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Has Specialization Put a Limit on How Far Cattle Contracting Can Go?

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IN 1776 Scottish philosopher Adam Smith published *An Inquiry into the Nature and Causes of the Wealth of Nations*, or as it is better known, *The Wealth of Nations*. In many mundane ways, Smith merely chronicled the burgeoning European industries he was observing; but, in doing so, he helped spread a revolutionary thinking about how factories could take advantage of specialization. Smith's discussion of a visit to a pin factory has been re-told so often that many people probably know the story without knowing the source. The story goes like this: If you were to make a pin, how would you do it? Well, you need to cut some steel, pound and twist it into a wire, cut the wire, straighten it, sharpen one end, affix a tiny ball to the other, and once, say, 100 were ready, box them up for delivery. Smith records 18 distinct tasks involved in making a pin and opines that an untrained 18th century worker could at best fashion one pin per day. Specialized training increases the output to a dozen per worker so that a factory of 100 workers might produce 1200 pins. However, in the modern pin factory he visited, instead of training one person to do everything, workers were each trained for just one of the 18 distinct tasks, and the factory produced 48,000 pins per day. From automobiles to computers to packinghouses, specialization increases output while lowering cost per unit. This revolution in specialization also leads to increased demand for inputs. As output increases, more and more inputs must be secured, whether those inputs are steel or soybeans, plastic or pigs. But what happens in industries that compete for those inputs? They often become concentrated.

Meat processing became very specialized in the last 50 years. Processing plants today package most cuts directly in the plant instead of shipping carcasses to the retailer to butcher and package for individual sale. Instead of a retail butcher slicing all of the cuts off of a side of beef, specialized workers at the packing plant now make the cuts as the meat proceeds down an assembly line into a package that then goes to the supermarket for minor trimming if any. This change in processing required a massive reorganization of supply chains, transportation, and technology at processing plants and, once in place, gave processors the ability to take advantage of enormous economies of scale. The result was a dramatic decline in costs per finished product. To further push processing costs down, packers needed to increase inputs so that the plants could take full advantage of the enormous size, technology, and labor used. Bigger plants meant fewer firms were needed, leading to evermore concentration in the processing sector. Today, four firms process 85 percent of cattle into beef (in value), four firms process 66 percent of hogs into pork, and another four firms process just over half of all turkeys (57 percent)

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and broilers (51 percent) (USDA 2016). However, this concentration seems to have mostly slowed. These four firms seem to be in no great hurry for further mergers and acquisitions. This can be for many reasons, but one of them could be that cost savings from scale are getting smaller. Securing inputs remains important, nonetheless. With fewer and fewer firms buying more and more inputs, how do they compete with each other while taking advantage of specialization's increasing demand for inputs? They secure their supplies through contracts.

This story is by now well-known and quite consistent with how industries throughout food manufacturing evolved. As processors moved to specialization, they needed consistent supplies of inputs. Along with modernization came a move toward increased usage of contracting to secure supplies months ahead of delivery. Fifty years ago, only about 11 percent of all agricultural goods were sold to processors via contracts; today it is closer to 40 percent (MacDonald 2015). In livestock, the movement toward contracting was even more dramatic. Today, 98 percent of hogs, 90 percent of poultry, and 70 percent of cattle are procured using some form of contracting (USDA 2016). The 90 percent for poultry is misleading since it encompasses both turkeys and chicken for meat and eggs. In fact, nearly 100 percent of broilers (chickens sold exclusively for meat) are contract sales. Since the beef industry has lagged the poultry and hog industries in contract adoption, it has been natural to assume that the beef supply chain has merely been catching up. The conventional wisdom is that cash markets will mostly disappear. Perhaps that is inevitable. Forecasting industry structure is always difficult. However, we recently

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reviewed a great deal of research and data related to US livestock production and have concluded that the beef industry might be slower to move toward an increased usage of contracts. In terms of the benefits of specialization, a steer is neither a four-legged chicken nor a big pig.

First of all, to accommodate specialization, it can help if the input (the animal in this case) is homogeneous. Getting chickens and pigs to conform to standard sizes and quality is actually easier to do if you are starting at a stage of heterogeneity. Think of American chickens and pigs at the beginning of the 20th century—breeds differed, feed was mostly scraps and varied grains, animals often rummaged around farms, and chicken sold for meat was usually once the bird's egg production waned. Once scientifically controlled genetics, feeding, and developing of animals purely for meat were brought into the industries, great advances in yield developed to take advantage of the scale of specialization that could also be brought to bear in the processing industries. However, because of their enormous capital costs, humans had been breeding cattle with great care and for specific purposes for thousands of years. Cattle bred specifically for meat derived from hundreds of hybrids over centuries into a handful of sturdy breeds that we use today. There are still improvements, of course, but the yield for cattle because of specialization was much less in the last century compared to poultry and hogs. In other words, because beef cattle became specialized much sooner, there is less room for productivity gains today.

