Consequence of Domestic Biofuels Policy on the U.S. Ethanol Export Demand

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Cross country ethanol demand

Domestic policies:

- Blending mandates
- Implied versus actual mandate

Retail market:

- E100 or E85: An example of Brazil

E10 demand:

- Still room for growth in many countries

Environmental issues:

- GHG emission reduction

U.S. exports

An increase in U.S. ethanol exports

- Greater demand for ethanol in other countries

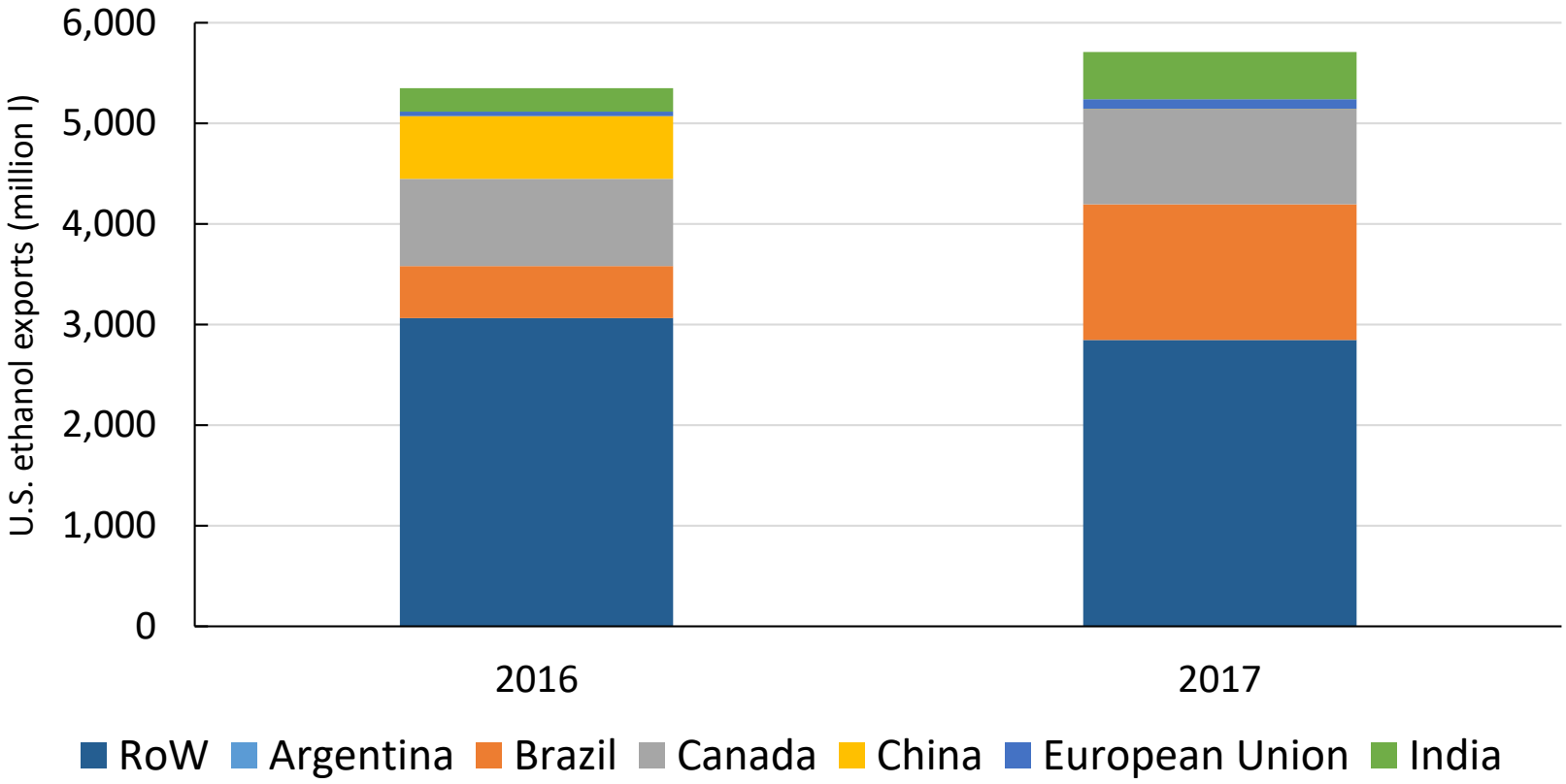
U.S. ethanol export demand

- Influenced by biofuel policies in other countries
- Price competitiveness between ethanol and crude oil

Shift in U.S. exports

- High-income countries (e.g. Canada) import ethanol for domestic mandate
- Fast-growing economies (e.g. India, other Asia) have potential for more ethanol use

Recent U.S. ethanol export destinations



Jan-Sep, 2016, 2017

Source: F.O. Lichts (2017)

