Economic Impacts of COVID-19 on Food and Agricultural Markets

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Introduction

By Keith H. Coble

It is my great pleasure to offer an introduction to this insightful set of essays resulting from a quickly organized but well thought out collaboration between the Council for Agricultural Science and Technology (CAST) and the Agricultural and Applied Economics Association (AAEA). It has been a pleasure to see the "nimble'"action of these two organizations. I hope that these essays will provide new thinking regarding COVID-19, and inform future policy discussions.

COVID-19 disrupted nations around the world in 2019 and 2020. It continues to cause death and economic damage in many countries. The changes in lifestyle and measures to reduce the spread of COVID-19 have signif cantly altered economic activity, employment, food consumption, and workplace environments. Dorfman discusses the broad macro-economic impacts that signif - cantly affect the food and agricultural sector. In a companion article, Featherstone examines the agricultural f nance issues that arise during and related to COVID-19.

U.S. urban health care issues commanded early attention during the outbreak, but then the limited resources of rural health care became a concern. In her article, Davis focuses on the needs and issues for rural health care. Aside from the signif cant health effects, COVID-19 also had many specif c impacts on our food and agricultural sector. Importantly, the effects of the pandemic have occurred worldwide impacting food systems and international trade (Sheldon and Grant).

While many may argue whether this was or was not a 'black swan' event, the particular form of COVID-19 strained our food and agricultural sector in ways that few had contemplated. Massive unemployment and quarantining suddenly altered the demand for food and the mix of food products demanded (Lusk and McCluskey). For example, the dramatic downward shift in disposable income strained social safety nets (Gunderson). Concurrently, demand shifted from food away from home to food at home (Richards) and caused signif cant food waste (Ellison, McFadden, Rickard, and Wilson).

Between food producers and consumers lies a complex and often-ignored food supply chain. It is ignored in part because it has consistently provided safe and plentiful food supplies. Iyar illustrates and discusses the unique nature of these supply chains. Often our attention has been focused on food-borne illnesses and the ability to convey desired food attributes to consumers. However, the pandemic turned our attention to the pandemic's human health effects and shutdowns affecting the labor supply (Charlton). This has led to many questions regarding the structure of our food supply chains and various what-if questions of alternatives. Tonsor and Schulz examine these questions specif cally in relation to the meat supply chain, one of the sectors of the agricultural economy most affected by the pandemic.

Because of the difference in the various supply chains, implications for farmers and landowners have varied as well. Hubbs and Irwin address major commodity markets while Tanger addresses the forestry sector. Thilmany McFadden and Malone focus in on local food systems that are shorter and generally simpler supply chains. These represent an alternative to the larger traditional supply chains.

Finally, we end with two companion articles that posit ideas for our research and outreach agenda in the future. Nayga and Zilberman answer the question of what are the relevant research questions given COVID-19. Anderson, Maples, and Low provide a parallel examination of the outreach and Extension efforts needed in light of the pandemic. Ultimately, we hope the insights offered here will provide some understanding of the shocks to our food system and ultimately some guidance for positive actions that might address the challenges as we move forward.

Macroeconomic Impacts and Policies in the Face of COVID-19

By Jeffrey Dorfman

In an effort to slow the spread of a worldwide pandemic, most countries shut down large segments of their economies (tourism, restaurants and bars, entertainment venues, personal service businesses, and many manufacturing facilities) and reorganized many other industries with most employees working remotely and retail establishments operating only through take-out and delivery channels. This led to a sharp and signif cant loss in gross domestic product (GDP) and a rapid rise in unemployment and underemployment as workers were either placed on unpaid leave or worked reduced hours. These public health-centric policies succeeded in bending the curve of the pandemic enough to keep hospitals from being overwhelmed but came at a considerable economic cost (Thunström et al. 2020). Now the challenge is to restore as much economic activity as possible while maintaining some measure of control and mitigation of the novel coronavirus. This will require new and innovative economic research and policy-making.

The federal government responded to what was the f rst-ever intentionally government-caused recession with unprecedented emergency f scal policy. Money has been appropriated by Congress for medical research, healthcare costs, additional unemployment insurance payments, forgivable loans to small businesses, and loans or bailouts for larger corporations. In addition, the Federal Reserve has actively used monetary policy and intervention in f nancial markets to maintain liquidity, support asset prices, and keep f nancial markets functioning smoothly. The hope is that these policies will minimize business and personal bankruptcies by ensuring that individuals and small businesses have cash to pay their bills, larger businesses have access to inexpensive capital, and payrolls are maintained as much as possible.

There have been some large company bankruptcies, mostly large brick-and-mortar retailers, but not yet a wave. While 40 million initial unemployment claims have been f led, 80% of those workers have reported their layoff is temporary, not permanent. Plus, roughly three-quarters of these claims are for reduced earnings, not complete unemployment. If these results hold for another month or two, the initial round of economic policy may have stemmed the tide.

Now we are moving into the second phase of the pandemic-initiated economic slowdown: a period in which we don't yet have a vaccine or a cure but need to reopen the economy and tread carefully toward economic normality. Even if governments could afford to f nance their economies endlessly through debt or monetization, we cannot consume without production, so economic activity must resume as much as is safely possible. In this phase, U.S. economic policy is likely to be more diff cult to get "right."

As we enter this tricky policy phase, Washington is mostly divided by party. For the most part, Republicans want to assist businesses to stay af oat and help them afford to keep employees on payrolls. In contrast, the consensus Democrat position is to continue generous unemployment

payments so workers can stay safely at home and provide aid to state and local governments so they can maintain their services to their residents and their payrolls (which are generally the largest local employers when schools are included in local government).

State and local governments face a large loss in tax revenue from reduced retail sales (hence, sales tax) and the inevitable erasure of corporate prof ts to be expected even in the most optimistic of economic outcomes. Because state and local governments must balance their budgets, absent federal (debt-f nanced) aid, state and local governments will be forced to either cut services (and payrolls), raise taxes, or both. Given that such actions will work against federal policy to support and stimulate the economy, state and local government aid should be a federal priority to avoid different levels of government taking economic actions that offset each other.

To further aid in a gentle transition back toward economic normality, federal economic policy will have to shift from sending families money to maintain social distancing to helping businesses maintain employment. The Paycheck Protection Program of loans to small businesses has been extended already to give business up to 24 weeks (compared to the original 8) to spend at least 75% of the money on payroll costs and thereby qualify for loan forgiveness. If the unemployment bonus of $600 per week from the federal government were also to continue, perhaps even to its original ending in July, businesses will face great diff culty in reopening because many workers are currently making more from unemployment than from working, particularly in the retail, hospitality, and personal services sectors that are home to so many small businesses. With the unemployment bonus, not working can pay the equivalent of about $50,000 per year right now. Few small businesses can compete with that when roughly half of all workers made less than that just a few months ago. A compromise during the transition would be to pay the $600 per week until July to all workers who suffered unemployment, even if they return to work.

The f nal policy instruments needed for a full recovery are those directed toward restoration of consumer conf dence. We can recover to an economy in a normal recession, not a depression, quite rapidly simply by ending the most severe stay-at-home orders, but employment and incomes won't fully recover until customers feel safe returning to restaurants, local shops, movie theaters, amusement parks, airplanes, and hotels. Until a vaccine and/or effective treatments are widely available, the best conf dence restorer will be clearly posted and followed safety protocols that minimize the risk of frequenting public businesses and maximize the amount of economic activity that can safely take place. But a full recovery requires either a vaccine or treatment that convinces people contracting the virus is more a nuisance than a mortal risk.

Still, while a complete economic recovery depends on the pharmaceutical industry, in the meantime economic policy will make a difference. The right policy choices can minimize the economic pain and help millions of American families and businesses get back on their feet again.

Global Trade in Agricultural Products: The Likely Impact of COVID-19

By Ian Sheldon and Jason Grant

COVID-19 has resulted in a reappraisal of global economic prospects. The World Trade Organization (WTO) forecasts signif cant declines in both the real value of global GDP and volume of trade in 2020, with economic recovery in 2021 being dependent on uncertainty about the duration of the pandemic and measures used to contain it. The WTO gives three scenarios for recovery: V-shaped, U-shaped, and L-shaped, based on how long containment measures remain in

place (WTO 2020a)[1]. Relative to the pre-pandemic baseline, real global GDP is forecast to decline in 2020 by -4.8%, 9.2%, and -11.1%, respectively, for the three scenarios. Forecast rates of recovery in 2021 are 4.2%, 8.1%, and 2.8%, respectively.

The decline in economic activity is expected to be accompanied by a substantial decline in trade that could exceed that recorded during the 2008-09 f nancial crisis. The real value of exports in 2020 is forecast to decline by -8.1%, -16.5%, and -20.4% under the three WTO scenarios. Although agricultural trade is not expected to be hit as hard as other sectors, the WTO predicts a signif cant reduction in the real value of exports by -6.5%, -11.2%, and -12.7% across the scenarios.

COVID-19 and Year-To-Date Trade Impacts

Table 1 shows for the f rst 3–4 months of 2020, total imports from and exports to the rest of the world by China, the United States, and European (EU)-28. EU-28 reports the largest decline in 2020-Q1 imports at -6.5%; China's total imports, through April 2020, are down nearly -6%, followed by the United States (through March) at -5.24%. While year-to-date changes through March in reported exports to the world are slightly lower for the United States, -2.3%, and EU-28, -2.15%. China's exports, updated through April 2020, have been more affected, falling by -9.0% in aggregate. At the time of writing though, agricultural trade does not appear to have been affected as much. China's agricultural imports (exports) through April 2020 are 10.5% (2.8)% higher compared to 2019, perhaps in part because of lessening United States-China trade tensions; U.S. agricultural imports (exports) are 4.3% (1.5)% higher, and EU-28 agricultural imports (exports) are 0.36% (5.3)% higher compared to 2019. Therefore, while total trade numbers through March-April of 2020 are broadly consistent with WTO projections, agricultural trade appears to be holding up quite well for this group of countries.

	China (Jan-Apr)	United States (Jan-Mar)	EU-28 (Jan-Mar)
Total Imports (all products)			
Year-to-Date %Δ in Imports relative to 2019	-5.97%	-5.24%	-6.50%
Largest % drop in bilateral trade among top origin countries	*Germany*	*China*	*Russia*
	-12.5%	-29.00%	-13.00%
Total Exports (all products)			
Year-to-Date %Δ in Exports relative to 2019	-9.00%	-2.30%	-2.15%
Largest % drop in bilateral trade among top destination countries	*UK*	*China*	*China*
	(-21.9%)	(-14.5%)	(-10.3%)

Table 1. Year-to-Date Percentage Changes in Total Merchandise Trade Relative to 2019.
Source: Authors' calculations from *Trade Data Monitor*.

[1] Note that other scholars suggest the possibility of a W-shaped recovery. See interviews with Carmen Reinhart and Kenneth Rogoff (bloomberg.com/news/features/2020-05-18/harvard-s-f nancial-crisis-experts-this-time-really-is-different), and Jeffrey Frankel (https://apnews.com/adab99c1d674ea016630103b4a66f5e8).

The Interplay of COVID-19 and US-China Trade Tensions

The longer-run impact of the pandemic on agricultural trade should, however, be placed in context: trade was already slowing down because of escalating political tensions, lower economic growth (IMF 2019), and the 2018 "trade war" which began with a series of unilateral policy actions by the United States against China and other trading partners (Fajgelbaum et al. 2020)[2]. While several affected countries f led complaints with the WTO, many retaliated with tariffs on a total of 8,073 products covering $127 billion of annual US exports (Amiti et al. 2020).

The U.S. agricultural sector was disproportionately affected by retaliation. Average tariffs increased from 8.3% to 28.6% on 908 products accounting for $32 billion worth of U.S. exports (Grant et al. 2020; Carter and Steinbach 2020). Tariff increases by a large country usually depress world prices, as occurred with China's retaliatory soybean tariff, resulting in a transfer from exporting to importing country(ies) (Adjemian et al. 2019). This terms-of-trade externality implies that unilateral tariff-setting is globally ineff cient, real consumer income losses generally not being offset by producer gains. These tariffs also had a signif cant impact on agricultural trade: the United States saw a reduction in its exports to retaliating countries of $15.6 billion (*trade destruction*), which was only partially offset by increased exports to countries that did not implement tariffs (*trade def ection*); and, non-retaliating countries saw an expansion of their exports to retaliating countries of $13.5 billion (*trade diversion*) (Carter and Steinbach 2020).

China's role in trade destruction and diversion has been prominent. Figure 1 plots the 2016/17 and 2018/19 agricultural marketing year (September-August), monthly values of combined exports to China by the EU-28, Brazil and Argentina (BRAR), and Australia and New Zealand (AUNZ) alongside the monthly value of U.S. exports to China. The dotted lines trace export values to China in a typical marketing year before the dispute (2016/17), and the solid lines represent export values to China during the dispute (2018/19). While trade diversion to the EU-28, BRAR, and AUNZ (green shaded area) is not a perfect one-to-one displacement of what is normally the United States' peak export marketing period, Figure 1 shows clearly the shift in

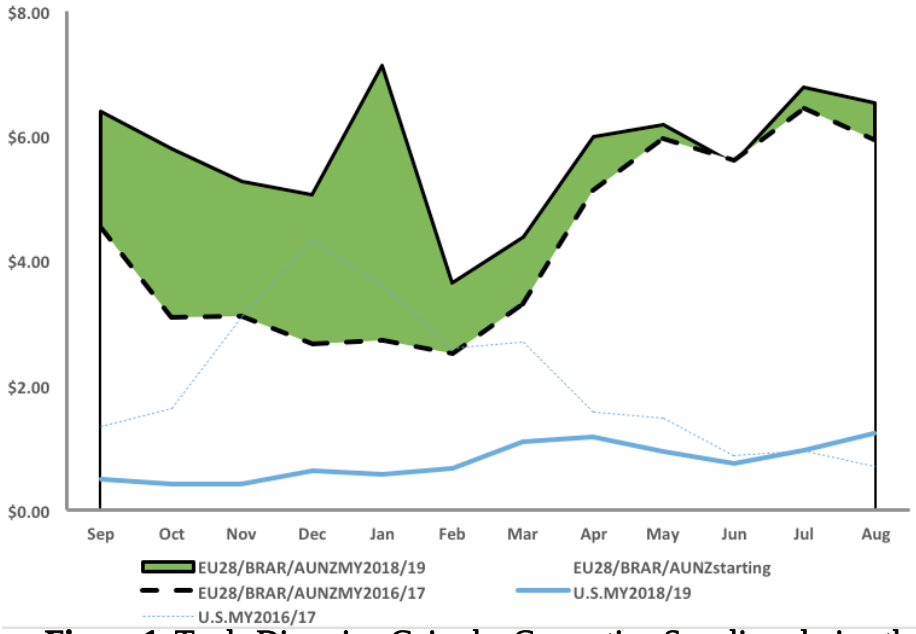


Figure 1. Trade Diversion Gains by Competing Suppliers during the US-China Trade Dispute, MY 2016/17 through MY2018/19 ($ Billion).
Source: Author's calculations from *Trade Data Monitor*.
Notes: EU28 denotes the 28 member countries of the European Union; BRAR denotes Brazil and Argentina; AUNZ denotes Australia and New Zealand. Marketing years (MY) for the US and other Northern Hemisphere countries typically run from September 1 through August 31 of the following year.

