In This Issue:

Impacts of the COVID-19 Pandemic on Agriculture and Natural Resources in the Western U.S.
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Special Issue of the Western Economics Forum

Impacts of the COVID-19 Pandemic on Agriculture and Natural Resources in the Western U.S.

By Jude Bayham\textsuperscript{1} and Jay Parsons\textsuperscript{2}

The COVID-19 global pandemic is the most significant public health crisis in over 100 years. As of March 2021, there were 115 million reported cases and 2.5 million deaths attributed to COVID-19 (The New York Times, 2021). The SARS-CoV-2 virus spread rapidly across the globe in the Winter and Spring of 2020, prompting widespread government intervention. Governments ordered people to stay at home across the US, all but essential businesses were asked to close, and schools began online instruction. The virus and the associated public health response have had profound impacts on nearly every aspect of society, including agriculture.

This special issue of the Western Economics Forum surveys the impacts of COVID-19 on several aspects of agricultural production, farm labor, rural migration, and university instruction. While the set of topics covered in this issue is by no means exhaustive, it provides a broad overview of how the pandemic has and will continue to impact agriculture and rural communities in the Western U.S. Three articles focus on the pandemic’s impact on animal agriculture with two articles focused on meat processing, while the other article focuses on the dairy industry. Two articles discuss region-specific impacts to agricultural production in Texas and California. Another article investigates the effects of the pandemic on agricultural labor with an emphasis on labor-intensive crops in the Western U.S. The issue also includes a contribution on rural migration during the pandemic using novel mobile device data. Last but certainly not least, the issue includes two articles on the impact of the pandemic on agricultural education in the university setting. In addition to the breadth of topics, authors represent 12 states and 12 land grant universities bringing a variety of perspectives to

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this survey of the impacts of COVID-19 on agriculture and natural resources in the Western U.S.

As the gravity of the pandemic became apparent, grocery stores struggled to keep shelves stocked and supply chains were disrupted all over the country. The pandemic exposed vulnerabilities in the food supply chain (Chenarides et al., 2021) while simultaneously highlighting flexibilities in local food systems (D. Thilmany et al., 2020; Dawn Thilmany et al., 2021). While agricultural production remained high overall, the structure of demand changed as people increased at-home consumption when restaurants were forced to close or operate at a limited capacity (Beckman & Countryman, n.d.).

Meat processing facilities across the country were deemed essential; however, the virus spread through staff populations creating disruptions in supply. In this issue, Bir et al. examine the increase in demand for local custom slaughter capacity and the factors contributing to it. They go on to describe challenges facing small-scale processors in Oklahoma, efforts to address these challenges utilizing coronavirus relief funding and the potential impacts of increased small-scale meat processing capacity. The Lacy et al. article explores similar issues in Nevada and Utah. They compare and contrast the regulatory structure in each state as well as hurdles to overcome for small local meat processors. They include results from two recent studies. One study examined the economic feasibility of a small meat processing plant in Utah. The other study summarizes the results of a survey looking at consumer preferences for local beef in Utah and Nevada.

The dairy industry was also greatly affected by the pandemic. Closures of schools and restaurants resulted in reduced demand for dairy products and led to large fluctuations in milk prices received by farmers. Sumner et al. examine these effects in the context of the significant role Western states play in U.S. dairy production. They also discuss payments made to the dairy industry through the various coronavirus relief programs. Western dairy states are also significant exporters of dairy products. Their article provides a thorough overview of the complex set of impacts the COVID-19 pandemic and subsequent Federal Government programs have had on the Western dairy industry.
At one point, the Texas High Plains region was considered a COVID-19 “hot spot” due to high numbers of positive cases. Jones et al. study the farm-level impacts of COVID-19 on six case study model operations created by Texas A&M AgriLife Extension Risk Management Specialists for the Texas High Plains region. Using stochastic simulation, they compare 2020 farm financial outlooks for two price and cost scenarios. The first is a January 2020, pre-COVID projection for the calendar year 2020. The second scenario is an early, post-COVID projection for prices and costs published in April 2020. Their analysis projected a substantial reduction in farm profitability and liquidity in the region due to the effect of COVID-19 on the agricultural economy. Their analysis included regular farm program payments but did not include the various ad-hoc financial support payments agricultural producers received from the Coronavirus Aid, Relief, and Economic Security (CARES) Act or the Coronavirus Food Assistance Programs (CFAP I and CFAP II). The six model farms experienced an average decline in net farm income of 23 percent and an overall increase in cash flow problems and liquidity risk, thus providing some justification for these ad-hoc financial assistance programs.

Other production sectors experienced challenges due to the public health measures intended to control the spread of SARS-CoV-2. In particular, labor-intensive production sectors and those producing fresh fruits and vegetables, especially in California, coped with social distancing policies and demand shocks as restaurants stopped buying fresh produce. The article by Goodrich et al. documents the challenges faced by California produce and nut producers. The authors note that US sales to restaurants, schools, and hotels fell by 68%, while demand for fresh fruits and vegetables at grocery stores increased by as much as 35% over last year. During the initial phase of the pandemic, export markets experienced disruptions affecting many California producers. The article concludes with a commentary about how long these trends may persist.

In another article focused on California agriculture, Hill and Martin document the effects of the pandemic on labor. Agricultural labor was deemed essential infrastructure, but there was concern that transmission of SARS-CoV-2 would create workforce shortages and that guest workers would be restricted from entering the country, compounding the shortages. Fortunately, these shortages did not materialize, and the H-2A guest worker program expanded to meet labor demands. The authors document how the pandemic accelerated several trends in the industry, including
investments in labor-saving technologies and increased importation of agricultural products.

As society began to adapt to the new COVID-19 reality, many decided to leave dense urban areas for less populated areas with outdoor recreation amenities. Several mountain communities in Colorado known for their outdoor recreation amenities experienced increased housing demand (Blevins, 2020). Americans saw outdoor recreation as a safe activity during the summer of 2020, and the sales of bicycles and other recreation equipment increased dramatically (Goldbaum, 2020; Green, 2020). Areas that depend on tourism spending were forced to balance livelihoods with public health in their communities. In this issue, Dimke et al. document evidence of increased migration to rural areas with access to outdoor amenities using anonymized mobile device records. The influx of new residents to these generally less populated communities can strain local infrastructure and drive up prices, but it can also provide economic development opportunities.

Most universities suspended in-person instruction in the Spring of 2020. While many continued online in the Fall of 2020, other universities attempted to resume some form of on-campus instruction and activities. Universities across the US quickly realized the challenges of managing the behavior of young adults during a pandemic that posed less health risk to the student population. A steep rise in COVID-19 cases led many universities to resume online instruction in the Fall of 2020. This issue includes two articles on the forced transition to online learning at many land-grant universities. The perceptions of students and faculty are discussed as well as considerations of equity.

The Kiesel et al. article focuses on the perceptions of students. They analyze data from a survey of student experiences with the shift to online instruction from Colleges of Agriculture at six Land Grant Universities in the US. The authors find that the experience of students varies widely. However, several themes emerge. Students without a strong internet connection or access to adequate study spaces had worse experiences with online learning. The results also suggest that active and engaged teaching methods improved student experiences in online courses.

The Brown et al. article focuses on the perceptions of faculty. It provides a clear synthesis of the positive and negative aspects of the shift to online instruction as reported in biweekly meetings organized by the leaders of the Teaching, Learning, and
Communication section of the Agricultural and Applied Economics Association. The authors note that the move to online instruction forced many instructors to re-examine their course materials, align with teaching objectives, and increased communication with students. The article also describes negative aspects of remote instruction, including student computing resources, lack of deeper connection with students, and academic dishonesty. The authors conclude with lessons learned and recommendations for improving both online and in-person instruction moving forward.

References


The Impact of COVID-19 on Meat Processing, and the Renewed Interest in Local Processing Capabilities

By Courtney Bir¹, Derrell Peel², Rodney Holcomb³, Kellie Raper⁴, and JJ Jones⁵

Short description: COVID-19 caused processing plant shutdowns, increasing concern regarding the current processing system. We evaluate the financial support and potential for an increase in small-scale processing.

Abstract
COVID-19 caused meat processing plant shutdowns, increasing public concern regarding the current processing system. We identify numerous issues and limitations to provide the basis for a discussion about the challenges of increasing local and small-scale processing. These include labor, inspection availability, rendering services, capital, waste management/environmental, water, liability and throughput consistency issues. The Oklahoma Department of Agriculture, Food and Forestry received $10 million in grants for the Food Supply Stability Plan for Oklahoma meat processors. This work examines the potential impact of an increased number of local meat processors, and the incentives created by Oklahoma to encourage such actions.

Introduction
Slaughter capacity was already a common topic of conversation in the meat industry for many states prior to COVID-19. Total industry slaughter capacity and utilization among the largest packers and the lack of small plant capacity to support demand for locally grown/processed meat have been points of concern and discussion (Shanker, 2017). Anecdotally, discussion of the lack of adequate small, local processing is

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common at the coffee shop. There has long been a steady flow of inquiries to OSU’s Food and Agricultural Products Center regarding the feasibility of small slaughter facilities. Some of the pressure comes from producers who want to better serve niche markets, and some comes from consumers who are more interested than ever in knowing where their meat comes from. That said, COVID-19’s impact on the meat supply chain certainly catapulted local slaughter capacity into the spotlight. The strain on the supply chain in response to COVID-19 lock-down related hoarding, shifts in demand from restaurant to at-home consumption, large commercial plant closures, and exploding local demand for “freezer beef”, made slaughter capacity a front-and-center discussion. We admit that many COVID-19 related supply chain issues have corrected themselves. However, as we prepare for the next shock alongside already existing interest, discussion surrounding small-scale meat processing will remain.

Early in the pandemic, consumers changed their shopping behavior. Many people were concerned about having enough food to sustain themselves during a 14-day quarantine period if exposed, and many felt the need to minimize grocery trips. These combined behaviors resulted in some product shortages in grocery stores (D’Innocenzio, 2020). In response to this behavior change, freezer and refrigerator shortages occurred due to increased demand and issues with production (Selyukh, 2020). This resulted in problems for those selling beef direct to consumers, as the demand for beef grew and, for a short time, the slaughter capacity was sustainable, but there was nowhere to go with the meat. Processors could not expand storage capacity nor could consumers acquire home freezer storage (Bendavid, 2020). Then short-term slaughter availability evaporated. One Western Oklahoma custom slaughter facility went from scheduling slaughter dates approximately 90 days ahead to one year wait times while a Central Oklahoma facility was forced to schedule slaughter dates for regular customers 18 months out (Oklahoma Farm Bureau, 2020). While wait times for slaughter slots have decreased somewhat, demand for those slots is still higher than in pre-COVID-19 times. Pre-COVID-19, customers would typically schedule 3 to 4 months out from when animals would be ready for slaughter. At one point, beef packers were operating at about 60% when compared to the previous year, and this bottleneck will take time to rectify (Lusk, Tonsor, and Shulz, 2020).

Furthermore, many restaurants were forced to close their dining-on-site options, and although some consumers shifted to take-out, consumption at restaurants decreased greatly overall. In states that had shelter-in-place orders, restaurant spending decreased by about 31.8% (Baker, 2020). Simultaneously, retail meat demand increased by approximately 60% (Thorn, 2020). Further complicating the issue, cuts typically purchased at restaurants differ from the cuts often prepared at home. In the case of beef, while restaurant consumers typically select higher quality steak cuts (e.g., prime rib, ribeye, T-bone, tenderloin, sirloin) or ground beef, grocery consumers are more likely to purchase less expensive beef cuts and ground beef for home
consumption. Additionally, those products are distributed through different channels and often processed on different production lines with packaging requirements which makes redirecting the product difficult. In Figure 1, the section from early March to early April, designated “shutdown” shows the impact of supply chain rigidities even though no overall shortage of beef production occurred during this time. Although a consumer’s preferred cut was perhaps not available at the grocery store at a price they were willing to pay, alternatives were, for the most part, accessible. This shift is important to understand when evaluating the shocks to the beef market related to consumer demand, as opposed to plant closures. As seen in Figure 1, beef production peaked between March 14, 2020 and April 11, 2020.

Meat packing and processing plants were not immune to COVID-19 related closures. The first sign of a potential issue was a cut in production at the JBS USA beef facility in Souderton, PA on March 31st, with many additional closures and staffing issues following at other plants (McCarthy and Danley, 2020). Meat processing plants are at an increased risk of COVID-19 spread due to difficulty with social distancing while harvesting and processing carcasses (Dyal et al., 2020). In Figure 1, the area marked as reduced slaughter corresponds to the period when total beef production decreased due to plant closures and diminished capacities. This period overlapped with the restrictions in food service and increased shortages of beef products in retail grocery markets due to a real, temporary lack of products. Crowded worker living conditions and transportation, socio-economic challenges which contribute to employees working while feeling ill, and potential language barriers in communicating COVID-19 best practices may also contribute to disproportionate spread of COVID-19 in meat processing plants (Dyal et al, 2020). Taylor, Bolous, and Almond (2020) estimated that livestock processing plants were associated with 6 to 8% of COVID-19 cases and 3 to 4% of COVID-19 deaths in the U.S. With capacity utilization temporarily reduced up to 41% (ERS 2020), beef production fell to a low of 350 million pounds on May 2, 2020 due to processor closures (Figure 1). The combined stressors of increased demand and inability to process beef contributed to the discussion surrounding increasing local slaughter capacity, with the hopes of decreasing reliance on larger facilities. In many cases, consumers noted a lack of product or reduced selections from early March on, but the initial impacts were due to supply chain rigidities while the later impacts were due to reduced beef production. It is important to understand the different causes of disruptions in beef product flows.

