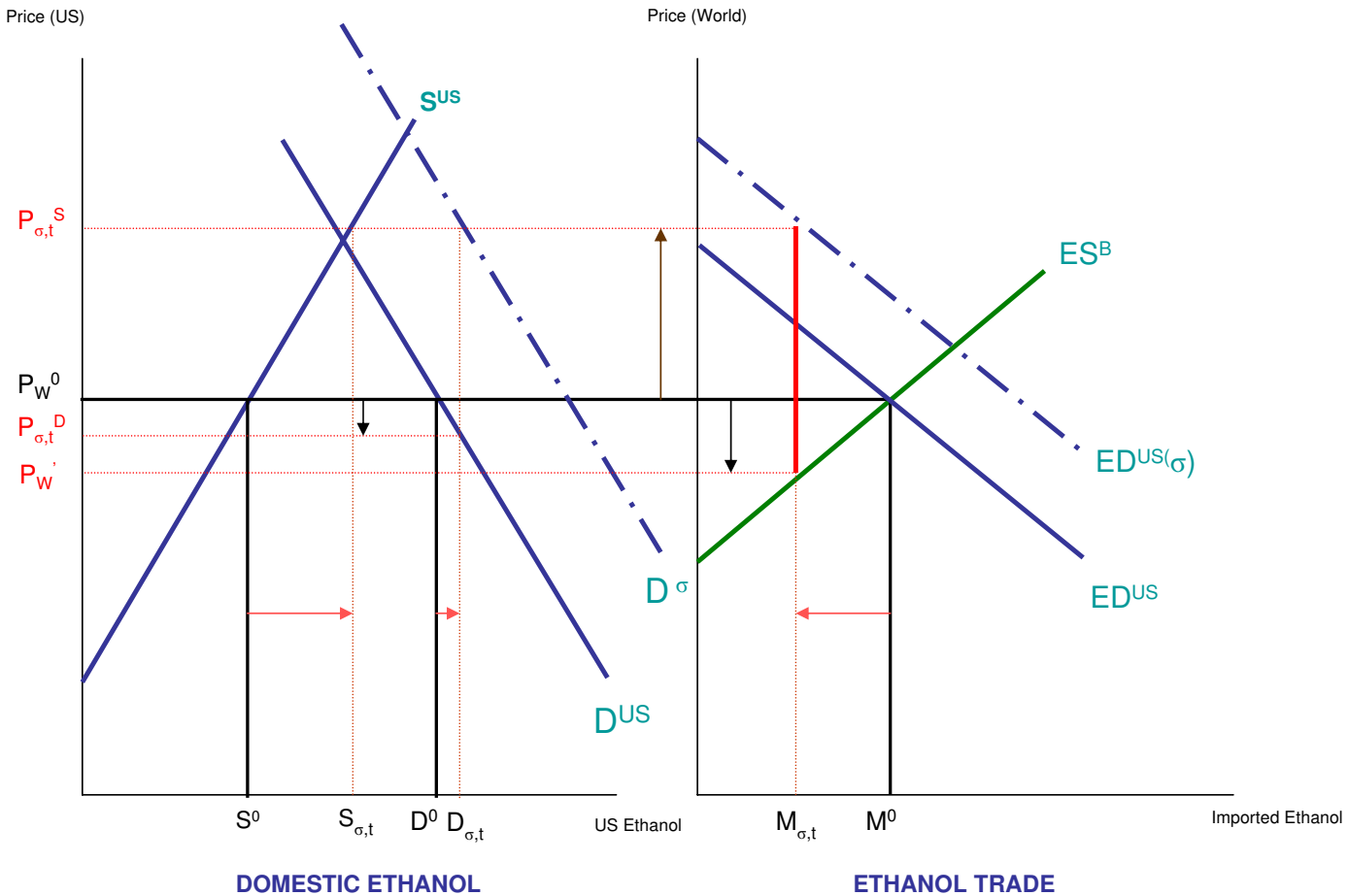
- The tariff increases the domestic price of ethanol to $(P_{\sigma,t}^{S})$
- Because of the subsidy, the price to consumers $(P_{\sigma,t}D)$ is lower