[2]In 2018 alone, the U.S. increased tariffs on a total of 12,043 products covering $303 billion of its annual imports.

sourcing of China's imports during the dispute. At the peak of this shift in January 2019, China imported 2.6 times ($7.1 billion total) more from competing suppliers compared to January 2017. The loss of market share in China has been particularly acute for US soybean exports, the value of which fell from $12.2 to $4.5 billion over 2017-19[3].

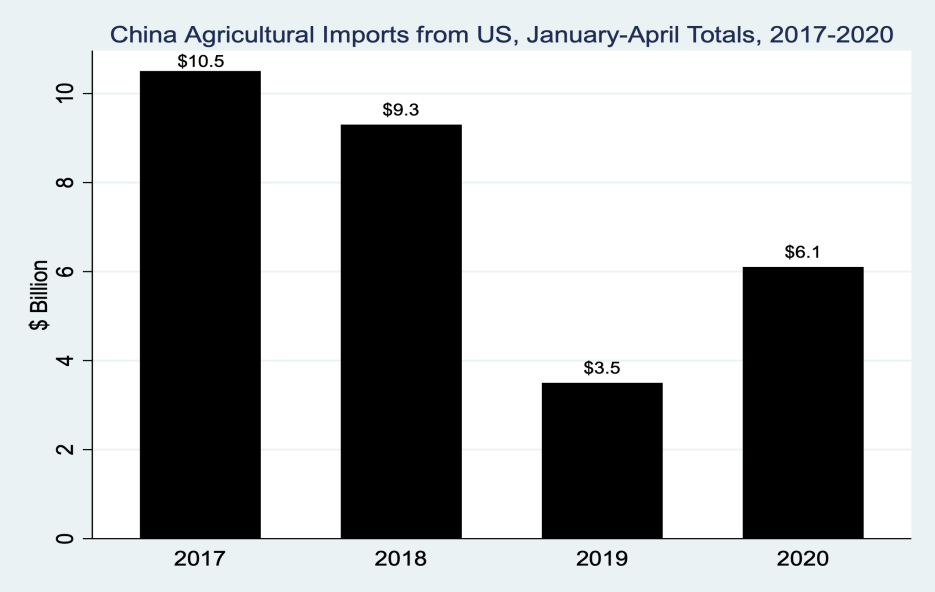


Figure 2. China Agricultural Imports from the US, January-April Totals, 2017-2020.
Source: Authors' calculations from *Trade Data Monitor*.

Given its political in-f uence, agriculture was a critical component of the Phase One Trade Agreement between the United States and China that went into effect on February 14, 2020. Specif cally, China committed to purchasing an additional $12.5 and $19.4 billion worth of U.S. agricultural products above 2017 levels in 2020 and 2021, respectively. Even before the pandemic, many observers suggested that meeting such growth targets would be diff cult (The Economist 2019)[4]. Based on China's growth rate before the pandemic, it has been predicted that by 2021, there will be a shortfall of $11.7 billion in U.S. exports relative to the target, and based on a declining trend projection for U.S. exports, the shortfall will be even larger at $24.8 billion[5]. As described in Figure 2, this expected shortfall is already borne out in the January-April China Customs Statistics. While improving on 2019 totals at the height of the dispute, 2020 January-April totals of $6.1 billion suggest U.S. agricultural exports are running at only 58% of the Agreement's 2017 baseline[6].

Given the WTO's forecast for growth in China's 2020 real GDP of -4.0%, -7.9%, and -9.9% over their scenarios, it seems unlikely it will meet its import commitments under the Agreement, and even if it were able to do so, it implies signif cant distortion to agricultural trade. Depending on what is assumed about the growth rate of U.S. agricultural exports to China, the latter's implicit import subsidies have been estimated to range from 12% to 23% up to 42% to 59% if China is to meet the 2020 and 2021 targets respectively (Feenstra and Hong 2020). Importantly, such implicit subsidy rates would result in a signif cant amount of trade diversion away from other exporting countries. As a practical matter, though, it is unrealistic to expect that Chinese state-owned enterprises (SOEs) could meet these import targets either with or without the pandemic.

A Return to Agricultural Protectionism?

Concerns have also been raised about the use of export policies to ensure food security during the pandemic (Glauber et al 2020). Data from the World Bank, Market Access Maps, and Global

[3] Brazil was the key benef ciary from trade diversion between the US and the rest of the world with soybean exports to China initially increasing from $20.3 billion in 2017 to $27.3 billion in 2018, before falling back in 2019 to $20.5 billion because of the outbreak of African Swine Fever in late 2018 (Statista 2020; Schott 2019; Nti et al. 2019)

[4] For example, former USDA Chief Economist Joe Glauber (The Economist, December 14, 2019).

[5] See Bown (January 21, 2020).

[6] See Bown (May 18, 2020).

Trade Alert as of late-April indicate 17 countries have implemented a total of 40 policy constraints on agricultural exports (WTO 2020b). For example, Vietnam stopped granting rice export certif cates through the end of March. While these policies have typically been used as a precautionary response and subsequently removed, their widespread application to staples such as rice and wheat could result in world price effects similar to the food price crisis of 2007-08 (Martin and Glauber 2020).

The economics of this are straightforward: if policymakers restrict exports of a staple to cap domestic prices, this will drive up the world price, while at the same time reducing the price received by producers in the exporting country(ies) (Sulser and Dunston 2020). If enough exporting countries do this, and importing countries either remove tariffs or subsidize imports, there is a collective action problem: countries implement "beggar-thy-neighbor" policies that ultimately makes all countries worse off. A key difference between now and the 2007-08 crisis is that staples are not in short supply, global stock-to-use ratios are close to the median value of the past two decades, global harvests are expected to be good, and world prices are stable. Therefore, if countries avoid intervening in markets, trade should minimize the risk of shortages during the pandemic.

Recent history of trade policy, though, suggests that the retreat from multilateralism by the United States and China, and the fact that the WTO's Appellate Board is currently in limbo, are likely to have a major impact on agricultural trade well beyond the pandemic. The U.S. adoption of a "power-based" approach to bargaining over trade, necessarily resulted in a more than proportional response by China (Mattoo and Staiger 2019). Subsequently, the United States and China's bilateral approach to trade negotiations has had, and will continue to have, a signif cant impact on agricultural trade f ows.

Nevertheless, as rhetoric over China's role in the pandemic heats up, there is the risk that U.S.-China trade relations break down altogether, and at the same time other countries enter a tug-of-war of polarizing policy responses (Orden 2020; Kerr 2020). The pandemic could lead to a pro-trade liberalization stance, minimizing future disruption of supply chains. Alternatively, anti-globalization sentiments could see attempts to reduce dependence on imported staple foods.

Supply Chain Issues

By Anath Iyer

Grocery Supply Chains

Grocery supply chains focus on getting products from the farm to the customer's home for consumption, and face intense retail competition. U.S. customers have benef ted from signif cant retail variety, with large retail stores carrying between 30,000 and 40,000 stock keeping units (SKUs). Retail and upstream competition have ensured low prices for food across many decades, with retail gross margins of around 25% and net margins of around 2% for food retailers. Figure 3 shows a variety of paths taken by products to reach the retail consumer.

There are at least three different f ows: (1) from the farm through distributors and warehouses to the store for fresh produce, (2) from the farm to a processor (e.g., meats or canned vegetables) to the store, and (3) from the farm to a fast-moving consumer goods plant (for example potato chips or cereal) to the store. These f ows have different degrees of automation, with ordering aided by

software and optimization to ensure that consumers face high in-stock levels while the system is eff cient in the level of inventory carried. The main steps with low levels of automation are the picking process at farms, the meat processing, trucking and store shelf restocking and checkout. Warehouses have seen signif cant adoption of automation because of the growth of e-commerce.

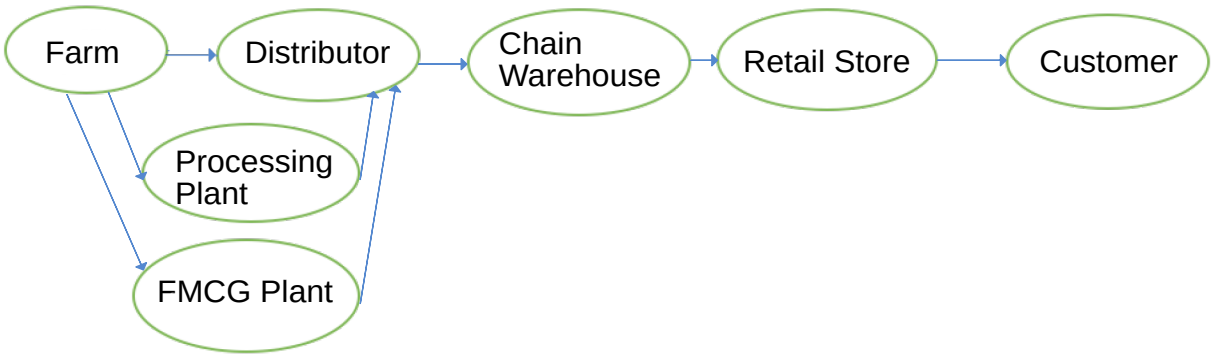


Figure 3. Products can reach consumers in many different ways.

Before the pandemic, consumers were accustomed to frequent grocery promotions, which enticed them to stockpile soup or f our on sale. Manufacturers offered trade promotions to retailers to get them to purchase in bulk and relied on stock pressure to cause retail promotions. And consumer segmentation at the retail store enabled those with a higher stockpiling propensity to f ll up their pantries with items on promotion to garner low average prices.

COVID-19 created an environment where there was a signif cant supply chain shift of food consumption—away from schools and restaurants to the home. With food away from home accounting for close to 50% of total expenditures, this required a signif cant shift for upstream providers of f our, yeast, toilet paper, and potato chips from industrial volumes and packs to retail order sizes. At the same time, consumers decided to stockpile food to compensate for supply worries (i.e., will product be available, will they be able to get to the store, etc. and demand increases because of more food consumed from home, worries about price increases, etc.). This demand shock and supply inf exibility created stress in the supply chain.

But manufacturers and retailers across the supply chain have responded. Retailers permitted customers to order online and pick up in parking lots with no fees, e-commerce merchants delivered to homes, and retailers reserved select time slots for vulnerable customers to shop. The surge in customers shifting to online ordering may result in the online channel or retailers remaining a signif cant portion of overall sales even after the pandemic. This increase on curbside pickup has even enabled some retailers, like Walmart, to grow the number of new customers to their locations, with larger dollar purchases per trip.

Manufacturers adjusted variety to enable higher demand items to be produced in larger volumes. For example, Frito-Lay decreased variety 21% to accommodate increased snack consumption. Consumers also started buying directly from f our mills in larger volumes (25 lb. bags instead of 5 lb. bags of f our), from community farms etc., as e-commerce enabled them to source different items from locations further away.

The vulnerability exposed during this period was the clash between demand satisfaction and the low automation steps (i.e., the large labor content manifest in employees at farms, meat proces-

sors, truckers, and retail stores). As these employees interacted with each other and with customers, their exposure to the virus had signif cant health consequences. The impact has been a change in the retail store to focus on cleanliness, regulating store traff c, one way lanes, self-checkout, etc., all transforming the retail experience. There are many open questions regarding how to make this supply chain more resilient. Will automation adoption increase? Will production be moved to smaller facilities that are more decentralized, yet eff cient, because of automation? How will customer retail experiences change?

Stores have also increased their adoption of robots for inventory tracking and price accuracy, started deploying kitting systems to pick and pack online orders, adjusted their software to permit app-enabled order history and substitution preferences, etc. They have converted some of their stores to lights-out warehouse locations to serve customers. And they have provided a blueprint for retail recovery, such as Kroger's sharing of their best practices.

How will the pandemic impact grocery supply chains? Consumers who are used to fruits and vegetables year-round require a global supply chain. As trade frictions and transport delays become the norm, fresh may need to be replaced by canned produce. But demands for fresh items may bring back reliance on local farms, particularly if consumers become aware of the sustainability impact of their choices. This may prompt the growth of sustainability indices, developed by retailers or manufacturers, to highlight the environmental impact of their supply chains. It may even increase the variety of fruits and vegetables and enable restoration of local taste preferences. But automation of the retail experience, robots in the farm and further deployment of robots both in the warehouse and to more frequently clean retail stores can be expected to be the norm for most stores.

But the role of the retailer in convincing the consumer to remain loyal will continue to require competitive prices and large variety, as well as exceptional service. Whether these services will include subscription models for staple items (i.e., automatic delivery following a scheduled frequency, or sensor enabled consumption tracking, include drone for low-weight deliveries, include fresh cut partially processed meals) remains a reality that only time will tell. But one thing can be expected to remain the same (i.e., intense retail competition, offering high variety couple with low grocery prices).