Small-scale Meat Processing

Meat Processing in Oklahoma

There are four categories of meat processing in Oklahoma: federally inspected, state inspected, custom-exempt, and Talmadge-Aiken Act (Table 1). The main differences between the categories include inspection requirements and geographic restrictions on
meat sales. Meat produced in state inspected facilities can only be sold in state currently. In most cases, this type of product is sold direct to consumers but possibly in local grocery or restaurants. Oklahoma is one of 26 states with state meat inspection programs (Holland and Bruch, 2013). Meat produced in federally inspected facilities is eligible to sell across state borders, but the small volumes usually mean that meat is marketed direct to consumers (including ecommerce) or to local grocery or restaurants. In some cases, large grocery chains may include some local product lines. Talmadge-Aiken (TA) plants are part of a federal-state cooperative program which utilizes state inspectors in federally inspected facilities. In essence, TA plants are the same as federally inspected facilities. Oklahoma is one of nine states that has TA plants (Holland and Bruch, 2013). Meat from custom-exempt facilities is not for sale and is produced solely for individuals for home use. Custom-exempt plants serve local markets and have decreased by 7.3% between 2012 and 2017 (Thilmany et al., 2020).

While most slaughter takes place in fixed-location facilities, there has been a growing interest in the potential for mobile farm slaughter (either inspected or custom exempt). Mobile farm slaughter does not include a stationary slaughter facility. Rather, dates will be scheduled for slaughter and processing at a specific farm in a region with the goal of increasing accessible slaughter capacity for smaller producers (Amann, 2017). Pre-COVID-19, Oklahoma was listed among states deemed as deficient in local slaughter capacity (Johnson, Marti and Gwin, 2012). Currently, total slaughter capacity for cattle in Oklahoma is about 800 head per week (OFR, 2020a), while Oklahoma has 5.2 million head of beef cattle as of January 1, 2020 (USDA-NASS, 2020).

**Issues Facing Small Processing Plants**

Despite the availability of local cattle for slaughter, small processing plants face numerous economic and logistical barriers. Among these are capital and scale. Processing plants are expensive due to several factors, including the additional concrete and steel to accommodate refrigerated storage rooms, the infrastructure to support hanging sides of beef, wash-down walls and floors (including drains in the floors), and the high cost of stainless-steel processing equipment (Gwin et. al 2011; ISU 2009). With limited slaughter capacity due to space and labor restrictions, operating efficiencies and revenue are considerably lower than larger scale operations. There are many regulatory issues including inspection, safe storage of products, liability and insurance costs, waste management and environmental requirements which can be difficult for small processors to manage. Seasonality in throughput of cattle and producer demand for processing services can impact cash flow and cost structure for small processing plants (Johnson, Marti and Gwin, 2012).

Additionally, as discussed above, not all cuts of meat are in equal demand or of equal value. Large processors may have the opportunity to partner with companies to sell their offal and lower value cuts. On the other hand, they may have the volume and
financial capabilities to generate value-added products from low-valued cuts, hides, and offal. However, small operations often struggle to find profitable market outlets for low-valued cuts and most likely have to pay a rendering company or waste disposal operator to take their offal. Oklahoma, like many other states, faces a harvest and processing bottleneck between the growing number of cattle producers interested in producing and direct marketing beef and increased interest among some consumers for locally-produced or specialty beef products.

One issue facing local processing operations besides capital and funding, is the lack of labor force. Many processors are barely able to find enough suitable and sustainable labor to work in current operations. Some recently closed operations noted lack of labor as one of the main reasons for closing the operation (J. Jones, personal communications). One potential resource in Oklahoma’s favor for building labor capacity is the established Career Tech system. In June 2020, Career Tech announced new online meat processing certification programs that could contribute to a skilled labor force in meat slaughter (OFR, 2020b). Additionally, Career Tech has the capacity to redirect resources toward fabrication and inspection. In some operations, the labor force is made up of mostly family members and friends. As the younger generations mature, the older generations are concerned with continuation of the family processing operation. The challenge of maintaining consistent throughput of animals impacts labor as well, increasing the difficulty of keeping skilled labor fully employed.

**Announcement of CARES Support**
The Oklahoma Department of Agriculture, Food and Forestry received $10 million in grants through the CARES Act Coronavirus Relief Fund for the Food Supply Stability Plan for Oklahoma meat processors (OFR, 2020a). The goal of this funding is to decrease Oklahoma’s dependence on outside processing plants and mitigate the consequences of processing plant shutdowns. Grants stipulated that the funds be used by the end of 2020, and could be used for expanding current facilities or for building new processing facilities with the goal of expanding local capacity. The grant closed August 14th, 2020 and 36 Oklahoma locations were awarded money (ODAFF, 2020).

**Potential Impacts of Increased Small-scale Processing**
One of the main issues with an increase in the number of small plants and an increase in capacity is the already strained supply of inspectors. As indicated in Table 1, all meat processing plants require at least some level of regulatory oversight as a matter of public safety. For example, currently there are 24 state inspected meat processing facilities, 7 federal facilities, and only 17 inspectors in Oklahoma (Bodine, 2020). One proposed solution is recruiting veterinarians to serve as inspectors, but there is a timing issue. The plant demand needs to be in place before the recruitment and hiring of new inspectors can begin (Bodine, 2020).
Slow decreases in U.S. packing capacity over many years combined with cyclical herd expansion since 2014 has brought beef production close to total slaughter capacity. Although it is unclear if the cattle industry is headed for contraction or expansion, there is an argument for additional investment in cattle slaughter capacity. However, the average capacity of the smaller plants is currently 15 head per week. Realistically, modest expansion of small packing and processing will not change overall capacity of the beef industry. It would take 1,000 or more plants with 15 head per week capacity to equal one large commercial packing plant. However, small plants may offer significant opportunities for some producers and consumers. However, there are significant economic challenges for small processors. Using a smaller processor may cost a producer $350 for slaughter and processing, compared to approximately $150 at a larger processor. Consumers who are still stockpiling meat may be willing to pay higher prices, but the price increase may not be sustainable in a post-COVID-19 environment. The higher cost for slaughter capacity may be sustainable if producers are meeting specific production desires of niche consumers, or if consumers value local production and processing. However, further research is needed to evaluate this scenario in the post-COVID-19 market. It is uncertain if expansion of small plant capacity will be sustainable post-COVID-19, given the economic and logistical challenges they face, though the increase in capacity may be beneficial in the short term.

Conclusion
Concerns about limited capacity in the beef slaughter and processing sector only grew during the COVID-19 pandemic. Meanwhile, small processors who were already operating with a backlog saw increased demand for their services by direct-to-consumer meat marketers. Besides CARES Act funding to support expansion of their operations, other bills such as the Processing Revival and Intrastate Meat Exemption (PRIME) Act and the Requiring Assistance to Meat Processors for Upgrading Plants (RAMP-UP) Act have been proposed/revived to support the growth of the small meat processing sector (Johnston 2020).

Only time will tell if 2020 efforts to expand the small processing sector will result in the pendulum swinging too far in the other direction, resulting in newly established or over-expanded meat processing ventures being crowded out from high-cost structures and a lack of consistent sustainable demand. Although new entrepreneurs may think that the demand for small-scale slaughter will be enough to overcome the issues related to economies of scale, labor shortage, and regulatory hurdles, it is possible that some establishments will simply not be economically viable. In fact, the American Association of Meat Processors, which represents more than 1,300 small to mid-sized processors, is unsure whether regulatory changes proposed during the pandemic are the best paths for long-term sustainability among small meat processors (Johnston 2020).
Another aspect that is difficult to predict is whether the changes in consumer purchasing behavior will remain after the pandemic. The purchase of freezers for additional food and meat storage during COVID-19 may be one indicator that general changes in shopping behavior will remain post-pandemic. The increased household freezer capacity will remain for a time post-pandemic, perhaps making large scale beef/meat purchased more attractive. Even within the pandemic time frame consumers have made shifts, dollars spent eating out remains low, but some consumers are now shifting back towards carry out food purchases (Ellison et al., 2020). Continued monitoring of markets and consumer behavior will be necessary to evaluate which changes will remain post-pandemic, and if increased small-scale meat processing will be necessary.

References


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<th><strong>Table 1. Definitions and Rules for the Four Meat Processing Types</strong></th>
<th>Federally Inspected</th>
<th>State Inspected</th>
<th>Custom Exempt</th>
<th>Talmadge Aiken Act</th>
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<tbody>
<tr>
<td><strong>Registration</strong></td>
<td>Must register and be approved by USDA, FSIS.</td>
<td>Must register and be approved by ODAFF.</td>
<td>Must register and be approved by ODAFF.</td>
<td>Must register and be approved by USDA, FSIS.</td>
</tr>
<tr>
<td><strong>Inspection</strong></td>
<td>Livestock and facilities are inspected.</td>
<td>Livestock and facilities are inspected.</td>
<td>Quarterly sanitation checks by ODAFF, no inspection of livestock.</td>
<td>Livestock and facilities are inspected.</td>
</tr>
<tr>
<td><strong>Inspector</strong></td>
<td>A USDA, FSIS inspector must be on site when livestock are harvested and daily during processing.</td>
<td>ODAFF inspector must be on site when livestock are harvested and at some point daily when processing is taking place.</td>
<td>NA</td>
<td>Federal plant with state-employed inspectors.</td>
</tr>
<tr>
<td><strong>Inspector Overtime</strong></td>
<td>The plant is responsible for paying overtime of inspectors.</td>
<td>The plant is responsible for paying overtime of inspectors.</td>
<td>NA</td>
<td>The plant is responsible for paying overtime of inspectors.</td>
</tr>
<tr>
<td><strong>Selling Capabilities</strong></td>
<td>Product can be sold and shipped globally.</td>
<td>Product can only be sold within Oklahoma.</td>
<td>Meat cannot be sold or donated; must be consumed by family or non-paying guests of the owner of the livestock.</td>
<td>Product can be sold and shipped globally.</td>
</tr>
<tr>
<td><strong>Plan Requirements</strong></td>
<td>Must create, implement and maintain HACCP and SSOP plans.</td>
<td>Must create, implement, and maintain HACCP and SSOP plans.</td>
<td>NA</td>
<td>Must create, implement and maintain HACCP and SSOP plans.</td>
</tr>
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<td><strong>Standard Requirements</strong></td>
<td>Must meet federal facility standards.</td>
<td>NA</td>
<td>NA</td>
<td>Must meet federal facility standards.</td>
</tr>
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</table>
Figure 1. Beef Production, Federally Inspected Weekly

<< Shutdown >>  << Reduced Slaughter >>

Million Pounds

02/15/20 02/22/20 02/29/20 03/07/20 03/14/20 03/21/20 03/28/20 04/04/20 04/11/20 04/18/20 04/25/20 05/02/20 05/09/20 05/16/20 05/23/20 05/30/20 06/06/20 06/13/20 06/20/20 06/27/20 07/04/20 07/11/20

2020 2019
Issues and Implications of New Conversations Around Meat Supply in the West

By Katherine Lacy¹, Ruby Ward², Malieka Bordigioni³, Staci Emm⁴, Karin Allen⁵, Anne Whyte⁶

Abstract
The onset of COVID-19 resulted in the disruption of many supply chains, mainly caused by impacts to labor, transportation, and declining market demand. The meat industry experienced some of the most significant supply chain impacts due to the current structure of the meat processing industry. Meat processing is a highly consolidated industry with production lines designed and dedicated to specific end consumers. This organizational structure contributed to livestock backlogs, leading to decreased production, consumer meat shortages, and increased consumer prices. As a result, many states are examining their existing meat supply chain to determine the feasibility of establishing local processing plants. This paper will present responses from states to meat supply interruptions, results from a meat processing facility feasibility study, and results from a survey of Nevada and Utah residents conducted during the summer of 2020 which captures consumer preferences for locally raised ground beef.

Introduction
Coronavirus Disease 2019 (COVID-19) highlighted the vulnerability in our meat supply chain, with production falling by over 40% for pork, 30% for beef, and 15% for chicken in the spring of 2020, within weeks of the declaration of the nation’s pandemic status (Reiley, 2020a, b; McDougal, 2020). As larger harvest and processing facilities restricted hours, implemented social distancing measures, or even shut down, output slowed, and ranchers were forced to consider other options, including diverting livestock to

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⁶ Researcher III, Department of Applied Economics, Utah State University.
approved small to mid-sized facilities. The resulting bottleneck highlighted the need for increased capacity and resiliency in the supply chain. To address this, several states earmarked Coronavirus Aid, Relief, and Economic Security (CARES) Act funds to assist meat processing facilities with infrastructure expansion and COVID-related expenditures.

While local plants lack the economies of scale that support lower consumer prices, regional plants may increase the resiliency of local foodsheds and food security. Because local processors must charge higher prices to cover costs, examining market demand and regional regulations are essential components of determining feasibility. Several studies have focused on aspects of local meat consumer preference and willingness to pay for local and primal cuts, but not for local ground beef, a highly-demanded, at-home meat product. Also, while USDA has set federal standards for certification and movement of meat between states, often vast differences exist in the structure of state inspection services. Utah has several levels of state inspection, including the Talmage Aiken program which permits meat to be sold across state lines with a USDA certification using a conforming state inspection program. This provides processors with more flexibility to expand to other markets. Nevada, in contrast, has passed legislation to allow custom processing (harvesting owned animals for personal use), but no state-level inspection program exists which allows intra- or interstate retail sales.