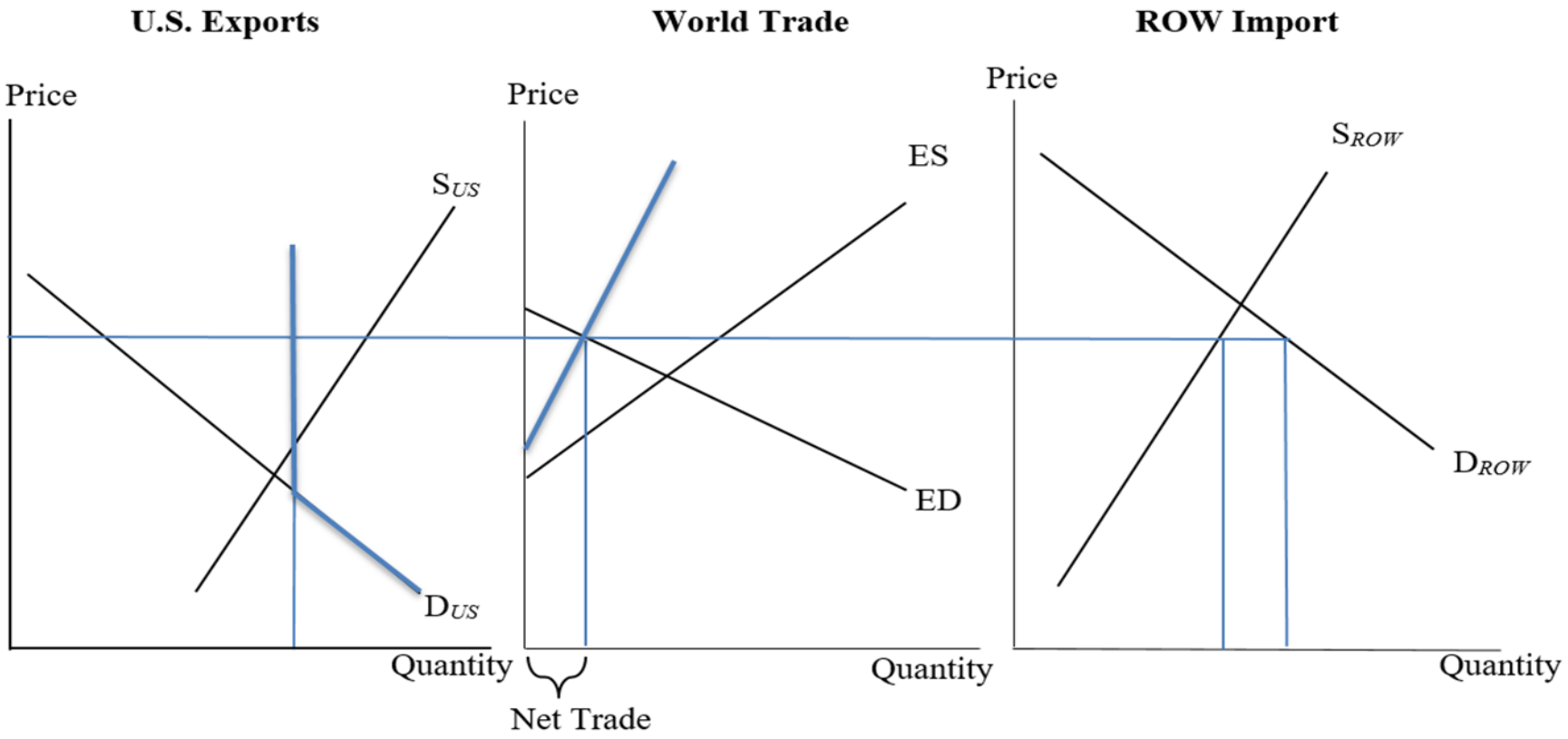
Approach & objective

Estimate U.S. export demand elasticities

- Percentages change in U.S. ethanol export demand associated with 1% increase in U.S. domestic ethanol price
- Percentage change in U.S. maize export demand associated with 1% increase in U.S. domestic ethanol price

Determine whether in the long term the U.S. ethanol export demands are becoming more or less price elastic given rising crude oil price, increasing world income and changes in market composition

Conceptual framework



Mathematical Model

Based on Gardiner and Dixit (1987) “Calculation approach”:

The U.S. export demand is represented as the sum of the difference between demands (D) and supplies (S) of all other counties (subscript *i*):

$$ED_{US} = \sum_i (D_i - S_i)$$

Taking the derivative of the above equation with respect to U.S. domestic price, we get:

$$\frac{\partial ED_{US}}{\partial P_{US}} = \sum_i \left(\frac{\partial D_i}{\partial P_i}\frac{\partial P_i}{\partial P_{US}} - \frac{\partial S_i}{\partial P_i}\frac{\partial P_i}{\partial P_{US}}\right)$$

This term can be expressed as $$\frac{\partial ED_{US}}{\partial P_{US}}\frac{P_{US}}{ED_{US}}=\sum_i \frac{P_{US}}{P_i}\frac{\partial P_i}{\partial P_{US}}\left(\sum_i\left(\frac{\partial D_i}{ED_{US}}\frac{P_i}{\partial P_i}-\frac{\partial S_i}{ED_{US}}\frac{P_i}{\partial P_i}\right)\right.$$

Or $$\frac{\partial ED_{US}/ED_{US}}{\partial P_{US}/P_{US}}=\varepsilon_{ED}=\sum_i \frac{\partial P_i/P_i}{\partial P_{US}/P_{US}}\left(\frac{\partial D_i/D_i}{\partial P_i/P_i}\frac{D_i}{ED_{US}}-\frac{\partial S_i/S_i}{\partial P_i/P_i}\frac{S_i}{ED_{US}}\right)=\sum_i \varepsilon_{P_i}\left(\varepsilon_{D_i}w_{D_i}-\varepsilon_{S_i}w_{S_i}\right)$$

U.S. export demand elasticity calculation:

