



## Global Competition Made 2018 a Bad Time to Start a Trade War

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**T**HE UNITED States is one of the largest players in the international agricultural market. With the continued growth of its agricultural output, the US agricultural sector has relied heavily on export markets to maintain its competitiveness and profitability. In fact, projections show the United States will export \$137 billion in agricultural commodities in 2020 (Daugherty and Jiang 2019). However, the 2018 trade disruptions with Canada and Mexico that led to a renegotiated, but still unratified NAFTA-like treaty (the USMCA) and the presently unresolved trade dispute between the United States and China have adversely impacted US agricultural exports (Amiti, Redding, and Weinstein 2019; Balistreri et al. 2018; Sumner and



exports of major importance, especially beef, corn, pork, and soybeans. In this article, we discuss a metric of the historical export performance of these commodities from 1980 to 2018 and show that the trade disruptions occur at a time when the United States is in a particularly precarious position. At the outset of the trade disruptions in 2018, Iowa farmers faced the most competitive markets they had ever faced for these commodities. The longer the disruptions continue, the harder it will be to regain market share in the future.

Consider competition in the soybean market. To say that a country has a **comparative advantage** in the production of a good is not to say that they are the best at producing that good. Rather, comparative advantage means that a country is better at producing that good in terms of its opportunity cost of producing something else. Even though China can and does produce soybeans, the United States has a comparative advantage in the production of soybeans because they can produce a lot of soybeans at a lower opportunity cost than China currently can. Thus, the United States ships soybeans to China and China ships, say, cell phones (its comparative advantage) to the United States. Both countries buy these products from each other for less than it would cost if they produced all of their own



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Hanon 2018).<sup>1</sup> Of concern is how such disruptions might affect the competitive structure of markets. As Balistreri et al. (2018) discuss, disruptions to US grain exports to the former Soviet Union in 1980 had long-run impacts on US export competitiveness. Likewise, as Chen et al. (2019) find, trade disruptions from the bovine spongiform encephalopathy (mad cow) disease outbreak had a severe impact on the competitiveness of US beef exports even long after markets reopened. Today, Iowa farmers are concerned about the long-run implications of the trade disruptions to

<sup>1</sup> The U.S. International Trade Commission's (USITC 2019) own projections of the overall economic impact of the USMCA on US GDP and US employment compared with the current baseline are an increase of less than 1% each.

soybeans and cell phones for their respective domestic markets (see Balistreri 2019 for a longer discussion). If the United States and China were the only producers of soybeans, the United States would be in a very good market position.<sup>2</sup> Obviously, the United States is not the only soybean exporter—Brazil, Argentina, Canada, Paraguay, and the Ukraine are also major players. So, what we need to know is how does the United States' comparative advantage compare with other soybean exporters?

Economics literature commonly uses the revealed comparative advantage (RCA) index (Balassa 1977; Balassa 1986) to measure the competitive

position of a country in the international market. We adopt a modified version of the RCA index by Yu et al. (2009), the normalized revealed comparative advantage (NRCA) index, to present the United States' and other top exporters' comparative advantages in the four agricultural commodities of interest.<sup>3</sup>

A country has a comparative advantage in a good if its NRCA is greater than zero, and it does not have a comparative advantage if its NRCA is less than zero. Likewise, NRCA indices that are higher or lower than that of another country indicate relatively competitive positions. The NRCA index allows us to study the dynamics of the United

States' international competitiveness in commodities over time.

Figure 1 presents export values and the NRCA indices from the top exporters of beef and pork. For both sectors, major exporters have generally experienced steady growth in export values since the 1980s. As of 2018, the United States has become the leader in export value in both beef and pork. Export values alone, nonetheless, do not necessarily reflect the competitiveness of the market. The graphs on the right side of figure 1 show that both the beef and pork export markets only became more competitive over time (the NRCA

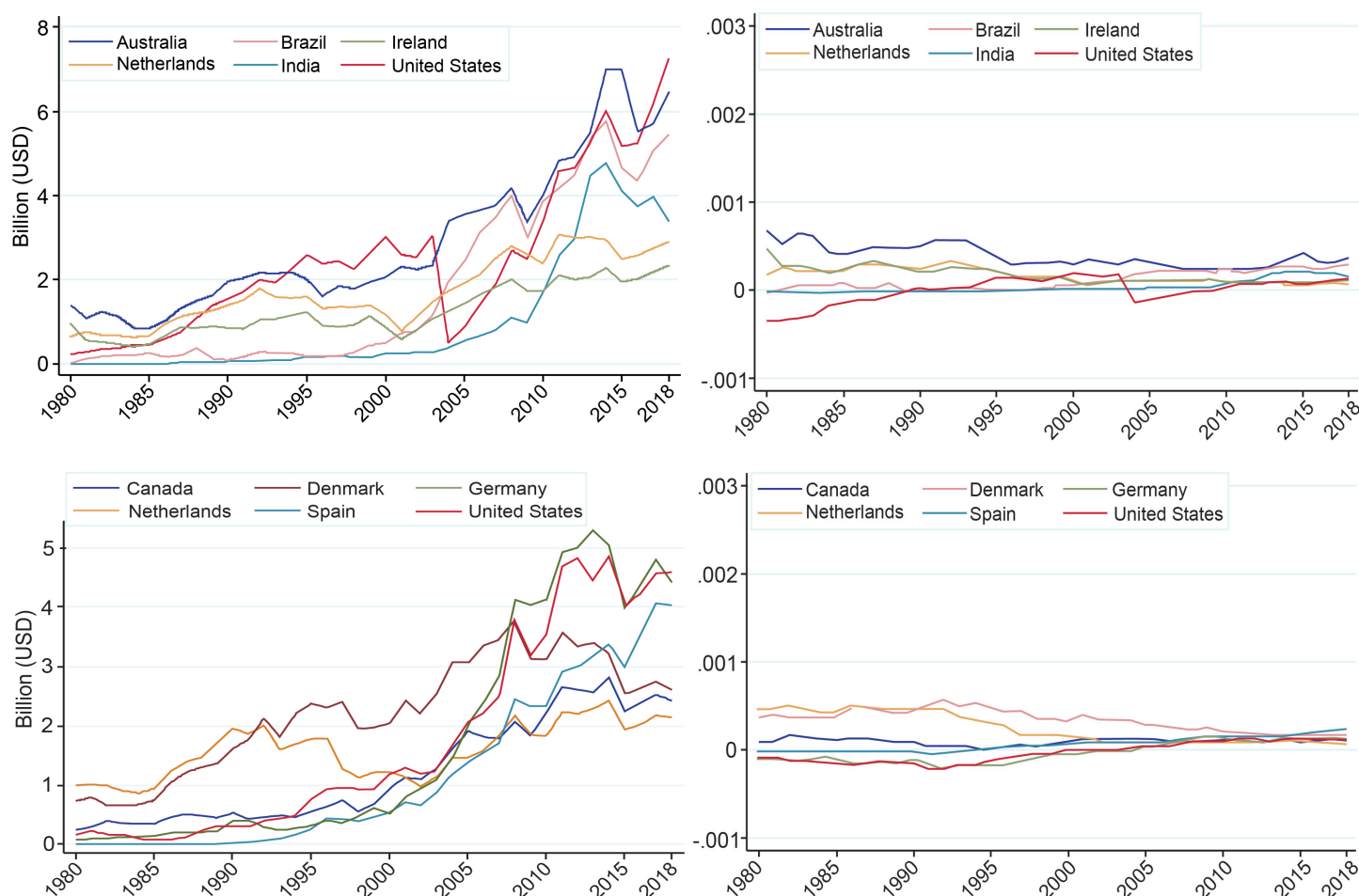


Figure 1. Beef (top) and pork (bottom) export value (left) and NRCA index (right).

Source: UN Comtrade Database.

Note: West Germany data replaces Germany data prior to 1990.

<sup>2</sup> We shall leave aside the fact that China is gearing up to produce even more soybeans in the near future.

<sup>3</sup> Chen et al. (2019) discuss the index in more depth.

indices converge). Although the export values are high, the United States is not as competitive in either pork or beef as it used to be. Figure 1 shows how the mad cow disease outbreak in 2003 led to a sharp decline in US beef exports (red line). The United States has slowly begun recovering its previous competitive position in terms of comparative advantage—for both pork and cattle, the international markets are very competitive.