This paper will present responses from states to meat supply interruptions, results from a meat processing facility feasibility study, and results from a survey of Nevada and Utah residents conducted during the summer of 2020 that captures consumer preferences for local ground beef.

Responses from States to Meat Supply Interruptions
The resulting bottleneck in meat supply from the pandemic highlighted the need for increased capacity and resiliency in the supply chain. Several states used CARES Act funds to assist meat processing facilities with infrastructure expansion and COVID-related expenditures to address this. A table summarizing these responses can be found in Potential for Growth in Local Processing and Sales of Utah Beef (Ward et al. 2020). These included partial or complete funding to increase worker safety and training and increase the harvest and processing capacity. Programs also provided funding to help facilities implement facility upgrades allowing them to participate in a federal or federal-equivalent inspection.

The Utah Department of Agriculture and Food (UDAF) implemented a “Temporary Grant of Inspection,” which was good for a period of 90 days and allowed qualifying
custom-exempt establishments with worthy kill floors the ability to market their product wholesale and retail within the state of Utah (Ward et al. 2020). (Note: custom-exempt is only approved for private, noncommercial use.) Those plants that participated were then able to supply their processed meat to restaurants and grocery stores within Utah. Additional requirements for these plants to participate were:

- Provide a written sanitation program approved by the state
- Develop a hazard analysis and critical control points (HACCP)
- Program must be approved by the state
- Develop a written recall program approved by the state
- Submit labels for approval by the state.

Nevada does not have a formalized meat inspection program within the state. All meat intended for commercial sale, whether retail or wholesale, must be processed under USDA inspection. But the state recently passed legislation to establish a custom slaughter program, and administrative rules are under development by the Nevada Department of Agriculture. A Nevada Extension team received a CARES Act grant (NDA, $249,052.58) through the Nevada Department of Agriculture for equipment infrastructure for a mobile USDA/custom slaughter unit and to build business development plans for entrepreneurs wanting to start a new business slaughtering and processing livestock in Nevada. The long-term Extension objective is to create a Nevada slaughter and processing infrastructure and build a workforce development program for local butchers.

The need to assist very small to small meat processing establishments is also recognized at the national level. The American Rescue Plan Act of 2021, H.R. 1319, signed into law on March 11, 2021, includes funding for investing in infrastructure and retooling support for food processors to build resiliency in the food supply. The Requiring Assistance to Meat Processors for Upgrading Plants (RAMP-UP) Act (H.R. 7490; S. 4298) would provide funding to certain small-scale meat processors to upgrade facilities so they meet USDA standards. For plants that meet this target within 36 months, the funds would not need to be repaid. The Processing Revival and Intrastate Meat Exemption (PRIME) Act (H.R. 2859; S. 1620) would allow custom exempt products to be sold in intrastate commerce. Sales options would include direct-to-consumer outlets, to restaurants, and through in-state grocery stores.

**Complex Regulatory Structures and Hurdles to Local Meat Processing**

While some of the effects of the meat supply chain disruptions were experienced in all states, there are important differences in the types of meat establishment inspections each state conducts. The Food Safety Inspection Service (FSIS) branch of the USDA
conduces inspections of meat establishments in all 50 states and territories and oversees cooperative agreements with states that choose to participate in “same as” or “equal to” inspections. All meat sold through retail or wholesale channels must be inspected under a federal or state program, while privately-owned animals can be processed for personal use at custom-exempt establishments (Table 1). These programs require a trained inspector to be present during all harvest and processing, but this cost is not transferred to the business unless these activities occur outside of regular business hours (i.e., weekends, swing or graveyard shifts, and holidays).

Table 1. Comparison of Meat Inspection Program(s) in Utah and Nevada.

<table>
<thead>
<tr>
<th>Inspection Program</th>
<th>State Participation</th>
<th>Sales Restrictions</th>
<th>Requirements for State Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Inspection</td>
<td></td>
<td>None</td>
<td>• Not applicable – conducted by USDA Food Safety Inspection Service</td>
</tr>
<tr>
<td>State-federal Inspection</td>
<td>Yes</td>
<td>In intrastate only, wholesale or retail</td>
<td>• aka State Cooperative Inspection or Meat Poultry Inspection (MPI) Program (9 CFR §321.1)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td>• State inspection “at least equal to” USDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Utah is one of 27 participating states</td>
</tr>
<tr>
<td>Federal-state Inspection</td>
<td>Yes</td>
<td>No</td>
<td>• aka Talmadge-Aiken (TA) Cooperative Inspection Program (9 CFR §321.2)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>None</td>
<td>• State must participate in approved MPI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Federal inspection conducted by State inspector – “same as” USDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Utah is one of 9 states with TA facilities</td>
</tr>
<tr>
<td>Cooperative Interstate Shipment Program</td>
<td>No¹</td>
<td>No</td>
<td>• aka CIS Program (9 CFR §321.3 and §332)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None</td>
<td>• State must participate in approved MPI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Federal inspection conducted by State inspector – “same as” USDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Only facilities with 25 or fewer employees</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 8 states participate</td>
</tr>
<tr>
<td>Custom Exempt</td>
<td>Yes</td>
<td>Yes²</td>
<td>Cannot be sold, donated, or otherwise enter commerce</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Slaughter-for-fee for owner of animal (9 CFR §303.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Inspection agency and framework depends on the other activities that are conducted by the establishment</td>
</tr>
</tbody>
</table>

¹ Utah Department of Agriculture and Food opted to continue participation in Talmadge-Aiken program.
² Nevada Department of Agriculture is developing rules to implement NRS 583.454, Custom Processing Establishment (SB390; 2019).
Utah and Nevada represent two extremes in terms of participation in cooperative programs; Utah participates in multiple programs, while Nevada participates in none. These differences impact the ability of states to respond to conditions seen during the COVID-19 pandemic. As explained in the previous section, Utah was able to adapt by expanding some of their existing inspection programs. On the other hand, Nevada struggled to adapt since new policies and inspection programs had to be created.

Most states administer some type of custom-exempt program, where owners can have animals harvested for a fee in an inspected facility. Custom-exempt products cannot enter intra- or interstate commerce. New ventures in beef processing must understand the regulatory structure and hurdles in their state. Opportunities that exist in some states may not work in another.

Local Processing of Beef
Various meat processing feasibility studies have been conducted. Focusing on the Intermountain West, the most recent research in this area was completed in 2014. A study done that year in Montana used 250 head per day (Bitz et al., 2014), and a study in the same year completed in Idaho primarily focused on a smaller scale operation processing more than 8,000 head per year (Saul et al., 2014). These more recent studies join a small body of literature that is mostly more than ten years old (Curtis et al., 2006 and 2008; Yorgey, 2008; Schahczenski, 2009). In general, because of economies of scale and the consolidation of the meat processing industry, it can be difficult for smaller plants to be successful.

A recent study in Utah looked at the feasibility of having a very small-scale meat processing plant (750 head per year) as a way of increasing the meat supply chain resiliency. If very small-scale plants can be feasible, it would allow for plants in smaller, more rural areas of the state. The pandemic highlighted limitations in having only a few larger plants, with each one servicing several states. When something happens at one or more of a limited number of processing facilities, the effects can be extreme. The Utah study estimated that it would require about $1.4 million investment to get started (e.g., building, equipment). It assumed an existing site with water lines and utility hookups to the property. Table 2 provides an overview of an enterprise budget for a very small-scale plant. A detailed budget is available in the referenced study. It should be noted that the budget was developed for a single shift. No work was done on the effects of including additional shifts or using overtime to increase capacity. The budget shows over $116,000 net income before tax for a combination of selling retail cuts wholesale and doing custom harvesting and processing. The retail cuts are sold at an average of $6.50 per pound to grocery stores. That price assumed a 30% price premium.
and a 30% margin at retail, resulting in a retail price of $9.28 per pound. It assumed that fed cattle were purchased at $115 per cwt. There was an 8% return on investment. The range of both wholesale prices and net income for a very small-scale plant can be seen in Table 3.

This budget shows possibility to be profitable for a very small-scale plant to operate. However, profitability depends upon positioning the meat as a premium product and operating the plant efficiently. For this study, custom processing is used as a way to defray the cost of labor and overhead and also smooth out production. This allows the plant to operate at a higher capacity and makes the operation more profitable. Such a business does not come without risk. The same study examined additional scenarios where the price varied and created a tool to allow customization of the budget and analysis.

Table 2. Summary Enterprise Budget for Very Small-Scale Processing Plant in Utah with 675 Head of Cattle (90% Capacity of 750 Head Facility)\(^3\)

<table>
<thead>
<tr>
<th>Sales</th>
<th>Total</th>
<th>Percent</th>
<th>Wholesale Per Head</th>
<th>Wholesale Per Pound</th>
<th>Custom Per Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Goods Sold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td>$672,750</td>
<td>59%</td>
<td>$1,495</td>
<td>$4.27</td>
<td></td>
</tr>
<tr>
<td>Marketing &amp; Distribution</td>
<td>$31,500</td>
<td>3%</td>
<td>$70</td>
<td>$0.20</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$155,480</td>
<td>14%</td>
<td>$230</td>
<td>$0.66</td>
<td></td>
</tr>
<tr>
<td>Supplies/inputs</td>
<td>$28,658</td>
<td>3%</td>
<td>$42</td>
<td>$0.12</td>
<td>$42</td>
</tr>
<tr>
<td>Total Cost of Goods Sold</td>
<td>$888,388</td>
<td>78%</td>
<td>$1,838</td>
<td>$5.25</td>
<td>$273</td>
</tr>
<tr>
<td>Gross Income</td>
<td>$244,487</td>
<td>22%</td>
<td>$437.20</td>
<td>$1.25</td>
<td>$212</td>
</tr>
<tr>
<td>Overhead</td>
<td>$128,268</td>
<td>11%</td>
<td>$190</td>
<td>$0.54</td>
<td>$190</td>
</tr>
<tr>
<td>Net Income</td>
<td>$116,219</td>
<td>10%</td>
<td>$247</td>
<td>$0.71</td>
<td>$22</td>
</tr>
<tr>
<td>Tax</td>
<td>$40,677</td>
<td>4%</td>
<td>$86.51</td>
<td>$0.25</td>
<td>$7.76</td>
</tr>
<tr>
<td>Net Income After Tax</td>
<td>$75,542</td>
<td>7%</td>
<td>$160.66</td>
<td>$0.46</td>
<td>$14.41</td>
</tr>
</tbody>
</table>

\(^3\)100% capacity is 500 head processed wholesale and 250 head custom processed. This budget assumed 90% capacity with 450 wholesale and 225 custom.

Table 3. Wholesale Price and Net Income Estimation of Very Small-Scale Processing Plant in Utah

<table>
<thead>
<tr>
<th>Retail</th>
<th>Avg retail prices</th>
<th>20% premium</th>
<th>30% premium</th>
<th>40% premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>40%</td>
<td>$5.74</td>
<td>$8.52</td>
<td>$6.89</td>
<td>$10.22</td>
</tr>
<tr>
<td>30%</td>
<td>$4.02</td>
<td>$5.96</td>
<td>$4.82</td>
<td>$7.16</td>
</tr>
<tr>
<td>20%</td>
<td>$4.59</td>
<td>$6.82</td>
<td>$5.51</td>
<td>$8.18</td>
</tr>
</tbody>
</table>

Estimated net income for various wholesale prices at 100% capacity

<table>
<thead>
<tr>
<th>Retail</th>
<th>Wholesale prices</th>
<th>Estimated net income for various wholesale prices at 100% capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>40%</td>
<td>$370,956</td>
<td>$(370,956) $79,056 $(250,416) $99,864 $(190,146) $189,324 $(129,876) $278,784</td>
</tr>
<tr>
<td>30%</td>
<td>$270,506</td>
<td>$(270,506) $70,044 $(129,876) $278,784 $(59,561) $383,154 $(10,754) $487,524</td>
</tr>
<tr>
<td>20%</td>
<td>$170,056</td>
<td>$(170,056) $219,144 $(9,336) $457,704 $(9,336) $576,984 $(151,384) $696,264</td>
</tr>
</tbody>
</table>

Estimated net income for various wholesale prices at 90% capacity

<table>
<thead>
<tr>
<th>Retail</th>
<th>Wholesale prices</th>
<th>Estimated net income for various wholesale prices at 90% capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>40%</td>
<td>$365,101</td>
<td>$(365,101) $(102,391) $(256,615) $58,637 $(202,372) $139,151 $(148,129) $219,665</td>
</tr>
<tr>
<td>30%</td>
<td>$274,696</td>
<td>$(274,696) $31,799 $(148,129) $219,665 $(84,846) $313,598 $(21,562) $407,531</td>
</tr>
<tr>
<td>20%</td>
<td>$184,291</td>
<td>$(184,291) $165,989 $(39,643) $380,693 $(32,681) $488,045 $(105,005) $595,397</td>
</tr>
</tbody>
</table>

Estimated net income for various wholesale prices at 80% capacity

<table>
<thead>
<tr>
<th>Retail</th>
<th>Wholesale prices</th>
<th>Estimated net income for various wholesale prices at 80% capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>40%</td>
<td>$359,246</td>
<td>$(359,246) $(125,726) $(262,814) $17,410 $(214,598) $88,978 $(166,382) $160,546</td>
</tr>
<tr>
<td>30%</td>
<td>$278,886</td>
<td>$(278,886) $(6,446) $(166,382) $160,546 $(110,130) $244,042 $(53,878) $327,538</td>
</tr>
<tr>
<td>20%</td>
<td>$198,526</td>
<td>$(198,526) $112,834 $(69,950) $303,682 $(5,662) $399,106 $(58,626) $494,530</td>
</tr>
</tbody>
</table>

Note: The estimated net income is a pre-tax profit estimation. Typically, owner(s) would need to pay self-employment and income tax on the profits. However, the rates would vary, and losses could be used to reduce tax obligations from other income.