Consumer Behavior during the Pandemic

By Jayson Lusk and Jill J. McCluskey

The f rst major wave of disruption to the food and agricultural sector from COVID-19 resulted from two massive and unexpected demand shocks. Shutdown and stay-at-home orders across the country resulted in a signif cant reduction in demand for food eaten in restaurants, cafeterias, and other food away from home settings. At the same time, demand for food purchased in grocery stores and supermarkets spiked. In mid to late March 2020, sales in grocery outlets increased 90% relative to the year prior, with the largest gains coming in categories such as paper products (e.g., toilet paper), frozen food, packaged foods, and meat before coming down somewhat in April. Online food sales rose at the onset of the shutdowns and have continued to increase through the time of this writing in May 2020. The stock-outs that occurred in many grocery stores were unprecedented and raised questions about the rationality of consumer behavior in the midst of the pandemic.

What drove consumers' stocking-up behavior? While consumer irrationality may have had some role to play in the run on grocery stores and concomitant stocking-out behavior, there are a variety of reasonable explanations and some unanticipated side-effects that we explore in this section.

About 54% of consumer food spending occurs on food eaten away from home (Okrent et al. 2018). Thus, one reason for the grocery stock-outs is simply that consumers shifted food demand from restaurants to grocers who were not prepared for the demand spike. However, there is some evidence to suggest that aggregate demand for some products actually rose in late March despite the closure of restaurants (Lusk 2020), which is consistent with the notion that consumers were not just shifting demand from one location to another but rather were stocking up, buying more than usual, and possibly "hoarding."

Hoarding behavior can result if large groups of consumers face similar information or face similar incentives (Bikhchandani, Hirshleifer, and Welch 1998). Consumers may have reasonably anticipated reduced mobility in the coming weeks either because of illnesses or government stay-at-home orders, leading consumers to "move forward" buying behavior and f ll pantries. Moreover, if consumers anticipate higher prices or limited availability in the future, they have an incentive to buy more today.

Media coverage affects consumer risk perceptions and consequently demand for business services and products. The media provide information but with their own objectives, including prof ts. The objective to sell stories often results in a negative slant or a bias toward the sensational. The media coverage of COVID-19 f ts this narrative. The media reported shortages of food items needed to "hunker down," which then caused additional shortages. Even if an individual consumer was not worried about their own mobility or income, they might reasonably observe other consumers' behavior and infer they should change their behavior as well. An information cascade refers to a situation where even rational consumers ignore their own beliefs because of the cumulative information conveyed in others' behavior (Anderson and Holt 1997). Seeing every other shopper with rolls of toilet paper might lead one to ask: what do they know that I don't? Thus, both media coverage and observations of others can result in self-fulf lling prophesies of shortages.

Social media also plays a role in food purchases. The choice of whom to follow results in a customized information f ow. Thus, in their use of social media, consumers often follow like-minded people and companies (Moe and Schweidel, 2014). This likely leads to reinforced opinions, lack of diversity of perspectives in information received, and divisiveness of the community.

The hoarding behavior of consumers following informational cascades, which results in shortages, is not necessarily in their collective self-interest. Behavioral economics provides insights on how to limit the impact of harmful cascades. First, grocery stores can introduce information about the health of their supply chains and indicate when the next shipments will arrive. They could go so far as allowing consumers to pre-order items to pick up in the future. Second, stores can limit purchases of hoarded items. This might signal scarcity but also appeals to consumers to help the public good. An alternative approach is to allow prices rise to ration and allocate the scarce resource. However, this could backf re if consumers surmise that prices will continue to rise in the future. The ability to buy in multiple markets, including online, may also help mitigate the perception of reduced availability, albeit at prices that consumers may consider excessive.

The pandemic shifted not only where consumers buy food but what they buy, which has potential health implications. The effect on healthfulness of food choice is likely ambiguous. There has been a decrease in away-from-home food purchases and an increase in home cooking. Food cooked at home is usually considered to be more healthful than food eaten away from home (Todd, Mancino, and Lin 2010). However, during the pandemic, there has been an increase in sales of processed, comfort foods, which were on the decline before the pandemic. Because many consumers do not have cooking skills, they may need to rely on processed foods. It also appears that consumers want familiar, comfort foods in times of uncertainty. Moreover, there is anecdotal evidence that being home all day causes people to snack more. By contrast, demand for meal kits, which are generally considered more healthful than highly processed foods, has been growing. In short, the pandemic has likely affected dietary quantity and quality, but in aggregate ways that are diff cult to discern at the present moment.

Finally, shifts in demand and supply chain disruptions have affected food affordability. The Bureau of Labor Statistics reported that the general consumer price index (CPI) fell from March to April 2020 (BLS 2020a); however, prices of food at home increased markedly. The food-away-from-home CPI increased 0.1% from March to April 2020 and was 2.8% higher than the year prior in April 2019. The grocery store CPI increased 2.7% from March to April 2020 and was 4.1% higher than last April; the recent monthly increase is the highest since the 1970s. Both supply and demand factors are affecting prices. Some of the demand-side factors are discussed in this article, and other authors have addressed the supply chain disruptions and meat packing plant shut-downs that added cost.

Consumers are both a partial cause of and victim to the COVID-19-related food disruptions. While stocking up behavior was not necessarily irrational, there are strategies to lessen the adverse effects of hoarding behaviors should similar events arise in the future.

Food Service versus Retail: COVID-19 Impacts

By Tim Richards

Arguably, the most dramatic effect of the COVID-19 pandemic has been the near-complete loss of an entire distribution channel for food producers. Despite the fact that our food system has evolved into an incredibly eff cient machine over the past 150 years, the pandemic has exposed an apparent lack of resilience that may lead to long-term changes in how food is produced, packed, and shipped. This section explains the underlying economic mechanism that is responsible for this lack of resilience, the types of changes that are needed, and whether they will be forthcoming, focusing on the U.S. fruit and vegetable sector as it remains highly fragmented—unlike the meat, dairy, and poultry sectors which are highly concentrated. Shocks like the COVID-19 pandemic expose a world in which specialization creates winners and losers and will likely lead to lasting change.

Unfortunately, the COVID-19 pandemic has also revealed a lot about what we do not know. While the widespread availability of retail scanner data over the past 30 years means that we know quite a bit about consumers' retail shopping habits, the volume of different types of foods sold at retail, and their prices, we know very little about foodservice. Even with the very best data available to private and government researchers (Richards and Padilla 2009), we can only arrive at back-of-the-envelope estimates of the relative volumes of each type of food that move into foodservice distribution relative to retail.

Gross markups for a meal at restaurants (excluding schools, hospitals, and other important elements of foodservice) tend to average about 300% (Forbes 2017), while they are typically 100% for fresh produce items at retail stores (USDA 2018). This means that the price consumers pay at restaurants is roughly double what they would pay at retail. Given that the share of food expenditure is now approximately 50% retail and 50% foodservice (USDA 2018), this implies that foodservice volumes are roughly half retail volumes, or approximately one-third of all food shipments go to foodservice and two-thirds to retail stores.

Interpreted differently, this means that approximately one-third of all shippers lost a substantial amount of business. Based on reports in the media, much of the lost foodservice business was, at least initially, donated, poured out, plowed under, or simply discarded (Yaffe-Bellany and Corkery 2020). How can fully one-third of the market fail to f nd buyers for their products?

The answer is a textbook case of economic hysteresis. Economic hysteresis is the perpetuation of a behavior or action, even after its initial cause has disappeared. For example, a driver who bought a Toyota Prius in 2014 when gas prices averaged $3.37 per gallon would likely not turn around and sell it in 2015 (when gas prices fell to $2.45 per gallon) even though the economic argument for buying it in the f rst place is no longer valid. In the fresh produce industry, the packaging, logistics, distributors, contracts, and transportation methods can be very different for the foodservice and retail distribution channels. For example, lettuce intended for foodservice is often packed in bulk, 50 lb. cartons with no distinguishing features for each head, while retail lettuce heads can be individually wrapped at the packing shed, with the packer's name and brand prominently displayed. Each of these points of differentiation involves a considerable f xed cost, so shippers tend to commit to either the foodservice or the retail channel. At the same time, the returns to shipping into each channel, and, more importantly, the difference in returns between the two channels, are highly uncertain. In this environment, therefore, the decision to either switch between channels, or maintain facilities to service both, entail a real option of considerable value. As is well understood, real options mean that rational producers will "wait" to switch between the two so that assets become f xed in either foodservice or retail applications (Dixit 1989; Richards 1996). This is hysteresis, as manifested in a fundamental lack of supply chain resilience.

If assets are locked into either foodservice or retail supply chains, then what can be done about it? That is, what is the appropriate policy response to f rms' rational behavior relative to their real options? Unfortunately, there isn't one, at least not one in the public arena. The fruit and vegetable sector in the United States is very competitive and well capitalized. Firms will fail, to be sure, but there is suff cient capital to acquire the functioning assets behind the failed f rms, exercise their real options, and develop the type of f exibility that the industry requires.

What will emerge out of the other side of this is a more f exible fresh-produce supply chain in which industry best practices will include fully interoperable packing lines, greater use of technology, more f exible distribution relationships, and fully fungible transportation systems. There may be consolidation as f rms acquire distressed assets, but the industry has a very long way to go to approach the levels of concentration seen in the dairy, meat, and poultry sectors. Hopefully, the fresh produce sector will emerge both eff cient and resilient to future shocks of this magnitude.

Although this focus is on the fruit and vegetable sector, does this reasoning apply to other agricultural industries? While many of the largest meat-processing f rms are large enough to have re-

tail and foodservice divisions, there is a signif cant fringe of smaller suppliers in every industry. Moreover, real option values rise in the level of uncertainty, so the value of creating f exibility is an order of magnitude higher than what it was before the pandemic began. Therefore, investing in supply-chain interoperability will be very general and expected by capital markets.

COVID-19 Impacts on the Meat Processing Sector

By Glynn Tonsor and Lee Schulz

Perhaps no segment of the U.S. agricultural supply chain has been more challenged by COVID-19 or discussed in the media as extensively as the meat processing sector. This is reaff rmed as the only piece of America's food supply chain for which President Trump invoked the Defense Production Act, classifying meat and poultry processors as essential infrastructure to help ensure continued operations.[7] Given the multitude of changes in the sector, it is useful to broadly summarize main developments. Importantly, there was no blueprint for navigating the shocks endured, and the extent of consequences continues to evolve.

Consistent with strong consumer demand signals both domestically and abroad (AgManager.info 2020a,b), the industry entered 2020 projected to produce record large volumes of meat. This has been both a blessing and a curse for the industry and society as a whole. These large inventories enabled greater production early in 2020, boosting meat stocks and providing conf dence that available meat supplies will be "suff cient" in the third and fourth quarters of 2020. However, the large animal inventories magnif ed the challenges of harvesting animals in a timely fashion during the pandemic. These dynamics ref ect biological processes inherent in the industry and production expansion decisions made well before COVID-19. These decisions, like those in most of society, were made under presumptions of no pandemic-induced demand or supply shocks.

COVID-19 has seemingly impacted every stage in the meat supply chain. Early in the pandemic, initial shocks mainly corresponded with stay-at-home-order-induced changes in meat product f ow, including large declines in food service activity and swift swings toward grocery stores as the predominant venue for meat and poultry purchases. Products such as bacon and high-end beef steaks, typically sold in greater volumes at restaurants, lost value while other products such as ground beef were central to consumers' building of at-home supplies. Corresponding demand differences appeared in USDA's daily and weekly beef and pork market reports on wholesale cutout and primal prices (USDA-AMS 2020).

In April, a second main shock developed as the ability to harvest animals and produce meat became constrained. This has been described as the primary bottleneck in the livestock-meat supply chain leading to much confusion. The worst of constrained harvest occurred for the week ending May 2 with USDA-reported, federally inspected steer and heifer volumes 41% lower compared to the same week in 2019 while barrow and gilt volumes were 36% lower. As a consequence, livestock prices plummeted, while retail and food service channels experienced reduced meat availability that subsequently resulted in consumers facing a mix of higher prices, altered product offerings available, and rationing on volumes allowed for purchase. Elevated media coverage and emotionally charged calls for change centered on a situation where the industry had a "surplus" of livestock (Schulz 2020) and yet a "shortage" of meat (AgManager.info 2020c) for consumers. This development was temporary yet one not previously experienced to the same magnitude and scope, leading to most of society taking elevated interest. On balance, however, this situation improved as the month of May concluded. It appears the improvement in livestock

[7] "Executive Order 13917 of April 28, 2020 Delegating Authority Under the Defense Production Act With Respect to Food Supply Chain Resources During the National Emergency Caused by the Outbreak of COVID-19" Code of Federal Regulations, U.S. Code 50/ Sec. 4501. https://www.govinfo.gov/content/pkg/FR-2020-05-01/pdf/2020-09536.pdf.

slaughter levels has stayed and prices have increased, while consumers entered the month of May with normal or above-normal stocks on-hand at home, which itself is a testament to the supply chain's ability to adapt throughout the pandemic (AgManager.info 2020d).

One thing clearly revealed is heightened vulnerability where labor is most involved. Effective and eff cient operation of meat packing plants is predicated on worker availability which is of utmost concern during the current crisis. The meat and poultry industry employs nearly 500,000 workers and represents nearly 30% of food and beverage manufacturing employees (USDA-ERS 2020). This workforce is distributed over tasks spanning from the initial animal harvesting efforts in meat packing plants to subsequent tasks for further processing and packaging meat items in processing facilities. This diverse set of tasks involves a series of precise functions requiring training. While the COVID-19 pandemic resulted in mass layoffs in several industries, the meat processing sector instead faced critical workforce shortages. Outbreaks of COVID-19 among workers at some facilities and social distancing, school and daycare closures, and measures to protect those people who are most at-risk limited the pool of workers to draw upon. The reserve pool of potential meat packing workers is negligible, even before accounting for these absentee issues.

The disruptions presented by COVD-19 to-date have been truly historic and never experienced by most involved. These disruptions occurred globally as multiple countries have been similarly challenged in harvesting animals and sustaining pre-COVID-19 desired meat production volumes. Given the global nature of the pandemic, it is our opinion that the meat processing sector's ability to adapt and begin the process of recovery has been remarkable.