Likewise, economists have shown that the processing efficiency gains, while increasing in all industries, have increased at a slower rate for beef than for pork and poultry. Yield, breeding, transportation, and logistic gains that resulted from moving chickens and hogs inside into controlled feeding operations do not have the same benefits for a large ruminant. Although the move to mind-bogglingly large cattle feedlots is astounding, it is important to note that nearly all of the cattle in those lots spend one-third to one-half of their lives in a pasture or range before they begin eating grain to fatten them for the packer. Why not specialize by moving calves into feedlots directly? With 155 million acres of federally subsidized rangeland (BLM 2017), feedlots are arguably at a competitive disadvantage for calf feeding, especially during spring and summer months when cheap forage is available to so many in the West. Even outside of the West where private lands exist, rangeland is still relatively cheap. While hogs and poultry can be raised anywhere in confinement, leaving good farmland to be used for profitable crops like corn and soybeans, cattle are raised on land that is already marginal. Moving cattle to feedlots does not free land for other uses because much of that land simply has no other uses.

For these and other reasons that we explain in much more detail in Crespi and Saitone (2018), we find that the current level of contract usage

African Swine Fever in China: An Update

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LAST NOVEMBER, we wrote an article (Shao et al. 2018) documenting the development of African Swine Fever (ASF) in China and its impacts on regional hog and pork prices. Since then, ASF has continued to ravage China's hog industry with 62 new cases from November 1, 2018 to March 27, 2019, resulting in a total of 114 cases. The total inventory of hog factories with ASF outbreaks has increased from 61,214 to 319,726 *(click here to see an animated map of ASF cases in China).* The pace of the outbreaks has somewhat slowed down from more than 20 cases per month in November and December last year to less than 10 cases per month this year. It is possible that the number of cases is greater than that reported, in part because provinces and producers do not have the economic incentive to report. In this article, we update the impacts of ASF on China's hog inventory, pork imports, and future soybean imports.

On January 24, China's government published an updated ASF emergency response protocol (MOA 2019) that shortened the post-outbreak period a facility must wait before resuming production—a sign that government is actively attempting to limit the impacts of outbreaks. However, new cases continue to pop up in scattered locations and in large facilities, suggesting that an effective method to contain the disease is still elusive.

According to official reports, the number of culled pigs is modest—916,000 as of January (Chen 2019)—but recent inventory statistics show a much larger impact. In December, January, and February, hog inventory dropped by 3.7 percent, 5.7 percent, and 5.4 percent respectively, a total of 14.1 percent, or 45 million pigs (see Figure 1). During these three months, sow inventory, which determines production capacity in the next year, also decreased by 13

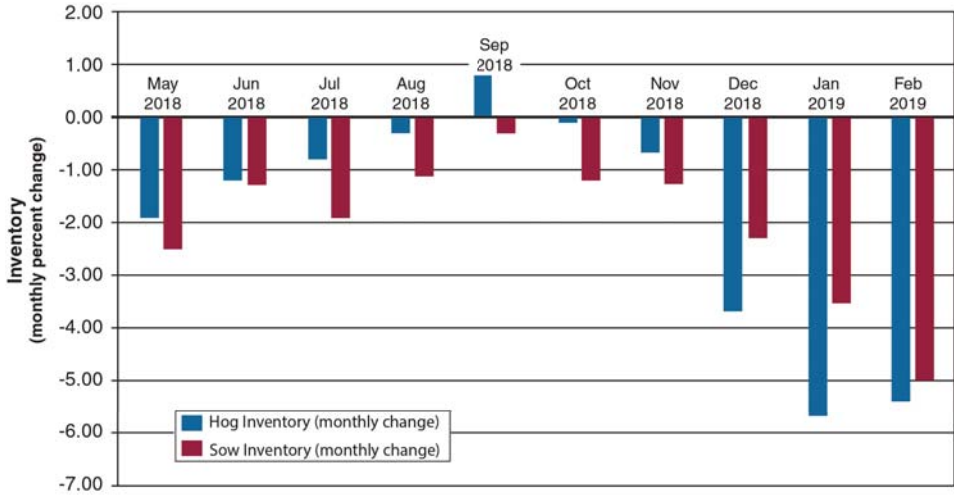

Figure 1. Monthly changes in China's hog inventory
Source: Ministry of Agriculture of China

in cattle procurement might be about optimal for cattle markets today. Of course, markets can change: new trade deals or the need for more stringent labeling, for example, might make contracting more important. Barring dramatic changes to demand, cattle might be at a point on the production function that makes movements to specialization less fruitful and, therefore, creates less need to control throughput into the processing facilities. Specialization may have reached its limit.

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percent, or 4 million sows. As part of its efforts to control the disease, the Chinese government outlawed the feeding of household waste to pigs. It seems likely that the farms relying on this form of feeding are the farms reducing their inventory.