Welfare Effect of a Subsidy and a Tariff



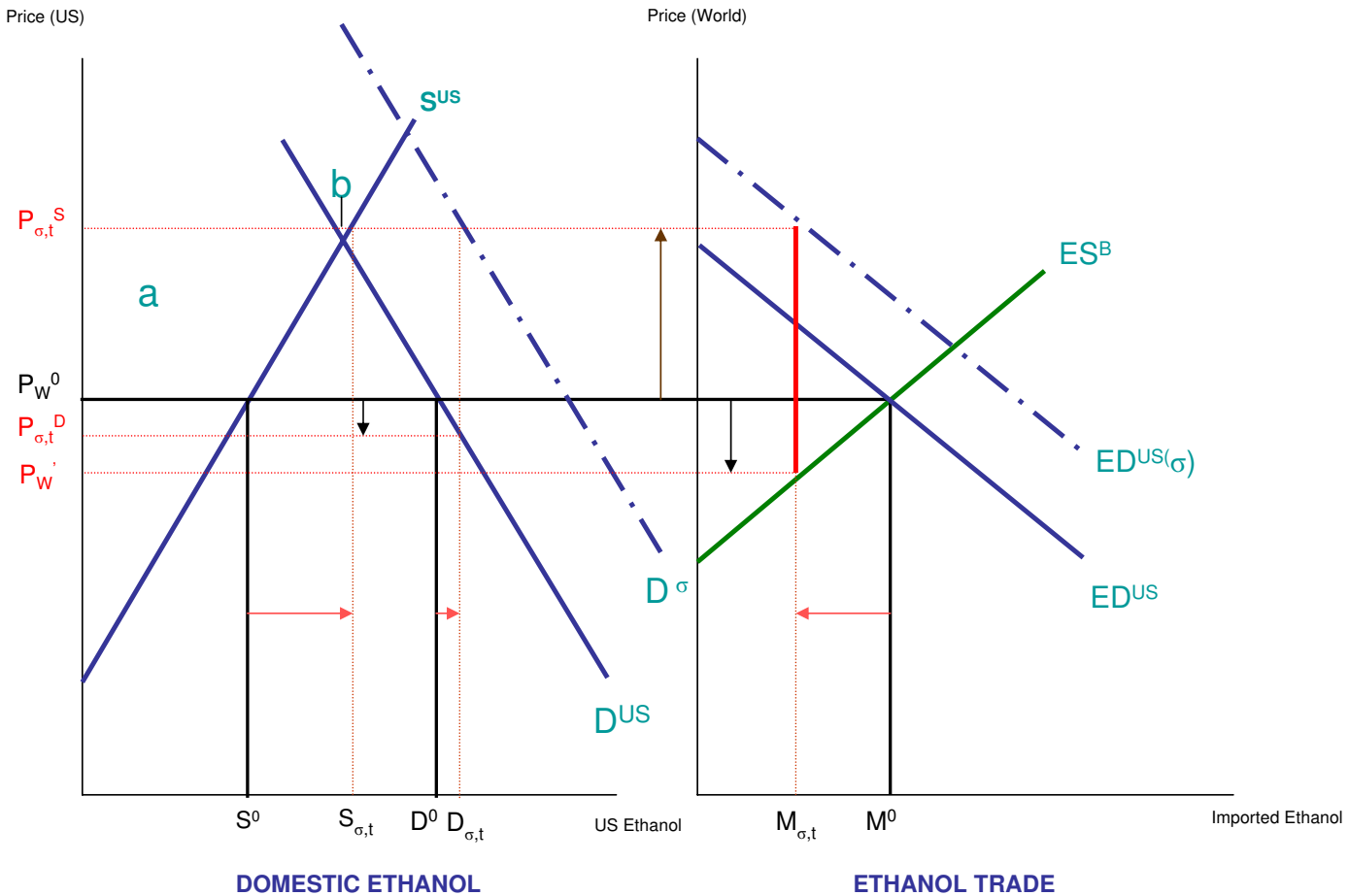
- Price received by ethanol exporters decrease