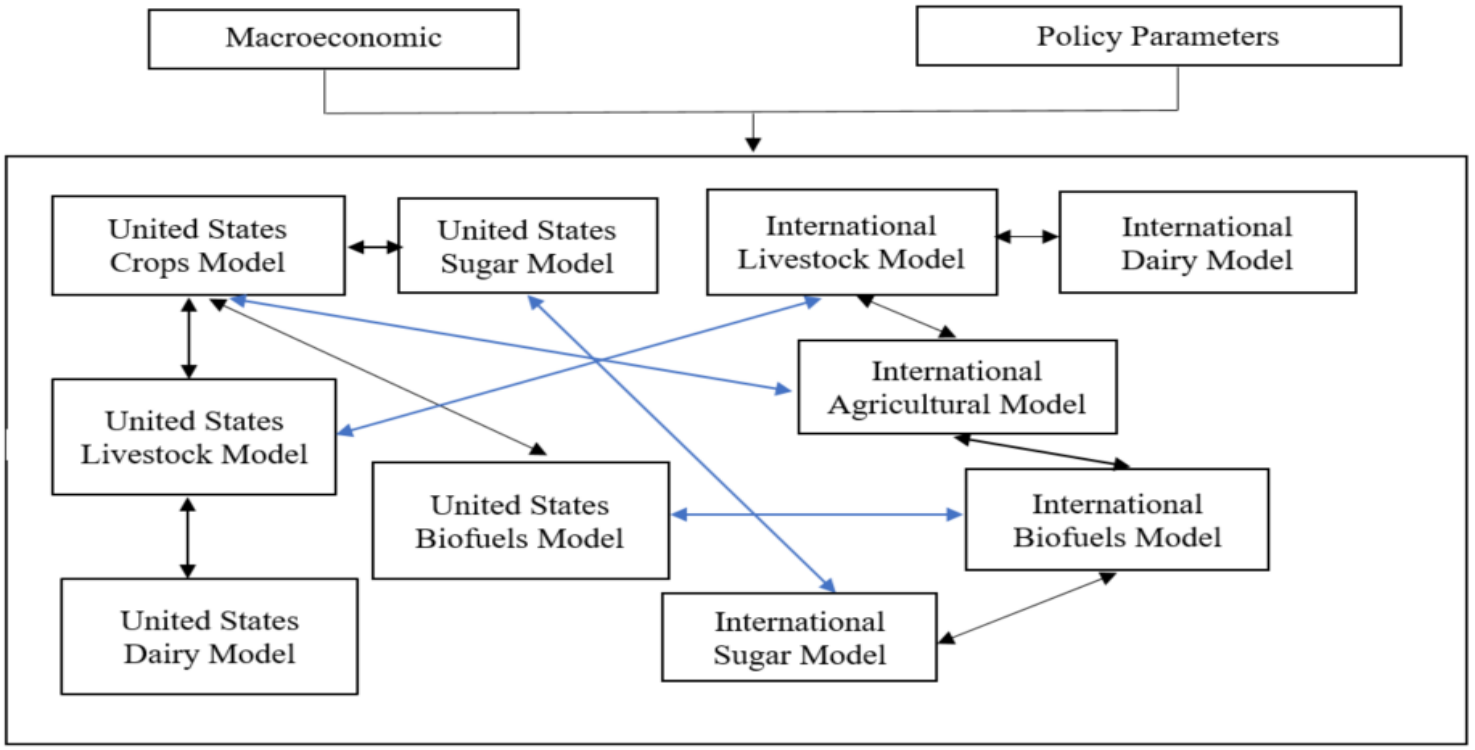
$$\varepsilon_{ED}=\sum_i \varepsilon^D_{P_i}\varepsilon_{D_i}w_{D_i}+\sum_i \varepsilon^S_{P_i}\varepsilon_{S_i}w_{S_i}$$, where $$w_{D_i}=\frac{D_i}{ED_{US}},\ w_{S_i}=\frac{S_i}{ED_{US}}$$

Modelling approach

- Multi-market multi-region non-spatial partial equilibrium modeling framework is used to estimate the U.S. export ethanol demand elasticity

- International biofuels, international agricultural, international sugar, international livestock and dairy are linked with corresponding U.S. models