Not surprisingly given the disruptions involved, there are calls for change (BEEF 2020). Long-term structural changes, and associated implications for the full farm-to-fork supply chain, are speculative at this point (Pershan 2020). They may include a mix of additional automation within plants to reduce dependence on labor, perhaps additional cold storage capacity, or possible adjustments in the number, size, or design of facilities. The calculus involved in making such changes is complicated, and care should be taken to appreciate the economic forces driving the industry's development to date. In each case, we encourage these and other possible adjustments to ref ect sound research-based information to guide f nal decisions. Ultimately a careful balance must be struck between eff ciency in desired protein production during "normal times" with increased system resiliency during pandemics and other possible major disruptions.

COVID-19 Impacts on Forestry and Wood Products Markets

By Shaun Tanger

COVID-19 has already created major disruptions in the forestry and wood products sector. In terms of adjustments made by industry participants, the results and actions are mixed. For timber landowners, the picture is a bit simpler than for those further up the supply chain. Many landowners have not been able to cut their trees or have had to take a much lower price. However, as is typical in forestry for short disruptions, landowners can delay harvest and wait for demand to rebound. Unlike the recession of 2007-2009, if the immediate effects of COVID-19 on housing starts are short-lived then the impact on the ability to harvest sawtimber (the high value products for timber owners) will be as well. Longer term, the story becomes more complex. Sawtimber prices, specif cally pine, have been relatively f at since the recession despite increases in lumber prices. This is not a consequence of demand as U.S. lumber mills are producing at levels

seen before 2007, and they are particularly strong in the southeast. The issue is that mill capacity has increased, while fewer mills exist as markets for landowners. This, combined with record levels of available sawtimber stumpage (excess supply) for lumber manufacturing, has led landowners to reconsider timber as a safe and prof table investment opportunity relative to alternatives. Many are now asking whether they should replant after a f nal harvest and/or add more timber acres to their balance sheet.

Complicating both the short and long run decision making of landowners is that of logging workforce obstacles. Many loggers are working on quotas already and, while they have been able to access the Paycheck Protection Program, they have not necessarily been able to make payments on equipment due to the extreme downturn in wood mill demand for logs.[8] Work reductions of 30% to 60% capacity for logging crews have been reported across the southeast. While loggers already faced incredible hurdles (e.g., rising truck insurance costs, labor shortages), adding an inability to service debt only worsened the challenge for many who operate on thin margins. Longer term this is likely to lead to fewer, larger operators that can afford rising regulatory costs and have economies of scale to increase prof ts on a per-unit basis. As logging operations grow larger, the minimum acres a landowner needs to have to entice a harvest on their property also grows. This is of special importance, since most landowners own less than 100 acres. COVID-19 is likely to exacerbate the trend of fewer/larger logging f rms moving into the future.

COVID-19-related problems have originated from aggregate demand collapses in the manufacturing sector (wood using mills). According to Random Lengths, beginning in mid-March into early-April, wood-using mill closures and curtailments were widespread across a number of products and companies (*Random Lengths*).[9] Weyerhaeuser reported between 15% to 25% reductions for various products (i.e. Lumber, OSB, and engineered products) across their operations in North America. As the number three producer of sawn wood products, this is signif cant and on par with other large sawn wood producers. Driven by housing start declines (approximately 40% of all sawn wood goes to new housing starts as of 2017) these large f rms were forced to curtail production. In some cases, estimates for curtailments and/or outright closure was only a few weeks or a month; in others, it is indef nite. Reports of mill workers conducting maintenance on facilities, due to production lines being down or shifts being reduced, have been widespread.

As housing goes, so goes the sawn wood market. Longer-term, because of spending now to avoid a worse crisis, it is likely that economic growth will be slowed in the years ahead. This could mean less robust housing starts. Many sawn-wood mill projects that were planned to begin construction are likely to be postponed or abandoned because of the crisis. Concurrently, home ownership is likely to take a step back as credit access becomes more diff cult and weary buyers prefer either to purchase a smaller home than they otherwise would have or to remain in the rental market for housing needs. During times of uncertainty, large purchases like a home are going to be reassessed. This will be made more likely if a subsequent outbreak of the virus occurs. In this case, both suppliers at the mill and the housing consumer are attempting to keep as much liquidity as possible because of uncertainty; which means less spending in the current period. One offsetting factor, for those comfortable with their job security, will be historically low interest rates. While there was an uptick in the monthly supply of homes in March, April supply numbers dropped slightly, indicating some hope that the housing market will shake off the effects quickly. Also, repair and remodeling are likely to see a boost as homeowners invest in home improvement as they forgo a new home purchase. This sector makes up 15% to 30% of wood product market share (e.g., sawn wood, plywood, oriented strand board, or other panels).

[8] Logging quotas refer to the practice of wood-using mills allowing a particular logging f rm to only bring a set number of loads of logs to the mill over a set period of time (i.e., daily, weekly).

[9] *Random Lengths* weekly report, Random Lengths Publications, Inc. Eugene, Oregon: April 17, 2020.

Stumpage markets for smaller diameter logs (pulpwood) are a bit more mixed because of their end users facing decidedly different demand conditions. Driven by the unprecedented purchasing of toilet paper, paper towels, and other hygiene products, market demand for pulpwood has been brisk. Reports of some toilet and tissue line wood mills are that production is up 20% since the initial run on these products. However, because of supply abundance, prices have not been largely affected by the crisis.

Pellet mills, which use residuals (chips and sawdust) from sawn-wood mills that have either closed or reduced production, are being forced to incur increased costs by buying roundwood pulpwood (or in-woods chips) directly. This is good for landowners who need f rst thinning, but not for pellet mill balance sheets; although most (68% of producers) expect those cost increases to be less than 10%. Still, those markets are not thought to be in peril because demand for energy in Europe, while down due to business closures, is buoyed in part by increased heating and cooling costs of those working from home.

While at home, many homeowners are turning to delivery services and e-commerce and that means increased use of boxes and other delivery packaging. U.S. e-commerce increased 49% in April, compared to the baseline period in early-March before shelter-in-place restrictions went into effect. A less well-known participant in that market, grocery delivery, saw a 110% increase in daily sales between March and April. Likewise, electronic sales were up 58%, and book sales have doubled.

Lastly, pulp and paper mills (which are the largest consumer of hardwood pulpwood) have been hit hard by the COVID-19 outbreak due to government and business work-from-home orders. While paper was already in a structural decline and is expected to continue to pull production facilities strategically, the short-term consequences may speed up the long-term plans, as it is unknown whether the returning workforce will continue, at least in part, to work from home when that option is available. This would also lead to structural shifts for the commercial real estate space, again with mixed consequences for the wood products sector as this sector accounts for 10% to 20% of wood product market share, depending on wood product category.

Local Foods and COVID-19

By Dawn Thilmany McFadden and Trey Malone

The COVID-19 pandemic has heightened concerns regarding vulnerabilities in the agri-food supply chain, challenging the resilience of the traditional U.S. food system. As is often the case, policymakers and consumers immediately explored emerging alternative food supply chains. Perhaps the most visible exploration occurred in the burgeoning U.S. local food system. At their core, local food chains are unique from traditional systems in three ways: they are more proximate, shorter, and smaller. These three differences make their responses to pandemic-centric supply chain disruptions distinctive.

Geographical Proximity

Consumers and policymakers generally agree that “localness” is related to the geographic distance between producers and consumers. At the extreme end of the spectrum, COVID-19 has led consumers to become increasingly interested in producing their own food, leading to stock-outs of backyard chickens (Chappell 2020) and garden supplies (Walljasper and Polansek 2020). In

addition, the value of geography in local food systems aligns with geographical indicators or place-based branding, inferring some type of differentiated quality because the product (or producer) is created nearby, or that the geographic "terroir" of a region creates unique f avor prof les in the end product. As food consumption shifted to home-cooked meals, some local food producers also experienced a boom in sales perhaps because of stock-outs in their normal retail outlets, a concern for interacting with large crowds at larger food retailers, or because they had more time to search out and prepare foods. For example, an April 18 *New York Times* opinion piece cited a food study reporting "54 percent of respondents said they cook more than before the pandemic... and 51 percent said they will continue to cook more after the crisis ends." (Taparia 2020). Although this characterization of "local" has created some demand-side gains for small producers, others have faltered if their sales strategy was built on food-away-from-home. For example, demand for seafood has dissipated as most sales occur at restaurants.

Fewer Steps between the Farm and the Table

Local food supply chains are often perceived to be "shorter", signaling fewer middlemen that either distort market transparency, capture an unfair share of prices received, or serve as a "bottleneck" moving food from farms to households. Since all concerns that COVID-19 could be transmitted by food were quickly and publicly denied, it is unlikely that there were signif cant concerns about the "number of hands" that foods moved through.

Yet, there has been heightened attention to the complexity of food f ows within the United States as a potential source of vulnerability at a relatively coarse spatial scale (Lin et al. 2019, Figure 4). So, these smaller enterprises and shorter supply chains within the food system may be more nimble or resilient, but many also point out they do not currently have the capacity to feed the country. But could they be "scaled up" to better balance the portfolio of assets, f rms, and

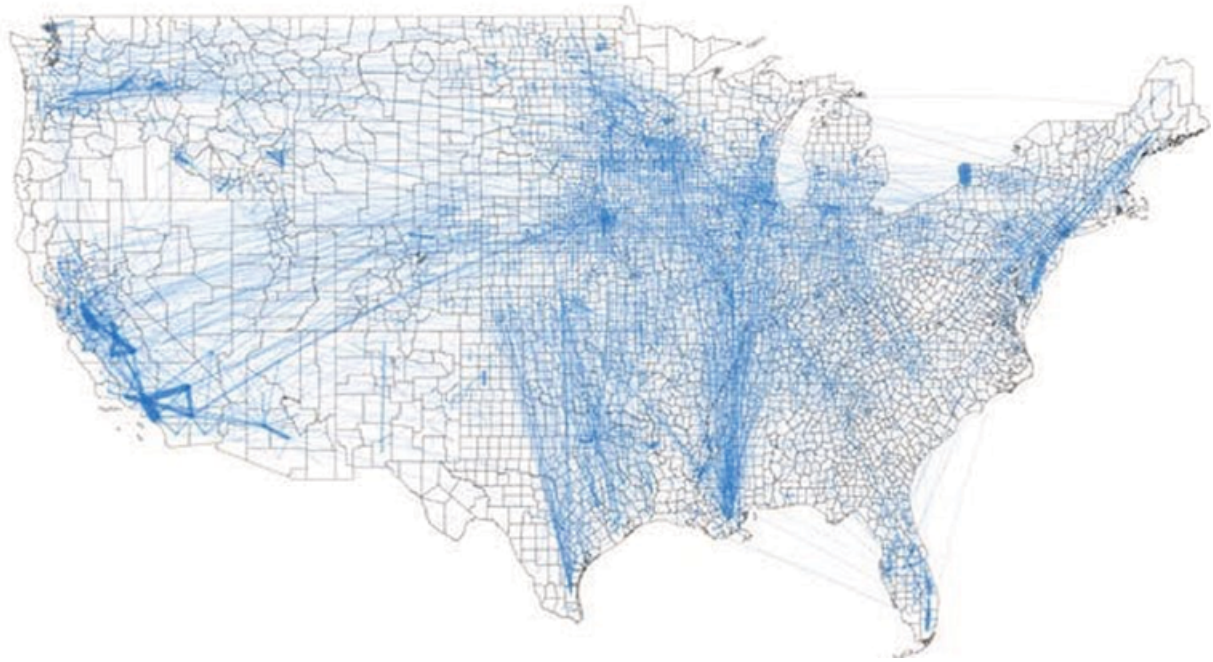


Figure 4. County Food f ow Networks within the United States, by tons, for all freight analysis framework data and for the largest 5% of county links (Lin et al. 2019).

choices U.S. food consumers have? COVID-19 may offer up an inopportune, but enlightening discussion of the tradeoffs between the resilience and eff ciencies of different systems.

Smaller Production Capacity

Simply measuring the "localness" of a system is likely to miss the nuances consumers attribute to the food they provide. Not only does the physical proximity of food production signal to the buyer that they are supporting their surrounding community and economy, consumers also generally perceive "local" as shorthand for other credence attributes. In the context of COVID-19, one important characterization of local food supply chains is that they are primarily serviced by small (or mid-size) farms, food, and beverage companies. Though more research is required, it has been posited that smaller enterprises can respond to market disruptions more effectively because a small f rm size affords producers more agility in shifting to new markets and products as they gain insights from an engaged customer base, e.g. the Scale paradox (Lucker, O'Dwyer, and Renner 2013). This is especially true with the rise of new technology and media platforms, as consumers increasingly seek to support social causes with their expenditures, and online platforms can be as simple as a link between a social media post and option to purchase (for delivery or curbside pick-up).

While a smaller production capacity might help explain the fewer relative number of COVID-19 concerns within local food systems, this limited capacity is also an important constraint on the potential for local foods to be the exclusive provider for the diverse basket of goods U.S. households demand. For example, at the height of processing shutdowns, hundreds of thousands of hogs (Lusk 2020) were not processed. Yet, the alternative network of small processors is equipped to process only a few animals each day, limiting the ability of local food systems to pick up slack capacity from their larger counterparts.

What is the Role of Local Food Systems in the Future?

Some have advocated for a shift toward local food systems, alluding to the potential for built-in resilience. Such tradeoffs to bolster resilience merit further research, though added resilience through localized supply chains are likely to come at a cost (Mulvany, Shanker, and Chipman 2020). Scale and supply chain capacity likely evolved to capture eff ciencies, so any reversal of these trends would have cost implications to the food system.

But, if it lowers the "risk" of vulnerabilities, what is the public will to offset such costs to assure food security? Early farm bills were targeting just such supply-side goals but have not been revisited for decades apart from increased local and regional food programming through the USDA Ag Marketing Service. Despite this limited public policy guidance developing local foods to promote food security, COVID-19 has stoked political conversations targeted at relaxing the regulatory burdens for small-scale producers. It currently takes thousands of regulations for a product to f ow through the U.S. food system, with the burden felt disproportionately by small producers (Malone and Chambers 2017). Renewed interest in legislation such as the PRIME Act suggests that COVID-19 might nudge policymakers to reduce regulatory constraints, though it is unclear what food safety concerns might need to be considered (Shackford 2020).