Welfare Effect of a Subsidy and a Tariff



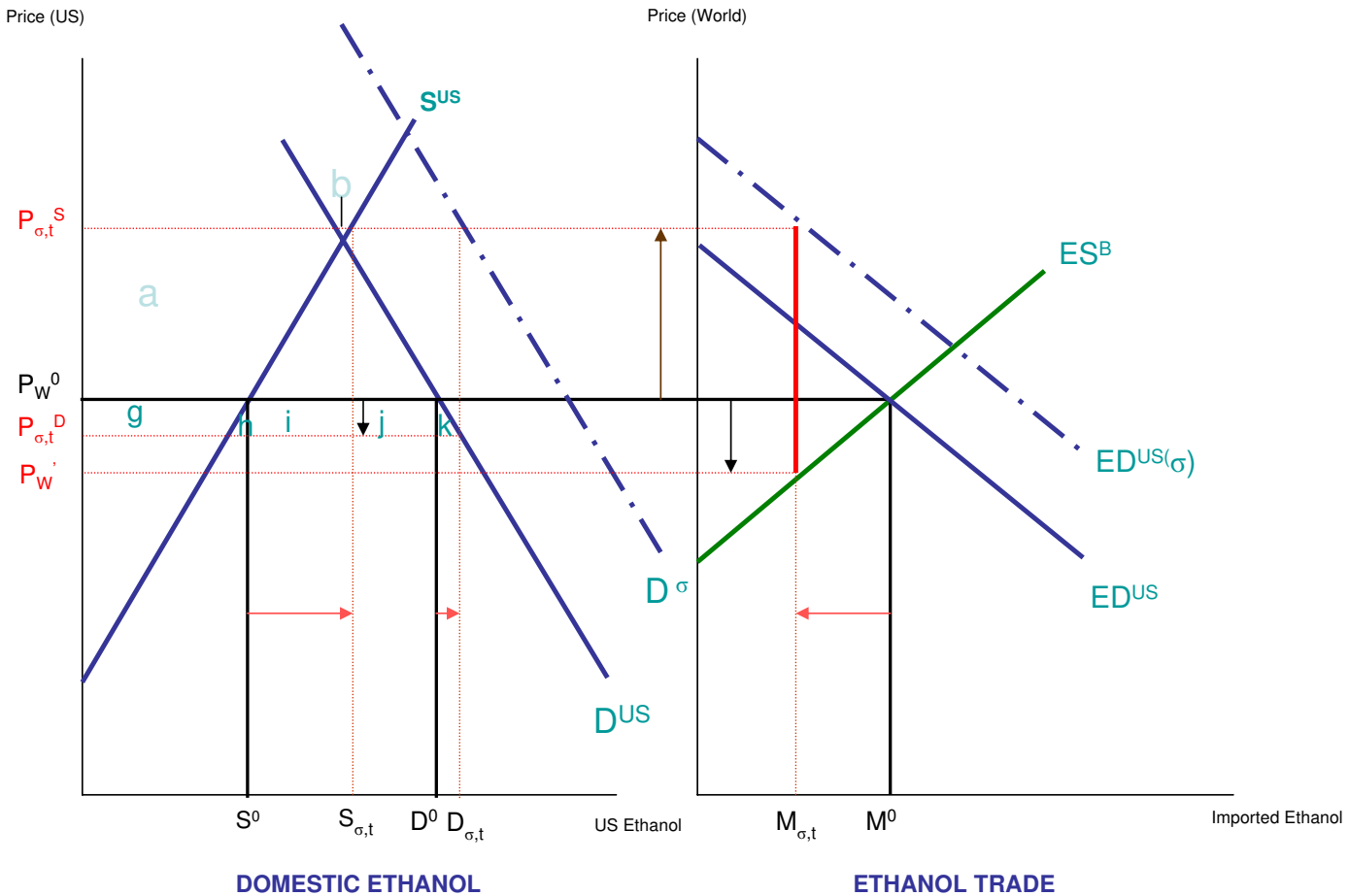
- **Domestic production and demand increase**
- **Imports decrease**