Model linkage

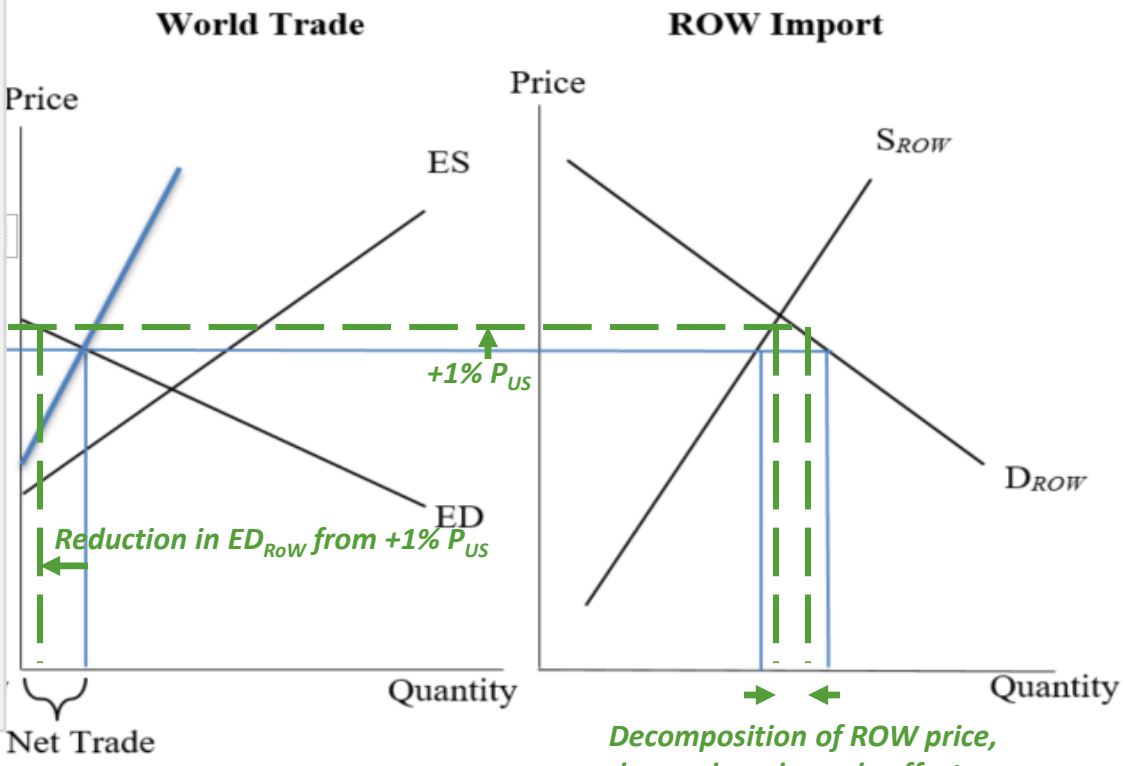


Estimation approach

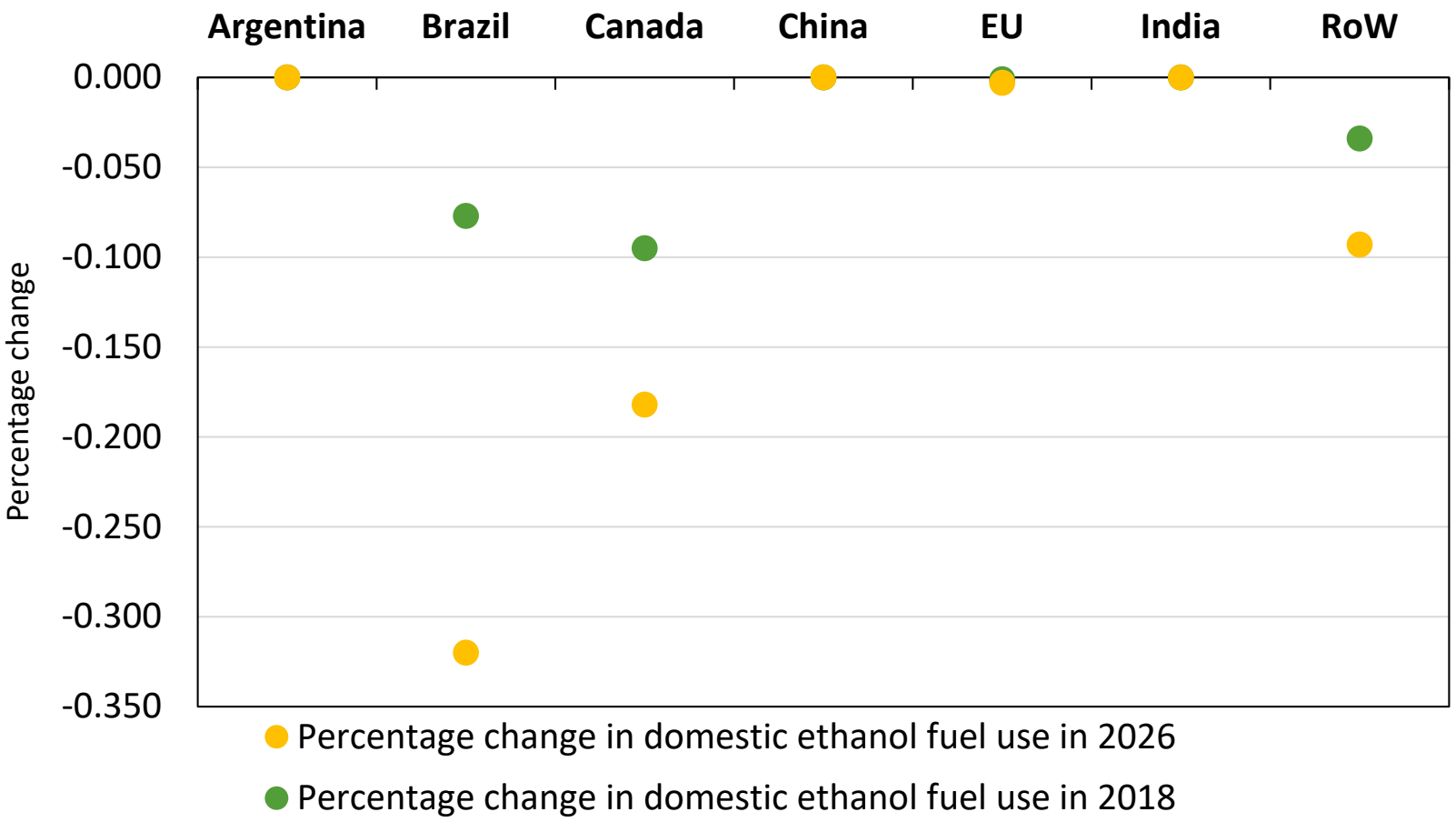
- U.S. export demand elasticities are estimated by introducing a 1% increase in the U.S. ethanol price for a year (2018 and 2026)
- Estimate the percentage changes in domestic ethanol production and uses due to 1% increase in ethanol price
- Estimate the country-specific percentage changes in maize exports and imports due to 1% increase in ethanol price