100% capacity is 500 head processed wholesale and 250 head custom processed. 90% capacity is 450 wholesale and 225 custom with 400 head wholesale and 200 custom for 80% capacity.


Consumer Demand for Local Meat

As discussed above, adding extra capacity to the meat supply chain through more local sales and smaller processing plants would require consumers to pay a premium. Studies have found that U.S. consumers strongly prefer U.S. produced steaks over imported Canadian or Australian steaks (Lim et al. 2013), and consumers are willing to pay a premium for steak and ground beef labeled as “U.S. Certified” (Loureiro and Umberger 2003). Within the U.S., studies have found consumers prefer locally raised meat over non-locally raised meat. When analyzing the beef market in Tennessee, a few studies found consumers and restaurants were willing to pay more for beef that carried a Tennessee label or was considered Tennessee Certified Beef than beef without these labels (Dobbs et al. 2016; Merritt et al. 2018; McKay et al. 2019). Chang et al. (2013) found South Dakota farmer’s market consumers were willing to pay a premium for locally produced ribeye steaks. These steaks were viewed by consumers as having a higher quality in terms of color and juiciness. Telligman et al. (2017) found Alabama consumers consider locally produced beef as healthier due to an assumed lack of hormones or chemicals and more desirable feeding practices but did not view the local beef as safer or more environmentally friendly.
Recently, the authors completed a survey looking at consumer preferences for local beef in Utah and Nevada. Detailed results can be found in Lacy et al. (2021). In Utah, 42% of respondents had purchased meat or produce directly from a local producer, while only 28% had in Nevada, and of all respondents, 65% had never purchased meat directly from a local farmer. Of those respondents, only 30% said that price was a concern, though they believed it was cheaper to purchase meat from their regular retailer.

Many of the survey participants were willing to pay a premium for locally raised ground beef (Figure 1). At an equal price, about two-thirds of Utah respondents would prefer locally raised ground beef while only about half of Nevada respondents reported the same. However, Nevada respondents showed less price-sensitivity than the Utah respondents as they were willing to pay for locally raised ground beef at higher markups. These results highlight the need to understand the local market and that there are differences in various regions.

Location and convenience are also important aspects in looking at increasing sales of local beef. Ward et al. (2021) also showed that supermarkets were by far the preferred outlet when purchasing local meat. Quality of the food was the most influential factor in determining where to shop, both pre- and post-COVID-19. Cleanliness and price increased in importance post-COVID-19, however over half of the respondents listed price as either the most influential or very influential in determining where to shop both pre- and post-COVID-19. This indicates that while consumers exist who are willing to pay more for local meat, many are very price-sensitive, and not all consumers will pay premiums intrinsic to locally raised meat. Care should be taken in how to position the product and understand consumer preferences.

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7 Respondents were asked a series of hypothetical willingness-to-pay questions for various price premiums (10, 20, 30, 40 or 50%) for locally raised ground beef. At these price premiums, participants were asked if they would prefer locally raised ground beef or non-locally raised ground beef. To reduce starting point bias, participants were randomly assigned a starting price premium and would move up or down based on their selected preference. See Lacy et al (2021) for an in-depth description of the survey.
Z-tests were calculated to test if the proportion of customers willing to purchase locally raised ground beef are significantly different for Nevada and Utah. The p-value ranges for these tests are denoted with stars next to the test statistic:

- * $p < 0.05$
- ** $p < 0.01$
- *** $p < 0.001$

Additionally, hypothesis tests were conducted to determine if the increased proportion of participants willing to pay a 30% premium compared to a 20% premium was statistically significant. We found the proportions were not statistically different even at the 10% significance level.

**Implications and Conclusions**

Overall, there is potential growth for local beef processing and sales. Consumers desire local beef products, and a significant portion are willing to pay a premium for it. However, consumer preference trends vary by location, and it is important to understand local markets and consumer preferences. Notably, the consumer demand was based on stated preferences rather than revealed preferences. Generally, stated preferences may be slightly lower than revealed ones (Carson et al. 1996). Even when a consumer states they would buy local beef products, their decision may change when actively making the purchase.

A very small-scale meat processing facility may be feasible but would require that beef be sold and positioned as a premium product. This works for niche products and could be combined with other quality characteristics, such as grass-fed, organic, natural, etc. Smaller processing plants in regional areas can increase the resiliency of the meat supply in the West and provide the potential for ranchers to develop additional revenue streams.
One of the issues impacting feasibility is the lack of awareness of local meat product availability and the desire for convenience. State programs such as Utah’s Own or Nevada Grown might be used to help build consumer awareness and visibility. Small-scale processing operations often cannot afford to have full-time brand managers and could benefit from associations, cooperatives, or other partnerships to help build the brand and spread the cost.

The overall meat supply chain was built and refined on the concept of economies of scale and fairly tight margins. With the pandemic highlighting limitations of that concept, there is increasing interest in having a more resilient supply chain with additional smaller operations. Additionally, the production and marketing of niche products that can command higher prices would be a beneficial strategy to offset the diseconomies of scale experienced by these smaller operations. The work highlighted in this paper would support that premise. Opportunities exist to improve the resiliency of the meat supply chain in the West, but it will require consumers who are willing to pay premiums for local and quality characteristics.

Programs which can defray the cost of renovations needed for a higher-level meat inspection or to help with capital needs is a possible mechanism to encourage additional smaller operations that could improve supply chain resiliency.

References


Reiley, L. 16 April 2020. Meat processing plants are closing due to COVID-19 outbreaks. Beef shortfalls may follow. The Washington Post. Available at:


Effects of the COVID-19 Pandemic on the Western Dairy Industry

By Daniel A. Sumner¹, Tristan M. Hanon², and Scott Somerville³

Abstract
Western dairy accounts for 46% of U.S. milk production and was hit by the COVID-19 pandemic in complex ways. The pandemic led to large fluctuations in U.S. prices of milk and dairy products. High prices during the summer made up for steep declines in the spring. Western milk production was up over 2019. Farm milk receipts were about the same as in 2019, and about 12% higher than in 2018. However, due to large government payments, 2020 was a relatively high net income year for the Western dairy industry, despite the variability and stresses caused by the pandemic.

Introduction
The dairy industry in the United States is driven by production in the Western States, where almost half of total U.S. production originates. In 2020, half of the top 10 milk producing states were in the West, accounting for 46% of total production (U.S. Department of Agriculture, 2021g). In general, dairies in the West tend to be larger, with more milk cows per dairy and higher milk per cow on average, when compared to their counterparts in the rest of the country.

Closures of schools and restaurants in response to the COVID-19 pandemic reduced demand for dairy products and led to large fluctuations in milk prices received by farmers. Based on data from 2013 through 2016, about 20% of dairy products were consumed away from home, with 40% of cheese and 25% of butter consumed away from home (Lin, 2020). Some months in 2020 saw prices for milk and dairy products that were both lower and higher than in previous years. While this led to uncertainty over prices throughout the year, when averaged across the year prices were comparable to 2019.

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Taken in combination with 2020 milk production, which was higher than in either 2018 or 2019, revenue in the dairy industry was about 12% higher than 2018 and about the same as in 2019 (U.S. Department of Agriculture, 2021e). Since it is beyond our scope to estimate what prices and production would have been in the absence of the COVID-19 pandemic, we compare 2020 milk production and dairy product prices to recent trends to assess the effect of the pandemic on the dairy industry. We also discuss payments made to the dairy industry through programs implemented by the Federal Government in response to the pandemic. We show that the main effects of the pandemic were increased price fluctuations, reduced production during the spring, and a large increase in direct payments to farmers and domestic dairy product consumers.

Effects of the Pandemic on Dairy Markets

Milk Production

Between 2018 and 2020, the dairy industry in the Western States accounted for an average of 45% of total U.S. production (U.S. Department of Agriculture, 2021g). Five Western States are among the top 10 milk producing states in the country and accounted for 86% of Western milk production in 2020: California, Idaho, Texas, New Mexico, and Washington. The other seven Western States (Arizona, Colorado, Wyoming, Montana, Utah, Nevada, and Oregon) combine for about 14% of production (Figure 1).4

Milk production per day was higher in every month of 2020 compared to 2018 or 2019 and generally followed the same patterns, but production dropped between March and April, a period where production usually ramps up during a normal spring flush (Figure 2). A large decline between April and May reduced production to almost the same levels observed in January, before continuing the typical decline seen during the summer months.

At the onset of the pandemic in spring of 2020, producers responded in the near term to changes in demand by adjusting supply at the farm. While farmers do not respond to short-term low prices by implementing large scale changes to their operations, such as tearing down milking parlors, they can reduce production by culling cows or adjusting feed rations. Fewer milk cows are typically sent to slaughter during the spring flush, with average slaughter per day decreasing through March, April, and May (Figure 3). However, the average daily number of milk cows sent to slaughter increased from March 2020 to April 2020, resulting in about 20,700 more milk cows slaughtered in April 2020 when compared to April 2018 and 2019. Average daily

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4 We include Texas in our definition of Western States since the majority of dairy production in Texas takes place in West Texas near New Mexico and the dairies that produce most of the milk in Texas are similar to the large-scale operations in other Western States. We do not include Hawaii and Alaska which produce very little milk.
slaughter fell sharply in May and stayed at low levels through June as herds were
rebuilt, increasing the US milk cow inventory on July 1, 2020 relative to the inventory
on January 1. Average daily slaughter remained low through November, contributing
to a 1% increase in milk cow inventory on January 1, 2021 relative to January 1, 2020,
and increasing the milk cow inventory to its highest level since 1995 (U.S. Department
of Agriculture, 2021f).

In regions regulated by the Federal Milk Marketing Orders (FMMOs), processors
that participate in the order may contribute to a revenue pool regulated by the
marketing order. The marketing orders set minimum prices that plants must pay for
farm milk, depending on the products that are produced with that milk. Plants that
produce beverage milk must pay into the revenue pool. However, plants that produce
other dairy products may choose whether or not to participate in the revenue pool.
Complex rules that differ by order cover entry to and exit from the pool.

When demands shift, such as when schools and cafes close, some farm milk
shifts from beverage milk to the manufacturing of products that can be stored, such as
cheese, dry milk powder, and butter. In FMMO regions, the share of milk used in
beverage products decreased by about 1.6% between March and April 2020, with a
corresponding increase in the share of milk used in other dairy products (U.S.
Department of Agriculture, 2021h; U.S. Department of Agriculture, 2021g). Compared
to a decrease in overall milk production of just over 1%, this was a relative shift towards
production of storable dairy products. This shift continued through the summer
months, with the quantity of milk used for beverage products and milk used for other
products changing by the same amount as overall production. Because sales did not
keep up with the increase in dairy product manufacturing, stocks of butter, cheese, and
nonfat dry milk increased by the end of April (U.S. Department of Agriculture, 2021b;
U.S. Department of Agriculture, 2021d).

The minimum price paid for milk used in beverage products (Class I) is based on
dairy product prices from the previous month, with some complicated adjustment for
mid-month projections and lags. For example, the minimum price for milk used in
Class I products in March was based on dairy product prices from February, while the
March minimum prices for milk used in other dairy products were based on prices
from March. As prices for butter, cheese, and nonfat dry milk fell throughout April, the
corresponding minimum prices for milk used in those products fell, but the minimum
Class I price was based on higher prices from March.

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5 The Class I price formula is based on an “advanced” calculation of the Class III and Class IV prices
using the dairy product prices from the previous month. Until May 2019 the base Class I price was the
higher of the Class III and Class IV prices. The calculation was changed to the average of the Class III and
Class IV prices plus a 74-cent differential.
Producers receive a payment that is equal to the average of the minimum prices, weighted by the share of milk used for products in each class plus whatever “over-order” premiums for which they are eligible based on quality or market scarcity. Therefore, producers who shipped milk to plants that contributed to the revenue pool in April received a payment that was inflated by the high minimum price for Class I milk. Even as milk production decreased and manufacturing shifted towards storable dairy products, the quantity of milk delivered to plants that participated in marketing orders increased by 6% between March and April. After the Class I minimum price incorporated the low product prices from April, a corresponding decrease occurred in the quantity of milk delivered to plants that contributed to the revenue pool of about 11% in both May and June.

During the early months of the pandemic, many news articles focused on farmers dumping milk in response to decreased demand due to school and restaurant closures (Yaffe-Bellany and Corkery, 2020). Despite the headlines, milk that was either used as feed, dumped on farm, or dumped at processing plants was a small share of total production. For example, the California FMMO reported that producers participating in the FMMO dumped 16 million pounds of milk in April, less than 1% of the total milk regulated by the FMMO (Hunter, 2020). Dairy cooperatives in the Western States sometimes implement programs that limit the quantity of milk that members may deliver in a given month. These programs could result in more on-farm dumping of milk; however, industry sources suggest that these limits were not tightened in response to the pandemic.

Dairy Prices
Farm demand for milk is derived from demand for dairy products. Prices of both cheese and nonfat dry milk rose steadily through 2019 and early 2020. Both prices declined in March 2020 (from February) before falling below the corresponding 2019 prices in April and May (Figure 4). Low product prices in April and May led to a collapse in the “all-milk price” received by farms in the Western States (Figure 5). Cheese prices rebounded through June and July, causing the all-milk price to jump above 2019 prices. The cheese price continued to fluctuate through the end of 2020. The all-milk price followed cheese prices, with some months below comparable 2019 prices and some months above.