Figure 2 shows corn and soybean export values and NRCA indices. In the 1980s, the United States was arguably the dominant supplier of corn and soybeans and had a relatively strong competitive position. For corn, as the industries in other countries started to expand, the US comparative advantage dropped significantly—Argentina and Brazil even surpassed the United

States when severe drought hit in 2013. We see a similar story for the soybean market with Brazil catching up by the 2000s and currently having a comparative advantage over the United States. The recent China-US trade disputes will likely only widen the gap.

These graphs all suggest the United States is entering a period of trade disruptions at a time when it is facing some of its most fierce export competition. Agricultural trade is often subject to shocks from trade disputes and phytosanitary emergencies. As such, a careful design of both domestic agricultural policies as well as cross-country trade negotiations is important to maintain competitiveness in the agricultural sector. We will explore this in future APR articles as more data become available, but in terms of the United States' competitive position in these four

commodities, this may have been the worst time to enter into a trade war.

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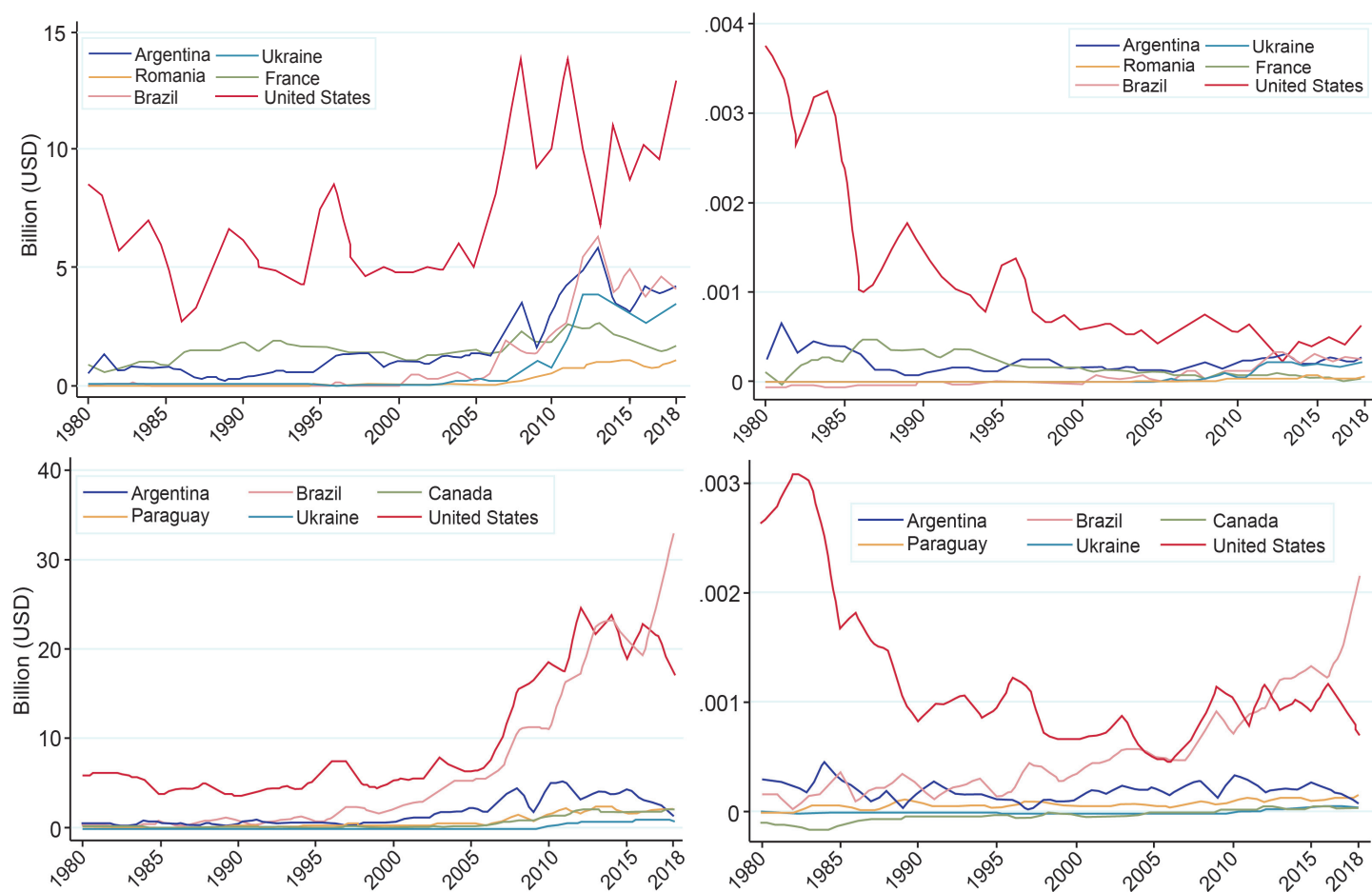


Figure 2. Corn (top) and soybean (bottom) export value (left) and NRCA index (right).  
Source: UN Comtrade Database.

# Production Projections and Trade Adjustments

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**A**S THE leaves change color and the temperatures fall, traders in agricultural markets concentrate on production and usage figures for crops and livestock. With the delays in crop planting and the uncertainty surrounding trade, USDA has had a more difficult time than usual estimating the supply and demand projections for the various agricultural markets. However, these estimates are under intense scrutiny as farmers enter the fields for harvest and trade representatives from China and the United States meet. Each month, USDA updates the supply and usage projections, and the October update sent mixed signals through the markets.

For the livestock markets, the general storyline is for increasing production over the next 15 months. Comparing the 2019 and 2020 meat production numbers, USDA is showing growth in all of the major meat sectors (beef, pork, broiler, and turkey). Pork is projected to see the largest increase, in part to fulfill trade expectations from the impacts of African Swine Fever in China and other southeast Asian countries. USDA expects beef and broilers to make modest gains and livestock prices to increase in general; however, cattle are the exception—price projections are flat.

As USDA has updated these numbers this month, they held beef production steady and increased pork production for next year and broiler production for this year and next, but pulled back on turkey production in both years, as shown in table 1. Those production shifts impacted expected prices, with small declines in the

Table 1. USDA Livestock Projections

Item	2019		2020		
	Forecast	Change from September 12	Forecast	Change from September 12	Change from 2019
Production -----Billion pounds-----					
Beef	26.95	**	27.67	--	0.72
Pork	27.58	--	28.68	0.27	1.10
Broilers	43.67	0.20	44.39	0.38	0.72
Turkey	5.85	-0.02	5.91	-0.02	0.06
Total Meat	104.77	0.16	107.42	0.64	2.65
Prices -----Dollars per cwt-----					
Steers	115.56	2.04	115.50	0.25	-0.06
Hogs	48.93	-0.48	57.50	-1.00	8.58
-----Cents per pound-----					
Broilers	87.7	0.5	91.0	-1.0	3.3
Turkey	88.5	0.2	90.3	--	1.7

Source: USDA-WAOB.

broiler and pork projected prices. In summary, the livestock production and price outlook points to 2020 being a slightly better year for the industry. Production remains at an all-time high, while prices mostly improve. The biggest challenge to this outlook will come from export demand—for prices to hold up under the pressure of record production, export demand must be strong. However, recent export data has revealed some cracks in international demand. For pork, overall export sales for 2019 are running 17% ahead of last year's pace; however, this is almost completely due to China. Purchases from our traditionally largest customers, including Mexico, our top pork export market, have declined by over 10% this year. For beef, overall export sales are down roughly 4% this year. The specter of export sale cancelations has also struck—early this month we saw a large sale previously marked for Hong Kong removed from the books. So, while there are challenges ahead for the livestock industry, there is a sense of muted optimism.