Conceptual framework – effect of U.S. price shock

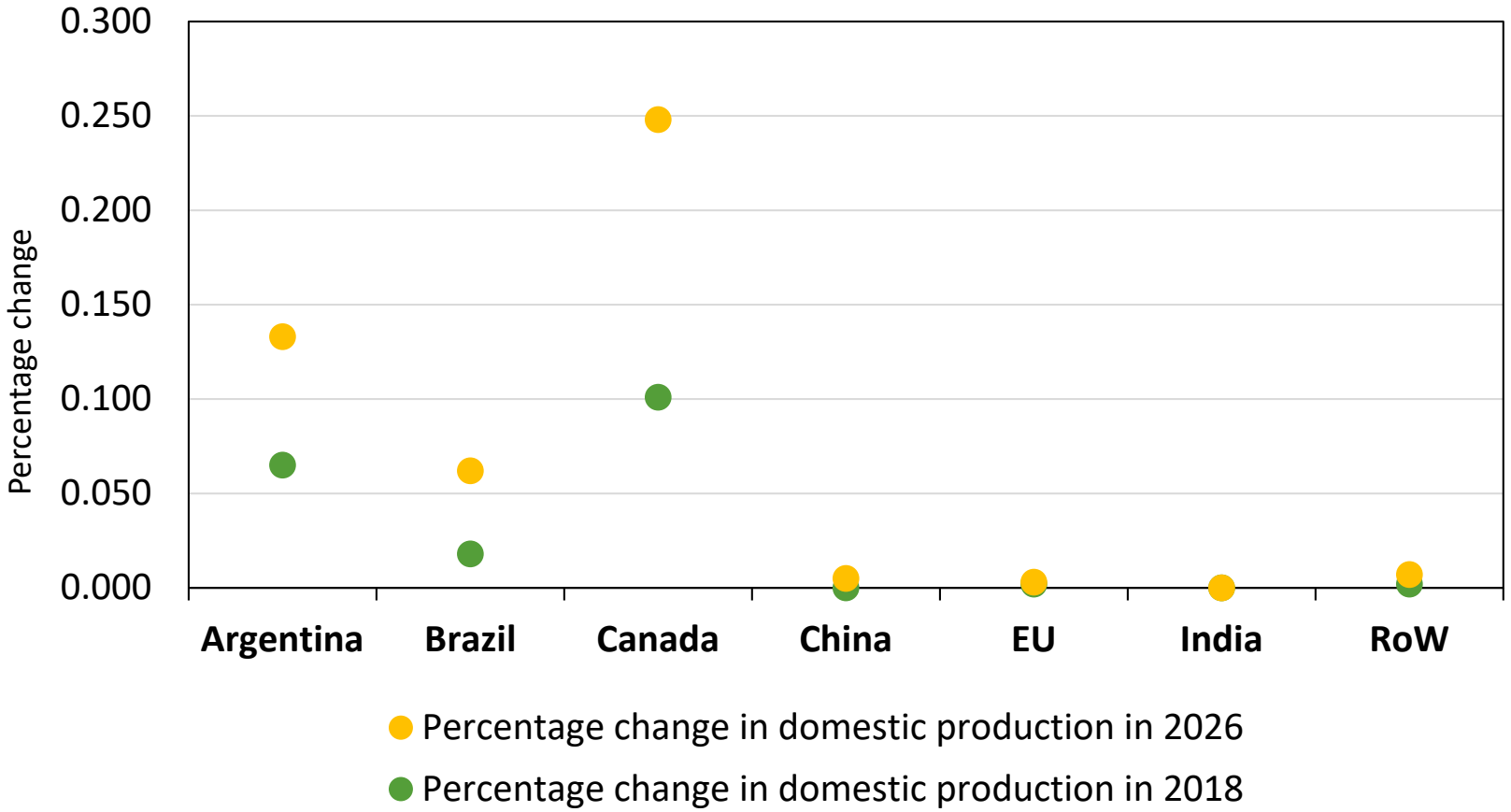
U.S. price is made exogenous and then shocked (+1%) for this experiment



