Ethanol and Food prices

1. Introduction

In this project I explored the relationship between Ethanol and food prices. The United States grows a lot of corn –96 million acres are dedicated to its cultivation. While corn itself is widely consumed, most American-grown corn is used less directly, either as Ethanol in the gas tank or as feedstock for cows, pigs, and chickens. It also is a major ingredient in other foods as a sweetener and as flour. Corn production, in turn, is resource intensive and requires fuel to cultivate it.

Since corn is a common and significant link between fuel and food, I am interested in understanding how the two relate to each other, and in this project, I sought to answer the question: how much does Ethanol prices change the price for food products, and does it impact certain food categories more than others.

These questions relate to a policy issue rather than a business issue, and specifically relate to the Renewable Fuels Standards, which came out of the Energy Policy Act of 2005. Is this policy causing additional costs for food consumers, and would this problem justify changes to the policy?

2. Recommendations

This is a cursory and initial exploration of the issue, and therefore I do not want to make bold recommendations. My main recommendation would be to explore the additional questions I list in Section 8 below.

The findings do suggest that it plays a small part in food prices. I believe that finding ways to use less corn as fuel would have a beneficial impact on food prices – if the alternative did not have a stronger opposite effect. Comparing alternatives is outside the scope of this project.

The findings do not suggest that Ethanol is responsible for a food price crisis, and I would not recommend changing the policy on those grounds.

3. Data

The US Department of Agriculture Economic Research Service:

- Prices of corn, ethanol, gasoline, blender cost
- From January 1982 to present day
- https://www.ers.usda.gov

The Bureau of Labor Statistics:

- Prices for various food types

- As early as 1967 through present day
- https://download.bls.gov/pub/time.series

4. Method

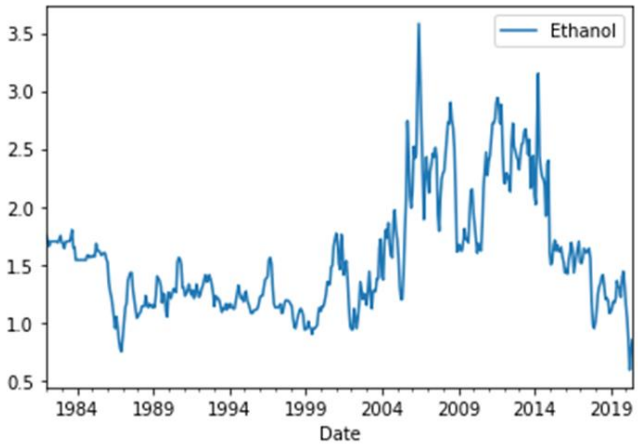
I used Augmented Dicky Fuller tests to test stationarity. None of the timeseries were stationary so I calculated annual differences for each. In so doing, I achieved stationarity. I then compared Ordinary Least Square regression models using different time frames and different lags.

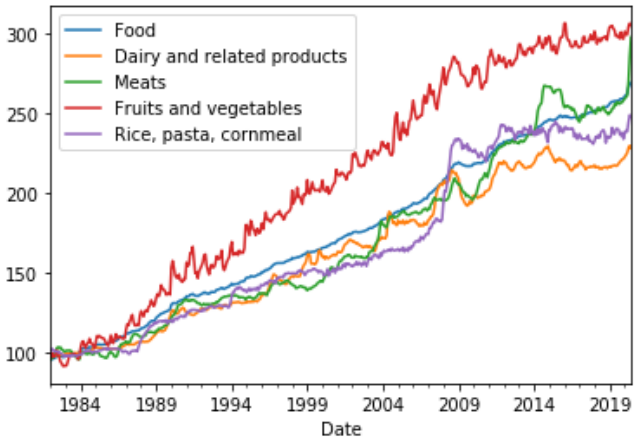
5. Data Cleaning

I merged data from the two sources and chose an initial timeframe of 1982-present day to have complete data for all variables. I selected a list of food categories from the overall list: Food generally, meats, fruits/vegetables, rice/pasta/cornmeal, and dairy products. Because each of these were on a different scale from Ethanol prices, I scaled each for visualization purposes. I used an Augmented Dicky Fuller test for stationarity on each variable, and ultimately created a new data frame with the annual differences of each.