That general sentiment holds for the crop side as well. USDA's crop price projections show slight improvement in farm financial conditions, but a slide in crop production is a partial driver of that price growth. Expectations are for the 2019 corn crop to be 640 million bushels smaller than the 2018 crop, despite more corn area this year. Projections show a decline in corn usage, a 318 million bushel reduction for feed and residual corn, and a 165 million bushel decline in exports. However, with supplies falling faster than usage, corn-stock-level projections show a continued decline and a projection for season-average price to climb to \$3.80 per bushel. Similar to livestock, the major concern will be in exports. Early export sales are running 50% below last year's pace. The combination of strong global corn supplies, a bounty of other feed grains, the various trade disputes, and the relative strength of the US dollar implies export sales recovery will be hard to come by. Another segment to watch will be ethanol. With the announcement





of a Renewable Fuels Standard deal on small refinery waivers, corn farmers are hoping for a rebound in corn use for ethanol. As table 2 shows, corn consumption via ethanol peaked in 2017. Weak processing margins in

ethanol and the RFS waivers drove the pullback in corn usage in 2018. The USDA projections show corn usage for ethanol stabilizing for 2019.

Meanwhile, projections show soybean prices rebounding, as the

planting problems this year will likely be a bigger market mover than the Chinese trade dispute. With 14% fewer soybean acres and nearly a five-bushel drop in national yields, soybean production is set to plummet to its lowest level in several years, with estimates nearly 900 million bushels below last year. While carryover stocks from last year's crop were quite high, total soybean supplies this year will be smaller for the first time in seven years. The need for soybean meal in livestock rations are highly supportive of domestic usage, which continues to build. However, as with the other commodities, the challenge will be in exports. USDA projects a slight increase in soybean exports. However, export sales do not show that expected boost. Currently, soybean export sales are down 20%, even after accounting for recent sales to China. In fact, China is one of the few markets where soybean export sales are up. Last year was all about the damage from the losses in the Chinese market. This year may be all about the damage from market losses outside of China.

Given an agricultural economy that has been in the doldrums for the past few years, these projections do not provide a great deal of relief. Financial concerns will still overhang rural communities, and the likelihood of improvement hinges on a more stable trade picture. Next month USDA will update all of these projections. In that update, we will continue to look not for the calm after the storm, but some signs that the storm clouds are moving away. ■

Table 2. Corn Supply and Use

		2015	2016	2017	2018	2019
Area Planted	(mil. acres)	88.0	94.0	90.2	89.1	89.9
Yield	(bu./acre)	168.4	174.6	176.6	176.4	168.4
Production	(mil. bu.)	13,602	15,148	14,609	14,420	13,779
Beg. Stocks	(mil. bu.)	1,731	1,737	2,293	2,140	2,114
Imports	(mil. bu.)	67	57	36	28	50
Total Supply	(mil. bu.)	15,401	16,942	16,939	16,588	15,944
Feed & Residual	(mil. bu.)	5,120	5,470	5,304	5,618	5,300
Ethanol	(mil. bu.)	5,224	5,432	5,605	5,376	5,400
Food, Seed, & Other	(mil. bu.)	1,422	1,453	1,451	1,425	1,415
Exports	(mil. bu.)	1,898	2,294	2,438	2,065	1,900
Total Use	(mil. bu.)	13,664	14,649	14,799	14,474	14,015
Ending Stocks	(mil. bu.)	1,737	2,293	2,140	2,114	1,929
Season-Average Price	(\$/bu.)	3.61	3.36	3.36	3.61	3.80

Source: USDA-WAOB.

Table 3. Soybean Supply and Use

		2015	2016	2017	2018	2019
Area Planted	(mil. acres)	82.7	83.4	90.2	89.2	76.5
Yield	(bu./acre)	48.0	52.0	49.3	50.6	46.9
Production	(mil. bu.)	3,926	4,296	4,412	4,428	3,550
Beg. Stocks	(mil. bu.)	191	197	302	438	913
Imports	(mil. bu.)	24	22	22	14	20
Total Supply	(mil. bu.)	4,140	4,515	4,735	4,880	4,483
Crush	(mil. bu.)	1,886	1,901	2,055	2,092	2,120
Seed & Residual	(mil. bu.)	122	146	113	138	128
Exports	(mil. bu.)	1,936	2,166	2,129	1,748	1,775
Total Use	(mil. bu.)	3,944	4,214	4,297	3,967	4,023
Ending Stocks	(mil. bu.)	197	302	438	913	460
Season-Average Price	(\$/bu.)	8.95	9.47	9.33	8.48	9.00

Source: USDA-WAOB.

# The Urgent Need to Address Nutrient Imbalance Problems in Iowa's High-Density Livestock Regions

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**T**HE IOWA Departments of Agriculture and Natural Resources and Iowa State University initially developed the Iowa Nutrient Reduction Strategy (INRS; ISU 2019a) in 2012 to provide a framework for mitigating point and nonpoint-source nutrient pollution across the state. A primary goal of the INRS is reducing total nitrogen (TN) and total phosphorus (TP) loads to Iowa streams by 45%, as established in the 2008 Gulf Hypoxia Action Plan (USEPA 2008). The INRS states that nonpoint sources contribute 92% of the TN loads that enter Iowa's stream system each year, based on a previous statewide nutrient balance study (Libra, Wolter, and Langel 2004). A core aspect of the INRS approach to addressing nonpoint-source TN pollution is the implementation of multiple management practices that are categorized as: nitrogen management (e.g., timing, nitrogen application rate, cover crops), land use (perennial crops, extended rotations, grazed pastures), and edge-of-field (e.g., wetlands, bioreactors, buffers). The INRS reports various statewide scenario analyses, including an assessment of 15 nitrate-N reduction practices that ranks cover crops (28%), wetlands (22%), bioreactors (18%) and perennial crops (18%) as providing the strongest reductions. Adoption of these practices remains low, largely because their economic benefits in terms of crop yield and farm revenue is neutral at best. The INRS scenario finds that various in-field nitrogen management practices, which can enhance farm profitability, offer little potential to reduce statewide stream nitrogen loading (estimated

reductions were 0.1–9%).

USDA Census data shows an increase in cover crops in Iowa from 379,614 acres in 2012 to 936,118 acres in 2017 (Dreibus 2019), which likely was due in part to the influence of the INRS. ISU Geographic Information Services also documents extensive use of terraces, grassed waterways, contour buffer strips, and other erosion control practices on cropland landscapes in over 1,700 Iowa watersheds (ISU-GIS 2019). In contrast to practices that trap nitrogen, adoption of erosion control practices is robust because they are necessary to maintain the long-term productive capacity of the farm and can enhance land value. Thus, while Iowa has made progress in reducing soil erosion, nutrient export from nonpoint sources remains severe and pervasive, as evidenced by: (a) measured average nitrate contributions from 1999 to 2016 of 45%, 55%, and 29% from Iowa stream sources to respective overall loadings in the Upper Mississippi River basin, Missouri River basin, and Mississippi-Atchafalaya River basin (Jones et al. 2018c); and, (b) a 73% increase in the five-year running annual average of nitrate-N loading to Iowa's streams between 2003 and 2018 (Jones and Schilling 2019). Thus, substantial challenges remain regarding the goal of reducing nutrient losses from Iowa cropland.

One possible intervention that warrants more investigation is the practice of fertilizing beyond the nutrient needs of Iowa crops. Although this is a contributor to elevated stream nitrate statewide, certain areas with concentrated livestock, especially hogs, are most likely to receive nitrogen

inputs well beyond crop needs (Jones et al. 2018b; Jackson et al. 2000). Mitigation of nutrient over-application “hotspots,” which can occur due to excessive combinations of manure and fertilizer nutrient applications on specific land parcels (Teshager et al. 2017; Secchi and McDonald 2019), could have disproportionately large benefits for statewide stream nitrate loading.

Recent research reveals that hotspots may be occurring in regions of intensive livestock production in Iowa, such as the Floyd and North Raccoon River watersheds (figure 1), which drain portions of northwest and north-central Iowa (Jones et al. 2018a; 2018b). We further explore the implications of achieving overall statewide water quality goals based on an evaluation of the nutrient balance and corresponding in-stream nitrate water quality indicators for the Floyd and North Raccoon River watersheds, which represent different ecoregions in Iowa but with similar intensive livestock production.