Changes in fuel ethanol use caused by +1% U.S. ethanol price



Changes in ethanol production caused by +1% U.S. ethanol price



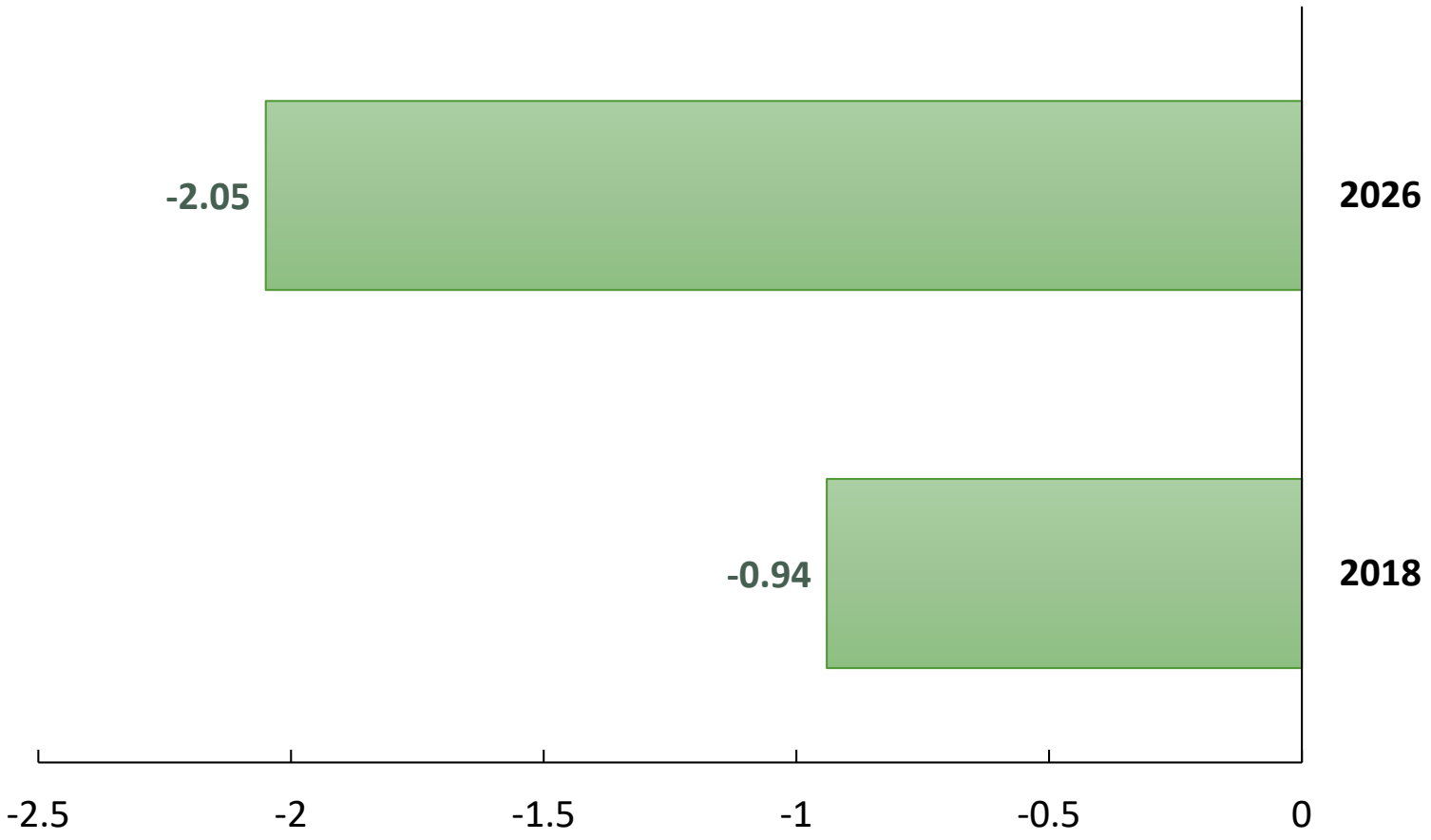
Ethanol demand shares and percentage changes in use in 2018

Country	Ratio of fuel use of ethanol to U.S. exports	Price transmission elasticities: Demand	Percentage change in domestic ethanol fuel use
Argentina	1.480	0.000	0.000
Brazil	35.71	0.300	-0.077
Canada	3.540	1.000	-0.095
China	4.760	0.000	0.000
EU	6.980	0.008	-0.001
India	1.560	0.000	0.000
RoW	4.150	0.500	-0.034

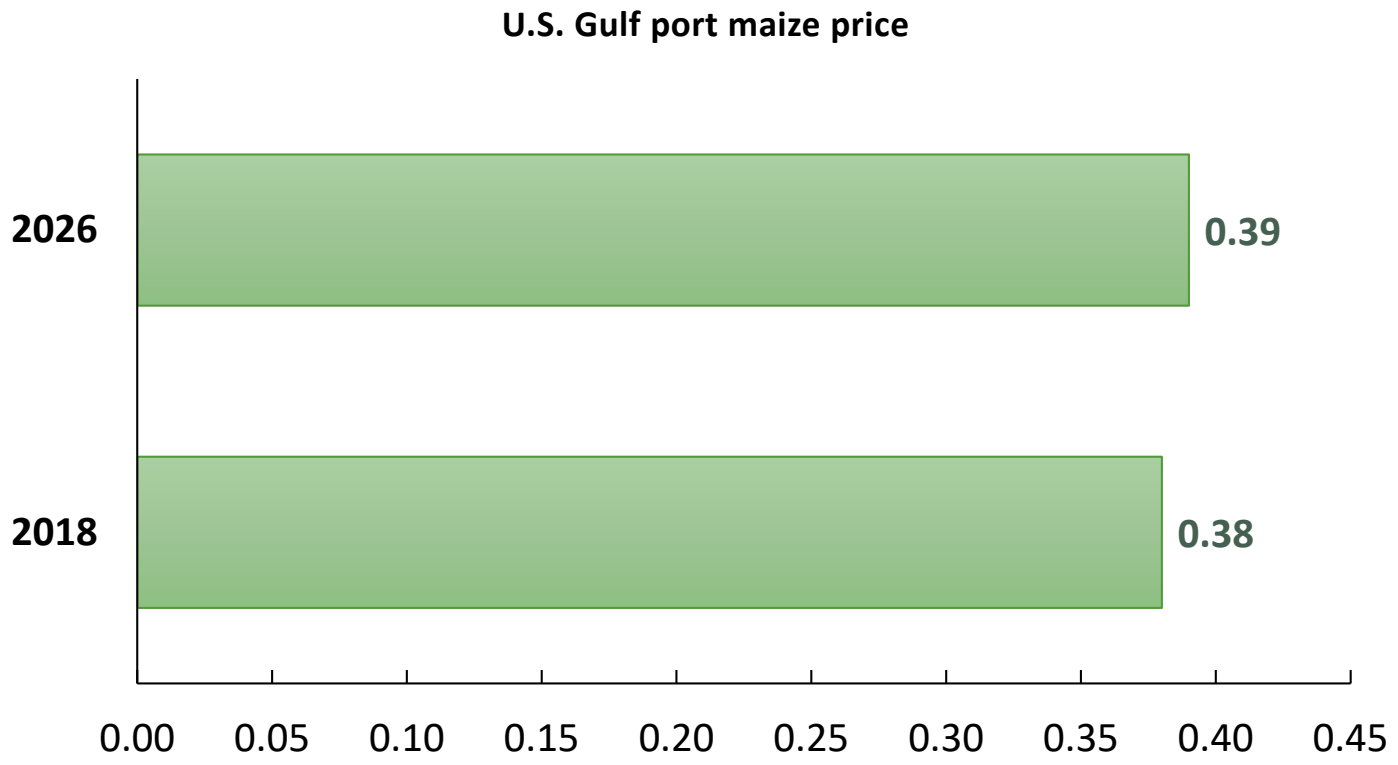
Ethanol production shares and percentage changes in supply in 2018