Ultimately, COVID-19 represents a test for all engaged in food and agricultural production in the United States. While the local food system is no exception, differences in geographic proximity, shortened supply chains, and limited production capacity has left local food producers uniquely

affected, and perhaps, well-positioned to reinforce or grow their place in the portfolio of food offerings and markets.

Food Loss and Waste in the United States during COVID-19

By Brenna Ellison, Brandon McFadden, Bradley Rickard, and Norbert Wilson

The COVID-19 pandemic has wreaked havoc on almost every aspect of daily life, including food production and consumer purchasing behavior. Consumers are experiencing a vicious cycle: shortages and stock-outs in grocery stores can lead to and rationalize stockpiling behavior, and stockpiling behavior can lead to shortages and stock-outs. Further up the supply chain, many producers are experiencing reduced demand from a restricted foodservice sector and reduced processing plant capacity. These disruptions will affect food loss and waste (FLW). Before COVID-19, the USDA and other sources estimated FLW at 30-40% of the food supply in the United States. Here, we discuss how these pandemic-induced changes in the food system may affect FLW in the short- and long-term.

Consumer-Level Food Waste

At least four factors could affect consumer food waste during the pandemic: (1) stockpiling behavior, (2) management of food stocks, (3) negative income shocks, and (4) rising food prices. Grocery store sales increased 31% in March and 13% in April 2020 over the same months last year (U.S. Census Bureau 2020). These increases suggest that consumers stockpiled foods in response to the pandemic.

Households that stock up on food, either highly perishable or shelf-stable items, may have increased food waste if they do not manage their food stocks well (Neff, Spiker, and Truant 2015; Thyberg and Tonjes 2016;). In times of scarcity, some households may be willing to accept a level of waste higher than usual to avoid having stock-outs at home. Others may be willing to incur increased waste to avoid shopping trips and close contact with other people (social distancing).

Household waste could increase during the pandemic from the factors above. However, negative income shocks could counteract food waste increases. The unemployment rate increased to 14.7% by May 2020 (BLS 2020b), and food prices are up 3.5% over last April (USDA-ERS 2020). For households that lost employment income, we expect to see less food waste, as waste is positively related to income. Rising food prices are likely to decrease food waste, regardless of income level, as households experience reduced purchasing power. In a worst-case scenario, the conf uence of these factors may lead up to 17.1 million more Americans to experience food insecurity (Feeding America 2020). Food waste has even greater salience for families who are food insecure than for those who are food secure.

Overall, we expect that food waste will increase for some food products among some households (e.g., those who over-purchase either highly perishable or more shelf-stable foods and do not manage their stocks well). However, food waste will decrease for others (e.g., those that are most affected by higher food prices and reduced employment income). Thus, the net impact of COVID-19 on household food waste will depend on unfolding factors linked to the economy, retail food markets, and consumer households.

Farm-Level Food Loss

For nearly a decade, U.S. consumers have spent more of their food budget on food away from home compared to food prepared at home (Okrent et al. 2018). Thus, changing consumer demand for food service has contributed to an evolution of the food supply chain. However, decreased demand in well-established markets (e.g., food service) because of COVID-19 and the transmission of COVID-19 among farm workers have disrupted the food supply chain and caused an increase in losses at the farm-level. The pandemic and shut down have led to reduced availability of and demand for food services. Monthly retail data for food services and drinking places indicate that sales were down 27% in March and 49% in April 2020 (U.S. Census Bureau, 2020).

Additionally, demand from large institutional buyers has fallen. For example, public schools are not serving the typical 45 million meals daily (FNS 2017a and 2017b). Products destined for food service use bulk packaging to reduce packaging and travel costs and use the infrastructure in place to supply these markets. Suppliers cannot easily redirect these specialized products through the retail food markets or other direct-to-consumer channels. As a result, producers have dumped 3.7 million gallons of milk and destroyed more than 107,000 unhatched eggs daily during the pandemic (Yaffe-Bellany and Corkery, 2020).

The impact of COVID-19 on workers in the food industry has been devastating (Swanson, Yaffe-Bellany, and Corkery, 2020). Outbreaks among farmworkers or changes in labor practices that reduce the number of workers will reduce the capacity of farmers to harvest certain crops. Beyond the farm, the pandemic has led to a reduction of capacity utilization at beef and pork processing plants by more than 30% (FRBKC, 2020), and worker attendance may have fallen by 50% in some chicken plants (Lauria, 2020). While outbreaks in poultry plants have been troublesome, the loss in capacity utilization was lower than in beef and pork plants because of the automated processing of poultry. For many specialty crops that are highly dependent on farm labor, changes in labor have affected harvest eff ciencies and will potentially increase the amount of food loss on farms.

Concluding Comments

FLW during COVID-19 highlights the interconnections between food production, food service, retail markets, and consumers in the United States. In the short run, the pandemic and shutdown promoted loss of product at the farm, hampered the foodservice industry, and altered food waste in households. Discussions about mechanization for specialty crops predate COVID-19 (Huffman, 2012). However, outbreaks during peak harvest times in the coming months could disproportionally affect foods that rely heavily on manual labor. Changes in FLW induced by COVID-19 point to the need for careful evaluation of the resilience of the food supply from the farm to the f nal consumer.

Food Insecurity during COVID-19

By Craig Gundersen, Monica Hake, Adam Dewey, and Emily Engelhard

The COVID-19 pandemic has drawn attention to the problem of food insecurity in the United States. This attention is primarily because of projections of increases in the number of people ex-

periencing food insecurity, many of whom have not experienced food insecurity until now. While COVID-19 has highlighted the importance of food insecurity, this was, of course, a leading health and policy issue long before COVID-19. In the wake of the Great Recession, more than 50 million people were in food insecure households, and even after ten years of declining rates more than 37 million Americans were food insecure in 2018 (Gregory and Coleman-Jensen 2019). (For a review of research on food insecurity, much of which has been done by agricultural economists see, e.g., Gundersen and Ziliak 2018.)

An important step for policymakers and program administrators tasked with addressing the anticipated increases in food insecurity is ascertaining its magnitude and distribution. However, doing so accurately, consistently, and in a timely manner can be challenging. While there are some measures of well-being that are readily available and updated frequently, such as the unemployment rate and prices, this is not the case for food insecurity. The off cial food insecurity rates come from a survey that is conducted in the December Supplement of the Current Population Survey (CPS), and the results for 2020 will not be collected until later this year and will not be released until September 2021. Since the COVID-19 crisis began, there have been several efforts to report about food hardship, most commonly by conducting surveys derived from the full food insecurity measure used in CPS. However, the results from these surveys can be misleading insofar as they use different sampling and survey methods than the CPS, rendering comparisons diff - cult if not impossible. Moreover, almost all these surveys were conducted for the f rst time during COVID-19 meaning that even from an internal perspective, it is not possible to even say whether rates are higher or lower under COVID-19.

Given the critical importance of understanding what will happen to food insecurity because of COVID-19, an alternative approach that addresses these limitations is needed. In particular, Feeding America, the nationwide network of 200 food banks in the United States, needs information about food insecurity at levels of geographic disaggregation for its member food banks. This section will describe the approach to generating projections of food insecurity rates for 2020 and provide a broad overview of our f ndings. (See Gundersen et al. 2020 for more details.)

Approach

This year marks the tenth anniversary of Feeding America's annual *Map the Meal Gap* (MMG) study which establishes food insecurity rates of all persons and children at the county and congressional district (CD) level for all counties and CDs in the United States (https://map.feedingamerica.org/). As described in Gundersen et al. (2017), these estimates are established as follows. First, the extent of food insecurity for each state for each year from 2009 to 2018 with data from CPS is established. (In previous years, this extended back to 2001 but the addition of a new variable—disability status—has only been collected since 2009.) With these state-level food insecurity rates, a model is estimated of food insecurity that is a function of the unemployment rate, the poverty rate, median income, homeownership rate, the proportion of the population that is African-American, the proportion of the population that is Hispanic, the proportion of the population that has a disability, state f xed effects, and year f xed effects. The second step uses the coeff cient estimates from step one plus data for the same variables def ned at the county (CD) level to generate estimated food insecurity rates. This data is taken from the American Community Survey (ACS).

The above methods allow for a base measure of food insecurity to be established for all counties for the full population and for children. Using this base measure, an estimation of what will hap-

pen to food insecurity in the United States in 2020 because of the COVID-19 pandemic can be established. To do so, considerations are made on what will occur if two of the variables in the model above—the unemployment rate and the poverty rate—increase along the lines predicted by expert opinions. (The other variables in the model are unlikely to change because of COVID-19.) In the most recent estimates of this (https://www.feedingamerica.org/research/coronavirus-hunger-research), the assumption is the annual average unemployment rate will increase to 11.5% (up 7.6 percentage points compared to 2018) and the poverty rate will increase to 16.6% (up 4.8 percentage points compared to 2018).

This increase in the unemployment rate, though, is unlikely to be uniform across all counties in the United States. Instead, certain industries and occupations will be disproportionately affected by COVID-19. So, further adjustments to the county-level and CD-level unemployment projections for the proportion of the population that is likely to lose their jobs, combining data from the American Community Survey with estimates by Hatzius and colleagues (2020) is made.

Findings

At the national level, Feeding America projects that there will be more than 54 million food insecure Americans in 2020. This is approximately 17 million higher than in 2018, the most recent year for which results are available. For children, the food insecurity rates are projected to increase to 18 million, up nearly 7 million from 2018.

These national estimates, though, mask substantial heterogeneity across states. This can be seen in Figure 5, taken from 19 May 2020 Feeding America report. In many cases, the ordering of states would be the same whether or not COVID-19 occurred. For example, the states with the f ve highest rates without COVID-19 are the same as with COVID-19—Mississippi, Arkansas, Alabama, Louisiana, and New Mexico. However, there are some states that will see much higher rates because of food insecurity. Nevada stands out—pre-COVID-19 it would have been 20th but post-COVID-19 it is projected to be 8th.

One of the key contributions from MMG is its portrayal of the substantial heterogeneity in local food insecurity. Figure 6, which displays county-level projected food insecurity rates for the overall population, portrays this. For states, projected food insecurity ranges from 12.0% in North

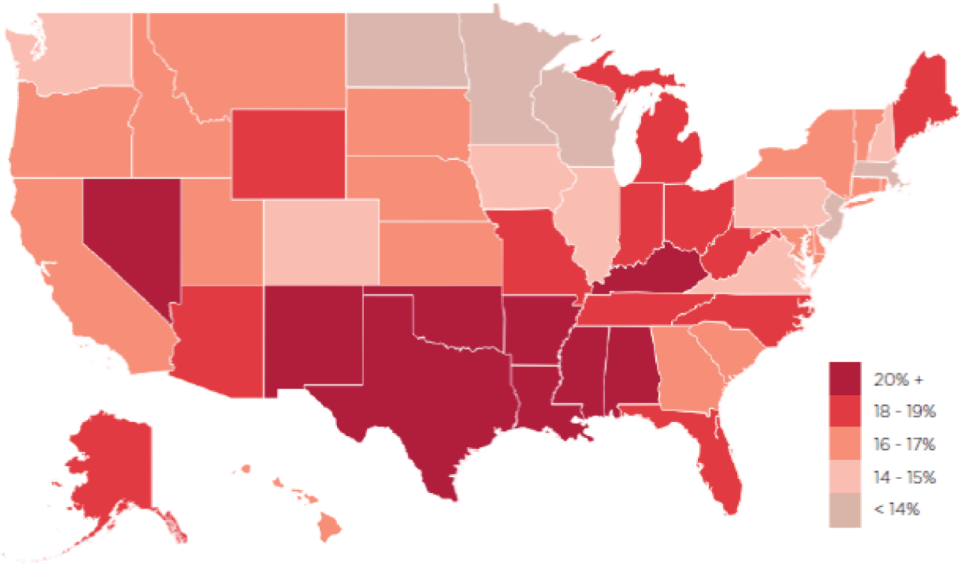


Figure 5. Projected rates of food insecurity among the overall population in 2020 by state.

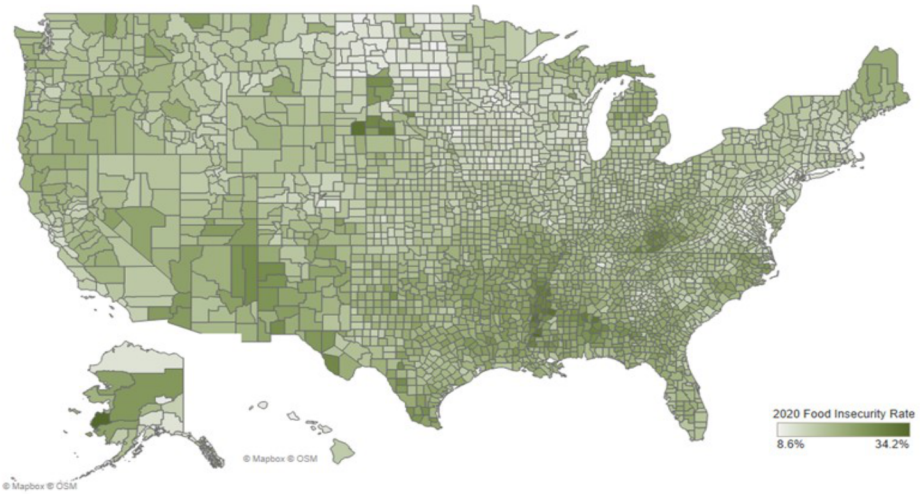


Figure 6. Projected rates of food insecurity among the overall population in 2020 by county.

Dakota to 24.1% in Mississippi. (For children, the range is from 18.4% in Massachusetts to 34.5% in Louisiana.) But, for counties the range of projected food insecurity goes from 8.6% in Loudoun County, Virginia, to 34.2% in Jefferson County, Mississippi. (For children, 11.3% in Falls Church City, Virginia, to 52.5% in East Carroll Parish, Louisiana.) Even within states there is enormous differences in projected food insecurity. Consider Alabama, the state with the third highest food insecurity rate. There, the projected rates range from 15.6% in Shelby County to 31.7% in Perry County. Or consider North Dakota where the range is from 8.7% in Sargent County to 22.9% in Sioux County.

