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Using an Equilibrium Displacement Model to Simulate the Impact of an Environmental Meat Tax on Grain and Livestock Markets

Regan Gilmore with Faculty Azzeddine Azzam

Background

As countries are increasingly recognizing the need to curb greenhouse gas (GHG) emissions in order to mitigate climate change, they have begun to look towards industries like agriculture that have previously been ignored in the climate change discussion. It is estimated that 22% of global GHG emissions originate from agriculture, 80% of which can be traced back to the livestock sector¹. Global GHG emissions from the livestock sector are estimated to be equivalent to exhaust emissions from all the vehicles in the world, including planes, ships, and land autos². As developing countries continue to industrialize, the projected growth in worldwide meat consumption alone is expected to be enough to push global temperatures past the 2 degrees Celsius danger level that scientists concede will be the tipping point for catastrophic climate change³. One policy recommendation for reducing GHG emissions from the livestock sector is to implement an environmental tax on meat consumption⁴. The objective of the tax is to internalize the environmental costs of meat consumption and promote more sustainable diets.

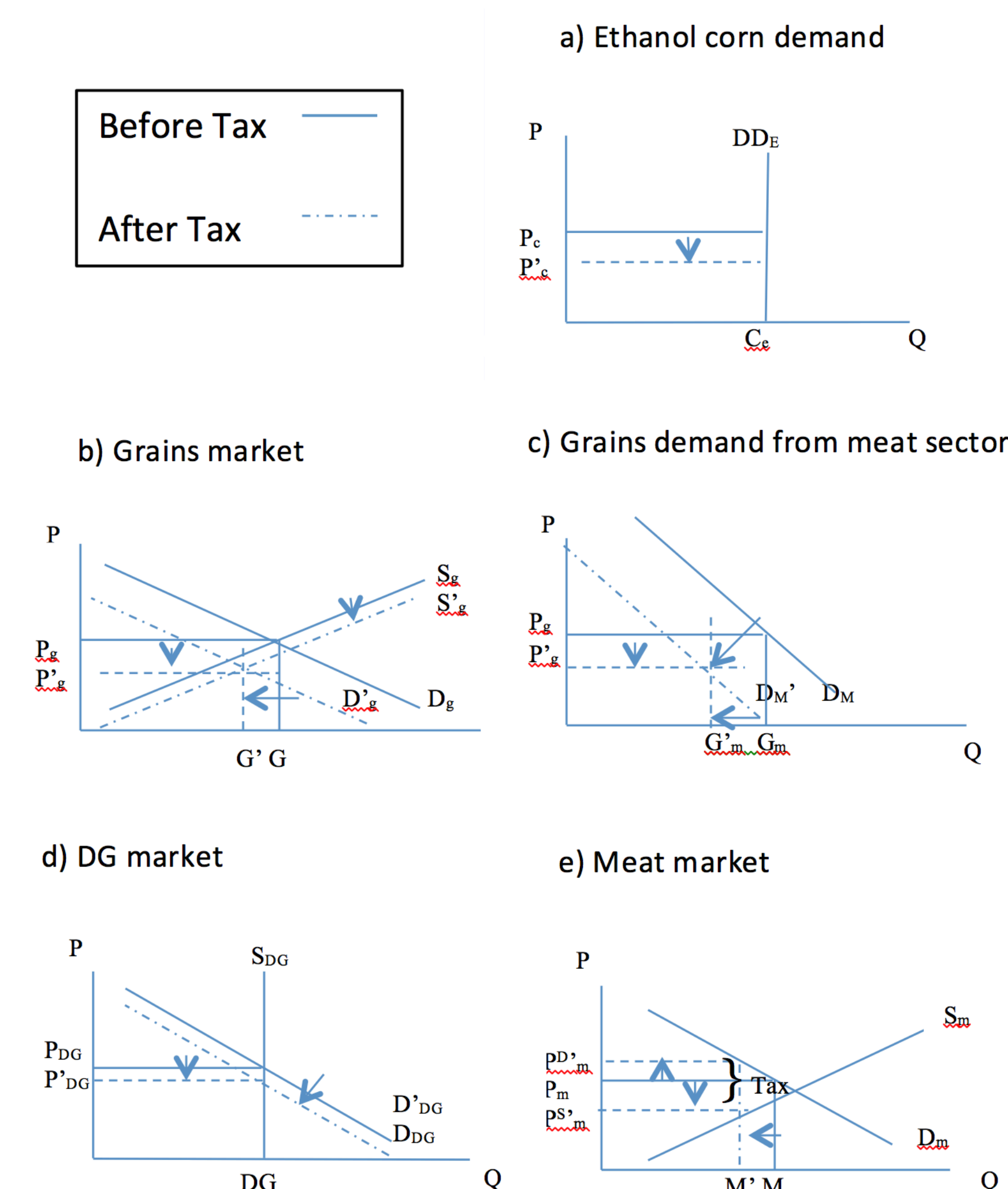
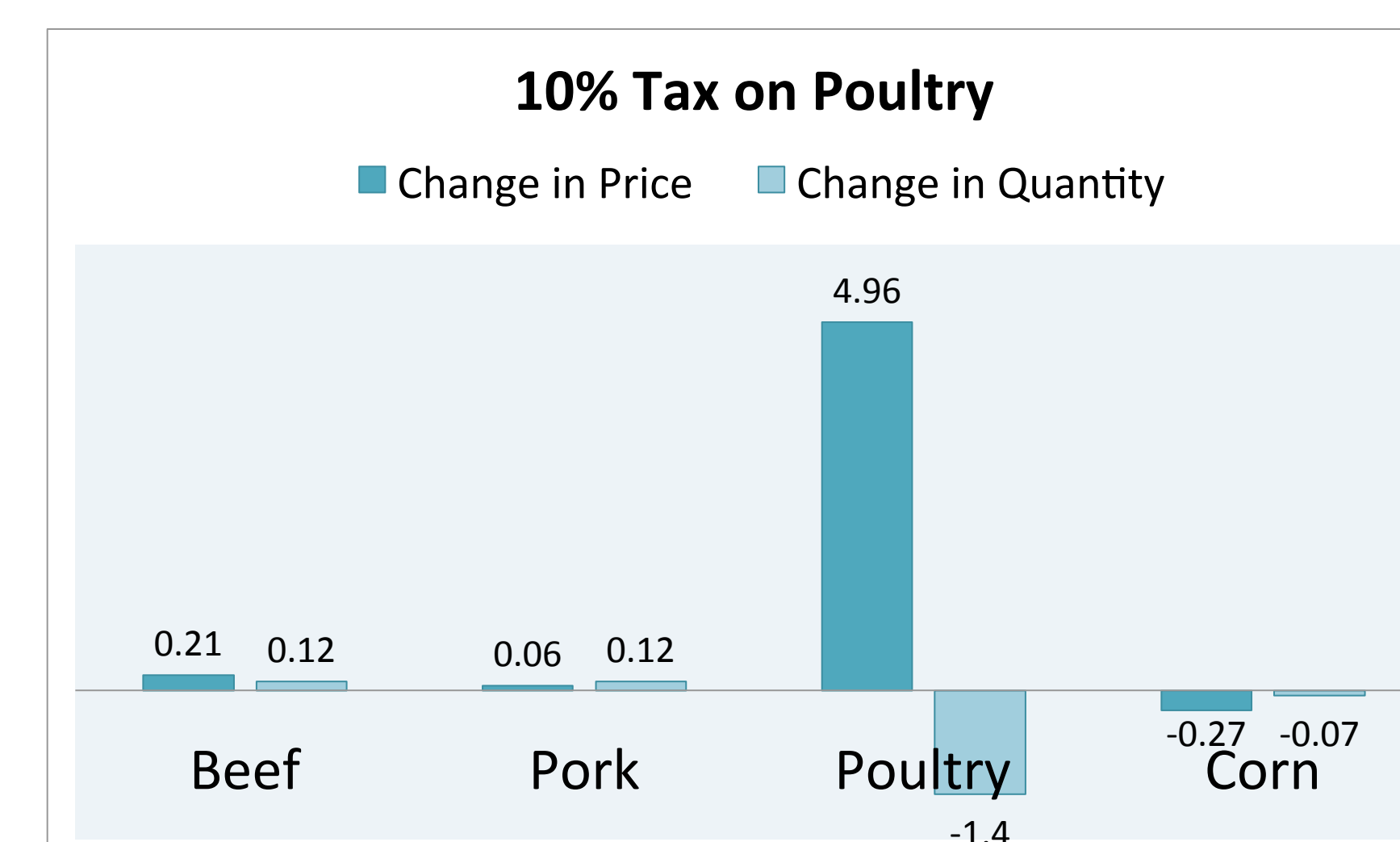
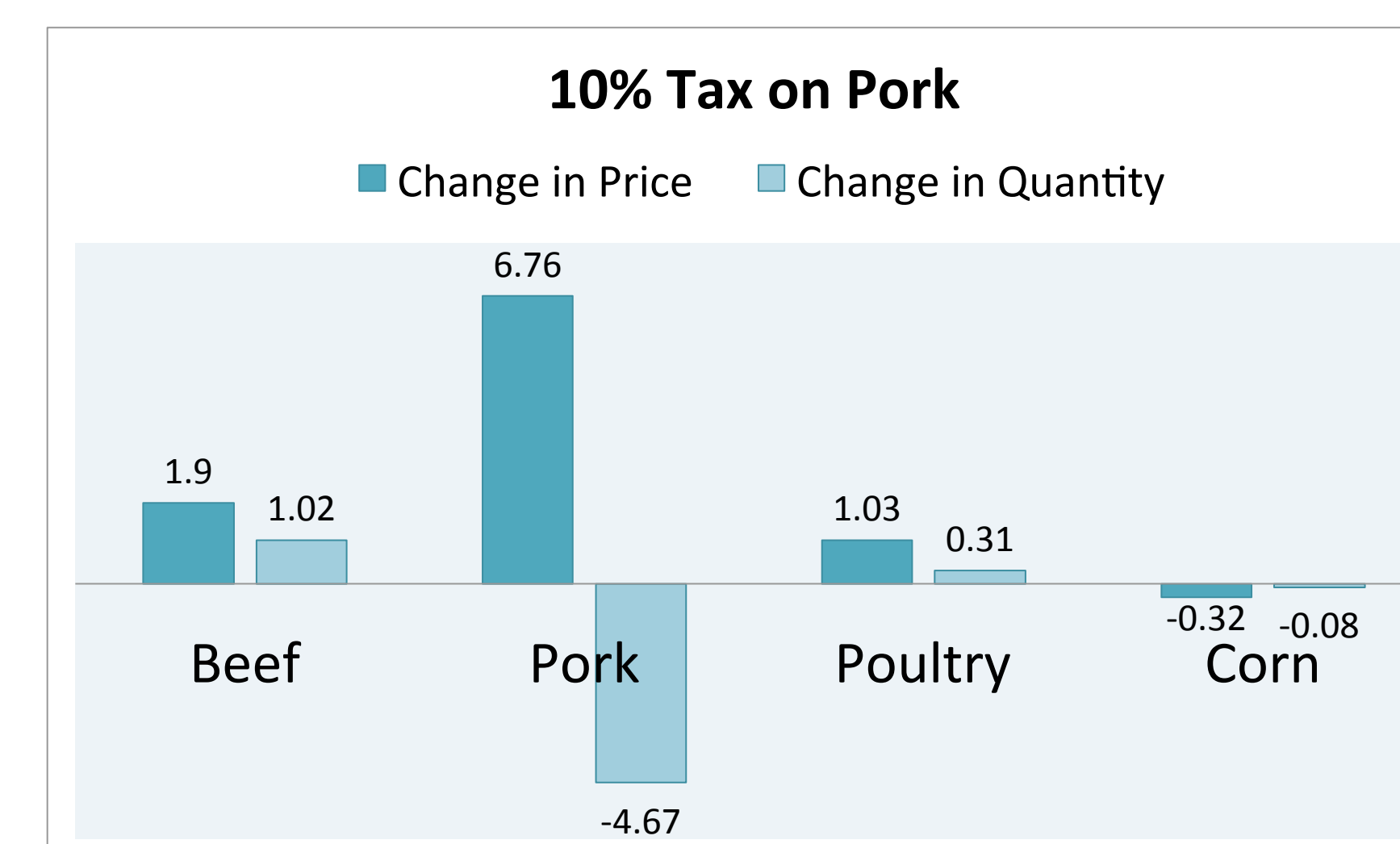
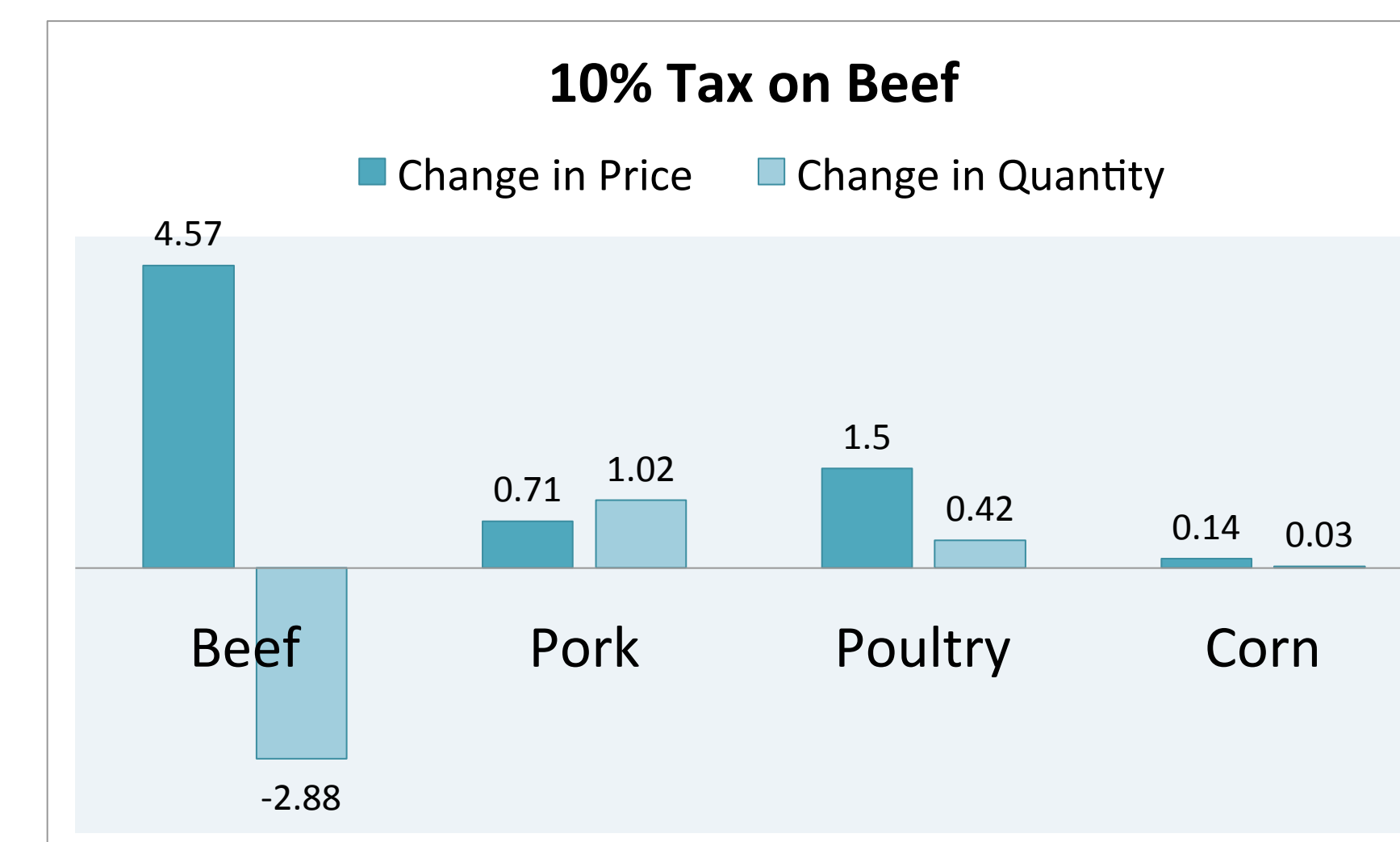
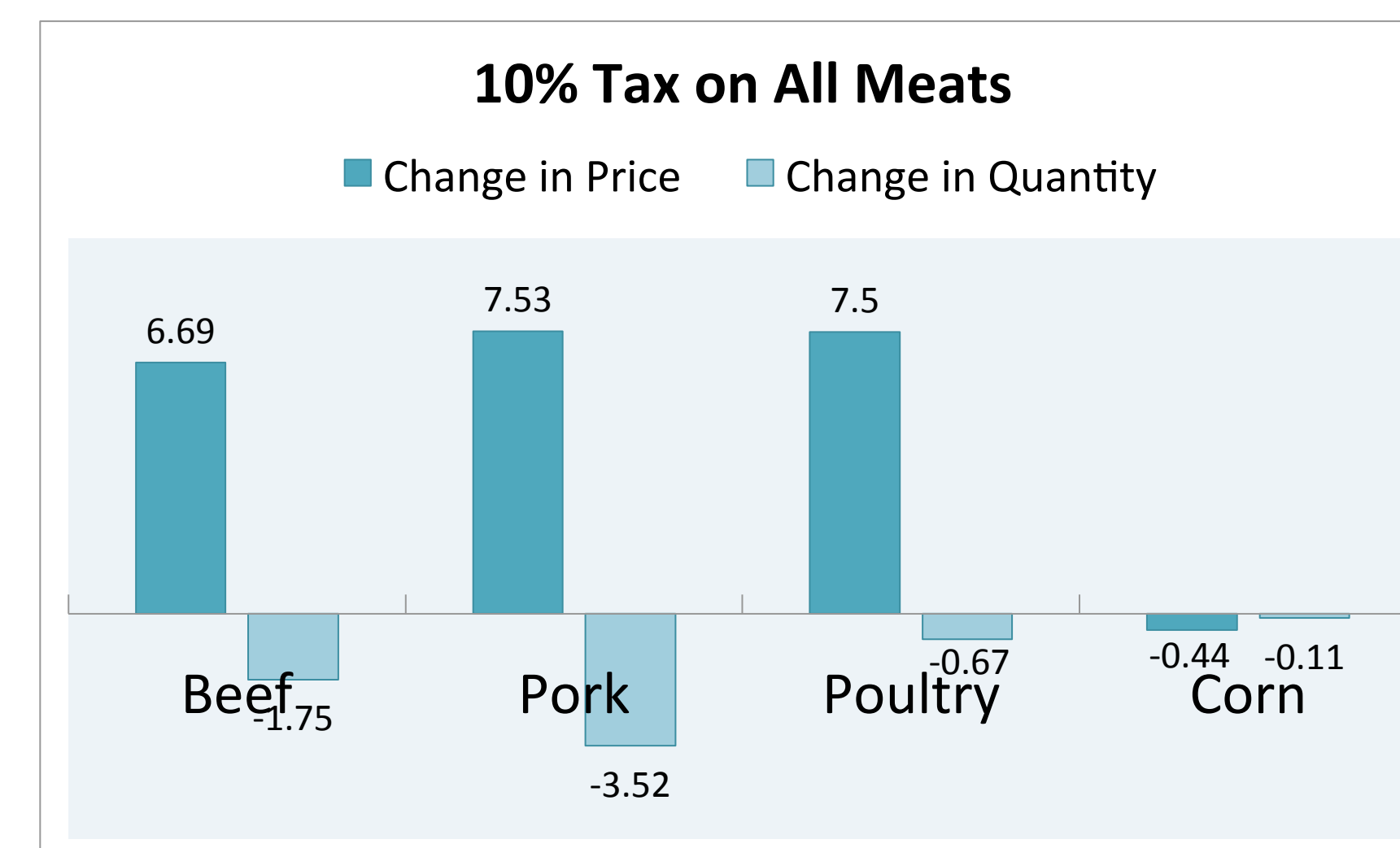
Research Question