The large fluctuations in the cheese and all-milk prices seen in Figures 4 and 5 underlie the broader effect of the COVID-19 pandemic on dairy prices. On average, prices across 2020 were similar to or higher than those in 2019. The average nonfat dry

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6 The all-milk price is a measure of the gross price received by farmers, including any premiums paid for milk quality but before any hauling fees or co-op dues. The average all-milk price for the Western States depicted in Figure 5 is weighted by production.
milk price for 2020 was the same as in 2019, while the average cheese price was nearly 10% higher. The average all-milk price was about 1% lower than in 2019, due to competing effects of low beverage milk prices and high prices paid for milk used in cheese production (U.S. Department of Agriculture, 2021a). While average prices compare favorably to 2019, large variations in prices from month to month created concerns that had to be dealt with by farms and milk handlers.

Exports
Western States are major exporters of dairy products to Asia, Mexico, and parts of Central America. Exports tend to follow a similar temporal pattern to milk production, with both 2018 and 2019 exhibiting peaks in the spring and lower export levels over the summer months. Exports were lower in March and April of 2020 as the pandemic began. Exports recovered and reached their highest level for 2020 in May and June (Figure 6). This pattern is almost the opposite of the trends observed in 2018 and 2019.

While the unit values (prices) of export products do not always follow the same patterns as domestic dairy product prices, in 2018 and 2019, unit values followed similar trends to domestic prices (Figure 7). In 2020, export unit values fell in April and May and stayed low through most of the summer, unlike the all-milk price and domestic product prices which began to recover over the summer. Despite lower summer prices, across all of 2020, the average export price per pound of milk solid equivalent was about 3% higher than the average value from 2019 (U.S. Department of Commerce, 2021).

Coronavirus, Dairy Farm, and Consumer Payments
The Coronavirus Aid, Relief, and Economic Security (CARES) Act directed the USDA to support farmers and ensure consumer access to food. The Coronavirus Food Assistance Program (CFAP) announced on April 17, 2020 authorized payments to farms affected by the pandemic. CFAP distributed payments in two rounds, and milk was one of several eligible farm commodities.

The CARES Act also established the Paycheck Protection Program (PPP) under the Small Business Administration, which allowed businesses, including dairy farms, to apply for loans to cover up to 8 weeks of payroll costs. The program initially operated between April and early August, and many applicants received complete loan forgiveness when funds were used to cover payroll and employees were retained.

As part of the CFAP, the USDA also authorized purchases of fresh produce, dairy, and meat products through the Farmers to Families Food Box Program. Several products were combined in boxes for distribution to consumers by food banks and other charitable organizations.
CFAP Farm Payments

The first round of CFAP, known as CFAP 1, paid dairy producers a lump sum payment based on milk production in January, February and March 2020. Payments were limited to $250,000 per person and legal entity, extending to $250,000 per shareholder for up to three shareholders if the business was a corporation, limited liability company or limited partnership, with all shareholders contributing at least 400 hours of labor to the business. This cap applied to the sum of payments for all commodities under which the producer applied to CFAP.

Dairy producers received a single payment calculated from two funding sources: the CARES Act and the Commodity Credit Corporation (CCC). The total CFAP 1 payment was $6.20 per hundredweight for milk production from January, February, and March 2020.

CFAP 2 was funded entirely with CCC funds and required that applicants derive at least 75% of their income from farming or have an average income of less than $900,000 in 2016, 2017 and 2018. Applicants with dairy operations must have produced and marketed milk commercially. Eligible dairy applicants received $1.20 per hundredweight for milk produced from April through August and for estimated milk production from September through December. Payments received through CFAP 1 did not count towards the payment cap under CFAP 2.

Producers received 80% of their maximum total payment upon approval of their application, with 20% reserved for payment if funds remained at the end of the application period. Since all available funds were expended, the reserved payments were never distributed. Accounting for these reserved payments, producers below the payment limit received $4.96 per hundredweight for milk, meaning CFAP 1 dairy payments were worth up to 27% of the all-milk price in the first quarter of 2020 for western dairies. CFAP 1 dairy payments to producers below the payment limit were worth up to 6.8% of the value of milk sales for western dairies in 2020. CFAP 1 payments to dairy operations in the twelve Western States were $593 million, about 12% of the $4.77 billion of milk revenue from Western States in January, February and March 2020. Dairy operations in the Western States received 33% of the $1.8 billion of CFAP 1 payments to dairy operations in the US, despite producing 46% of milk.

CFAP 2 payments to dairy operations in the twelve Western States were $437 million, equivalent to 37% of the approximately $1.2 billion of CFAP 2 payments to dairy operations in the US. CFAP 2 dairy payments to dairy producers below the payment limit were worth up to 5.1% of the all-milk price for western dairies in the period of April through December 2020.

Total CFAP payments to dairy producers below the payment limit were worth 11.9% of the all-milk price for Western States in 2020. According the US Census of Agriculture in 2017, there were 143 dairies in the Western States with 5,000 or more milk cows (U.S. Department of Agriculture, 2019). For a 5,000 lactating cow herd, total
CFAP payments were worth about 7% of the all-milk price in 2020, based on monthly average milk yield for Western States and a maximum CFAP payment in 2020 of $1.5 million (U.S. Department of Agriculture, 2021a; U.S. Department of Agriculture, 2021g).

The payment cap impacted dairies in the Western States. Table 1 shows the milking herd size, at an average milk yield, that would meet the payment caps for both CFAP 1 and CFAP 2. Large dairies are likely to have more than one actively engaged shareholder and qualify for the higher payment caps of $500,000 or $750,000. Based on Census of Agriculture data from 2017, 94% of the value of milk sales in Texas, Idaho, and California was from dairies with more than 500 cows (U.S. Department of Agriculture, 2019). Dairy herds with greater than 2,500 milk cows were responsible for 71% of the value of milk sales in Texas, 70% in Idaho, and 45% in California. Any dairies of this size received a CFAP 1 payment equivalent to less than $4.96/cwt (80% of the total payment of $6.20/cwt) for milk production in January, February, and March 2020. The payment cap is less likely to apply to dairy operations in the Midwest and East Coast. Only 0.5% of dairy operations in Wisconsin and New York had greater than 2,500 milk cows in the 2017 Census.

Paycheck Protection Program Payments to Dairy Operations

Between April and August 2020, businesses in the Western States received a total of $149 billion in loans through the PPP, with loans totaling $364 million granted to dairy farms, or just over 2% of the total. As of March 2021, about 34% of PPP loans were forgiven, equivalent to about $179 billion. Loan totals in each state were roughly proportional to milk production. However, California received a larger share of PPP loans relative to its share of western milk production, while Texas and Utah received a smaller share. When considered on a cents per hundredweight basis, with total loan amounts divided by milk production between April and August, loans range from 36 cents per hundredweight in Utah to 94 cents per hundredweight in California, and about 76 cents per hundredweight on average.

After a hiatus of four months, the Consolidated Appropriations Act of December 2020 included an extension of the PPP from January to March 2021. Under the reauthorization, PPP loans were separated into “first draw,” with conditions identical to the original 2020 round of loans, and “second draw” loans. Second draw loans are only available to businesses with fewer than 300 employees that used all of their first PPP loan and incurred a 25% reduction in gross receipts in at least one quarter of 2020 relative to 2019 performance. Out of $42 billion in loans to businesses in Western States in 2021 thus far, about $36 million have gone to dairy operation, or just under 0.1% of the total.
Farmers to Families Food Box Program

The Farmers to Families Food Box Program initially authorized $3 billion in purchases, with the intent of purchasing $100 million per month each of fruit and vegetable products, meat products, and dairy products (U.S. Department of Agriculture, 2020). The program received additional funding authorized in three additional rounds through the end of 2020. By the end of the fourth round on December 31 just over $4 billion of food products were purchases for use in food boxes (U.S. Department of Agriculture, 2021i). A fifth round was authorized by the Consolidated Appropriations Act of December 2020, with an intent to purchase an additional $1.5 billion of food products by the end of April 2021.

Food boxes compiled and distributed with food purchased by this program could contain fresh beverage milk, cheese, and butter. While the share of total purchases that went to dairy products is not clear, if we assume that purchases continued along the lines suggested in the initial announcement, with one-third of the available funds used to purchase dairy products, then about $1.3 billion in dairy products were purchased by the end of 2020. This is equivalent to about 3.3% of U.S. milk production in 2020 (U.S. Department of Agriculture, 2021a; U.S. Department of Agriculture, 2021g).

Demand for dairy products was also supported during the pandemic by other provisions in the CARES Act and related programs that provided less restrictive or supplemental support for USDA food assistance programs. These programs helped maintain food demand in poor households. Broader income supplements, such as direct payments to U.S. taxpayers and extended and supplemental unemployment insurance, helped maintain personal income during the pandemic. Despite added food assistance and income supplements, USDA reports that reported food insufficiency rose substantially during 2020 compared to 2019 (U.S. Department of Agriculture, 2021c).

Conclusion

The COVID-19 pandemic created conditions that led to large fluctuations in prices received by dairy farmers and responses that reduced milk production. However, these effects did not last throughout the year, as high prices during the summer made up for steep declines in the spring. For the dairy industry, cash receipts were about the same as in 2019, and about 12% higher than in 2018. Across agriculture as a whole, net cash income increased by about $27 billion over 2019, almost entirely due to a $24 billion increase in government payments (U.S. Department of Agriculture, 2021e). This relationship may hold for the dairy industry. Due to more milk production and large government payments, 2020 was a relatively high net income year for the western dairy industry, despite the variability and stresses caused by the pandemic.
References


Available online at https://usda.library.cornell.edu/concern/publications/rx913p88g?locale=en.


Tables and Figures

Figure 1: 2020 Dairy Milk Production in Western States, 1.02 Billion cwt

Source: USDA National Agricultural Statistics Service, Milk Production.
Figure 2: Milk Production in Western States, 2018-2020

Figure 3: Average Daily Milk Cows Slaughtered, 2018-2020

Figure 4: Cheese and Nonfat Dry Milk Prices, 2019-2020

Figure 5: Weighted Average Western States All-Milk Price, 2018-2020

Figure 6: Average Daily Exports from Western Customs Districts, Million Pounds of Milk Solids Equivalent

Figure 7: Unit Value of Exports from Western Customs Districts, USD per Pound of Milk Solids Equivalent

Table 1: Approximate Herd Size That Reaches Each Eligible Payment Cap for the Dairy to Receive the Equivalent of $4.96/cwt From CFAP 1, or $1.20/cwt From CFAP 2.

<table>
<thead>
<tr>
<th>Payment Cap</th>
<th>CFAP1*</th>
<th>CFAP2**</th>
</tr>
</thead>
<tbody>
<tr>
<td>$250,000</td>
<td>657</td>
<td>1,157</td>
</tr>
<tr>
<td>$500,000</td>
<td>1,313</td>
<td>6,941</td>
</tr>
<tr>
<td>$750,000</td>
<td>1,970</td>
<td>10,411</td>
</tr>
</tbody>
</table>

*Based on California average milk yield per cow of 20.5cwt/cow/month for January Through March 2020.

**Based on California average milk yield per cow of 20cwt/cow/month for April Through August 2020.

Source: USDA National Agricultural Statistics Service *Milk Production*, author calculations.
Analyzing the Impact of COVID-19 on Texas High Plains Agriculture

By DeDe Jones¹, Dr. Steven Klose², Will Keeling³, and Dr. Greg Kaase⁴

Introduction
Texas High Plains producers faced many new uncertainties with the arrival of COVID-19. Significant supply chain disruptions, reductions in consumer demand and decreases in travel negatively affected agricultural operations. In addition, efforts taken to stem contagion lessened the amount of food consumed away from home, and restrictions on movement sharply reduced gasoline usage, and with it demand for grain ethanol. Elevated cases among livestock processing facilities disrupted normal business practices and increased costs. In fact, early in the pandemic the Texas High Plains region was considered a COVID-19 “hot spot” as many area processing plants faced reduced workforces and slower production times due to high numbers of positive cases. This study looks at the farm-level impacts of COVID-19 on six case study model operations created by local Texas A&M AgriLife Extension Risk Management Specialists.

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3 Risk Management Program Specialist I and M.S.; Texas A&M AgriLife Extension Service; Department of Agricultural Economics; Lubbock, Texas
4 Risk Management Program Specialist III; Texas A&M AgriLife Extension Service; Department of Agricultural Economics; College Station, Texas
Model Farm Overview

Extension Specialists developed model farms by organizing focus groups and collecting industry data. Texas A&M AgriLife Extension District 1 consists of 22 counties in the High Plains region. For study purposes, these counties were grouped into six clusters, each representing similar cropping and livestock production systems (Figure 1). Risk Management Specialists then conducted focus groups within each cluster, consisting of County Extension Agents, agricultural producers, Farm Service Agency employees, and agribusiness representatives. During these meetings, participants described the structure and characteristics of a typical operation in their area. Initial price data was obtained from the January 10, 2020 World Agricultural Supply and Demand Estimate (WASDE) Report from USDA and January baseline projections from the Food and Agricultural Policy Research Institute (FAPRI). To determine the impact of COVID-19 on 2020 prices, this study relied heavily on a FAPRI report released in April of 2020 which provided early pandemic impact estimates on U.S. commodity markets, farm incomes, and government outlays. Local basis was calculated through focus group discussions, contacting grain elevators and cotton gins, and referencing the Texas A&M AgriLife Extension Economics basis website. Crop yields and cattle stocking rates came primarily from focus group estimates.