Conclusion

While these projections of increased food insecurity rates are of great concern, they would have been far worse were it not for the resiliency of the agricultural supply chain in the face of COVID-19. Given that food prices are a key determinant of food insecurity (e.g., Courtmanche et al. 2019; Gregory and Coleman-Jensen 2013), if there had been price increases due to agricultural supply chain breakdowns, the food insecurity rates we have estimated would have been much higher. In other words, the projected increase in food insecurity is because of projected increases in unemployment and poverty and not problems within the agricultural sector. Future researchers may wish to consider why this success occurred and, in particular, the protections it afforded vulnerable persons.

Crop Markets Suffer Massive Demand Shock from COVID-19

By Todd Hubbs and Scott Irwin

There is no historical analog to the speed and magnitude of the aggregate demand shock caused by the lockdowns associated with COVID-19. The disruption of supply chains, shuttering of businesses, and massive unemployment create an unprecedented degree of uncertainty about the direction of the global economy. Major crop markets ref ect this new reality and are expected to continue to do so for the next several years.

The initial shock from COVID-19 lockdowns caused many crop prices to nosedive as retail establishments shuttered and the economy ground to a halt. The closing of restaurants and the service sector shifted, and in some cases stopped, the f ow of agricultural commodities through various supply chains. As unemployment levels have climbed to levels unheard of since the Great

Depression, consumer behavior may be changing for years to come. It seems naïve to believe this is a short-run phenomenon. The impact on feed grains, oilseeds, and f ber comes from food demand and retail purchasing. On top of this demand shock, the thawing of trade relations with China and the hopes of increasing demand around the world for primary commodities prompted producers to ratchet up supply. The result, over the short-run, is building stocks as demand has waned. While the recent opening of economies around the world holds some promise, the setbacks associated with the downturn combined with uncertainty related to the pandemic are likely to dominate into the 2020-21 marketing year and beyond.

An expectation of increased bankruptcy f lings and slower economic growth looks to hinder demand prospects in the upcoming marketing year. A resurgence of the pandemic in the fall hangs over economic prospects as well. The uncertainty associated with health outcomes cannot be separated from economic outcomes. While there is potential for a vaccine emerging over the next year, previous vaccine development timelines suggest a great deal of uncertainty. The ample supplies forecast for feed grains and oilseeds requires expanded consumption to keep stocks in check. Potentially exacerbating the impacts of COVID-19, the trade relationship with China looks to be under pressure as well. As the world emerges from lockdowns, the lasting economic effects may hurt trade relationships and, in turn, exports of U.S. crops. Expanded ending stocks seem probable for most f eld crops in the next marketing year and longer. Only the magnitude of those stock levels remains in question.

U.S. corn ending stocks in 2020-21 came in at 3.32 billion bushels in USDA's initial forecast for the marketing year in their May World Agricultural Supply and Demand Estimates (*WASDE*) report.[10] The 1.3 billion increase in stocks projected by the USDA from the current marketing year is primarily due to the massive 97 million planted acres, which combined with trend yield results in an expected 16 billion-bushel U.S. corn crop. While corn acreage may not hit those lofty projections, the prospect of losing even two million acres from planting does little to mollify the growth in ending stocks. The total consumption forecast of 14.8 billion bushels relies on 6.05 billion bushels of feed and residual use. If the demand for meat continues to be impacted by changing consumer preferences and high unemployment, this forecast may come in on the high side. Corn use for ethanol in the U.S. remains a concern as gasoline demand looks to recover over the next year. The same issues driving consumer preferences should impact gasoline consumption as well. At 5.2 billion bushels of corn use for ethanol, the next marketing year's forecast seems feasible, but remains uncertain. A trend yield corn crop on expanded acreage holds the prospect of over three billion bushels of carryout even with robust demand at lower prices.

U.S. ending stocks for soybeans may continue to grow this marketing year as export totals continue to disappoint. Brazilian soybean exports hit record levels over the last few months. Under phase one of the trade agreement with China, that country should buy a substantial amount of soybeans next marketing year. Growing political discord with China on geopolitical and virus-related issues places expanded exports in uncertain territory. The 2.05 billion bushel USDA forecast for soybean exports next marketing year faces both these political issues and expanded South American production. The USDA forecast of 405 million bushels for U.S. ending stocks in 2020-21 sits 175 million bushels lower than estimates for the current marketing year. An expectation of crush remaining steady, while probable, in no way diminishes the need for expanded export totals. Stiff competition from the rest of the world and a growing political brouhaha makes lower ending stocks highly contingent on Chinese soybean imports.

[10] All USDA estimates referenced in this article for specif c commodities are drawn from the May *WASDE* report found at this link: https://downloads.usda.library.cornell.edu/usda-esmis/f les/3t945q76s/w6634p60m/2v23wd923/latest.pdf

Larger wheat supplies from major foreign exporters dampen prospects for wheat prices in the upcoming marketing year. World ending stocks less China sits at 5.5 billion bushels, up over 180 million bushels. Domestic wheat production sits at 1.866 billion bushels for the 2020-21 marketing year on lower yield projections. The USDA forecast for U.S. ending stocks sits at 909 million bushels, down from 978 million bushels estimated for the current marketing year. Domestic use looks to see lower feed use on abundant feed grain crops at lower prices. The outlook for wheat remains very similar to last year with slightly lower production and consumption.

U.S. cotton ending stocks saw an initial USDA forecast of 7.7 million bales in the 2020-21 marketing year. World ending stocks came in at 99.43 million bales, up from 97.2 in the current marketing year. World ending stocks jumped 5.58 million bales this marketing year in the last USDA report. This drastic increase stemmed from a decline in use for the marketing year as economic contractions hurt cotton consumption. U.S. ending stocks numbers for next marketing year come in to question due a projection of a nearly seven percent jump in cotton exports. Like soybeans, the prospect of expanded exports hinges on economic recovery and political considerations. The 2020 crop got off to a good start and 19.5 million bales seem reasonable at this point. Cotton supply seems plentiful and world demand looks weak.

Summary

The impacts of the massive demand shock associated with the COVID-19 pandemic on crop markets look to continue over the next couple of years. Implications for major f eld crops tend toward growing global ending stock levels, lower prices, and tighter margins. While the uncertainty related to health and economic outcomes remains huge, the prospects for dramatic price recovery in crop markets in the near future appears to be small. A more optimistic price scenario requires a quick V-shaped global economic recovery, weather-related production shortfalls in major crop producing areas, or both.

Coronavirus Impacts and Agricultural Finance

By Allen M. Featherstone

The shutdown of the U.S. economy by government off cials in response to the novel coronavirus pandemic has had and will continue to have major ramif cations on the agricultural f nance sector, not only in the U.S. but globally. The focus of this article is the U.S. agricultural f nance system, but many of the effects in the U.S. will also affect the f nancial sector across the globe.

Sector Income Effects

The novel coronavirus has had far-reaching effects on the farm income picture nationwide. The Food and Agricultural Policy Research Institute (FAPRI) estimates a decrease of $4.72, $2.05, $0.40, $0.61, and $4.08 billion in receipts in 2020 for the crop, soybean, wheat, cotton, and other crop sectors, respectively. For the livestock sector, receipts are expected to fall by $9.57, $2.24, $0.05, $3.97, and $0.40 billion for the cattle, hog, poultry, milk, and other livestock sectors, respectively. Production costs are expected to decrease and government payments are expected to increase from the baseline resulting in net farm income falling by $20.08 billion in 2020 (Westoff, Meyer, and Gerlt 2020). A study by Peel and colleagues indicates that for 2020, the estimated impact to the cattle sector is a loss of $9.17 billion, close to the estimates of FAPRI (Peet et al. 2020).

A study by Ibendahl, Herbel, and O'Brien (2020) indicates that excluding the Coronavirus Food Assistance Program (CFAP) payments, net farm income for Kansas Farm Management Association farms would fall from $110,380 to $14,358. The percent of farms that would have a negative net farm income is expected to increase from 18% of farms in 2019 to 40% of farms in 2020.

The 2020 farm income outlook is negative. With CFAP, a total of $16 billion is targeted to the agricultural sector, with $9.5 billion from the Coronavirus Aid, Relief, and Economic Security (CARES) Act and $6.5 billion from the Commodity Credit Corporation (CC). The CARES act funding compensates farmers for losses due to price declines from January 15, 2020 to April 15, 2020 (Reid et al. 2020). The CCC payments are expected to compensate producers for on-going market disruptions as the COVID-19 pandemic wanes. While the CFAP payments are within the range of the net farm income losses (i.e., $20 billion from the FAPRI estimate), it is important to understand the differences in payments. The payments are based on inventory levels of unpriced non-specialty crop (grains and oilseeds) inventories produced in 2019, spoiled or sold specialty crops in 2020, and livestock sold (January 15 to April 15) or in inventory from April 16 to May 14, 2020.

The distributional effects of the CFAP payment will vary widely by farm and commodity. The livestock and specialty crop payments generally cover a portion of 2020 income losses. The CFAP payment for non-specialty crops covers inventory losses for the 2019 unpriced crop but does not provide income protection for the 2020 crop as the non-specialty crop payments are based upon 2019 inventory that was not sold or priced before January 15, 2020. The implication is that the CFAP provides cash to crop producers for 2019 production. As an example, the CFAP payment maintains accrual net farm income for 2019. The 2020 production for non-specialty crops (all-year) and specialty crops produced after April 15, 2020 is not accounted for in the CFAP. Inequities could also occur if there are losses in the livestock sector after May 14, 2020. Losses could also occur if the effects from the pandemic last beyond 2020 and into 2021, though FAPRI expects an increase in net farm income of $0.29 billion from the pre-COVID-19 baseline (Westoff et al. 2020). FAPRI's estimate of net farm income in 2021 expects government payments to increase to $4.5 billion up from $2.3 billion in 2020. The non-specialty crop sector is likely the most at risk moving forward in 2020.

Interest Rate Effects

COVID-19 has had far reaching effects on the U.S. macro economy. Figure 7 examines the daily f ve-year and ten-year U.S. Treasury Bond rates over the last year. Rates had generally fallen from between 2.0% and 2.5% from March of 2019 to between 1.5% and 2.0% from August 2019 through January 2020.

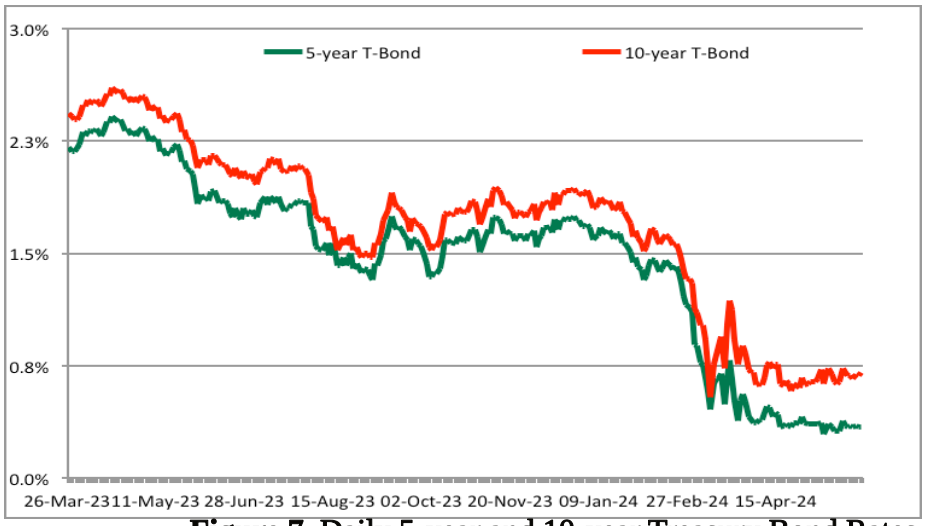


Figure 7. Daily 5-year and 10-year Treasury Bond Rates.
Source: Federal Reserve Economics Data, St. Louis Federal Reserve

Because of COVID-19, U.S. Treasury rates fell to less than 0.5% for f ve-year Treasury bonds to less than 1.0% for ten-year bonds. These rates are as low as they have been over the last decade.

Figure 8 provides the rate at which the Federal Farm Credit Banks Funding Corporation obtains funds for the Farm Credit System over the last decade. Farm Credit rates had been falling since November 2018. The rates dropped signif cantly in March 2020 to the lowest levels in the last decade. Subtracting the Federal Farm Credit Banks funding rate from the comparable Treasury rate provides a measure of the perceived riskiness of the agricultural sector (Figure 9). After a spike at the end of March 2020, the premium has returned to pre-COVID-19 levels for the one-year rate. The f ve-year, ten-year, and thirty-year spreads, while they have decreased, have not returned to pre-COVID levels. Investor sentiment indicates that funding of agriculture is expected to be costlier compared to the general economy before COVID-19.