Welfare Effect of a Subsidy and a Tariff



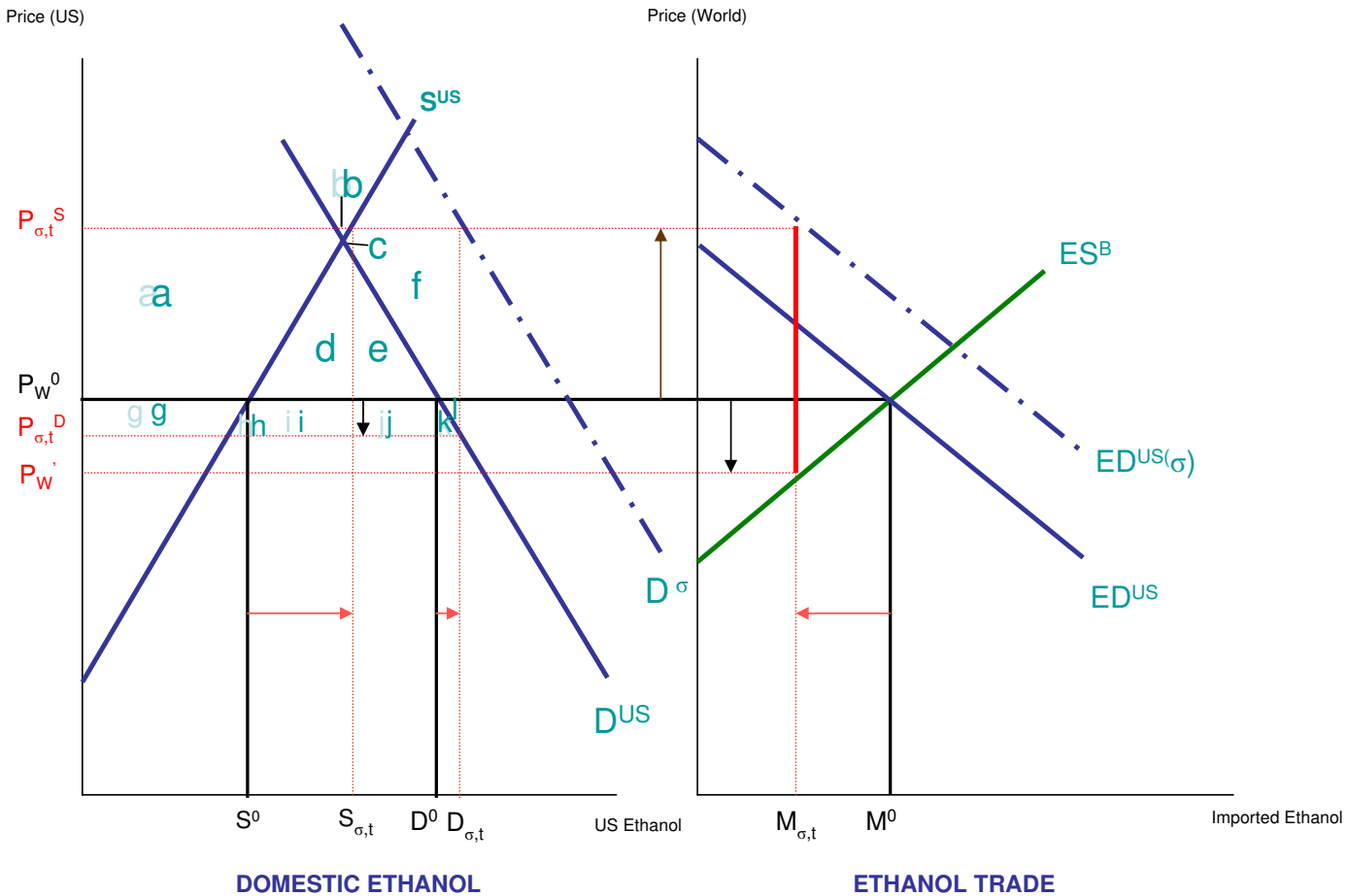
- **Producers gain from the price increase**