After the ASF outbreak began, the Chinese government restricted cross-province hog and pork transportation (see Shao et al. 2018 for details), which resulted in regional hog and pork imbalance and price divergence (see Figure 2). Arguably, these policies have caused more turmoil than the disease itself. In December 2019, realizing the detrimental effects of complete cross-province transportation ban, the government allowed "point-to-point" live hog transportation from hog farms to slaughterhouses in other provinces (MOA 2018a). The rules for which farms and slaughterhouses qualify for point-to-point transportation favor large producers, which could accelerate the upscaling of China's hog industry. As a result of this relaxation of transportation restrictions and the slowing down of the disease, regional prices substantially converged by February 2019, as seen in Figure 2 (for more detailed graphs see Inouye 2019). China's hog market in the near future will be driven by the overall inventory decline instead of regional imbalance.

The damage of ASF has already significantly influenced China's pork imports. After the initial tariff increase on US pork in April 2018 (Li 2018), pork exports to China reduced to a trickle. In December 2018, US exports to China started to pick up with 7,823 metric tons of pork exported by the first week of January 2019. After several weeks of zero exports, trade resumed with 17,215 metric tons exported in the second week of February 2019. The net sales of 23,846 metric tons in the first week of March was the third-largest weekly sale since USDA started publishing weekly country-specific export data. As of the writing of this article, the total commitment (total export+outstanding sales) of pork export to China is at 142,845 metric tons, almost five times the total export to China last year (Figure 3). Given the high tariffs, the Chinese government is likely behind these purchases, either by directly ordering state-owned firms to buy or by waiving tariffs. In this regard, we note that COFCO, a state-owned enterprise, did not pay a duty on imported soybeans destined for the state reserve.

In recent media reports, it has been suggested that China will purchase 300,000 tons of US pork this year (Mayeda 2019). This may explain the rapid increase in CME lean hog futures contracts. The sustainability

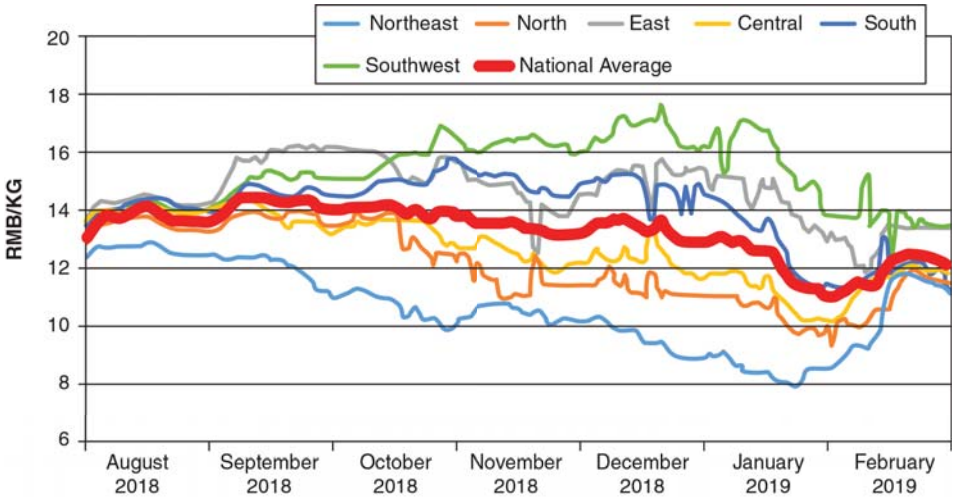

Figure 2. Live hog prices by region

Source: Zhue.com.cn, adopted from Inouye (2019)

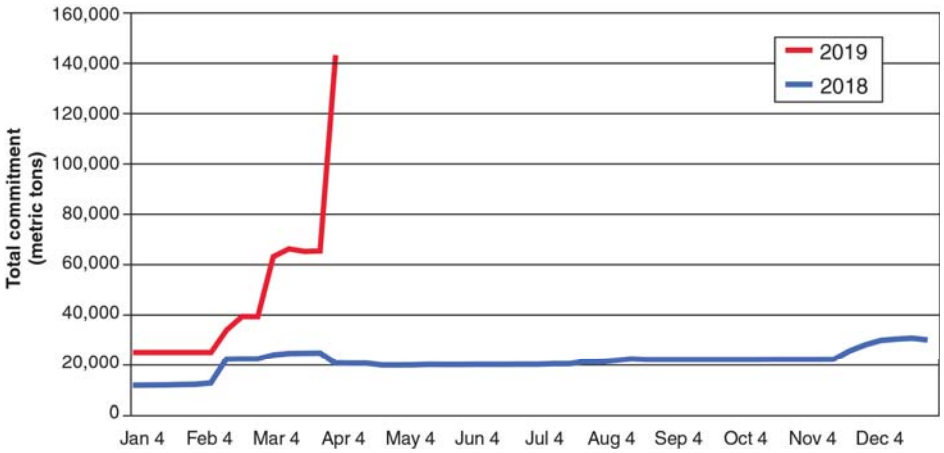

Figure 3. Cumulative pork export from the United States to China

of strong export performance to China will depend on the outcome of the ongoing trade talk as well as export competition from the European Union (EU), which accounted for 76 percent of pork exports to China in 2018. However, the EU's hope of exporting more pork to China this year is clouded by the discovery of ASF in member countries including Belgium, Poland, Latvia, Hungary, and Romania, among others.