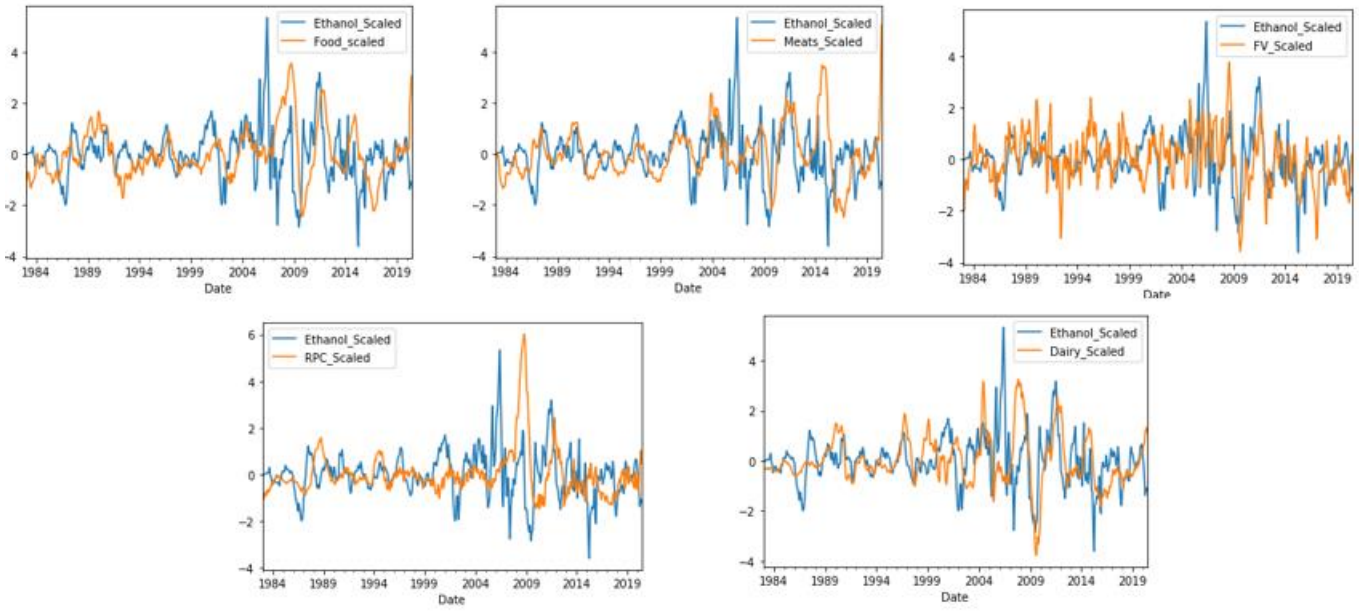
6. EDA

I plotted the timeseries.





I scaled each and replotted.



Initial observation suggests that food prices and Ethanol may covary but at a slight lag. The original time series show that meats and dairy show volatility after 2005, a period in which there is also volatility in Ethanol prices.

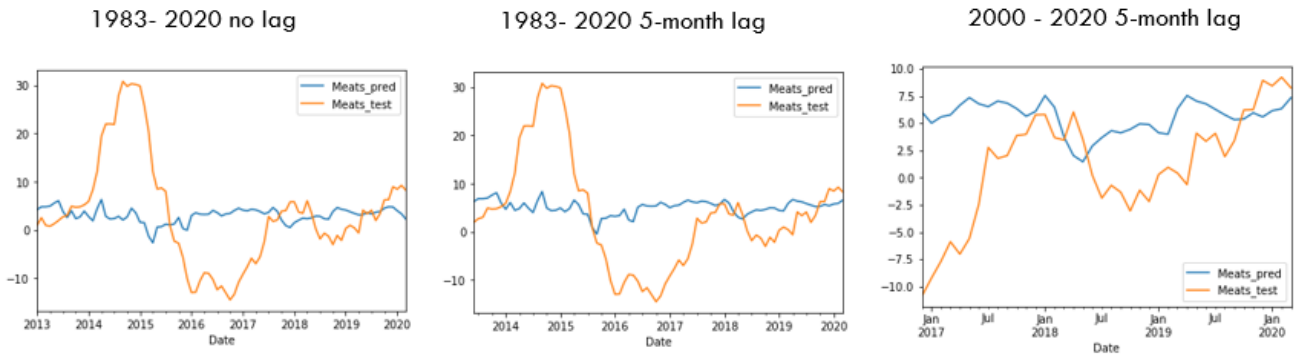
7. Ordinary Least Squares Regression

- I split the time series into a train set from 1983 through 2012, and a test set for all points thereafter
- I calculated the mean squared deviations and r2 for each lag 1-20 months
- Based on results, I decided to use a lag of 5 months
- Finally, I tested to see if the relationship was stronger by shortening test set to 2000-2016 and test for all points thereafter

r^2 score	Food	Meats	Fruits/Vegetables	Rice/Pasta/Cornmeal	Dairy
No lag 1983-2020	0.019	0.065	0.064	0.001	0.058
5-month lag 1983-2020	0.120	0.158	0.086	0.074	0.064
5-month lag 2000-2020	0.134	0.139	0.148	0.074	0.100

Ethanol Coefficients	Food	Meats	Fruits/Vegetables	Rice/Pasta/Cornmeal	Dairy
No lag 1983-2020	0.8062	3.7059	4.1128	0.4470	4.0745
5-month lag 1983-2020	2.0086	5.7782	4.7093	5.5555	4.3160
5-month lag 2000-2020	1.9486	6.2178	5.2152	5.3194	5.2047

I plotted the differences between the predicted values and the test set. As an example, here is how the three models compared when regressing Ethanol on Meats:



8. Conclusions

- Ethanol and food do appear related – based on F statistics
- At most changes in Ethanol prices only predict a small portion of variation in food category price changes with the highest r^2 score being about 0.16
- The impact on Meats was consistently higher than the Rice/Pasta/Cornmeal and Dairy
- The impact on Meats was only slightly higher than Fruits/Vegetables

8. Ideas for future study

- Why do Meats and Dairy products have different impacts, and why is the r^2 for Fruits/Vegetables and Ethanol higher than Dairy and Ethanol?
- How does Ethanol compare to other predictors of food prices in terms of r^2?
- What other forecasting models would be appropriate for this kind of econometric research?
- How do different alternatives to Ethanol compare in terms of impact of food prices?
- This study only looks at American food prices. How does Ethanol impact world food prices?
- It would be important to understand how emerging technologies may change prices, how climate change will affect food prices, and how different fuel options interact with both technology and climate changes.

9. Credits

Thanks to Tianyao Yue for guidance as my Springboard mentor.