## Data

We derive corn and soybean areas and yields for each watershed from USDA-NASS (USDA 2019) county-level data based on the area portion of each county within the watershed, and base the nitrogen content of harvested grain on Blesh and Drinkwater (2013) and USDA (2009). We obtained commercial nitrogen-fertilizer sales data from Gronberg and Spahr (2012) and the Iowa Department of Land Stewardship (IDALS). We derive watershed-level data from the county data by adjusting the total amount



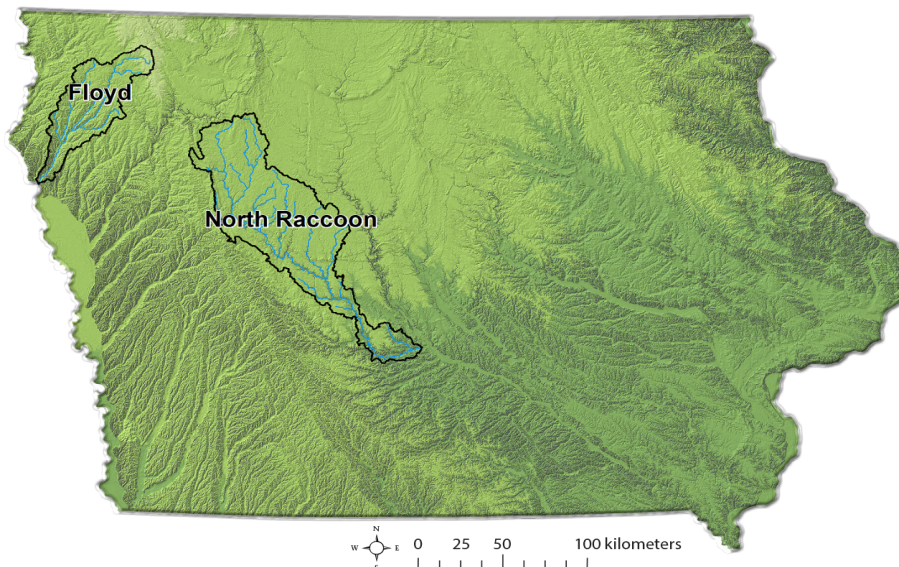


Figure 1. Locations of the Floyd and North Raccoon River watersheds.

based on the area portion within the respective watershed. For years with missing county-level data, we estimate commercial fertilizer amounts by using the calculated rate per corn area for years where data exists, then we adjust the watershed total based on the number of corn acres for the respective year. We derive watershed livestock populations from USDA-NASS (USDA

2019) and the Iowa DNR AFO database (IDNR 2019b), and use Iowa Geological Survey values (IGS 2006) to calculate manure N content; however, we do not consider poultry manure due to the absence of reliable county-level data for most years. We calculate soybean nitrogen fixation based on the approach in Barry et al. (1993). We obtained water quality data (stream nitrate

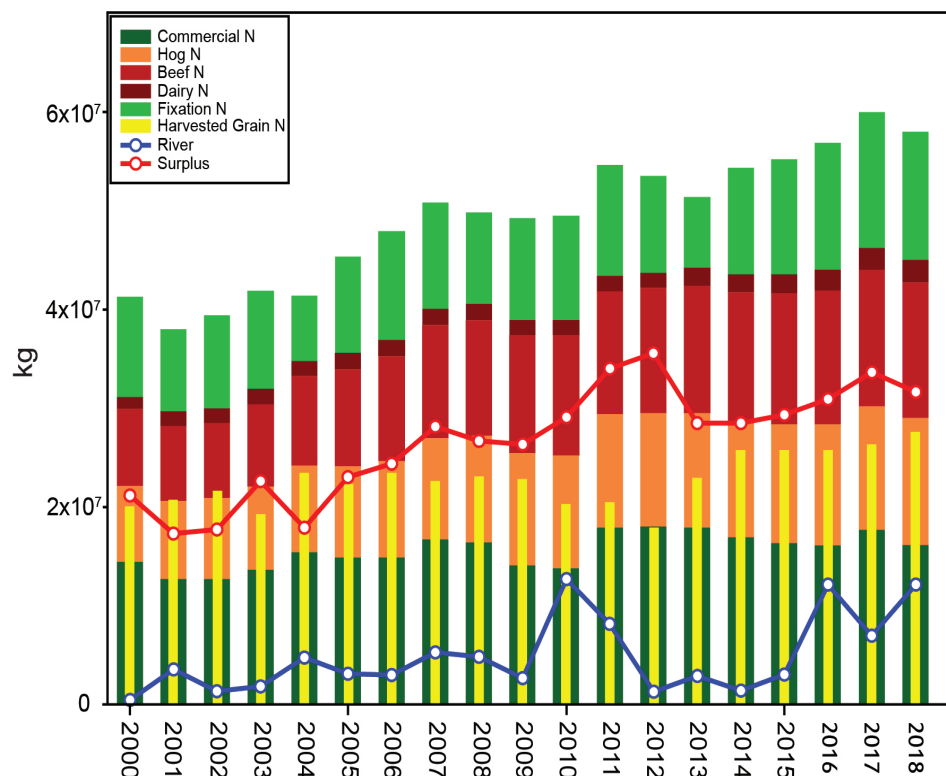


Figure 2. Nitrogen inputs and outputs for the Floyd River watershed in northwest Iowa, 2000–2018.

concentrations and loads) from the Iowa DNR ambient water monitoring program (IDNR 2019a), and calculate stream N loads (mass) by multiplying concentrations by daily USGS discharge readings, and use linear interpolation to estimate concentrations on non-analysis days.

## Discussion

Figures 2 and 3 illustrate simple nitrogen budgets for both watersheds from 2000 to 2019. We consider commercial N, manure N (dairy, beef, and hog), and soybean fixation from the previous year as inputs, and consider the “surplus” the sum of the inputs minus the harvested grain N. In both the Floyd River and North Raccoon watersheds, N inputs far exceed the N harvested in the grain (Floyd=217%; North Raccoon=140%) over the 19-year period. In fact, the N surplus in the Floyd River watershed exceeds the harvested grain N in every year since 2005 and was nearly double the grain N in the drought year of 2012. Illustrating the importance of N contribution by animals, manure N was 79% of the total input amount for the Floyd River watershed, but only 20% for the North Raccoon watershed. To emphasize, these values do not include poultry manure.

Interestingly, a much higher percentage of the N surplus reaches the stream in the North Raccoon watershed than it does in the Floyd River watershed (63% versus 18%, respectively), likely reflecting landscape and climate differences. Water yield (runoff volume adjusted to watershed area) from the North Raccoon watershed is about 1.8 times that of the Floyd River watershed.

The North Raccoon watershed, situated on the recently-glaciated Des Moines Lobe, is intensely drained with field tiles known to hasten the delivery of nitrate to the stream network. ➡



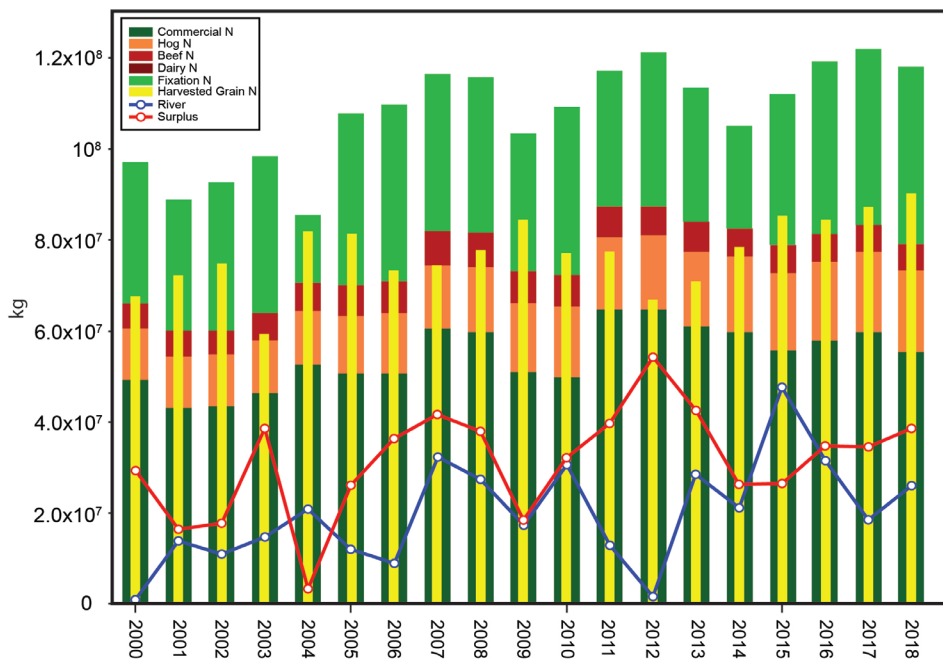


Figure 3. Nitrogen inputs and outputs for the North Raccoon River watershed in north central Iowa, 2000–2018.