While ASF brings opportunities for pork exporters, it is bad news for soybean exporters. According to our estimation, a 14 percent decrease in pork production would lead to a 10 percent decrease in soybean import demand.[1] In addition to the negative impact caused by ASF, the recent change in China's feed protein standard may also decrease soybean demand. On October 26, 2018, anticipating potential difficulty in soybean imports due to the trade war, the China Feed Industry Association published a new feed standard (MOA 2018b) with lower minimum protein requirements for hog feed. Official sources in China have estimated that this policy change could result in an 11-million-ton reduction in soybean meal demand and a 14-million-ton (16 percent) reduction in soybean import demand (MOA 2018b). ASF and the change in feed standard together would result in a 24 percent reduction in soybean import demand.

In summary, the ASF outbreak in China has caused impacts larger than what the official number of culled pigs would imply. China's hog inventory has decreased by 14 percent while sow inventory has decreased by 13 percent. While in the earlier months of ASF the Chinese market was driven by regional imbalance, it is now driven by the sharp reduction in overall herd size. The perspective of shortage and high prices has driven China to import large amounts of pork from the United States despite the tariff. We expect that high imports are likely to continue, especially if trade talks progress smoothly. At the same time, ASF and the reduced feed protein standard may reduce soybean export to China by 24 percent, other things being equal.

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[1]China produced 54.15 million tons of pork in 2018 (PS&D database, accessed in March 2019). Using a feed-pork ratio of 4.5, this level of pork production would require 243.675 million tons of feed. In China, about 20 percent, or 48.735 million tons, of feed is comprised of soybean meal. Since the soybean to soybean meal ratio is about 78 percent in China, producing 48.735 million tons of soybean meal would require 62.48 million tons of soybean. A 14 percent reduction in soybean demand for hog feed translates to an 8.75 million ton reduction in soybean demand. If all that reduction is applied to import demand (88 million tons in 2018), there would be a 10 percent reduction in import demand.

The Yin and Yang of Agricultural Trade

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IT'S A fascinating, but uncertain, time in the agricultural markets. Global and US supplies of agricultural products are at or near record levels. At the same time, global demand for agricultural products continues to grow, pressured by both population and income growth. Markets work to distribute the products across the globe, and government policies can definitely shape that distribution. Myriad new trade agreements, trade disputes, and tariffs introduced over the last 15 months are reshaping global agricultural trade flows. Some of that reshaping has been beneficial to US producers, while some of it has been harmful. Trade policy does not exist in a vacuum—while a tariff may be targeted at one specific country, the tariff's impact can (and often does) spread beyond the borders of the two countries involved, which is true of trade agreements as well. The impacts of the trade agreements are not limited to only those countries within the agreement.

Global trade policy is going through a period of major change. There's the US-China trade dispute, the reworking of NAFTA/USMCA and KORUS agreements, the ongoing tensions from the US steel and aluminum tariffs, the trade challenges over Britain's exit from the European Union, and the establishment of the Trans-Pacific Partnership (TPP) without the inclusion of the United States. These policy changes are bringing some trade partners closer together, pushing some further away, and creating conflicting signals in many cases. To explore recent trade flow changes, we examine export sales so far this year versus at this point last year. The four figures follow the same basic pattern. The first six bars show the export sale