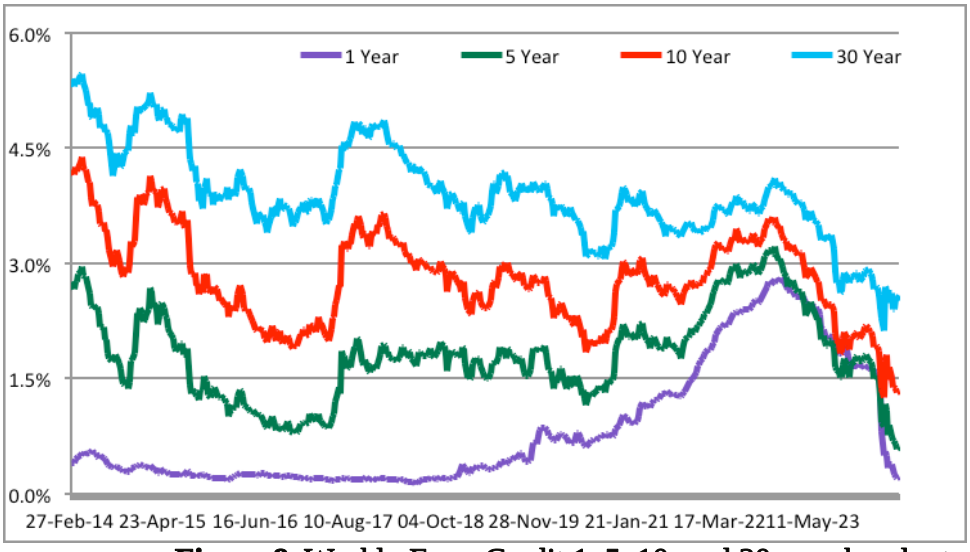


Figure 8. Weekly Farm Credit 1, 5, 10, and 30-year bond rates. Source: Federal Farm Credit Banks Funding Corporation

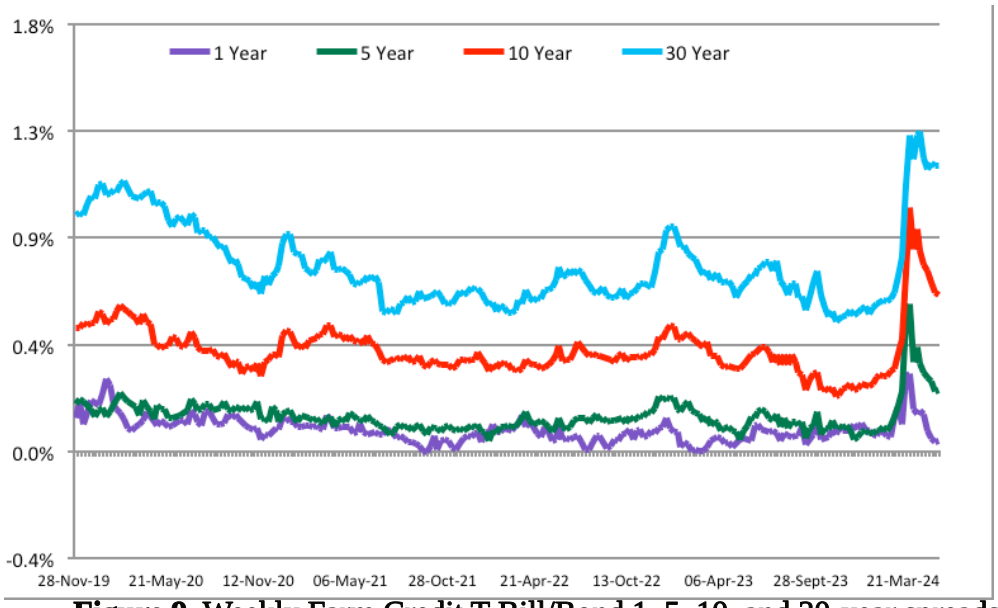


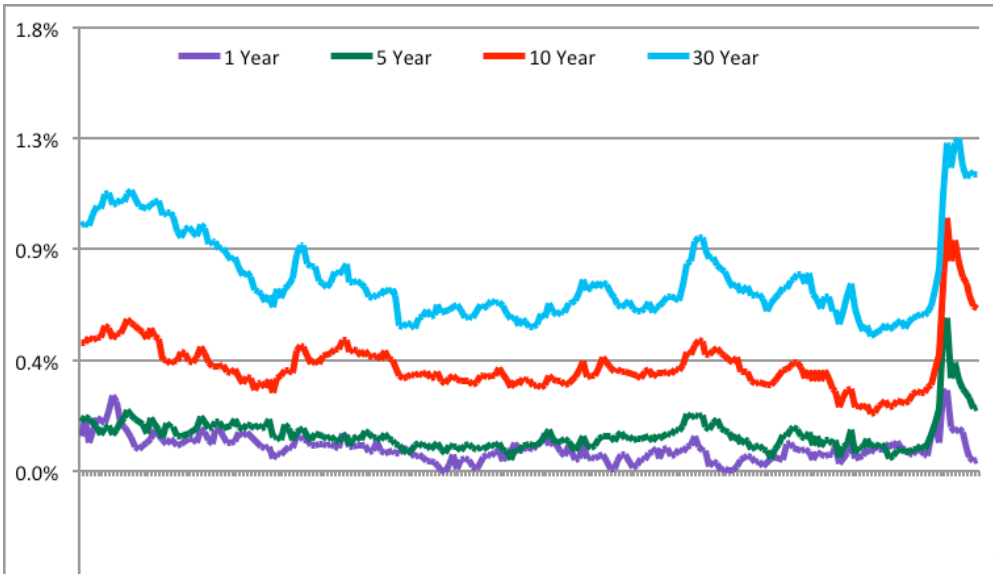
Figure 9. Weekly Farm Credit T-Bill/Bond 1, 5, 10, and 30-year spreads

Longer-Term Effects

Farm income and interest rate changes affect asset values and farm bankruptcies. Land values are the capitalized value of future returns to land. The effect on land value will ultimately depend on

whether income and interest changes are viewed as transitory or permanent (Featherstone and Baker 1987). If income changes are viewed as transitory, little adjustment will occur in rental rates and land values. If the effect of COVID-19 is more permanent because of food supply chain changes and/or agricultural trade f ow changes, land values may drop. If economy-wide interest rates increase or the agricultural sector is viewed as riskier, causing the cost of funds for farm lending premium to increase, land values could fall. The inelastic nature of food demand will likely result in the changes in agricultural income being transitory. Interest rate changes could be more permanent given the amount of liquidity injected in the economy.

Farm bankruptcies could spike over the next year or two because of a relatively weak liquidity position for many farm operations. Figure 10 provides information on the soundness of agricultural borrowers and commercial banks that lend to production agriculture. Over the last year, the percent of nonperforming loans has increased. However, the soundness of commercial banks that lend to agriculture has been constant. Agricultural banks remain relatively strong with a fairly sound portfolio of agricultural loans. While the agricultural sector will struggle over the next year because of COVID-19 with some farmers exiting the sector, lenders to production agriculture are strong.



Conclusion

The prof tability of production agriculture will be stressed in 2020 because of COVID-19. The sector has enough strength overall to weather what the sector has experienced through June 1, 2020. A second wave of infections leading to additional shutdown of segments of the U.S. economy would lead to further deterioration in the sector. Parts of the sector will see more diff culty than others. The f nancial position of lenders is such that credit will be available to f nancially viable producers. The f nancial position of agricultural producers given income and liquidity levels from 2018 and 2019 will be stressed throughout the rest of 2020.

50% Unauthorized and 100% Essential: Farm Labor Supply and Demand during the COVID-19 Pandemic

By Diane Charlton

On May 22, 2020, 72 members of the House of Representatives wrote a letter to House Speaker Nancy Pelosi and House Minority Leader Kevin McCarthy requesting that the government pro-

vide free COVID-19 testing, education and training, and personal protective equipment for farmworkers. Farmworkers are essential for maintaining an uninterrupted food supply to the nation, but ensuring adequate farm labor supply throughout a pandemic is tenuous. Farm employers must provide for the health and safety of their workforce, f nd creative methods to recruit workers during a season of restricted immigration, and adapt to major disruptions in the food supply chains by adjusting inputs and production methods.

Agricultural activities expose workers to increased risk of contracting COVID-19 and spreading it to others. During a typical farm season, farm workers often work near one another, travel to worksites together, and reside in tight living quarters among other farm workers. Some farmers and farm labor contractors are taking precautionary measures to ensure that workers can socially distance, such as providing additional buses to transport workers to f elds, more handwashing stations in the f elds, face masks for employees, employee sick leave and health benef ts, and separate living quarters for workers who have tested positive for COVID-19. Nevertheless, COVID-19 is spreading rapidly through many farm worker communities where workers cannot afford to take time off work or rent individual living space. Yakima County, the highest producing county in Washington State of apples, sweet cherries, pears, squash, and peppers, has the highest per capita infection rate of COVID-19 on the West Coast, and a farm in Tennessee reported that every one of its 200 employees had had the virus (Dorning and Skerritt 2020). This demonstrates how precautions to improve social distancing, though costly to the producer in the short-run, may be vital to preventing a future outbreak.

Real U.S. farm wages were rising, reports of labor shortages were becoming more frequent, and H-2A visa demand was increasing before the COVID-19 pandemic (Zahniser et al. 2020). Nearly 50% of the crop workforce is unauthorized and 10% are international shuttle migrants (workers who live part of the year in another country).[11] On March 20, 2020, the United States and Mexico closed their border to nonessential migration, and on April 22 President Trump signed an executive order temporarily restricting immigration. Total apprehensions of unauthorized immigrants on the U.S. Southwest border declined by nearly 50% between March and April 2020 in contrast with increases in apprehensions between the same months in both 2019 and 2018.[12] Absent a drastic change in border patrol in 2020, this suggests that fewer unauthorized immigrants are attempting to enter the United States during the pandemic.

Congress made temporary allowances to help farms and small businesses retain their workforce during the pandemic. The Small Business Administration published an interim f nal rule on April 30, 2020 allowing seasonal employers to use any 12-week consecutive period from May 1, 2019 to September 15, 2019 to calculate their maximum loan amount from the Paycheck Protection Program (PPP). Although immigration to the United States has been temporarily restricted, nonimmigrant guest workers with an H-2A or H-2B visa can still migrate to the United States. H-2A workers represented approximately 10% of the full-time-equivalent crop workforce in f scal year 2019 (Costa and Martin 2020). There were 276,811 certif ed H-2A positions in f scal year 2019, up 9.6% from the previous year.[13] Currently, new and returning H-2A applicants can temporarily receive visas without in-person interviews, and employers can obtain new H-2A visas for nonimmigrant workers who are already residing in the United States. Nevertheless, employers still may not be able to recruit suff cient workers, particularly if typical migration networks are constricted. H-2A consulting f rms and growers' associations, like the Washington Farm Labor Association (WAFLA) and North Carolina Growers' Association, that recruit workers on behalf of farm employers will likely play a critical role in connecting employers to new guest workers.

[11] Author's interpretation of the Department of Labor, Employment and Training Administration (2016) National Agricultural Workers Survey.

[12] Total apprehensions increased between March and April of 2019, 2018, and 2016. In 2017 apprehensions decreased, but only by 6%. Data source: U.S. Customs and Border Protection 2020.

[13] Figures based on calculations from the United States Department of Labor Employment and Training Administration, Off ce of Foreign Labor Certif cation. "H-2A Disclosure Data". https://www.foreignlaborcert.doleta.gov/performancedata.cfm Retrieved May 23, 2020.

Layoffs in the service sectors and high unemployment rates may increase the local farm labor supply. However, workers do not generally return to the farm sector once they f nd jobs in the non-farm sector. Increased unemployment benef ts, which are currently available through July, make it more prof table for many workers to remain unemployed than to seek new jobs, particularly in low-paying sectors like agriculture (Scott 2020). Nevertheless, access to unemployment benef ts and ease of applying for unemployment varies across U.S. states (Desilver 2020). Unauthorized workers are unable to access unemployment benef ts, though they may qualify for other state benef ts (Smith 2020; Garcia and Hellerstein 2020).[14] States like California are temporarily providing additional economic safety nets for unauthorized immigrants. However, many unauthorized immigrants may be reticent to apply for benef ts for fear of exposing their immigration status.

Anticipating labor needs during the pandemic will be particularly diff cult in the agricultural sector. Prior to the pandemic, 54% of U.S. food expenditures were to restaurants and cafeterias,[15] which mostly closed in March and April. The pandemic severely interrupted food supply chains as consumers f ocked to grocery stores to stock up on freezer and nonperishable items. With fewer markets available for fresh fruits and vegetables, along with products like f uid milk and cheese that were traditionally served in school cafeterias, some farmers have redirected crops to ranches for livestock feed or tilled their produce back into the soil. Nationally, farm employment typically peaks in July (Costa and Martin 2020). Schools and restaurants are slowly opening up across the country, though still implementing social distancing protocols. Consumer expenditures have smoothed since the initial announcement of the pandemic in March, but many consumers will likely prefer budget meals prepared at home to eating out as long as the country is in an economic downturn. As consumers revert, at least in part, toward their pre-pandemic purchasing habits, producers should f nd increasing shelf space for perishable crops. However, food processors may have to convert their facilities to produce food products better suited for dining at home. Obtaining suff cient workers and taking precautions to keep workers safe and healthy will be two primary objectives for employers at all stages of the food supply chain during the summer months of 2020, particularly as summer travel and social activities increase.

COVID-19 and Rural Health Care

By Alison Davis

COVID-19 rates, both infection and death rates, in rural communities are smaller than those in their urban counterparts. As of April 27, 2020, there were 114.9 cases per 100,000 people in non-metro communities compared to 327.5 per 100,000 people in metro communities. The death rates, measured as number of deaths per 100,000 people, in urban areas was 26 times larger than non-metro counties. However, the rate of increase in cases is now larger in non-metro counties as COVID-19 spreads to outlying areas and testing availability continues to improve (Fehr et al. 2020). The spread of COVID-19 has not been uniform across non-metro counties. Rural hotspots have emerged in communities with prisons, nursing homes, meat packing plants, persistently poor African-American communities, and tribal nations (Marema 2020). In addition, these same communities are often riddled with poor health conditions leading to higher rates of hospital utilization and a greater risk for death (CDC 2013).

As the nation prepared its health care sector for COVID-19, hospitals across the country inventoried available capacity for treating COVID-19 patients. Urban and rural hospitals alike alerted

[14] "Governor Newsom Announces New Initiatives to Support California Workers Impacted by COVID-19." 2020.
[15] Purdue University (2020).

community leaders to their personal protective equipment (PPE) shortages as well as the need for respirators, ventilators, negative pressure rooms, and intensive care unit (ICU) beds. Rural hospital leaders were also concerned about the lack of workforce trained and able to support COVID-19 patients. However, in most instances, high-risk patients who presented COVID-19 symptoms at rural hospitals were transferred to larger urban hospitals for treatment. Thus, the burden on rural hospitals to date has been relatively minor.