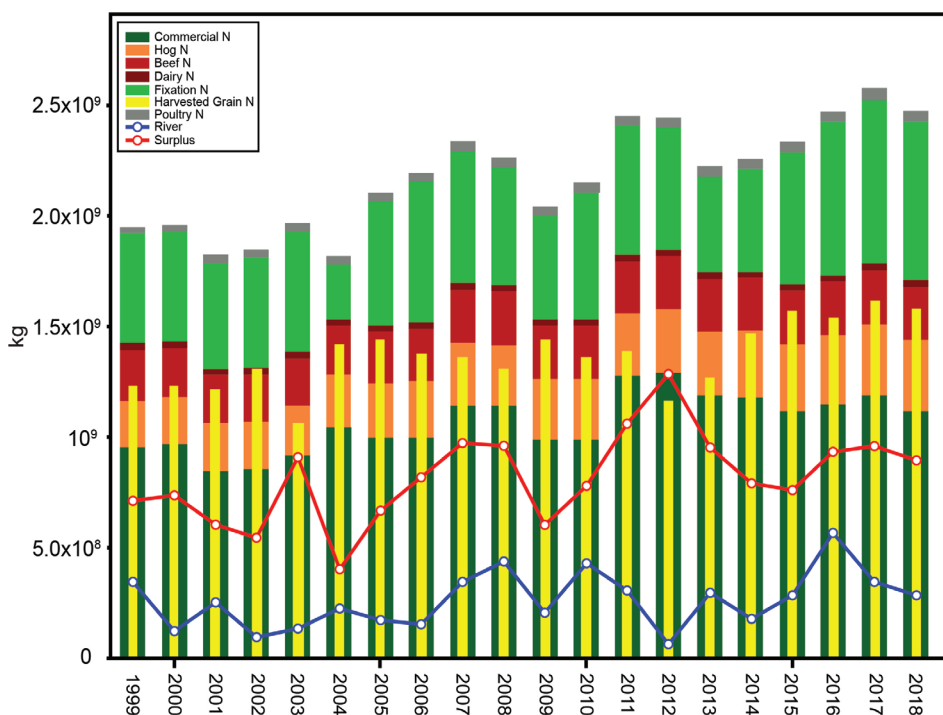


Figure 4. Iowa Statewide nitrogen inputs and outputs (including drainage areas in southern Minnesota), 1999–2018.

High-nitrate shallow groundwater entering the stream network through alluvial pathways likely drives stream nitrate in the drier Floyd River watershed, where tile is less common.

Because of the abundance of soil N, denitrification, whose contribution as a loss mechanism increases with increasing soil N concentrations, is

probably a bigger loss pathway in the Floyd River watershed. Even so, nitrate concentrations in the Floyd River watershed are very high (long-term average of 11.7 mg/L) and are often the highest in Iowa for a stream of that size (i.e., HUC8 level watershed).

Over the 19-year period, annual average concentrations range from

6.2 (2000) to 17.9 mg/L (2016) in the Floyd River watershed and 3.9 (2002) to 18.2 mg/L (2013) in the North Raccoon watershed. Concentrations in both rivers exceed the standard for safe drinking water (10 mg/L) much of the time, with the annual average in the Floyd River and North Raccoon watersheds below 10 mg/L in only four and seven of the 19 years, respectively.

We also derive stream nitrate loads from Jones and Schilling (2019) to evaluate similar statewide data (figure 4). Compared to the analysis above, the statewide data include poultry manure and Minnesota areas draining to Iowa. When Iowa is considered as a whole (including MN areas draining to Iowa), total inputs are 160% of the harvested grain N. Manure N makes up 26% of the input total, a figure that has not substantially changed over the past 20 years. About 32% of the “surplus” eventually finds its way to the outlets of watersheds draining to the Missouri and Mississippi Rivers. Crop yields (calculated as harvested grain N) have clearly increased over the past 20 years, but not nearly as fast as N inputs and stream nitrate loads (table 1).

#### Implications

Edge-of-field and other N trapping treatments supported by taxpayer-funded cost share, such as cover crops, woodchip bioreactors, saturated buffers, and denitrifying wetlands, are currently highlighted in the INRS as primary practices for reducing nitrate losses from Iowa cropland landscapes. These treatments can be very effective in trapping edge-of-field nitrates and/or specifically removing excess nitrate from subsurface tile drains at a local scale. For example, Castellano et al. (2019) report that bioreactors, saturated buffers, and wetlands respectively intercepted 12–100%, 27–96%, and 25–78% of the nitrate transported in tile drains. However,



**Table 1. Changes in Total Mass (Mg) and Percent Changes for Statewide Nitrogen Balance Components during the Past 20 Years**

N Category	Difference (Mg)	% Change
Total inputs	661,370	36
Surplus	332,553	51
Grain N	328,817	27
Commercial	310,291	34
Fixation	186,845	41
River	154,254	83
Hogs	122,916	59
Beef	22,464	10
Chicken	17,997	76
Turkey	4,144	59
Dairy	-3,287	-11

the overall cost of implementing these practices across the state of Iowa to effectively control nonpoint-source nitrate losses would likely require billions of dollars, which could prove prohibitive.

The nutrient balance analyses reported here for the Floyd and Raccoon River watersheds point to a potential partial alternative and inexpensive solution (i.e., better aligning N inputs with crop needs, particularly in regions with intensive livestock production). There is abundant evidence in the literature that Net Anthropogenic Nitrogen Inputs (NANI) correlate well with stream nitrate in the US Corn Belt (McIsaac et al. 2001; Hong, Swaney, and Howarth 2011; Hong et al. 2012), while Khanal et al. (2014) and Jones et al. (2018a) demonstrate manure-fertilized rotations have higher net N (i.e., difference between inflows and outflows) statewide in Iowa. The long-term excessive in-stream nitrate concentrations documented for the Floyd River, North Raccoon, and other Iowa stream systems impacted by intensive livestock production further underscore the urgent need to improve management of land-applied nutrient inputs in these regions. Thus, we suggest a renewed emphasis on appropriate nitrogen inputs, which would not solve all of Iowa's water quality problems but could serve as an important step in mitigating excess

nitrate export to Iowa's stream system. One place to begin is with Iowa's Manure Management Plans, which still allow farmers to apply nutrients based on the archaic and discredited "yield goal" strategy (Rodriguez, Bullock, and Boerngen 2019). Aligning manure nitrogen inputs with economically optimal nitrogen rates (ISU 2019b) would bring an immediate reduction in the N surplus statewide, especially in watersheds where livestock populations are dense.

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# Impact of African Swine Fever on US and World Commodity Markets

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**R**ECENT OUTBREAKS of African Swine Fever (ASF) in Vietnam, Cambodia, Laos, South Korea, and especially China, have generated interest in how world commodity markets will adjust in response to pig herd losses due to the disease and to panic culling to avoid the negative impacts of the disease. This adjustment is complicated by the retaliatory duties of 25% and 60% that China has placed on US soybean and pork exports, respectively, and the duration of temporary exemptions on these tariffs on soybeans and pork. It is clear that a scarcity of pork will cause a reduction in pork consumption in impacted countries and a switch to alternative proteins. It is also clear that countries (such as the European Union and Brazil) who have direct access to China's pork and chicken markets will see an increase in exports. What is less clear is the second-round impact of these adjustments. Will the United States ship more pork to markets vacated by the European Union and Brazil as these countries pursue lucrative markets in China? What is the net impact on US and world soybean and corn exports and prices? What would be the implications for the United States if China removes retaliatory duties?