Table 1 summarizes model farm characteristics by cluster. Operational features vary greatly by county group, reflecting the diversity of Texas High Plains agriculture. Overall, six crops are analyzed with both dryland and irrigated production practices. Several entities also include leased stocker cattle, owned stocker cattle, and/or cow-calf herds. To incorporate farm program payments, all base acres are enrolled in the Price Loss Coverage (PLC) program, and all crops are eligible for marketing loan payments. Any financial support received from the Coronavirus Aid, Relief, and Economic Security (CARES) Act or the Coronavirus Food Assistance Program (CFAP) is not included in this analysis due to difficulties in accurately estimating producer eligibility. Finally, this study projects that most farms will replace equipment during the analysis period, with market prices based on input from local dealers.

After developing model operations, risk management economists ran a financial outlook projection using Texas A&M AgriLife Extension Service’s Financial and Risk Management (FARM) Assistance Program. FARM Assistance is a pro forma financial analysis that incorporates stochastic simulation to evaluate price and yield variability. The program assists farmers and ranchers with strategic planning and risk management. Each model operation simulates two scenarios. The first uses USDA’s and FAPRI’s January 2020 price and cost projections released prior to COVID-19 which assume the implementation of a Phase 1 trade deal with China and a 2.8% rise in consumer expenditures.
Table 1. 2020 Model Farm Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1 NorthWest</th>
<th>Cluster 2 Northeast</th>
<th>Cluster 3 Southwest</th>
<th>Cluster 4 Central</th>
<th>Cluster 5 Southeast</th>
<th>Cluster 6 East</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crop Acres</td>
<td>3,000</td>
<td>3,000</td>
<td>2,040</td>
<td>3,240</td>
<td>5,000</td>
<td>260</td>
</tr>
<tr>
<td>Total Pasture Acres</td>
<td></td>
<td>1,000</td>
<td></td>
<td>1,000</td>
<td></td>
<td>4,270</td>
</tr>
<tr>
<td>% Owned Acres</td>
<td>40%</td>
<td>40%</td>
<td>75%</td>
<td>50%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>% Irrig Acres</td>
<td>75%</td>
<td>50%</td>
<td>50%</td>
<td>33%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Corn Acres</td>
<td>775</td>
<td>500</td>
<td>230</td>
<td>400</td>
<td></td>
<td>260</td>
</tr>
<tr>
<td>Silage Acres</td>
<td>225</td>
<td></td>
<td>105</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum Acres</td>
<td>485</td>
<td>350</td>
<td>420</td>
<td>724</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat Acres</td>
<td>590</td>
<td>900</td>
<td>575</td>
<td>994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton Acres</td>
<td>675</td>
<td>750</td>
<td>710</td>
<td>1,122</td>
<td>4,688</td>
<td></td>
</tr>
<tr>
<td>Peanut Acres</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>312</td>
<td></td>
</tr>
<tr>
<td>Fallow Acres</td>
<td>250</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Stockers (#Head)</td>
<td></td>
<td>200</td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td>Cows (#Head)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>200</td>
</tr>
</tbody>
</table>

For the second scenario, January projections are adjusted to reflect early estimates of COVID-19 impacts on agricultural markets, farm income and government payments detailed in an April 2020 FAPRI publication. These impacts include a 2.2% fall in consumer expenditures and reductions in fuel and fertilizer expenses of 8% and 6%, respectively. FAPRI’s report also projects significant market instability which causes 2020 crop prices to fall by 5%-10% and livestock prices to decline by approximately 8%-12%. Finally, regional modifications are incorporated by applying local basis data to national price projections. These commodity price assumptions are shown in Table 2.
Table 2. 2020 Local Commodity Price Assumptions

<table>
<thead>
<tr>
<th>Commodity</th>
<th>January Projected</th>
<th>COVID-19 Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn ($/bu)</td>
<td>$3.90</td>
<td>$3.55</td>
</tr>
<tr>
<td>Corn Silage ($/ton)</td>
<td>$36.97</td>
<td>$33.48</td>
</tr>
<tr>
<td>Wheat ($/bu)</td>
<td>$4.54</td>
<td>$4.28</td>
</tr>
<tr>
<td>Sorghum ($/bu)</td>
<td>$3.60</td>
<td>$3.29</td>
</tr>
<tr>
<td>Seed Sorghum ($/bu)</td>
<td>$10.76</td>
<td>$9.79</td>
</tr>
<tr>
<td>Cotton ($/lb.)</td>
<td>$0.62</td>
<td>$0.55</td>
</tr>
<tr>
<td>Peanuts ($/ton)</td>
<td>$443.66</td>
<td>$429.09</td>
</tr>
<tr>
<td>450 lb. Stocker Calf ($/cwt)</td>
<td>$177.33</td>
<td>$153.36</td>
</tr>
<tr>
<td>750 lb. Stocker Calf ($/cwt)</td>
<td>$145.33</td>
<td>$121.36</td>
</tr>
<tr>
<td>1100 lb. Culled Cow ($/cwt)</td>
<td>$63.19</td>
<td>$52.12</td>
</tr>
<tr>
<td>2000 lb. Culled Bull ($/cwt)</td>
<td>$83.19</td>
<td>$72.12</td>
</tr>
</tbody>
</table>

Farm-Level Impact Analysis

Study results provide a 2020 farm financial outlook under the January baseline projection versus COVID-19 conditions and represent a general economic overview for area producers. Table 3 and Figures 2 and 3 show the anticipated financial performance for each Texas Panhandle operation. Results indicate substantial reductions in farm profitability and liquidity due to COVID-19's effect on agriculture. While the impact is marginally lessened by lower fuel and fertilizer expenses under the COVID-19 scenario, overall results show significantly reduced revenues due to falling crop and livestock prices. Farm program payments grow with these declines in crop prices, but even with higher government payments, agricultural profits are negatively impacted.

Much of the increase in 2020 payments come from an elevated likelihood of higher loan deficiency payments or marketing loan benefits in cotton. PLC payments received in 2020 are only marginally higher because they are based on 2019 crop marketing year prices. When the economic impacts of COVID-19 began in March of 2020, the 2019 crop was mostly sold, meaning the marketing year average price which triggers PLC was largely established. Crop marketing year prices in 2020 may trigger higher PLC payments, but that relief will not come until the Fall of 2021. As a result, these higher payments do little to lessen any current cash flow problems producers experience. It is also important to note that any financial support received from the Coronavirus Aid, Relief, and Economic Security (CARES) Act or the Coronavirus Food Assistance Program (CFAP) is not included in this analysis due to difficulties in accurately estimating producer eligibility and a lack of published guidelines when the study was conducted. As a result, the overall drop in farm income may be less substantial than is projected here.
Across all six model farms, net cash farm income exhibits an average 23% decline. Cluster 6 is a ranching enterprise and shows the largest drop due to greater decreases in livestock prices relative to crop prices and a lack of conventional support payments. Each entity also displays a loss of equity and reductions in ending cash reserves under the COVID-19 scenario. Furthermore, even under the January baseline most farms projected negative cash balances due to high levels of carryover debt coming from low market prices in recent years. This situation worsened as prices fell even more from COVID-19 impacts, creating an overall increase in cash flow problems and liquidity risk. Producers may have trouble paying off operating note balances at the end of 2020 and greater struggles with loan renewals in 2021.

Table 3. 2020 Model Farm Results Under January vs COVID-19 Conditions (in $1,000s)

<table>
<thead>
<tr>
<th></th>
<th>Net Cash Fm Income</th>
<th>Real Net Worth</th>
<th>Farm Program Pmts</th>
<th>Ending Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>January Projected</td>
<td>COVID Impact</td>
<td>January Projected</td>
<td>COVID Impact</td>
</tr>
<tr>
<td>Cluster 1</td>
<td>$330.4</td>
<td>$256.5</td>
<td>$1,257.2</td>
<td>$1,207.5</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>$241.2</td>
<td>$203.6</td>
<td>$1,173.9</td>
<td>$1,149.1</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>$114.7</td>
<td>$89.4</td>
<td>$985.1</td>
<td>$968.3</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>$119.9</td>
<td>$94.9</td>
<td>$1,569.4</td>
<td>$1,552.7</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>$123.3</td>
<td>$84.9</td>
<td>$848.2</td>
<td>$812.7</td>
</tr>
<tr>
<td>Cluster 6</td>
<td>$44.9</td>
<td>$16.1</td>
<td>$3,849.3</td>
<td>$3,765.6</td>
</tr>
</tbody>
</table>
Summary and Conclusions
FARM Assistance financial analysis of six case study operations in the Northern Texas Panhandle verify that supply chain disruptions, changes in consumer demand, and breakdowns in the manufacturing and processing sectors due to COVID-19 could have negative consequences for agriculture. Study results show a potential loss in profitability and increases in operational liquidity and solvency risk, which, in turn, may affect producers’ abilities to obtain adequate financing. Long-term implications of COVID-19 remain uncertain. While current market conditions and 2021 projections from both USDA and FAPRI indicate a considerable market recovery, additional analyses should be conducted as the full magnitude of this pandemic and its effect on agricultural production becomes clearer.

References


COVID-19 Impact on Texas Production Agriculture, Agricultural and Food Policy Center, Department of Agricultural Economics, Texas A&M University System, AFPC Research Report 20-01, April 2020. 

https://agecoext.tamu.edu/resources/basis-project/basis-data/

https://downloads.usda.library.cornell.edu/usda-esmis/files/3t945q76s/79408c82d/jw827v53v/latest.pdf
Abstract
California consistently leads the U.S. in the value of agricultural commodities produced, specializing in the production of high-value fruit, vegetable, and nut crops. In this article, we outline the short-term, medium-term, and evolving long-term impacts of the COVID-19 pandemic on California’s produce and tree nut industries. Many of California’s top commodities are labor intensive and highly perishable, e.g., strawberries and lettuce, and consequently these types of commodities experienced some of the worst economic impacts of the COVID-19 pandemic. These initial impacts included higher production costs due to social distancing and other worker protection measures, and the discarding of millions of dollars’ worth of produce which was intended for the food service sector. Other top commodities, such as almonds and processing tomatoes, have highly mechanized operations with relatively non-perishable products. These have been more resilient to the short-run effects of the pandemic on supply chains but have experienced disruptions in international trade. In this article, we highlight the differential effects of the pandemic on California’s high-value crops.

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across the food service and retail supply chains, discuss the mitigating effects of federal, state and industry support, and highlight emerging consumer trends.

Introduction and Background
The spread of COVID-19 and the public responses and policies that followed have caused disruptions to the food supply chain and challenged the agricultural sector in new ways. In this article, we discuss the initial and evolving impacts of the COVID-19 pandemic on California’s produce and tree nut industries. We evaluate the differential effects of the pandemic across these industries, spanning demand disruptions, export challenges, and emerging consumer trends. We also highlight challenges on the supply side which stem from the use of hired farm labor, the seasonal timing of operations, and the difficulty in adapting to the shifts in demand.

California is known for its production of a diversity of high-value crops. With total revenues of roughly $50 billion annually, the state consistently leads the nation in the value of agricultural commodities produced. Fruits, vegetables, and nuts make up most of California’s top 10 agricultural commodities (Figure 1). Over a third of the country’s vegetables, two-thirds of all fruits, and virtually all the almonds, pistachios, walnuts and processing tomatoes produced in the U.S. are grown in California. With over 400 commodities grown in the state, the diversity of crops grown in California is larger than other places in the U.S. Though most of California’s crops are typically grouped together into the specialty crops category, no industry looks the same.

Figure 1 California’s Top 10 Agricultural Commodities

Source: California Agricultural Production Statistics, California Department of Food and Agriculture (2019 Crop Year)
The effect of the COVID-19 pandemic on fruit, vegetable, and nut production in California depends highly on a number of factors: the degree of mechanization along the supply chain, the degree of labor intensity and the extent to which social distancing hinders productivity, the perishability and storability of the crop, the adaptive capacity of the supply chain and the demand changes from food consumed away from home to food consumed at home.

Many of California’s top commodities are labor intensive and highly perishable, e.g., strawberries and lettuce, and consequently these types of commodities experienced some of the worst economic impacts of the COVID-19 pandemic. One short-run outcome in these industries was the discarding of millions of dollars’ worth of produce which was intended for the food service sector. In both the short- and medium-term, these industries have faced higher production costs due to social distancing and other worker protection measures. Other top commodities, such as almonds and processing tomatoes, have highly mechanized operations with relatively non-perishable products. These industries have been more resilient to the effects of the pandemic on supply chains but experienced short-term disruptions in international trade.

**Demand Disruptions: Food Service and Export Markets**

Undoubtedly, the largest demand disruption due to COVID-19 occurred in the food service channel. In 2019, the U.S. food marketing system supplied about $1.77 trillion worth of food in approximately equal amounts via the food service and food retailing channel (USDA ERS, 2020a). Government-imposed lockdowns in 2020 effectively closed cafeterias in schools and institutions, hotels, full-service restaurants, and even fast-food outlets temporarily. These lockdowns resulted in 22% reductions in sales in March and 68% reductions in April, before starting to bounce back in May. Food service outlets saw the largest monthly increase in June before trending lower once more at the end of 2020. The reported gain of 6.9% in January of 2021 is a hopeful sign which points towards a slow recovery (U.S. Census Bureau, 2021). January sales are still registering 16% below their pre-COVID levels, and restaurant operators do not expect operations to return to normal before the end of 2021 (National Restaurant Association, 2021).