What are the potential effects of imposing a hypothetical environmental tax on meat consumption, including beef, pork, and poultry, on the livestock and grain markets in the United States from farm to fork?

Equilibrium Displacement Model

To consider the hypothetical tax, I have adapted an existing grain and livestock equilibrium displacement model (EDM) developed in part by my UCARE advisor, Dr. Azzeddine Azzam⁵. The EDM is written in matrix form as $Ax=b$, where A is a 43 by 43 elasticity coefficient matrix, x is a 43 by 1 vector of percent changes in the prices and outputs of the grain and livestock markets, and b is a 43 by 1 solution vector used to simulate hypothetical tax rates, such that $x=A^{-1}b$. In addition to capturing the linkages between the beef, pork, and poultry markets at retail, wholesale, and farm levels, the EDM includes the linkages between the corn, soybean, distilled dry grains, and ethanol markets. The latter linkages capture the competition between ethanol and livestock for corn.

Impact on Markets



References

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Discussion

- Taxing **all meats** simultaneously at 10%
 - Beef – The retail price of beef increases by 6.69%, and consumption decreases by 1.75%.
 - Pork – The retail price of pork increases by 7.53%, and consumption decreases by 3.52%.
 - Poultry – The retail price of poultry increases by 7.5%, and consumption decreases by 0.67%.
 - Corn – The price of corn decreases by 0.44%, and corn usage decreases by 0.11%.
- Taxing one meat only at 10%
 - Beef** – The retail price of beef increases by 4.57%, and beef consumption decreases by 2.88%. The retail price of pork increases by 0.71%, and pork consumption increases by 1.02%. The retail price of poultry increases by 1.5%, and poultry consumption increases by 0.42%. The price of corn increases by 0.14%, and corn usage increases by 0.03%.
 - Pork** – The retail price of beef increases by 1.9%, and beef consumption increases by 1.02%. The retail price of pork increases by 6.76%, and pork consumption decreases by 4.67%. The retail price of poultry increases by 1.03%, and poultry consumption increases by 0.31%. The price of corn decreases by 0.32%, and corn usage decreases by 0.08%.
 - Poultry** - The retail price of beef increases by 0.21%, and beef consumption increases by 0.12%. The retail price of pork increases by 0.06%, and pork consumption increases by 0.12%. The retail price of poultry increases by 4.96%, and poultry consumption decreases by 1.4%. The price of corn decreases by 0.27%, and corn usage decreases by 0.07%.

The next step in this project is to estimate the appropriate environmental tax for each of the three meats, since they each generate different GHG emissions. These calculated tax levels will then be incorporated into the EDM to solve for the expected changes in meat consumption and associated changes in GHG emissions. This project will be continued through a UCARE project next year.