In mid-October 2019, the Chinese Ministry of Agriculture and Rural Affairs reported the September 2019 hog inventory is down by 41.4% compared to a year prior, and the size of the breeding herd declined by 38.9% from September 2018 to September 2019. This represents a loss of about 10 million sows over a year, which is larger than the entire US inventory of 6.3 million head (USDA-FAS 2019). In addition, ASF outbreaks have appeared

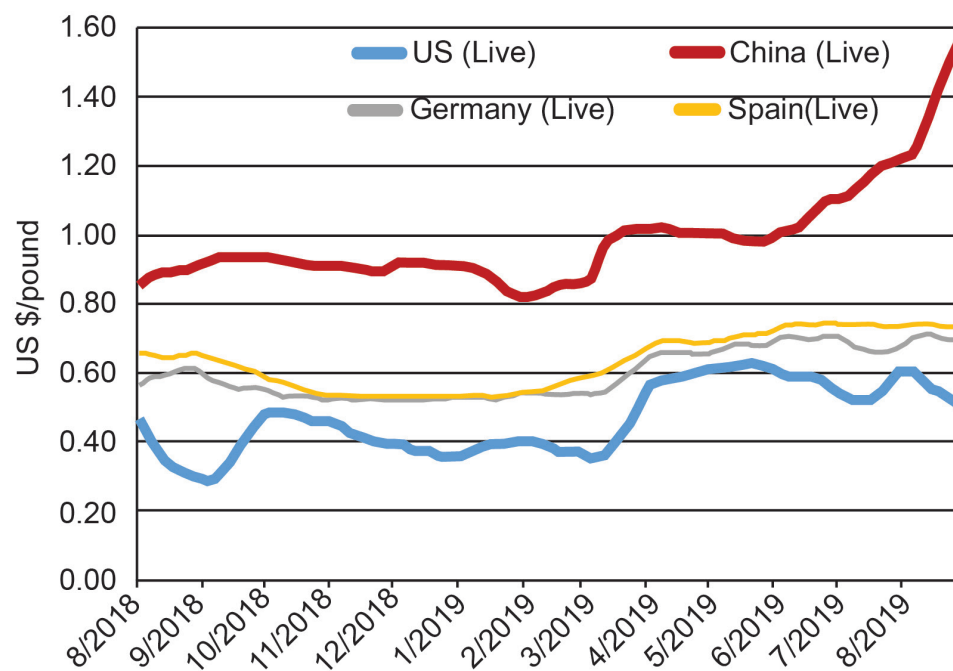


Figure 1. Live hog prices weekly, August 2018–August 2019.

in all Chinese provinces with the most recent outbreak in October (see the ASF map at [https://www.card.iastate.edu/ag\\_policy\\_review/f18-asf/](https://www.card.iastate.edu/ag_policy_review/f18-asf/)), and thus the inventory decline is viewed by some as an underestimate of the true scale of the loss (Pig Progress 2019).

Figure 1 shows the impact of reduced production on Chinese live hog prices. The most recent weekly data from October 9 shows that Chinese live hog prices at \$1.93/lb (¥30/kg) are now three times the US level (\$0.68), and have jumped over 100% over the past year.

## The CARD-FAPRI Model – Assumptions and Scenarios

The CARD-FAPRI modelling system is well suited to evaluate some of these first- and second-round impacts. The system is a partial equilibrium model that contains supply and demand equations for all of the important temperate commodities in every

important producing or consuming country (Tokgoz et al. 2007). This commodity/country-wide coverage is important because it allows for adjustments in production and consumption in places like Brazil and the European Union. Although the scale of losses in Asia is massive, it is modest when compared to worldwide protein production. The CARD-FAPRI model allows for these worldwide protein adjustments.

We examine two scenarios. In both we assume that China, Vietnam, South Korea, and the “Rest of Asia” region incur a 30% permanent reduction in their sow herd. The “Rest of Asia” is a catchall for smaller countries such as Laos and Cambodia that we do not model explicitly. As of yet, there are no impacts on pork production in Thailand, Taiwan, Indonesia, and Japan.

One scenario (“Duty and ASF”) assumes that the retaliatory duties on US pork and soybeans remain in



place. The second scenario (“Only ASF”) assumes removal of these duties. Recent progress in US-China trade talks have led China to exempt duties on US pork and soybean exports, in part to alleviate ASF. In the “Duty and ASF” scenario, US soybean and pork prices fall below the prices in other exporting countries. In the “Only ASF” scenario, the US price is also the world price.

Note that if one believes that the 30% reduction is reasonable then the difference between the “Only ASF” and “Duty and ASF” becomes an estimate of the damage caused by the retaliatory duties. This is true, because in this case the “Only ASF” scenario becomes the baseline.

It is very possible that a vaccine will be developed or that some countries will find a way to eliminate the disease in the next ten years. If this happens, then the “Only ASF” scenario will revert to baseline levels.

## Results

Figure 2 shows that the disease presents significant growth opportunities for US pork exports: specifically, a persistent 30% decline in Asian hog inventory boosts US pork exports by 3.4 million metric tons, which would translate into over \$7 billion. This is also consistent with our previous estimate of a possible \$8.9 billion export growth for US pork once China removes non-tariff barriers (Li, Zhang, and Hayes 2018). However, tariffs would more than wipe out (or possibly reverse) the possible growth in US pork exports if the trade tensions persist.

Figure 3 shows that the elevated export demand due to ASF will also push US pork prices from \$50/cwt to close to \$60/cwt, a potential gain at risk of not being realized due to the trade tension.

One would expect that the reduction in hog and sow inventory would also lead to slightly weaker

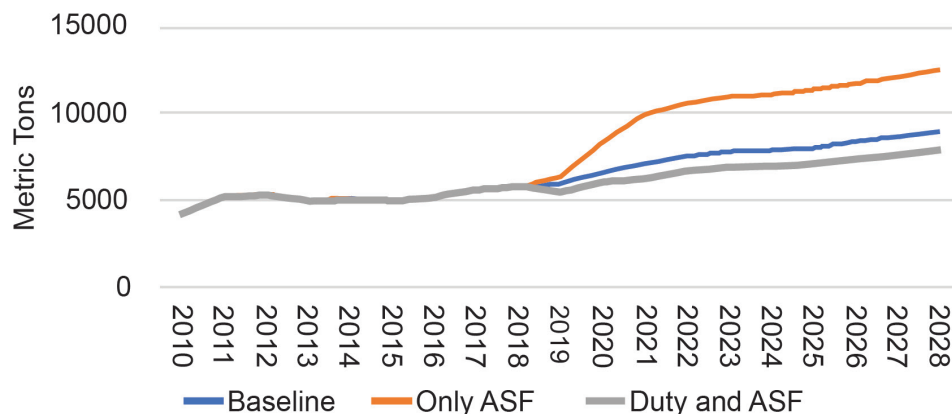


Figure 2. US pork exports (Metric tons).

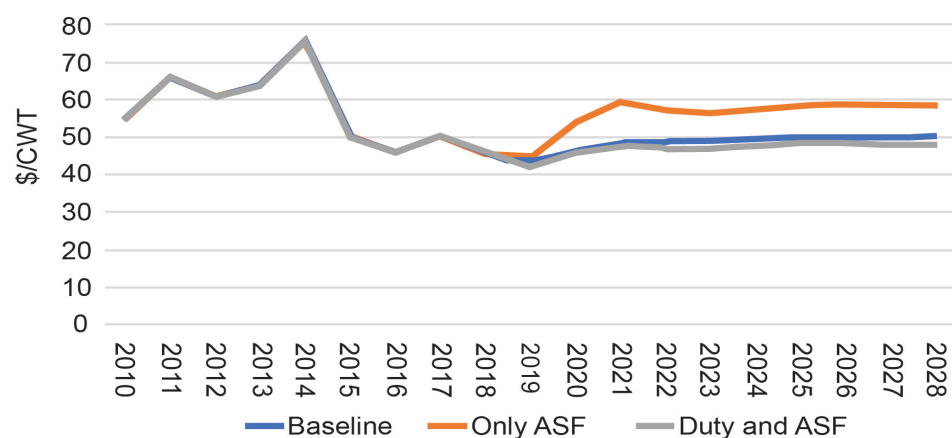


Figure 3. US pork price (\$/CWT).

demand for feed grains. However, the model output for corn (not shown here) shows almost no impact. This corn price response is muted because worldwide consumption of other proteins increases and these birds and animals need to be fed.