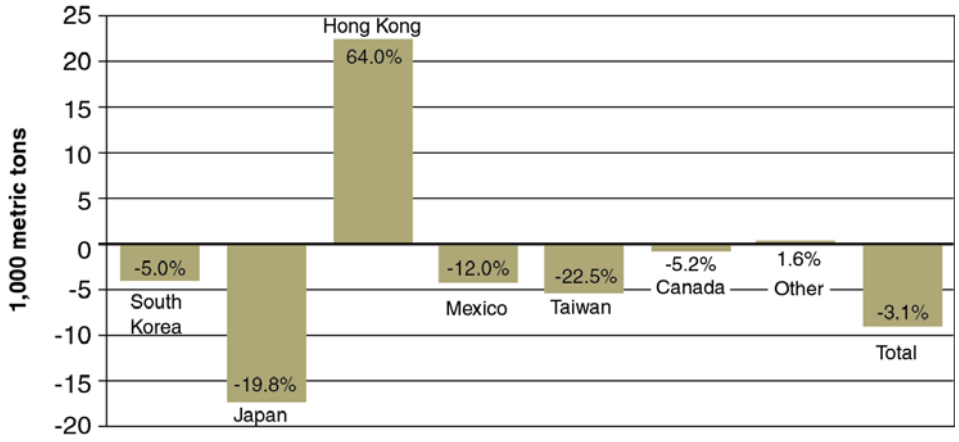

Figure 1. Shifts in US Beef Export Sales
Source: USDA-FAS

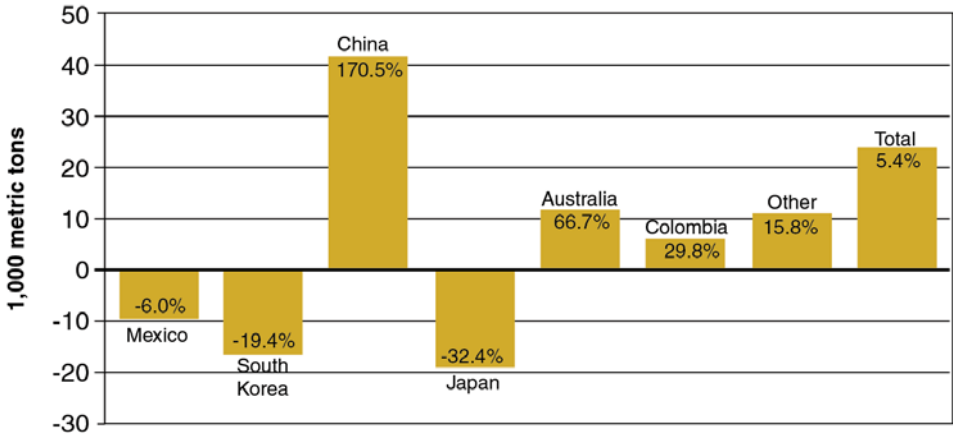

Figure 2. Shifts in US Pork Export Sales
Source: USDA-FAS

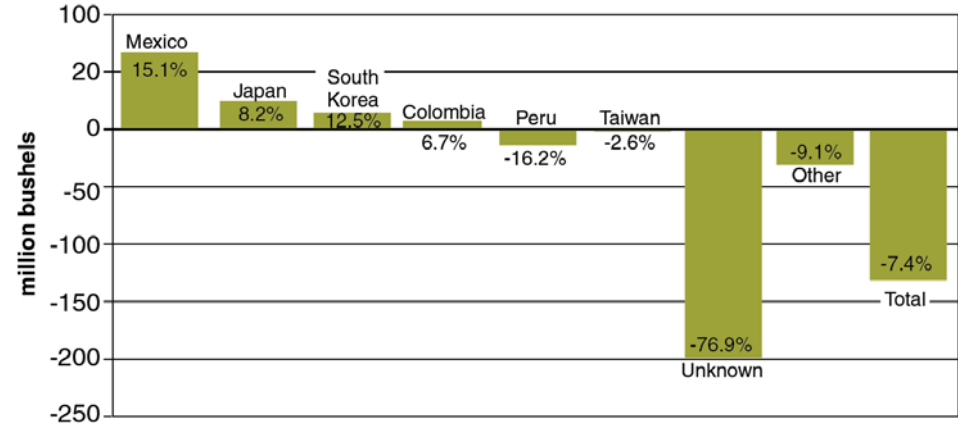

Figure 3. Shifts in US Corn Export Sales
Source: USDA-FAS

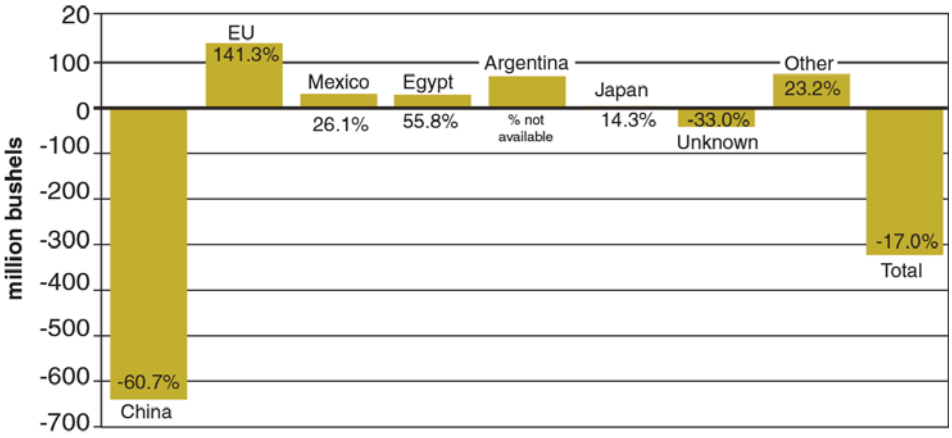

Figure 4. Shifts in US Soybean Export Sales

Source: USDA-FAS

changes to the six largest current export markets for each commodity, listed in order. "Other" shows the export sale changes to the rest of the world. "Unknown" shows the change in sales to unknown destinations (with an export sale, the destination does not have to be listed until the shipment is ready to go). "Total" summarizes the overall change in export sales. The percentage given in each bar is the percent change year-over-year for that country or region.

For the livestock sector, trade has been a positive factor for the past few years. Global income growth has driven meat demand higher and both the beef and pork industries have benefitted from that surge in demand. However, the beginning of 2019 has shown some reversal in that fortune. Beef export sales have dropped by 3.1 percent year-over-year (see Figure 1). While Hong Kong has purchased more US beef, beef sales to our other large markets are down. Some of the reduction was expected—for example, South Korea purchased a record amount of beef last year, partially in preparation for and celebration of the Winter Olympics. However, there is some concern that the progress with the TPP deal is taking a bite out of beef exports. Japan, Mexico, and Canada are all part of TPP, along with Australia, which is another major beef exporter. The lower beef tariffs within TPP are providing opportunities for Australia to gain beef market share at the expense of the United States. But while beef exports are currently down, USDA's projections indicate beef exports could be up by roughly 2 percent at year's end.