The disruption in the food service industry was accompanied by a surge in demand at retail. Produce never quite experienced the kind of retail surges seen in meat, dairy, dried and canned goods during the early phase of the pandemic, but demand for produce still increased significantly. While other factors aside from the pandemic may be affecting trends year over year, Figure 2 reveals an initial surge in mid-March of 2020 with a peak of 35% growth in fresh produce retail sales overall. Throughout summer, demand stabilized with both fresh fruits and vegetables selling at elevated levels relative to 2019. Fresh vegetables continue to outperform fresh fruits but
neither increases have offset the reduced demand via the food service channel, despite higher profit margins in the retail sector.

Tree nuts are perceived as a healthy snack, have a long shelf life, and are often used in baking, which experienced a revival to provide some comfort at home. As consumers hoarded staple foods at the beginning of the pandemic, tree nuts surged in sales. Shipments from tree nut handlers to domestic retail outlets in March 2020 were higher than in March 2019 for almonds (31%), pistachios (13%), and walnuts (18%) (Almond Board of California, 2020b; Administrative Committee for Pistachios, 2020; and California Walnut Board, 2020).

Figure 2 Growth in Fresh Produce Retail Sales Compared to the Same Time Period of the Previous Year, March 2020 Through January 2021

Disruptions in export markets also impacted California’s agricultural industries to varying degrees. Table 1 shows how California’s produce and tree nut industries differ in their reliance on export versus domestic markets. California is the sole U.S. exporter for almonds, pistachios, and walnuts, with roughly two-thirds of production being exported. Roughly 30% of processing tomatoes are exported, primarily to Canada, and strawberries and lettuce also rank in the top 20 export commodities (California Department of Food and Agriculture, 2019).

One relatively large export market for California almonds and walnuts documented sizeable disruptions due to the pandemic. The Indian government issued a three-week lockdown beginning March 25, 2020, which caused a shortage of workers at Indian ports, potentially due to confusion regarding which industries and workers were considered “essential” (Almond Board of California, 2020a). As a result, no
California pistachios were exported to India in April; almond and walnut exports dropped 52% and 12% as compared to April 2019 exports. These supply chain challenges combined with trade turmoil, which emerged prior to the pandemic in major export markets (e.g., China, India, and Turkey), meant that 2020 tree nut exports did not adjust proportionately to changes in production compared to 2019. While almond production increased by 12% between 2019 and 2020, exports only increased by 6% overall; pistachio production decreased by 27%, while exports decreased by 32%; and walnut production decreased slightly by 4% but exports decreased by 7%.

**Table 1 Percentage U.S. Production in Domestic and Export Markets and California’s Share of U.S. Receipts, 2015-2019 Average**

<table>
<thead>
<tr>
<th></th>
<th>Exports</th>
<th>Domestic</th>
<th>CA Share of U.S. Receipts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>69</td>
<td>32</td>
<td>100</td>
</tr>
<tr>
<td>Pistachios</td>
<td>63</td>
<td>41</td>
<td>100</td>
</tr>
<tr>
<td>Walnuts</td>
<td>73</td>
<td>28</td>
<td>100</td>
</tr>
<tr>
<td>Head Lettuce</td>
<td>6</td>
<td>94</td>
<td>63</td>
</tr>
<tr>
<td>Leaf and Romaine</td>
<td>10</td>
<td>90</td>
<td>63</td>
</tr>
<tr>
<td>Strawberries</td>
<td>13</td>
<td>87</td>
<td>88</td>
</tr>
<tr>
<td>Processing Tomatoes</td>
<td>27</td>
<td>74</td>
<td>93</td>
</tr>
</tbody>
</table>

*Sources: USDA ERS Fruit and Tree Nuts, Vegetable and Pulses Yearbook Tables, 2018-2019 California Agricultural Statistics Review*

*Note: Tree nut export and domestic percentages do not sum to 100 due to inventory carry-over between marketing years.*

**Emerging Consumer Trends at Retail**

Notwithstanding early supply chain challenges and temporary surges due to panic buying, retail demand has since stabilized at slightly elevated levels related to 2019, suggesting moderate and evolving impacts of the pandemic on overall produce demand. Some produce categories, including berries, lettuce, oranges, cherries, and mushrooms significantly outperformed others during the early months of the pandemic and might reflect changing consumer preferences. Table 2 reports the top 10 early pandemic powerhouses—produce categories with the highest absolute dollar gains from mid-March to the beginning of September 2020, relative to the same period in 2019. Of course, these numbers need to be interpreted with caution because other factors may be influencing these trends. Berries, for example, have seen enormous growth throughout the last decade and their strong performance during the beginning months of the pandemic is likely an indication of longer-term changes in consumer preferences (Ogg, 2020). Avocado purchases, while not listed here, also continue to grow steadily, and continue to defy pre-pandemic trends in reduced consumption of fruits and vegetables overall (Produce for Better Health, 2021). Not all the consumer
retail trends reported here are attributable to relative changes in demand caused by the pandemic and could simply reflect changes in crop yield or other short-term supply changes.

The strong performance of these commodities may further be a result of five overall consumer trends which emerged since the start of the pandemic: (1) more meal occasions at home; (2) higher valuation placed on shelf life and flexibility; (3) greater emphasis on personal (immune system) health and nutrition; (4) increase in e-commerce; (5) ensuing economic decline and uncertainty. How these relatively short-term trends translate into persistent medium- and long-term changes remains to be seen, however, and will likely have important implications for the produce and nut industries.

### Table 2 The Early Pandemic Top Sellers Based on Absolute Dollar Gains, March 15-September 6, 2020

<table>
<thead>
<tr>
<th>Top 10 Produce Items (in absolute $ growth)</th>
<th>Absolute $ gain vs YA (Mill)</th>
<th>Average $ % growth</th>
<th>Total $ sales (Mill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berries</td>
<td>510</td>
<td>15.4</td>
<td>3,900</td>
</tr>
<tr>
<td>Potatoes</td>
<td>478</td>
<td>34.8</td>
<td>1,900</td>
</tr>
<tr>
<td>Lettuce</td>
<td>474</td>
<td>12.1</td>
<td>4,400</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>400</td>
<td>22.6</td>
<td>2,200</td>
</tr>
<tr>
<td>Oranges</td>
<td>264</td>
<td>56.4</td>
<td>714</td>
</tr>
<tr>
<td>Peppers</td>
<td>259</td>
<td>24.9</td>
<td>1,300</td>
</tr>
<tr>
<td>Cherries</td>
<td>239</td>
<td>86.5</td>
<td>996</td>
</tr>
<tr>
<td>Onions</td>
<td>233</td>
<td>22.2</td>
<td>1,300</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>151</td>
<td>27.7</td>
<td>697</td>
</tr>
<tr>
<td>Melons</td>
<td>123</td>
<td>6.2</td>
<td>1,900</td>
</tr>
</tbody>
</table>

Source: IRI, Total U.S. MULO, Sales March 15-September 6, 2020 versus same period a year ago. (Reported at the PMA Fresh Summit, Oct 16 2020)

The first trend, more meal preparations at home, is likely the reason behind the sales increase for vegetables relative to fruit. When cooking additional lunches and dinners at home, relatively more vegetables than fruits will be used in the preparation. The second trend relating to the importance of shelf life might be behind the sustained relative increase in the share of sales of frozen produce depicted in Figure 3. Figure 3 shows that shares of shelf-stable and frozen produce spiked in March and April, as consumers substituted away from more perishable produce. We saw a renewed increase in shelf-stable foods as the number of COVID-19 cases spiked from November

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4 Of course, these simple differences do not control for year over year fluctuations that would have likely occurred even in the absence of the pandemic. Using a difference-in-differences approach would provide additional insights but is beyond the scope of this paper.
2020 to January 2021. Throughout 2020, shares of frozen produce remained elevated relative to 2019 levels. This might be an indication that the emerging trends observed during the earlier months have persisted. In addition to the two trends already mentioned, the continued economic hardship and the increased time demands on families as schools remained closed likely resulted in increased price sensitivity and need for convenience, offering additional explanations for the persistent increase in the share of frozen produce.

In general, consumers continue to rely on staples and well-known produce that, in addition to a longer shelf life, give them flexibility. One area where this trend is evident is in the comparison of domestic tree nut consumption between 2019 and 2020. Domestic consumption in 2020 increased for almonds, walnuts, and pistachios, despite production decreases in the latter two (USDA ERS, 2020b). One of the trends which might feed into the extraordinary growth in berry and avocado sales, as well as the strong performance of oranges and tree nuts, is the continuous emphasis on personalized nutrition, diets optimized for individual lifestyles and values, and even produce as prescriptive medicine. While brands tried to stay away from explicitly mentioning the pandemic and highlighting immune-boosting qualities in their messaging, consumers continue to have strong preferences for superfoods, tree nuts packed with protein and “good” fats, and produce high in vitamin C and antioxidants, for instance.

**Figure 3 Share of Produce Sales Across Fresh, Shelf-stable, and Frozen, 2019 and March 2020 Through January 2021**

![Figure 3](image-url)

*Source: IRI Integrated FreshTotal U.S. MULO (Compiled from several Produce Blue Book reports)*
One of the most pronounced consumer trends of the pandemic is certainly the increase in e-commerce. While grocery delivery sales started to decline slightly in August compared to the previous months, they amounted to $5.7 billion in sales and were still 5 times larger than in 2019 (Brick Meets Click, 2020). Most of this growth is driven by sales increases via well-established online platforms, like Instacart and Walmart.com. Produce is still a small percentage of online grocery sales, making it harder to capture consumers’ attention and incentivize impulse buys than in the produce section of a brick-and-mortar grocery store. Nevertheless, this trend is likely here to stay. Here too, consumers were more likely to purchase staples and well-known produce. A recent report by IRI indicates that the early acceleration in e-commerce continued after the late summer months, and retailers have increased their investments in these services (IRI, 2021).

Finally, the sudden and severe loss of income and continuing uncertainty for many families resulted in a trend back to the basics and away from value-added products. Most food products, including tree nut and produce items, have a small income elasticity of demand, but consumers are substituting across and within categories away from value-added and higher-priced products towards commodities. Salad mixes continued to do well, as they give consumers flexibility in their use, and price promotions have helped to encourage purchasing of other value-added products that communicate additional benefits clearly.

Supply Disruptions: On-farm Operations and Shifting Markets
On the supply side, the degree of reliance on hand labor is a large contributor to the magnitude of the impacts of the pandemic experienced by a given industry. Agricultural equipment operators are typically socially distanced given the nature of their job, so few adjustments may have been needed in highly mechanized industries. However large users of hand labor where laborers work closely together have experienced increased costs associated with social distancing measures, likely having a large impact on grower profitability for as long as the pandemic persists. Table 3 displays labor costs broken down into shares of equipment-operator labor and non-equipment labor for select commodities in California. Tree nut and processing tomato production have a much heavier reliance on machinery operators than lettuce and strawberry production. For strawberries in particular, labor costs make up a large percentage of total operating costs and revenues per acre.

5 While Amazon dominated the online purchases for nonedible products, Instacart and Walmart.com outperformed Amazon for edible products during the pandemic so far according to IRI retail data.
Table 3 Labor Percentages of Operating Costs by Select Commodity

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Equipment Operator Labor/Total Labor Costs</th>
<th>Non-Equipment Operator Labor/Total Labor Costs</th>
<th>Irrigation Labor/Total Labor Costs</th>
<th>Labor Costs/Total Operating Costs</th>
<th>Labor Costs/Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pistachios</td>
<td>77</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Processing Tomatoes</td>
<td>47</td>
<td>6</td>
<td>47</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Almonds</td>
<td>46</td>
<td>27</td>
<td>27</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Walnuts</td>
<td>44</td>
<td>27</td>
<td>29</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Lettuce-Iceberg</td>
<td>37</td>
<td>26</td>
<td>37</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Lettuce-Romaine</td>
<td>31</td>
<td>36</td>
<td>33</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Strawberries</td>
<td>4</td>
<td>95</td>
<td>1</td>
<td>39</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on various University of California Cost and Return Studies

On-Farm Operations

The seasonal timing of on-farm operations early in the pandemic also played an important role in how industries were impacted. Tree nut and processing tomato operations had more time to adjust to social distancing practices given the timing and mechanization of operations, while fresh fruits and vegetable operations were impacted immediately.

When the pandemic began, tree nut operations were doing regular orchard maintenance such as applying fertilizer or weed control, operations often done by equipment with one operator. Tree nut growers and processors had time to adjust practices before the busy harvest season in the fall. Processing tomatoes are transplanted throughout January to June to be harvested from June to October. While some growers were transplanting tomatoes at the beginning of the pandemic, transplanting is typically done mechanically.

By taking advantage of different regional growing seasons, lettuce and strawberries can be harvested year-round in California. Peak strawberry production occurs in April and May in California (Boris et al. 2006), while peak lettuce production occurs during May and June (Smith et al. 2011). Thus, both lettuce and strawberry growers were preparing for peak season when the pandemic first began. Labor-intensive operations such as hand weeding and harvesting needed to be performed. Lettuce and strawberry operations had to make adjustments quickly to prevent the spread of COVID-19 among their workers.

In these high-labor industries, immediate responses to the pandemic involved implementing social distancing requirements, installing additional washing and disinfecting stations, implementing disinfection protocols, making personal protective
equipment (PPE) available to all employees, and providing emergency housing to employees who tested positive and needed to isolate (Monterey County Agricultural Commissioner’s Office, 2020). Implementing these measures and operating below optimal capacity due to social distancing rules significantly increased costs per unit of output for these operations. The leafy greens industry had to reduce each crew by 18% in processing and 15% in harvesting to comply with CDC guidelines, increasing the total time spent processing and harvesting. While these measures decreased efficiency, the industry successfully avoided outbreaks like the ones documented in meat packing, which undoubtedly would have been even more costly.