Figures 4 and 5 show US exports of soybean meal and soybeans. The 25% retaliatory tariffs resulted in significant reduction in US soybean exports (as more beans are crushed domestically in response to higher local margins), but the United States increases exports of soybean meal to Argentina and countries formerly served by Argentina while China buys more soybean meal from Argentina. ASF leads to reduced feed grain demand and results in lower exports of soybeans and soybean meals.

The impact of ASF on US whole soybean (figure 5) and corn exports (not shown) is extremely small. This is

true because worldwide production of other proteins increases to fill the gap in Chinese pork production.

## Conclusion

ASF is a black swan event in the global agricultural markets. So far, it has affected multiple countries in Eastern Europe and Asia and resulted in a loss of nearly 40% of the hog inventory of China—the largest pork producer in the world with half the pigs globally. Our CARD-FAPRI model shows that ASF would significantly boost US and global meat exports and impact crop and livestock prices. Of course, this relies on the successful prevention of outbreaks of ASF in the United States or other major pork production regions such as Western Europe.

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# E15 Demand and Small Refinery Waivers: A Battle over Long-Run Market Share

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**I**F YOU follow news around the Renewable Fuel Standard (RFS), you have probably heard about small refinery exemptions (SREs) and E15. E15 is a small market—just over half of one percent of gas stations in the United States sell the fuel (RFA 2019). Meanwhile, SREs reduced the total RFS mandates by over four billion gallons from 2016 to 2018 (Irwin 2019). In this article, I argue that the battle over E15 is intricately related to SREs beyond the ‘great compromise’ the Trump administration is selling to the ethanol and oil industries.

## Ethanol demand: A brief history

The original RFS essentially guaranteed the conventional ethanol industry a 15 billion gallon per year market beginning

in 2015. Almost five years past this mark, the industry has yet to realize that level of ethanol demand. Among the problems contributing to this are rigidities in types of ethanol-blended fuels that retailers can sell and, absent substantial price discounts, lackluster demand for high-blend ethanol fuels.

Before this summer, the US Clean Air Act effectively dictated that ethanol be sold to US consumers in two blends: E10 (10% ethanol) and E85 (51–85% ethanol blends). However, to use E85, consumers need to own flex-fuel vehicles (FFVs) and gasoline stations need specialized fueling infrastructure. For a variety of reasons, the market never really took off, and the primary way firms complied with the RFS until 2013 was through converting gasoline

from E0 (no ethanol) to E10 nationwide. Figure 1 compares monthly ethanol production, adjusted for imports and exports, to ethanol demand under a national 10% ethanol blend.<sup>1</sup>

The E0-to-E10 strategy faced a serious problem beginning in 2013/14. In 2013, net monthly ethanol production averaged 1.06 billion gallons (bgals) per month, while the most ethanol that could be blended as E10 was 1.11 bgals. Ethanol production and E10 demand converged in 2014 at 1.11 bgals and 1.12 bgals per month, respectively. Since 2014, the annual potential for ethanol in E10 has fluctuated between about 14 bgals and 14.2 bgals. While we have seen some months where ethanol production exceeded the E10 blend wall, it has never been more than 15 million gallons above the blend wall in any given month, highlighting the limited sales of high-blend ethanol fuels to date.

Pouliot and Babcock (2015) argue that E85 could bridge the roughly 800-million-gallon gap between the blend wall and the 15 bgal conventional mandate. Realities on the ground show that: (a) at current prices consumers are not willing to buy that much E85; (b) the EPA is unwilling to allow compliance credit prices to increase to the level needed to spur consumer demand for E85; and, (c) the market for E85 vehicles is declining given the phase-out of government subsidies for their production (Lade 2018). This leaves the ethanol industry in a bit of a bind. In the absence of large-scale E85

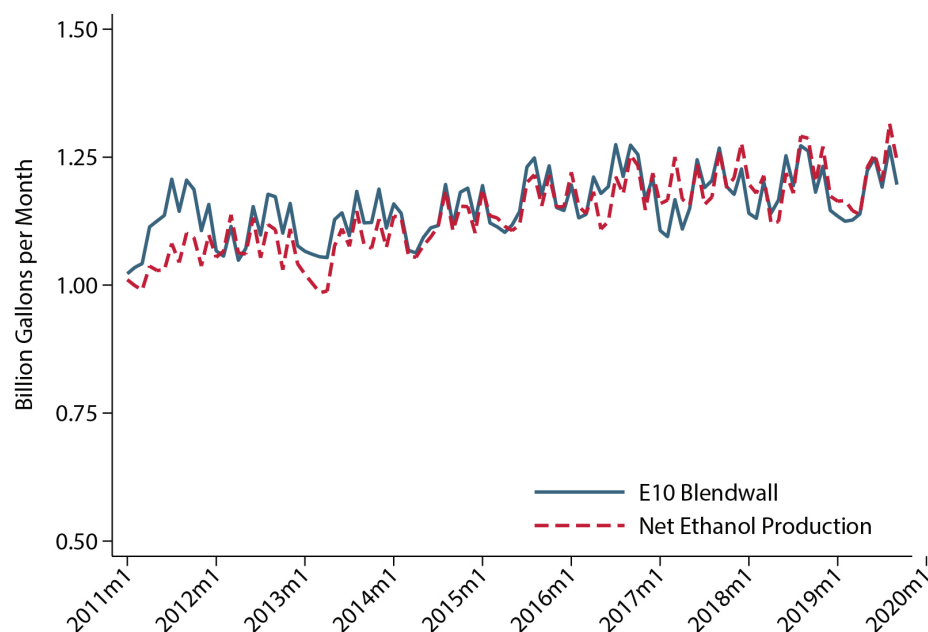


Figure 1: US ethanol production and the blend wall.

Source: US Energy Information Administration and author's calculations.

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<sup>1</sup> I construct my measure of net ethanol production using data from the Energy Information Administration on monthly US ethanol production plus imports minus exports. The blend wall estimate is monthly product supplied for finished gasoline reported by the EIA multiplied by 0.10. The measures are admittedly crude, and alternative measures of domestic ethanol use would show slightly different results.



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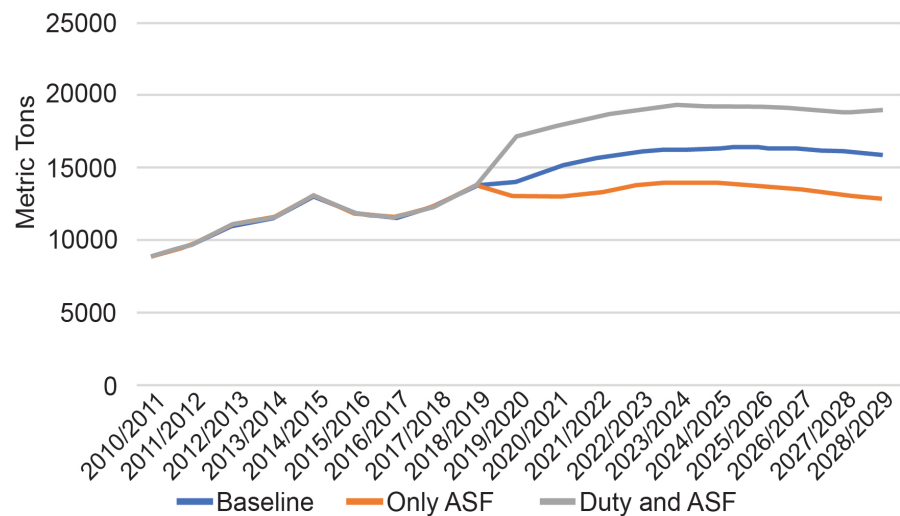


Figure 4. US soybean meal exports (Metric tons).