Country	Ratio of ethanol production to U.S. exports	Price transmission elasticities: Supply	Percentage change in domestic production
Argentina	1.47	0.200	0.065
Brazil	36.83	0.028	0.018
Canada	2.41	1.000	0.101
China	13.26	0.000	0.000
EU	9.21	0.008	0.002
India	3.42	0.000	0.000
RoW	7.35	0.500	0.002

Comparison between 2018 and 2026: U.S. ethanol export elasticities



Consequences to the maize market

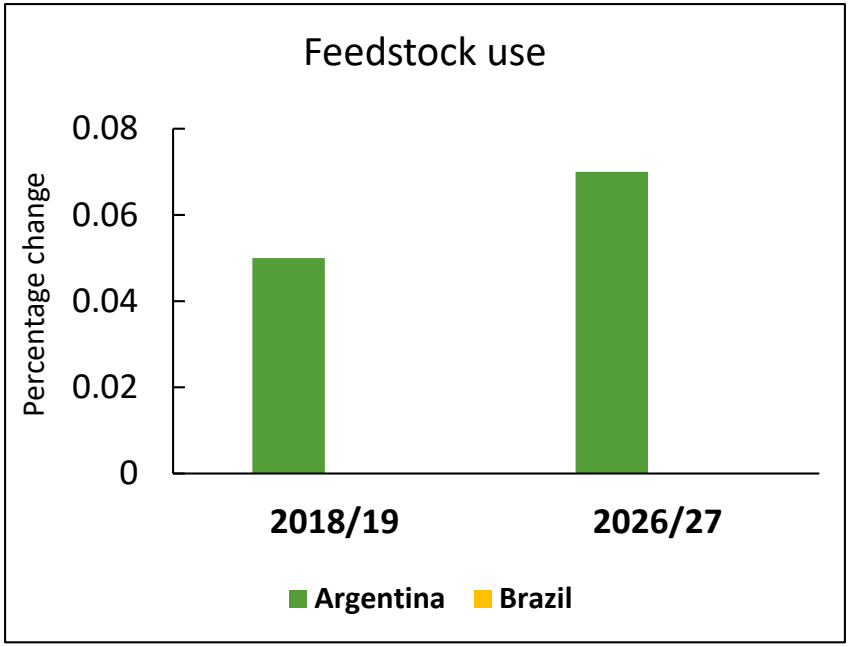


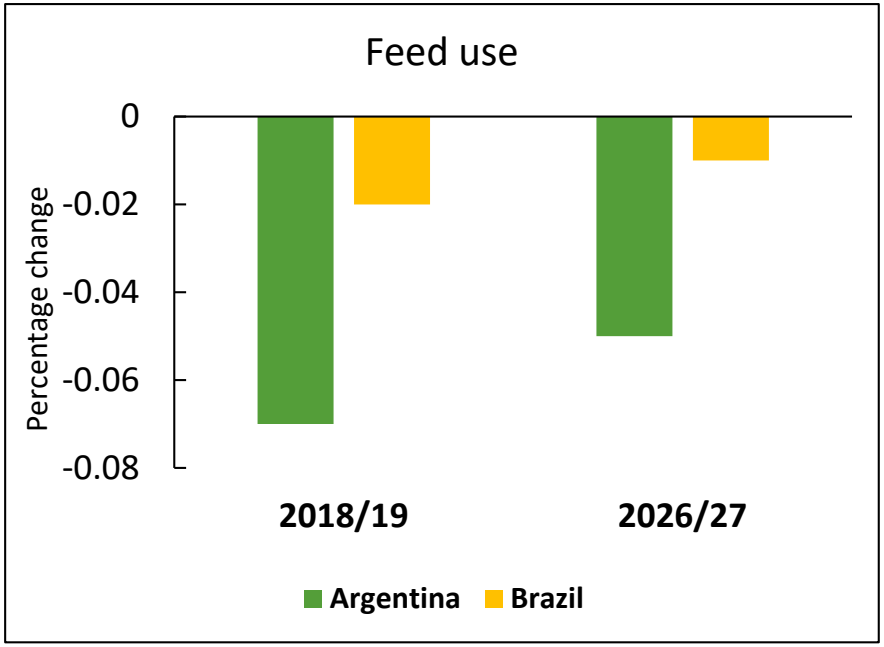
Changes in maize exports and imports by country (in percent)