At the same time, though, hospitals were ordered to suspend all elective procedures. This was especially troublesome for rural hospitals, many of which have experienced high levels of f nancial distress. Over the last decade, 130 rural hospitals have closed (UNC 2020). Rural hospitals are particularly vulnerable because of the payer mix of their patients: a large majority of patients are covered by Medicare, Medicaid, or self-insured compared to urban hospitals where a larger share of patients are privately insured. Over the last decade, rural hospitals have been forced to diversify their portfolio of services to generate enough revenue to offset their expenses, and many hospitals have been able to stay af oat because of their elective procedure offerings. With the suspension of elective procedures, rural hospital hallways were empty; clinic exam rooms were empty and rural providers were losing revenue hourly. As a result, many hospitals in both rural and urban communities started laying off and furloughing a signif cant share of their employees (Paavola 2020). It is expected that urban hospitals will invite their workers back more quickly than rural hospitals as the demand for services returns at a faster rate in metropolitan communities. The demand for hospital services in rural places is not expected to recover at the same rate. These effects are not limited to rural hospitals, but also to clinics and other supporting health services in the community.

In response to these f nancial losses, the CARES Act provided $10 billion to Critical Access Hospitals, rural acute care general hospitals, rural health clinics, and community health centers in rural areas across the country (HHS 2020).[16] No hospital has or will receive less than $1 million, and the distribution varies by the hospital's expenses. Clinics are guaranteed a minimum of $100,000 with additional payment based on operating expenses. These funds, for many hospitals, might more than offset lost revenue while elective procedures were suspended; however, the funding amount was signif cant because of the anticipated further f nancial losses these rural health providers are expected to endure over the next 12 to 18 months. In addition, hospitals are eligible for additional funds through the Small Hospital Improvement Program (SHIP) to support hospitals in preventing, preparing for, and responding to COVID-19 including but not limited to PPE, workforce training, HVAC systems to promote facility air quality and hygiene, and telehealth equipment and software systems.

Other COVID-19 Consequences for Rural Health Care

Telehealth has become an important tool for health providers, particularly for rural facilities. There are several implications for this surge in adopting telehealth.

(1). By, in effect, forcing telehealth upon the community and seeing its success, it will be very diff cult to stop once this public health emergency ends. If the insurance industry (including Medicaid and Medicare) can compromise on billing regulations, telehealth could result in new revenues for rural health care providers and reduce the number of patients leaving their community for doctors' visits.

[16] Critical Access Hospitals, designated in 1997 as part of the Balanced Budget Act, were established to provide limited inpatient and outpatient care. They are typically limited to no more than 25 inpatient beds and receive 101% cost-based reimbursement.

(2). The ability to implement telehealth technology relies on access and utilization of high-speed internet for both providers and patients. The lack of uniform access across rural communities is a known problem; the solution is not as quickly identif ed.

(3). A new revenue-generating market will attract additional providers. There is a concern that large corporate medical organizations may start to market telehealth services to patients in rural communities. This further separates the touchpoint between provider and patient. In addition, this would likely result in a further lack of supply of local rural health care providers.

The ongoing economic crisis should not be considered separately from the health care crisis. With the media's attention geared toward COVID-19, the rural drug abuse crisis has received little coverage. While fewer Americans died from drug overdoses in 2018 compared to 2017, "deaths of despair" actually increased. Those numbers are expected to increase faster because of COVID-19, particularly an increase in minority deaths (Lang 2020). Drug overdoses and suicide attempts create an additional burden for the rural healthcare system including hospitals, emergency medical systems (EMS), and mental health care providers.

COVID-19 to date has been primarily an urban problem. While pockets of rural communities have been affected, those have been explained by specif c events including outbreaks at nursing homes, prisons, meat packing plants, etc. It will take some time (and exhaustive testing) to determine the extent to which rural communities were infected. If the data suggest that rural communities indeed fared better, and we expect that additional public health crises will continue to emerge, then there will likely be an increased number of households considering a move to rural America. Are our rural communities prepared?

Research Priorities to Fill Critical Knowledge Gaps Caused by the Coronavirus Pandemic

By Rodolfo M. Nayga, Jr. and David Zilberman

The novel coronavirus pandemic has signif cantly affected the agri-food sector and has caused previously unimaginable disruptions in the food supply chain. These disruptions have exposed critical gaps in our knowledge of how to make the agri-food sector and supply chain more resilient and adaptable to major crises such as pandemics. The goal in this section is to pinpoint and discuss some of the most important research topics that researchers should consider to better analyze the impacts of shocks like COVID-19 and to f ll some of the critical knowledge gaps identif ed by the pandemic.

The pandemic has demonstrated the crucial importance of the agri-food supply chain. While agricultural economists traditionally address many aspects of food supply, there is a need to further develop foundational knowledge on the economics of agri-food supply chains (Zilberman, Lu, and Reardon 2019), especially during disasters. This should include both conceptual and empirical analysis to quantify and assess agri-food supply chain outcomes and agribusiness behavior and their impacts on the farm sector and consumers. Such analysis would, among others, allow improved understanding of the conditions leading to vertical integrations, various types of contracting, and adoption of various processing, shipping, and marketing technologies. This understanding will allow us to improve the prediction of effects of shocks like COVID-19, changes in international trade conditions, and design of policy interventions.

The pandemic identif ed specif c challenges facing agri-food supply chains that require better understanding and research. One of the major disruptions in the food supply chain during the pandemic was caused by the closing of several meat processing plants because of COVID-19 infections among its workers. Given the relatively high concentration in the meatpacking industry, production capacity in the United States was signif cantly curtailed by these plant closures. This has caused meat shortages and price increases in some retail stores despite no shortage of livestock. Critical research is needed to look at why the current system broke down and how we can make it work more effectively and eff ciently for all parties, including cattle producers, meatpackers, retailers, and consumers. There is also a need for better understanding of economies of scale issues in the meat industry and an assessment of how much cushion in plant capacity is needed during pandemics and other catastrophic disasters.

Another major disruption caused by COVID-19 was the closure of restaurants because of stay-at-home directives. Food sales from restaurants practically dried up during the stay-at-home orders, while food sales from grocery stores and online retailers signif cantly increased. These sudden shifts in consumer demand stressed the food supply chain and had an immediate impact on producers of perishable agricultural crops because the foodservice industry accounts for about half of all perishable food grown, and food products destined for the foodservice industry are different in terms of size, packaging, and labeling requirements from those destined for food retail outlets (Cagle 2020). Research is needed to examine how the food supply chain can overcome these logistical diff culties and how the system can signif cantly reduce food waste at the farm level. For example, can online platforms that can connect retailers, processors, and producers along the food supply chain reduce the logistical bottlenecks in the food supply chain?

Research on local and regional food systems should also be prioritized to assess how these can be reengineered so that they can feed people especially during catastrophic events. For instance, research is needed on how local and regional food systems can be redesigned so that they can ef-f ciently and effectively produce and distribute food from farmers to food banks or via direct market channels. During the pandemic, food banks experienced an unprecedented shortage of food due to collapsing economic conditions from lost employment and jobs while food products from farmers and food processors were being dumped and wasted because of the breakdown in the supply chain (Newman and Bunge 2020). Critical research is needed on how to make food supply chains more nimble and shorter during catastrophic events.

Workers along the food supply chain have been deemed essential during the pandemic. In addition to working close to each other, many of these workers, especially those working in agricultural farms, are on H-2A (temporary agriculture worker) visas. They live together and travel together on buses, requiring them to be in close quarters with each other. If an outbreak occurs among these workers, replacements will be diff cult to f nd in on short notice. Consequently, a rapid spread of the virus would be costly for workers and producers alike and could lead to further disruptions in upstream segment of the food supply chain (Luckstead, Nayga, and Snell 2020). Research is needed on how to protect the physical and mental health of all workers in the agri-food sector and how to make the agri-food labor supply more robust during catastrophic events.

The far-reaching health and economic effects of COVID-19 and widespread business closures have signif cantly increased food insecurity, which have made it more diff cult for low-income households to afford food. While the Families First Coronavirus Response Act provided emer-

gency Supplemental Nutrition Assistance Program (SNAP) supplements and eased program administration during the pandemic, critical research is needed on how to make federal food assistance programs such as SNAP more responsive to the needs of food insecure households during catastrophic events. For instance, research is needed on how these programs can be further enhanced to make sure that low-income families with children who are missing out on school meals during catastrophic events can get enough food to eat.

The COVID-19 crisis has also shown us the danger of disregarding scientif c knowledge. There is a need to reassess the regulation of new technologies in the United States and globally. For example, researchers and the industry have been unable to take full advantage of the new opportunities new genomic insights have provided agriculture. The advent of gene editing and the reduced costs of genome sequencing offers unique opportunities for faster development of cures for zoonotic diseases that will prevent the emergence of pandemics. It can also lead to the development of new agri-food products that can help the food system become safer, more productive and, more resilient during pandemics. Furthermore, modern biotechnology provides the foundation of a modern bioeconomy (Zilberman et al. 2013) that will allow the expansion of products that can empower the agri-food and rural sectors.

Another much needed critical area of research is on the effect of environmental degradation on the occurrence of infectious diseases and pandemics. For example, research shows that deforestation contributes to the presence of more infectious disease outbreaks in humans (Olivero et al. 2017). This is because deforestation causes increased interaction between humans and populations of infected wildlife such as bats that were previously isolated. The increased interaction allows viruses to mutate and jump to other species, which can then lead to human infection directly or through an intermediary species. Research is also needed on the assessment of effect of the pandemic on the environment during and after COVID-19, and how to "f atten the carbon curve."

Last but not the least, the overall impact of COVID-19 on agricultural trade is still uncertain since it would depend on how long world economies will recover. Research is needed on how international trade can be safely maintained amid pandemics and other global catastrophic events.

Post-COVID Outreach Priorities

By John Anderson, Josh Maples, and Sarah Low

As a result of the COVID-19 pandemic, decision makers—farmers, business managers, community leaders, policymakers, consumers—are currently operating in an exceptionally uncertain environment. The agricultural and applied economics profession exists to render conceptually sound, data-driven, actionable intelligence from a confusing swirl of information. Therefore, our profession should have a great deal to contribute at such a time as this. Such a contribution presumes that the good and relevant work of agricultural and applied economists f nds its way to those decision makers who can put it to use. Thus, the outreach component of our professional mission is an important one, and never more so than at the present time. In this piece, we will brief y identify key outreach/extension priorities for addressing the ongoing COVID-19 pandemic and its eventual aftermath.

The most obvious, and pressing, need in the immediate term is for outreach related to policy analysis. Policy decisions are being made, as they always necessarily are, in the midst of crisis.

Political timelines do not generally admit the kind of meticulous, thoughtful, and comprehensive analysis that academic practitioners are most comfortable performing. And political decisions will hinge on more than economic analysis, no matter how compelling that analysis may seem to economists. Still, the role of economists in the policy process is an important one. Informing the ongoing policy response to COVID-19 must be considered a high priority for the profession.

Already, the agricultural and applied economics profession has made important contributions to the policy process. Higher prof le examples of this work include the effort by Peel and colleagues (2020) to quantify economic damages in the beef sector and Thilmany and colleagues (2020), quantifying economic damages to local and regional food markets. Both were instrumental to developing emergency relief programs. Many agricultural and applied economists are engaged right now in estimating economic damages at the state level. This work will be vital to state and local governments as they make revenue projections, prioritize spending, and evaluate policy responses.

Looking ahead, the profession should be strategic in planning to offer objective, research-based evaluation of policy alternatives and consequences in the areas likely to be the focus of the longer-term COVID-19 policy response. These may include trade, rural healthcare and infrastructure development, farm income support, and supply chain regulation and structure.

There is also likely to be considerable demand for outreach information and support from more traditional Extension clientele. The production agricultural sector entered the COVID-19 pandemic after having endured several years of low prof tability (Kauffman and Kreitman 2020). While some major crops have fared better than others so far (e.g., rice in comparison to corn), we should anticipate that the severe global economic shock of the pandemic will ultimately prove bearish for the entire commodity sector. Thus, outreach programming dealing with farm f nancial management and f nancial stress mitigation will be a high priority.

The COVID-19 pandemic has surfaced supply chain risks that few had anticipated, at least in terms of scope. There will be great interest among industry participants in increasing supply chain resilience. For example, local and regional food systems have received signif cant attention in the pandemic as a possible means of relieving stress on commercial supply chains by essentially creating some slack capacity in the food processing and distribution system. Much outreach work is currently and will continue to be needed to assess the feasibility of particular projects, to support management and marketing at all levels, and to educate participants on regulatory/legal aspects of such projects. At the farm-level, interest in supply chain resilience will manifest as demand for information on a relatively wide variety of topics: general price and production risk management, labor recruiting/retention strategies, contract evaluation, and evaluation of alternative enterprises, production systems, and markets. Additionally, agricultural market organization will come under increased scrutiny, and there will be signif cant demand for information on benef ts and costs of changes to market structure. Adapting work on these topics to COVID-specif c coordination problems presents an excellent outreach opportunity for the profession.

Similarly, there will be great interest in and need for outreach related to community and economic resilience. Clearly, rural healthcare should be a key focus for outreach work: assessing factors affecting resident health; identifying, evaluating, and communicating prevention and treatment best practices; evaluating and prioritizing rural healthcare investments; among many others. Rural infrastructure will be an outreach priority—with essentially every school in the country moving to remote delivery this past spring, broadband access, speed, reliability, and cost

became a higher-prof le topic than it already was. Work will be needed to assess def ciencies and evaluate infrastructure investments in light of the changes wrought by COVID-19.

Finally, the impact of COVID-19 on many state and local governments could be devastating, compromising their ability to provide key services in sectors vital to the long-term viability of rural economies (e.g., K-12 education) and forcing signif cant layoffs, exacerbating unemployment.[17] As state and local governments wrestle with these challenges, pressing information needs will surface: impact analyses, sales tax revenue projections, economic recovery and resilience strategies, longer-term economic development priorities, and assessment of strategies for meeting education priorities.

The COVID-19 pandemic has highlighted the relevance of the agricultural and applied economics profession like no event since the farm f nancial crisis of the 1980s. The pandemic has also highlighted the breadth of expertise represented by the profession, creating a tremendous opportunity to contribute meaningfully to important decisions that will be made in the wake of this crisis by individual farms and businesses as well as by policymakers at every level of government. Timely and effective outreach is thus a central obligation of the profession at this time.

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