Welfare Effect of a Subsidy and a Tariff



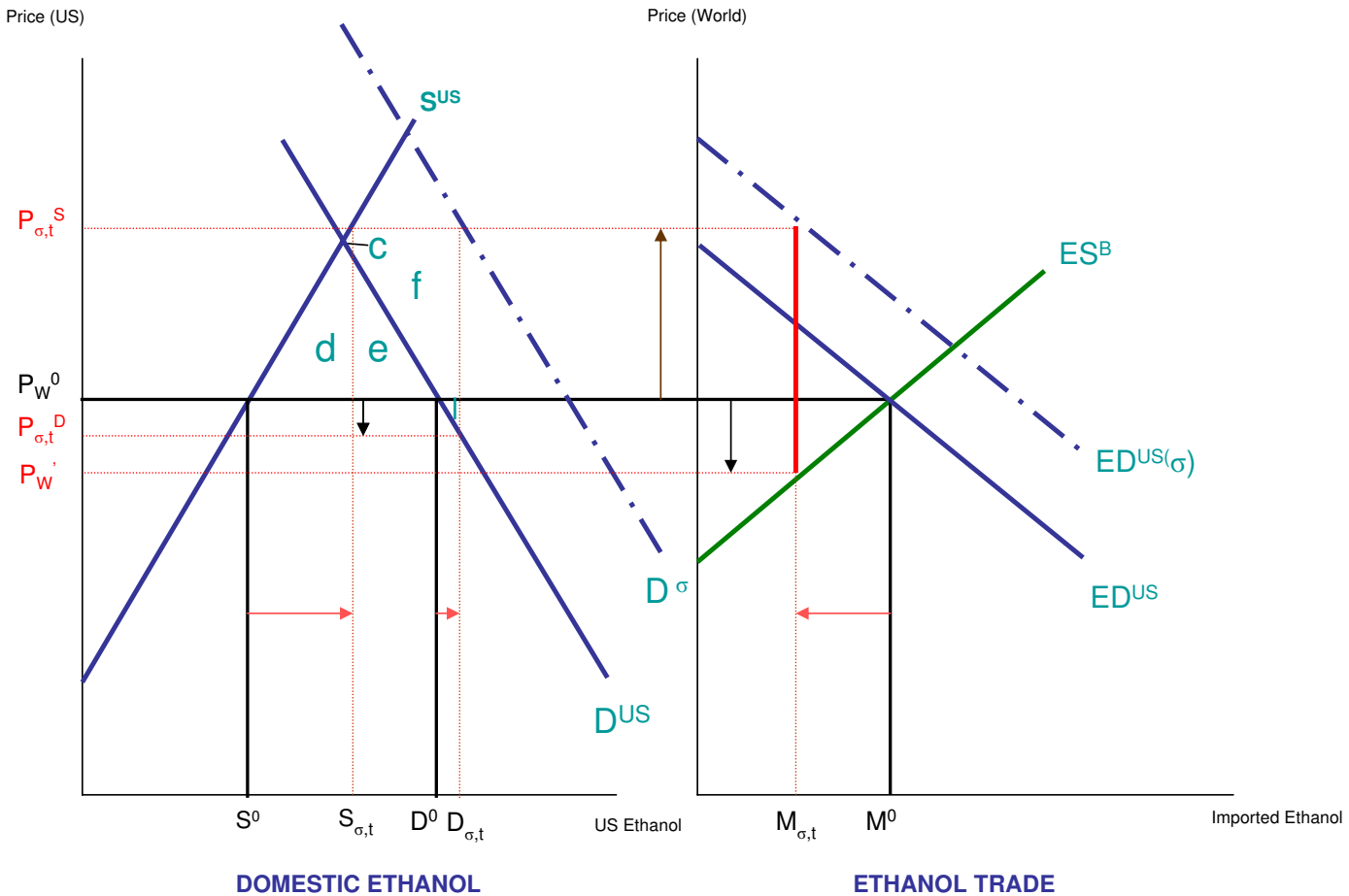
- **Consumers gain from the lower price**