The TPP effect may also be showing up in pork exports. Mexico and Japan have reduced their pork purchases from the United States; however, Australia, another TPP member, has expanded its pork purchases. As with beef, South Korea has backed down significantly. But the major shift over the past few weeks is due to China. Throughout 2018, China and the United States have argued about trade and imposed tariffs on each other. When those tariffs hit pork, export sales to China dropped dramatically. During this period, China has also been dealing with the ramifications of African Swine Fever. The Chinese hog industry has significantly culled its herd in an attempt to halt the disease's spread. And while this sizable reduction in pork capacity was expected to force China to expand purchases in the global pork market, those expected sales did not show up as the 2018 calendar year closed. The 2019 calendar year for pork opened similar to beef, with an overall reduction in sales. However, over the past four weeks, the United States has seen a sizable uptick in sales to China. Currently, pork export sales to China are up 170 percent. This increase in sales is happening even though the pork tariff remains in place. It looks as though the African Swine Fever outbreak has finally grown large enough to have major global impacts. Looking forward, USDA expects pork exports to remain roughly 6 percent ahead of last year (see Figure 2).

Shifting to crops, the 2018 calendar year was a mixed bag on the export front. Corn exports were relatively strong, while soybean exports suffered as the US-China trade dispute grew. Export sales so far in 2019 have indicated a further erosion in the global market. For corn, the largest changes have been in sales to unknown destinations. Compared to last year, we have seen a 200 million bushel drop in sales to unknown destinations (see Figure 3). Usually, these sales ultimately end up being shipped to our larger markets. So, while the bars for our six largest export markets are generally headed higher, the reduction to unknown destinations could indicate that this is a short-term illusion.

Meanwhile, for soybeans, the major story is still the dispute with China. While China has made several purchases during the trade truce, the export deficit compared to last year remains incredibly large. The soybean tariffs are responsible for the 600 million bushel plus hole in exports. And as both the United States and China deal with the trade disruption, many other countries are adjusting their soybean trades to compensate, both in terms of quantities and sources. China was very aggressive in the South American soybean markets, displacing traditional customers there. In fact, they were so aggressive that Argentina has had to import soybeans to keep their

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International Trade Policy: Insights from a General-equilibrium Approach

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IT IS easy to convince Iowa farmers that the trade war with China has substantial costs, as current agricultural commodity prices reflect reduced export demand. Rather than bear the burden of retaliatory tariffs, China moved toward other sources and substitutes for soybeans (see related article by Chad Hart and Lee Schultz in this issue of the APR) . The adverse export-demand shock is absorbed within the US market by inventory (and eventually production) adjustments and price reductions, and farm revenues fall as a result. This narrative might well outline the primary mechanism by which many Iowa farmers feel the pain of the trade war, but it is woefully incomplete.

In an effort to explain the impacts, economists often adopt simple market models of supply and demand. However, looking at the market for soybeans (or any other export good or service) in isolation provides an incomplete picture that fails to identify the adverse impacts of the US tariffs on Iowa's farmers, independent of China's retaliation.

The principles that dominate our modern study of international trade were established by David Ricardo over 200 years ago (Ricardo 1817). Ricardo's guidance on how to think about international trade might be viewed in two ways—a great theory that endures because it is correct, or an antiquated idea that needs revision.

Perhaps more importantly, it fails to provide a compelling argument against the trade war beyond the farm. Under the same isolated construct, one might argue that from the perspective of steel and aluminum workers the trade war is exactly what America needs, and the longer it lasts the better.

In this article, I highlight some general-equilibrium principles for thinking about international trade and argue that a general-equilibrium perspective is essential for understanding the impacts of trade disputes. Only from this perspective can we consistently evaluate the benefits and costs of trade policy. The overwhelming conclusion from this perspective is that international trade is net beneficial—the benefits from international trade outweigh the costs when evaluated across all markets.

The principles that dominate our modern study of international trade were established by David Ricardo over 200 years ago (Ricardo 1817). Ricardo's guidance on how to think about international trade might be viewed in two ways—a great theory that endures because it is correct, or an antiquated idea that needs revision. Skepticism around Ricardo's ideas is understandable, especially the strong

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domestic soybean crushing facilities running. It is rare for Argentina to purchase US soybeans, as they are the third-largest soybean producer in the world. Last year at this time, Argentina had purchased no soybeans from the United States (hence, the "% not available" notation on their bar). Several other countries and regions (the European Union, Mexico, Egypt, etc.) have shifted some of their purchases from South America to the United States. Those additional sales have helped close some of the Chinese gap, overall soybean export sales are still down roughly 300 million bushels (see Figure 4).