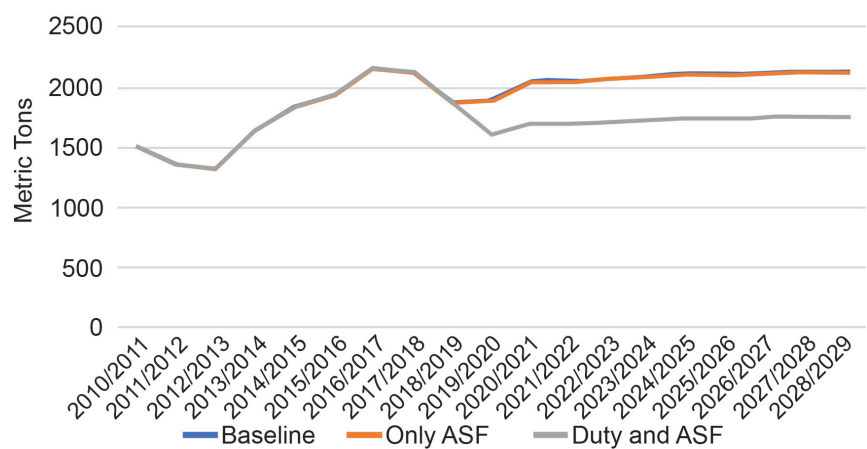


Figure 5. US soybean exports (Metric tons).

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adoption, refiners have complied with RFS mandates exceeding the blend wall by taking advantage of flexibility in the program and purchasing compliance credits generated through increased biodiesel blending.

**E15 demand: A new way to break the blend wall?**

The ethanol industry seems to have shifted focus from E85 to expanding the market for E15 (fuel containing 15% ethanol).<sup>2</sup> Why would the industry lobby so hard to expand market access of a lower-blend fuel? Because the vehicle market is far greater for E15. In 2011, EPA granted a partial waiver to E15, approving its use in any model-year vehicle 2001 or newer (EPA 2011). Where FFVs make up around 7% of the passenger vehicle market, E15 can

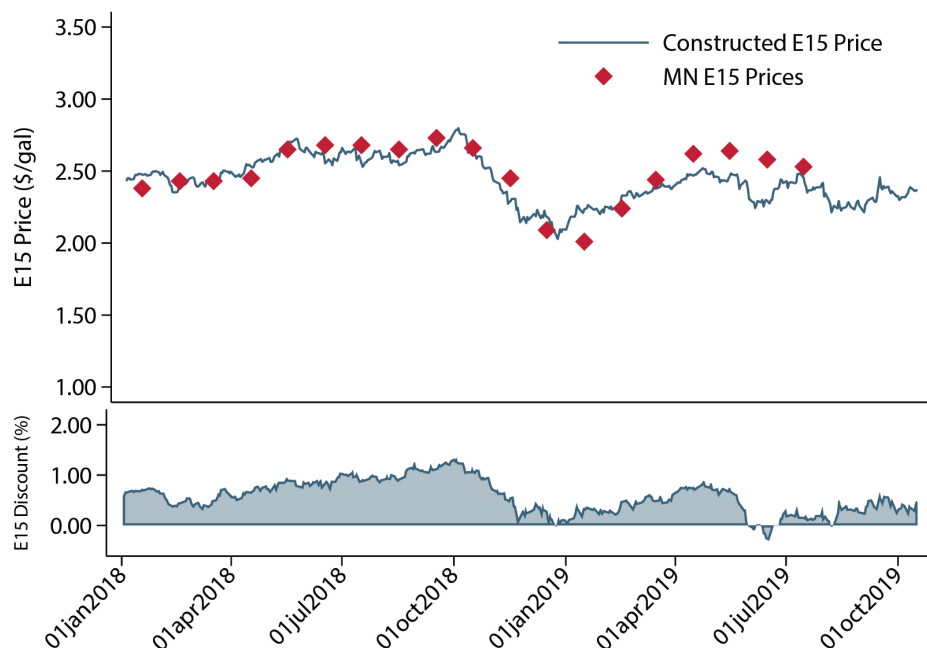
be used in more than 90% vehicles. However, the industry faced another obstacle: most retailers were not allowed to sell E15 in the summertime. Station owners are unlikely to invest in infrastructure for products that they cannot sell half the year. However, this changed in March 2019 when EPA finalized actions to allow year-round E15 sales (EPA 2019a).

**Small refiner waivers and E15 demand**  
The ethanol industry now has a new means to break the blend wall. Even modest E15 adoption could substantially expand domestic ethanol demand, eroding refiners' market share. The success of E15, however, depends crucially on consumers' willingness to pay for the new product. Most consumers know that ethanol has lower energy content than gasoline, thus E15 needs to be around 1.7% cheaper than E10 to make up for the lost fuel mileage.

However, we know that E85 consumers use rules of thumb (Lia, Pouliot, and Babcock 2018), and often do not purchase E85 in large quantities unless the discount is well below energy parity. Further, consumers face conflicting information about E15 (Edmunds 2013). All of this likely increases the discount needed for large-scale E15 adoption.

E15 price data is relatively scarce. To explore where prices stand, I constructed my own estimates of retail E15 and E10 prices since 2018 using data from the Chicago Mercantile Exchange and assuming typical mark-ups and taxes for Minnesota. The top panel of figure 2 presents my estimated E15 prices and compares them to monthly E15 prices reported by the Minnesota Department of Commerce. The bottom panel shows the E15 price discount relative to E10.<sup>3</sup> The top figure confirms that my constructed estimates follow closely to actual retail prices. The bottom panel shows the E15 price discount is small and has not exceeded 1.5% since 2018. The discounts are not large enough to spur substantial E15 sales.

Now we come to the crux of my argument. At least in the short run, spurring large-scale E15 demand will require noticeably lower prices than E10. Given market prices over the last two years, the only way to realize these large E15 discounts is by increasing the implicit RFS subsidy for ethanol. Enter small refinery waivers. The EPA has vastly increased the use of SRE provisions since 2017 (EPA 2019b). SREs have lowered compliance credit prices, decreasing the RFS subsidy for ethanol and limiting the discount retailers can offer for E15. So long



**Figure 2. Constructed and actual Minnesota E15 prices.**

Sources: Chicago Mercantile Exchange, MN Department of Commerce, and author's calculations.

<sup>2</sup> This is not to say the industry does not still promote E85.

<sup>3</sup> Specifically, I use ethanol and RBOB gasoline price data from CME and calculate a weighted average E10 and E15 price series assuming each contains 10% and 15% ethanol, respectively. I assume each price is marked up by a \$0.015 /gallon transportation cost, a \$0.27 /gallon retail markup, and a \$0.4919/gallon sales tax. Estimates do not include RIN prices. The choice is intentional to illustrate the potential E15 price discount as a stand-alone product with no RFS support.

as SREs remain commonplace, as EPA indicated they would (EPA 2019c), E15 price discounts will be low, limiting the current and future potential for the E15 market.

#### The battle for market share in a declining market

If projections are correct, the liquid transportation fuel market is in decline. The Department of Energy anticipates gasoline use will decline from 137 bgals per year to around 110 bgals by 2030. How much of that market will be gasoline versus ethanol depends on what fuels are available to consumers and the level, or lack thereof, of government support for biofuels. Assuming support for conventional ethanol eventually phases out, E10 and E15 will need to stand on their own. As we see in figure 1, E15 is just not cheap enough to spur large-scale consumer adoption. If, however, SREs are removed and ethanol subsidies under the RFS increase to historical levels, we may see some consumers begin to use E15 regularly. Over time, as the fuel becomes less of a novelty, the E15 market could expand, eroding gasoline's market share. This is not a situation the fossil fuel industry wants to see. Thus, the

battle over SREs can be cast as a battle over long-term market shares, where one side wants to ensure this new product market remains small, and the other wants to see it expand.

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# Congratulations on your retirement, Becky!

The CARD director, staff, affiliates, and collaborators wish to give their sincerest thanks to Becky Olson, who is retiring after 29 years of outstanding service to Iowa State University. Becky's attention and concern for producing the highest quality products made everything we produce in CARD look and sound better. She will be missed. This is the last Ag Policy Review that Becky will help create and we want to take this opportunity to express our gratitude and wish her the very best in her retirement!

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