Welfare Effect of a Subsidy and a Tariff

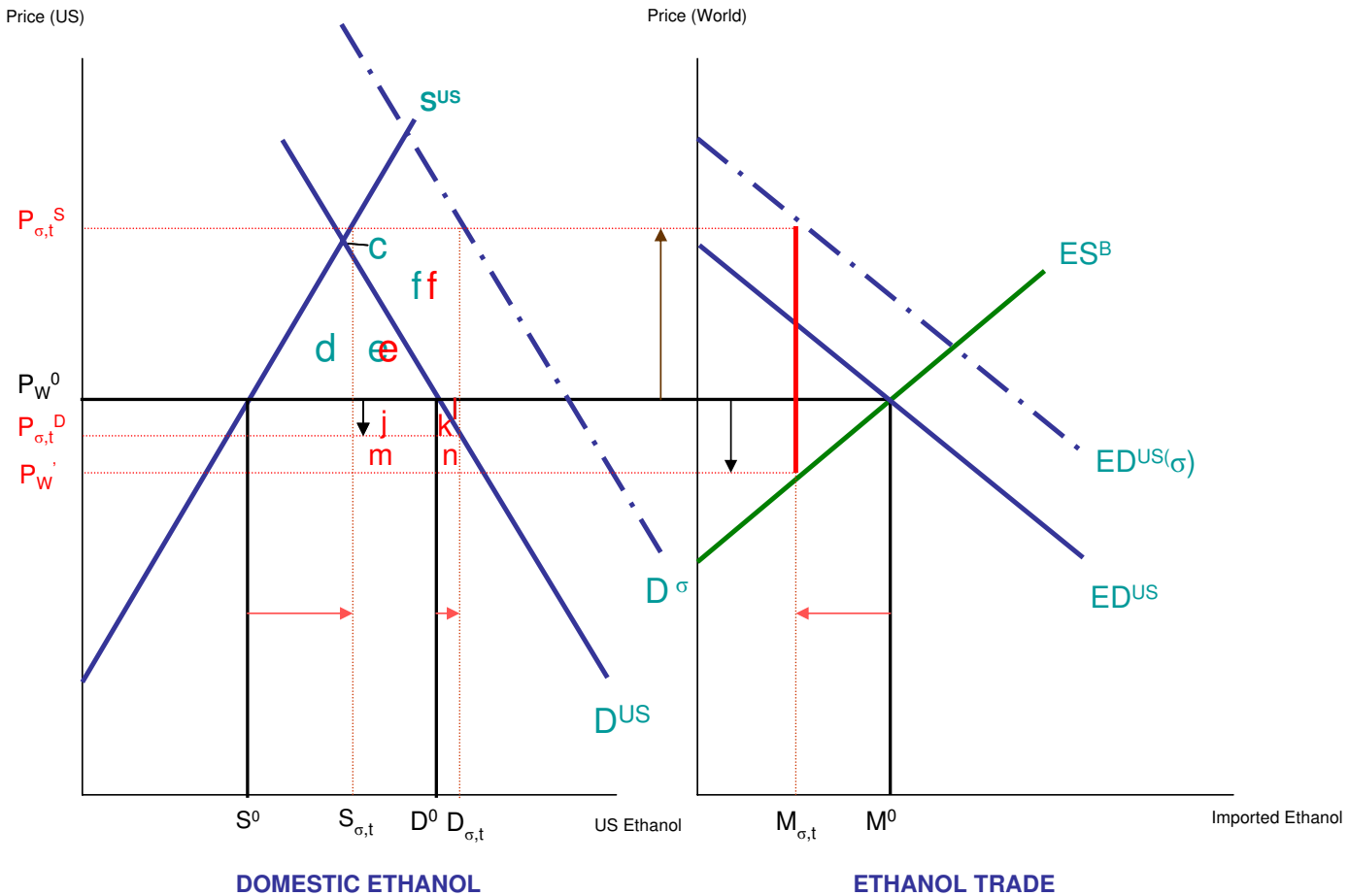


- **The government incurs costs from providing the subsidy**

Welfare Effect of a Subsidy and a Tariff

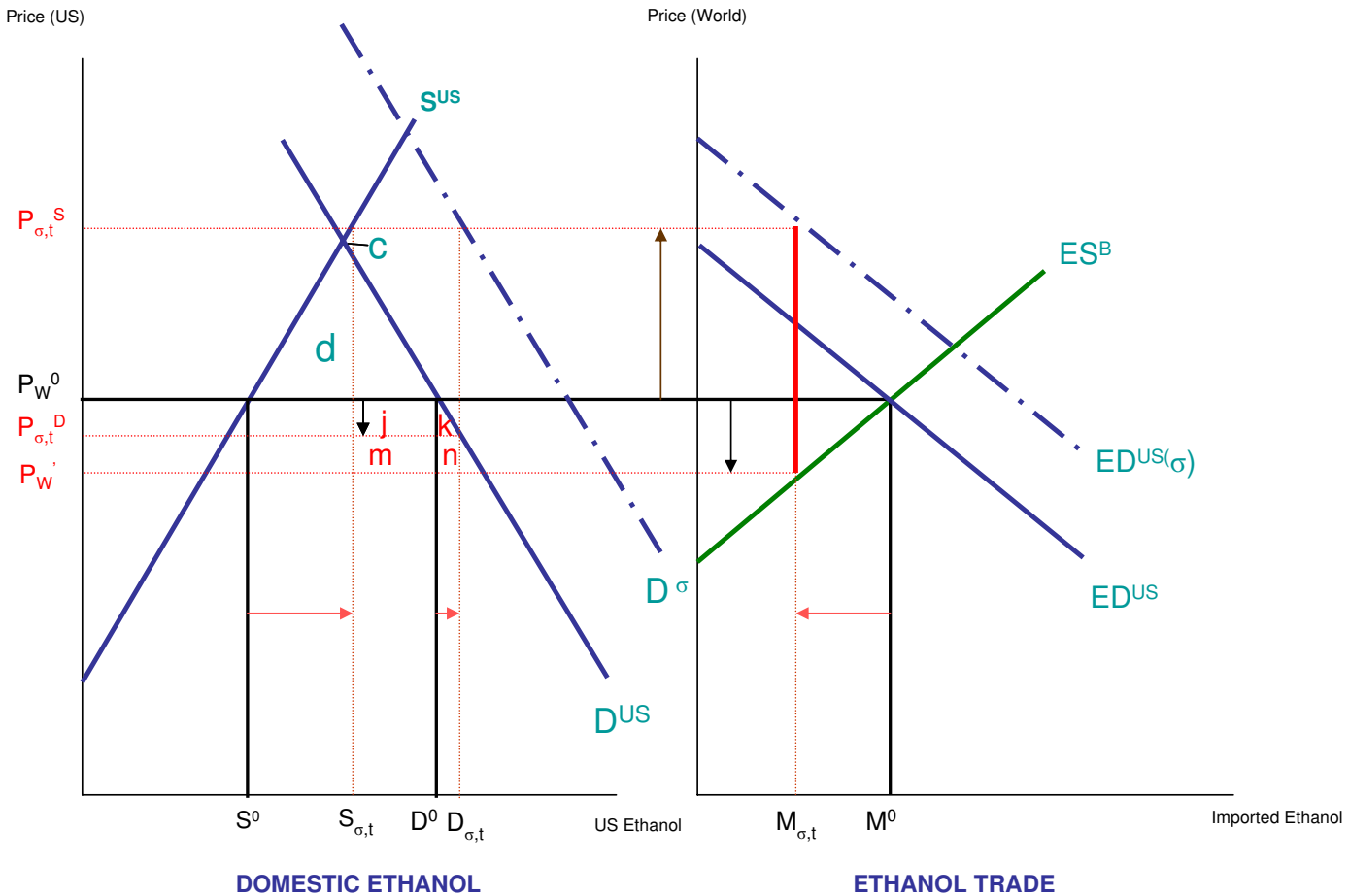


Welfare Effect of a Subsidy and a Tariff



- **The government gains revenues from the tariff**

Welfare Effect of a Subsidy and a Tariff



- **The welfare effect of the subsidy and tariff depends on the relative sizes of the tariff revenues compared to the cost of providing the subsidy**

Numerical Results

	Unit	Non Intervention	Subsidy & Tariff	Change
Welfare Change	B$			**-3.2**
Quantity				
Miles	B miles	2960	2966	**0.19%**
Gasoline	B gallons	112.1	112	**-0.09%**
Ethanol				
Domestic Supply	B gallons	4.5	4.9	**9%**
Imports	B gallons	0.73	0.65	**-85%**
Total Demand	B gallons	5.2	5.5	**6%**
GHG Emissions	M mT C	366.8	367.1	**0.08%**
Consumer Price				