Exports remain a key feature for US agriculture, but 2019 is starting out fairly rough. The ratification and implementation of the USMCA and KORUS agreements should solidify export sales with three of our largest partners (Canada, Mexico, and South Korea). However, the bigger impacts for 2019 will likely come from two other trade stories, the potential for a deal with China and the impact of the lack of participation in TPP. The TPP fallout may already be showing up in the livestock markets, and the lack of a breakthrough with China continues to cast a shadow over soybeans. ■

conclusion of the gains from trade. Does free trade really generate positive outcomes for everyday people, or is it something the elites promote because it benefits them?

Among economists, Ricardo's theory of trade is best known by the subtle idea that a pattern of comparative (as opposed to absolute) cost advantages is sufficient for gains from trade. That's fine, but what does it have to do with everyday people and does it add to the current policy debate? Frustratingly, a clear statement of comparative advantage requires an almost cartoonish characterization of the economy. We most often adopt Ricardo's construct of a model where the whole world is reduced to two countries (England and Portugal) and two goods (wine and cloth). For the average Iowan, it is probably sufficient to say that Iowa is a good place to grow corn and soybeans and there is international demand for these goods. Similarly, China is a good place to produce photovoltaic solar panels and there is international demand for these solar panels.

So what can we get out of Ricardo's theory that is relevant? First, Ricardo takes a clear general-equilibrium approach. We cannot consider international trade in wine without thinking about how this interacts with other markets. Second, the Ricardian model takes a distinct barter approach to international trade (e.g., England trades cloth for Spanish wine or Iowa trades soybeans for photovoltaic solar panels). Again, this is a bit cartoonish, but the barter approach provides an important simplification that facilitates a deeper understanding of critical issues like trade deficits (as discussed later) and the distribution of the gains from trade. Clearly, the gains from trade will not be distributed equally among countries or people within those countries. Modern extensions of general-equilibrium theory, in fact, show clear groups of winners and losers (Stolper and Samuelson 1941). A general-equilibrium model only shows that within a country the benefits to the winners are greater than the costs to the losers. In an ideal world we could redistribute the gains through a clever tax policy. While international trade clearly has distributional impacts, trade restrictions are a poor choice for redistribution—the general-equilibrium approach clearly shows that direct subsidies achieving the same level of production are less costly than tariffs.

The general-equilibrium approach is also particularly useful in dispelling some popular misconceptions about trade. The following statements are easily falsified under the most basic general-equilibrium trade models:

1. Exports are good, and imports are bad.
2. Trade is a zero-sum game.
3. Countries lose when they trade with low-wage countries.
4. Countries lose when they trade with distorted or planned economies.
5. Small countries lose out to large countries in trade.
6. Trade deficits will be reduced by tariffs.
7. Trade deficits represent a country's losses from trade.
8. The gains from trade are higher for a country that has a trade surplus.
9. Trade wars can be won.
10. It is easy to win a trade war.

Trade imbalances are the most misunderstood and misused statistics in all of trade policy. Trade deficits sound bad, and some politicians leverage this for their benefit. Once we consider trade deficits through a general-equilibrium lens they are not so scary. International trade economists tend not to be worried about trade deficits, due to trade deficits being largely separable from tariffs and other trade policy distortions that are harmful.

So what is a trade deficit and what does it mean? First, we need to understand that the trade balance is a component of an important general-equilibrium accounting identity—the balance of payments. The balance of payments is essentially a ledger of a country's international transactions, and just like standard accounting, every debit is accompanied by a credit. If I sell a zucchini at the local farmer's market for $1 my CPA would say there is a $1 debit to my vegetable account and a $1 credit to my cash account. The balance of payments does this type of accounting for a country's imports and exports, although it is a bit more complex because trade partners use different currencies.

Let us examine how the balance of payments works. Imagine the United States wants to buy a solar panel from China. Which currency is used in the transaction, dollars or yuan? Let us say that China is willing to accept payment in dollars. Solar panel producers in China, however, have to pay for inputs in yuan, so why *would* the Chinese accept dollars? There are really only two possibilities. First, China may want to buy something that dollars do buy, like US produced soybeans. Second, they may want to hold dollar denominated assets as an investment (e.g., a bond). If the original purchase was in yuan the outcome is the same—the US must acquire yuan by selling goods or services (soybeans) or an asset (bonds) to China. In this example, the balance of payments states that

the value of US imports of solar panels minus the value of soybean exports must equal the number of bonds sold to foreigners. Imbalanced trade does not mean that some country gets something for nothing, and it does not mean that some country wins relative to another. Imbalanced trade simply means that a country is engaging in normal economic activities—borrowing from or lending to the rest of the world. Some may contend that borrowing is bad, but is it really? Are mortgages bad? What about equipment loans? Borrowing is only bad, even over a long horizon, if the interest you pay exceeds your discount rate, but if that were true the remedy is simple: don't borrow.