Net exporters	2018/19	2026/27		Net importers	2018/19	2026/27
Argentina	0.02	0.12		**China**	-0.52	-0.14
Australia	0.44	0.40		**Egypt**	-0.10	-0.01
Brazil	0.21	0.38		**EU-28**	0.05	0.05
India	0.50	0.10		**Indonesia**	-0.47	-0.27
Nigeria	3.59	0.89		**Japan**	-0.12	-0.02
Paraguay	0.03	0.07		**South Korea**	-0.05	-0.01
Russia	0.06	0.04		**Malaysia**	-0.04	-0.01
South Africa	0.62	0.34		**Mexico**	-0.05	-0.05
Ukraine	0.01	0.04		**Philippines**	-0.30	-0.07
				Taiwan	-0.05	-0.01
				Thailand	-0.49	-0.33
				Vietnam	-0.03	-0.09
				Rest of world	-0.10	-0.13

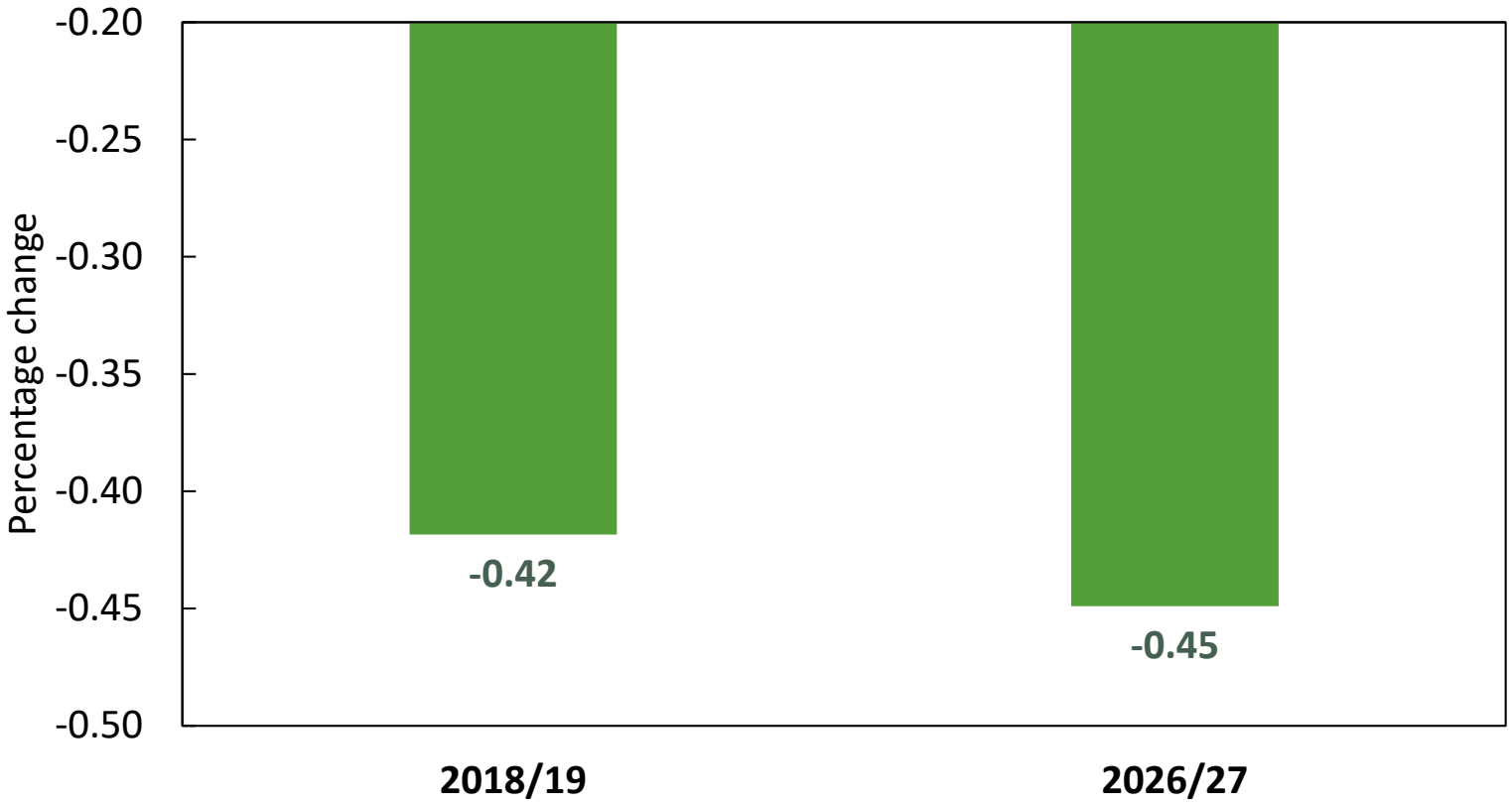
Changes in maize use: feedstock use vs feed use

Example of two South American countries:





U.S. maize export demand response to a change in the U.S. ethanol price



Discussion and conclusion

- In near future (2018) U.S. ethanol export demand is less elastic compared to the medium-term (2026)
- Country-specific domestic policy plays an important role in defining future U.S. ethanol export demand
- 1% increase in U.S. ethanol price can decrease U.S. maize exports by 0.42 percent in 2018/19 and by 0.45 percent in 2026/27
- Feedstock use for ethanol production increases while feed use in livestock industry decreases

Thank you

Questions!!!