Ethanol	$/ gallon	2.8	2.7	**-3%**
Gasoline	$/ gallon	2.6	2.6	**-0.34%**

Valuing Environmental Impacts

GHG

- Carbon price: \$ 25 per ton
- GHG emissions increased by 0.3 M tons
- Cost of increase in GHG emission is \$ 7.5 M
- Total welfare loss: deadweightloss + cost of increase in GHG emissions
- Total welfare loss: **3.2 B** + 0.008 B = 3.208 B

Valuing Environmental Impacts

GHG

- Carbon price: \$ 25 per ton
- GHG emissions increased by 0.3 M tons
- Cost of increase in GHG emission is \$ 7.5 M
- Total welfare loss: deadweightloss + cost of increase in GHG emissions
- Total welfare loss: **3.2 B** + 0.008 B = 3.208 B

Miles

- Cost of miles externalities: \$ 0.08 per mile
- Miles increased by 6 B
- Cost of increase in miles is \$ 480 M
- Total welfare loss: deadweight loss + cost of increase in GHG emissions + miles externalities
- Total welfare loss: **3.2 B** + 0.008 B + 0.48 B = 3.7 B

Conclusions

- The subsidy and tariff causes economic losses of $3.2 B
- These policies do not help mitigate GHG emissions
- The subsidy and tariff also increases miles consumption through its effect on fuel prices
  $\longrightarrow$ lower fuel prices, increase in miles $\longrightarrow$ increase in congestion, traffic acccidents, air pollution

Conclusions

- The subsidy and tariff causes economic losses of $3.2 B
- These policies do not help mitigate GHG emissions
- The subsidy and tariff also increases miles consumption through its effect on fuel prices
  $\longrightarrow$ lower fuel prices, increase in miles $\longrightarrow$ increase in congestion, traffic acccidents, air pollution
- The combined effect of the subsidy and tariff decreases welfare by $3.7 B
  - $3.2 B in policy costs, $500 M in environmental costs
  - Of environmental costs, 96% are from increased miles, 96% from GHG

Questions?

Thank you.