In a general-equilibrium model, asking why the United States has a trade deficit is equivalent to asking why foreign countries like holding dollar denominated assets; or, equivalently, why the United States sells so many high-quality bonds. To the extent that aggregate US savings rates are relatively low, which is partially driven by the expanding government budget deficit, we will have a trade deficit. In Ricardo's general equilibrium everything is connected; thus, soybean demand depends on Chinese tariffs, but it also depends on US import tariffs and how many bonds we need to sell to foreigners to finance our tax cuts.

These theoretical discussions are understandably tiring, so let's look at some real numbers. In 2018, I joined a team of researchers in measuring the economic impacts of the trade war using a detailed general-equilibrium simulation model. See Balistreri et al. (2018) for the full study, including appropriate caveats associated with particular assumptions and results. To illustrate the findings, I reproduce here the impacts on real US Gross Domestic Product (GDP) decomposed into expenditure categories and income by sector (including tax payments). Table 1 shows that the overall impact is a loss of $67 billion in GDP. The sectoral income decomposition clearly shows the distributional impacts—gains in electronic equipment manufacturing and ferrous metals and losses in oil seeds (e.g., soybeans) and meat products (e.g., pork and poultry). The general-equilibrium perspective on international trade is particularly useful in this context because it considers all impacts of the new tariffs, provides a consistent assessment of the winners and losers, and measures the net loss in income.

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Table 1. US Real GDP Impacts Decomposed

Expenditures	Benchmark (billion $)	Change (billion $)	Change (%)
Consumption	12,122	-123.7	-1.0
Investment	3,439	83.0	2.4
Government	2,601	-11.3	-0.4
Net Exports (X-M)	-802	-14.7	1.8
Total	17,360	-66.8	-0.4

Income by Sector		Benchmark (billion $)	Change (billion $)	Change (%)
osg	Public administration, defense, health, education	3,746	-38.8	-1.0
trd	Trade	2,244	-26.7	-1.2
obs	Business services nec	1,718	-2.4	-0.1
dwe	Dwellings	1,541	-17.4	-1.1
ofi	Financial Services	1,323	-3.6	-0.3
cns	Construction	1,125	-8.8	-0.8
ros	Recreation and other services	589	-7.2	-1.2
ome	Machinery and equipment nec	576	19.5	3.4
crp	Chemical, rubber, plastic products	461	2.7	0.6
cmn	Communication	372	-1.1	-0.3
isr	Insurance	362	-0.1	0.0
otp	Transport	324	-1.2	-0.4
ppp	Paper products, publishing	274	-0.6	-0.2
fmp	Metal products	193	1.8	0.9
mvh	Motor vehicles and parts	177	-0.5	-0.3
ele	Electricity	196	-2.2	-1.1
ofd	Food products nec	166	0.2	0.1
cru	Crude oil	169	4.7	2.8
lum	Wood products	153	0.6	0.4
otn	Transport equipment nec	139	-2.7	-2.0
atp	Air transport	104	0.5	0.5
eeq	Electronic equipment	100	13.2	13.2
nmm	Mineral products	89	0.5	0.6
i_s	Ferrous metals	78	8.6	11.0
tex	Textiles	78	0.2	0.2
wtr	Water	76	-0.9	-1.2
omf	Manufactures nec	67	-0.7	-1.1
b_t	Beverages and tobacco products	66	-0.9	-1.3
nfm	Metals	53	1.1	2.0
wap	Wearing apparel	48	0.1	0.3

Income by Sector (continued)		Benchmark (billion $)	Change (billion $)	Change (%)
oil	Petroleum, coal products	47	0.9	1.9
col	Coal	45	-0.9	-2.1
wtp	Sea transport	43	-0.2	-0.5
gdt	Gas manufacture, distribution	38	-0.1	-0.4
cmt	Meat: cattle, sheep, goats, horse	38	0.2	0.5
gro	Cereal grains	33	-0.7	-2.1
omn	Minerals nec	32	-0.5	-1.4
mil	Dairy products	32	0.0	0.1
omt	Meat products nec	30	-0.3	-1.1
v_f	Vegetables, fruit, nuts	25	0.0	0.1
ocr	Crops nec	20	0.3	1.5
osd	Oil seeds	20	-3.5	-16.9
gas	Gas	18	0.6	3.2
frs	Forestry	15	-0.2	-1.3
oap	Animal products nec	12	-0.4	-3.3
lea	Leather products	12	0.6	5.0
ctl	Cattle, sheep, goats, horses	11	-0.2	-1.6
rmk	Raw milk	7	-0.2	-2.7
wht	Wheat	7	0.5	7.7
fsh	Fishing	4	0.0	1.0
sgr	Sugar	4	0.0	0.6
vol	Vegetable oils and fats	4	0.1	2.1
pfb	Plant-based fibers	3	-0.2	-5.2
c_b	Sugar cane, sugar beet	2	0.0	-1.9
pdr	Paddy rice	1	0.0	-0.8
pcr	Processed rice	1	0.0	1.2
wol	Wool, silk-worm cocoons	0	0.0	23.1
c	Consumption (tax)	212	-2.1	-1.0
i	Investment (tax)	36	1.7	4.6
g	Government (tax)	0	0.0	0.5
Total		17,360	-66.8	-0.4

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