**Shift from Food Service to Retail**

The shift in consumption from food away from home to food at home meant any California produce or nuts destined for food service outlets had those marketing options severely reduced. For those trying to pivot to retail, bulk packaged foods had to be repackaged into smaller grocery sizes, which for some industries was easier than others.

Strawberry growers typically market their production through shippers who then sell to brokers supplying the food service industry or to retailers selling directly to consumers. Often sales from shippers are contracted two to four weeks in advance, though spot market sales of fresh strawberries still exist, often from smaller shippers (Mohapatra et al. 2010). Strawberry sales to the food service sector typically make up 20-25% of sales. Fresh strawberry shipments decreased by 35% between the weeks of March 14 and March 21, a time when in previous years shipments would be increasing (California Strawberry Commission, 2021).

Roughly half of California’s leafy green production goes toward the food service industry, making it vulnerable to a sudden shift. According to Taylor Farms, the nation’s largest producer of leafy greens and a major player in the food service channel, some categories such as loose-leaf romaine lettuce dropped to 40% of pre-pandemic levels, while some, like iceberg lettuce, remained at 80% in the early months. By late summer, many operations had adjusted, and all categories stabilized to sales at about 70% of pre-COVID-19 levels. Rapid early volume reductions in food service sales and unexpected changes in product mix, coupled with 60-120 day growing cycles, depending on the season, meant that Taylor Farms had to till under $11 million in produce by early summer.6

A relatively small percentage of tree nut production, roughly 13%, goes to the food service industry. Tree nuts are storable, so any prepackaged nuts destined for

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6Insights were shared during an interview with Mark Borman, president of Taylor Farms, California in preparation of a commentary and webinar on the effects of COVID on the produce industry (See Kiesel, 2020).
food service industries could be stored and sold later or repackaged for retail. Across the industries, there are numerous tree nut handlers that have the capabilities of processing different products. Transfers between almond handlers in March and April 2020 were 38% higher than those months in 2019 (Almond Board of California, 2020b), suggesting handlers were able to transfer nuts destined for food service packaging to be processed into retail products.

Processing tomato harvest dates are scheduled by the processor so that the processing plant can run at capacity throughout the harvest season. Most processing tomatoes are initially processed into tomato paste and only later processed into other products such as spaghetti sauce, ketchup, etc. Tomato paste is a storable product, which helps to partially alleviate losses. Similar to tree nuts, bulk product that was originally intended to be an ingredient in food service manufacturing could be stored until the food service sector recovered, or shifted to use in retail production. For example, processors could repurpose a 300-gallon package of tomato paste intended as an ingredient in food service spaghetti sauce to make sauces in retail-size containers, which were in high demand as consumers stocked up on storable products. Canneries likely faced increased costs and logistical challenges in the conversion process, but the lengthy shelf-life of the 300-gallon product helped aid these adjustments.

Overall, the extreme fluctuations during the early months of the pandemic likely resulted in significant and immediate losses of highly perishable produce, although most suppliers tried to pivot and reposition produce as rapidly as possible for distribution in the retail channel. How quickly grower-shippers have been able to transition has depended on planting cycles, and the flexibility of processing equipment and packaging.

Governmental and industry support played a big part in dampening losses in the food service channel. Most notably, the Farmers to Families Food Box Program (FFFB) allowed grower-shippers, processors and distributors to contract with USDA and pack fresh produce boxes distributed to consumers in need. By mid-September, USDA had purchased more than $3.6 billion worth of food, and contracts approved in the fourth round delivered an additional $500 million of food through Dec. 31, 2020 (USDA AMS, 2020). In the fourth round of FFFB, USDA made significant changes to companies supplying produce. Large players like Sysco Corp., a leading wholesale distributor to restaurants, and educational and healthcare facilities, did not see their $100 million contracts renewed while others (e.g., Oakes Farms Food & Distribution Service, a wholesale distributor to restaurants in the eastern U.S.) saw dramatic increases in their contract volume. While costs per box were as high as $60 in the third round of FFFB,

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7 The program supplies boxes of fresh fruits and vegetables, dairy products and meat products. Contractors package these products into family-sized boxes and transport them to food banks, community and faith-based organizations, and other non-profits.
companies that saw their contracts renewed in round four lowered their costs to below $40 per box, indicating that offering boxes at lower costs at least partially explained the shifts in suppliers (Johnson, 2020). The fifth round of FFFB contracts announced in January 2021 have been extended through April. Prices decreased once more with some vendors offering boxes below $30 a box. Most of the $1.5 billion budget allocated to USDA AMS in December will fund the food box program, although some will go to support the food service supply chain in other ways. The food box program will likely continue beyond April, although pieces of the program are expected to be redesigned after feedback is gathered (Johnson, 2021).

Impacts to Consumer Prices
Overall, COVID-19 will likely result in upward pressure on consumer prices for labor-intensive commodities. Quantity reductions, coupled with increased costs of regulatory requirements, will lead to shifts in supply that will push wholesale prices upward.

Produce markets tend to be volatile. Supply shortages, new safety measures, and logistical challenges in the beginning of the pandemic might have contributed to slightly higher retail food prices observed initially. During the initial panic-buying stage, highly perishable items were sometimes pushed to the back of the priority list as retail partners were having a difficult time restocking their shelves. Figure 4 shows modest price increases of less than 5% above 2019 levels across fresh fruits and vegetables, as well as processed fruits and vegetables. The price increases in processed fruits and vegetables occurred much more rapidly as initially consumers stocked up on storable produce. In the later months of 2020, prices remained modestly above their 2019 levels.

The magnitude of these price changes and the longer-term impact of increased costs and uncertainty in the demand for produce will vary across commodities depending on the type of contracts utilized and the relative market power of the negotiating parties. For leafy greens for instance, most growers sell their harvest under long-term contracts, while strawberry growers sell a larger share of their harvest under short-term precommitments or on the spot market. In general, retail contracts are negotiated over even longer time periods than grower-shipper-processor contracts, and continuously increasing market concentration in the retail sector will put downward pressure on wholesale prices going forward. The more immediate price changes observed likely reflected changes in operational costs at the retail level or strategic pricing, and additional price increases due to the various supply chain disruptions during the pandemic. It is likely that not all cost increases along the supply chain were

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8 While the composition of these boxes varies, Oakes Farms Food & Distribution Service will pack combo boxes consisting of meat, dairy and produce. For produce, they plan to pack apples, pears, sweet potatoes, onions, carrots, cucumbers, squash, and tomatoes.
passed on, so retail prices may increase further once long-term contracts are renegotiated.

**Figure 4 Fruit and Vegetable Price Monthly Percentage Change 2019 to 2020, Consumer Price Index**

![Graph showing the percentage change in fruit and vegetable prices from 2019 to 2020.](image)

*Source: Bureau of Labor Statistics, CPI data, seasonally adjusted, U.S. city average*

How pronounced these increases will be will depend on the relative bargaining power of processors and retailers, and persistence of consumer trends. In general, processors and producers that were more easily able to switch into the retail channel might be better positioned when re-negotiating new long-term contracts. However, retailers will try to negotiate lower prices to be able to continue to run price promotions and attract consumers. The previously discussed emerging consumer trends might translate into longer term changes in product assortment. A move towards commodities and larger package sizes in retail due to increased at-home consumption (as compared to away-from-home and on-the-go consumption) might mean lower profit margins for processors in retail overall. Stakeholders all along the supply chain will likely try to spread out their incurred losses across all their product offerings. Although how much prices will increase over the longer term will likely depend on how severely and how long the emerging consumer trends will affect produce demand.

To further put the recently observed and relatively short-term changes into perspective, a research report just published by the Produce for a Better Health Foundation (2021) confirms that fruit and vegetable consumption has declined by 10% since 2004. Americans eat produce just once a day on average, despite the continuous industry and public health efforts to promote their consumption over the last decade. Effective marketing will be more important than ever to try to reverse these longer-term trends, especially in light of likely price increases across the board as a result of the pandemic. The observed pandemic-induced increases in retail demand might be
temporary and unlikely to translate into increased demand overall. They also suggest, however, that campaigns which are able to convince shoppers that they can be proactive about their health, care about sustainability and their communities, and enjoy delicious meals when purchasing produce will mean that at least some categories (e.g., berries, avocados, and almonds) will continue to outperform others despite likely price increases.

Conclusion
The COVID-19 pandemic and ebb and flow of restrictions and regulations that have followed have challenged the food sector from farm to processor, retailer to restaurant. California’s produce and tree nut industries have faced different types of demand shocks and supply challenges. In particular, tree nut and processing tomato industries had to make few adjustments due to their mechanization and longer shelf-life. While these supply chains are less likely to be substantially changed in the long-term due to the pandemic, additional inventory from trade uncertainties and food-service sector disruptions might result in reduced farm-gate prices in the short- to medium-term.

Fresh fruit and vegetable industries faced some of the largest challenges due to the disruptions in the food service sectors, and the relatively short shelf life of fresh produce. Food service losses are only partially offset by increases in the retail sector, despite higher margins realized in this channel. The incurred losses and increased labor costs associated with the pandemic-related protective measures will likely lead to higher prices across the board when long-term contracts are renegotiated. Increased prices and ensuing economic uncertainty present challenges for the fresh produce industry as it must rethink strategies to increase fruit and vegetable consumption given the declining consumption trends of the last decade. Additionally, fruit and vegetable growers, handlers and processors might explore mechanization even more quickly than they otherwise would have. Reduced reliance on hand labor will decrease production costs as well as make these industries more resilient to future pandemics.

In general, the longer-term outlook for specialty crop agriculture will largely depend on the timing of the economic recovery, changes in market structure and concentration, and the permanence of emerging consumer trends.
References

Administrative Committee for Pistachios (2020) *March 2020 Shipment Reports*, https://acpistachios.org/industry-resources/shipment-reports/


COVID-19 and Farm Workers

By Alexandra E. Hill\textsuperscript{1}, Philip Martin\textsuperscript{2}

Abstract
The COVID-19 pandemic disrupted the US economy and labor market, sending the US unemployment rate to almost 15 percent in April 2020. Almost all agricultural industries were deemed critical infrastructure industries, meaning that farm, food processing, transport, and supermarket workers were expected to continue working during lockdowns. We document three major effects of the pandemic on farm labor. First, there is, as of yet, no evidence of significant farm labor shortages due to COVID-19, as had been feared early in the pandemic. Second, the H-2A guest worker program expanded despite high unemployment rates, highlighting the difficulties of moving jobless nonfarm workers into seasonal farm jobs. Third, we postulate that COVID-19 and fears of future pandemics will accelerate three ongoing trends: investments and improvements in labor-saving mechanization, increasing utilization of H-2A guest workers, and rising imports.

Keywords: pandemic, agricultural labor, production, H-2A program, mechanization

Introduction
The COVID-19 pandemic led to lockdowns which reduced employment and increased unemployment. During 2019 and the start of 2020, the US unemployment rate was near 3.5 percent, the lowest rate since 1969 (Edwards and Smith, 2020), but after the onset of COVID-19 the unemployment rate rose to 14.7 percent, the highest rate since the Depression Era (Amadeo, 2020). Figure 1 shows trends in US nonfarm employment and unemployment since 2018. US payroll employment (seasonally adjusted) peaked at

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152.5 million in February 2020 with an unemployment rate of 3.5 percent. Employment fell to 130.3 million in April 2020 and the unemployment rate rose to 14.7 percent. Employment has since rebounded somewhat, reaching 141.7 million in September 2020 with the unemployment rate falling to 7.9 percent.

The roller coaster US labor market involved large job losses and gains within six months. Government shelter-in-place orders reduced employment, especially in travel, hospitality and related service industries, while many professional workers switched from working in offices to working remotely from their homes. One exception to shelter-in-place orders were essential workers, especially in food production and health care services, who were expected to continue to work in person.3

Figure 1. US Employment and Unemployment in 2020

Notes: Seasonally-adjusted monthly employment (in 1000s of employees) and unemployment (percent unemployed) statistics from the US Bureau of Labor Statistics.

3 State governors issued executive orders that defined essential services in their states. One review identified 12 sectors that employed 55 million US workers in 2019, including health care (30 percent of essential workers), food and agriculture (20 percent), and the industrial, commercial, residential facilities and services industry (12 percent), which includes janitors and maintenance workers. https://www.epi.org/blog/who-are-essential-workers-a-comprehensive-look-at-their-wages-demographics-and-unionization-rates/
Workers producing food on farms were considered essential in all states. There are two million farms in the US, a majority of which are small, money-losing hobby and retirement operations (USDA NASS, data from 2017 Census of Agriculture). Roughly a quarter of these farms, 513,000, hire at least one farm worker, but most farm employment is concentrated on the 10 percent of farm employers that hire 10 or more workers. There were fewer than 37,000 such farms in 2017. Some of these farms also hire indirectly, as when they rely on farm labor contractors and other intermediaries to bring workers to their farms.

Table 1 shows that roughly 850,000 self-employed persons and 1.5 million wage and salary workers were employed in US agriculture in 2016. The employment of farmers and family members in agriculture declined by 5 percent between 2006 and 2016 and is projected to decline by another 3 percent by 2026. However, significant growth occurred in the average employment of hired agricultural workers between 2006 and 2016, up 23 percent, and is projected to remain stable through 2026. These projections suggest that hired agricultural workers will account for nearly two-thirds of employment in US agriculture by 2026.

Table 1. US Agricultural Employment in 1000s, 2006-26

<table>
<thead>
<tr>
<th>Sector</th>
<th>2006</th>
<th>2016</th>
<th>2026</th>
<th>Change 2006-16</th>
<th>Change 2016-26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag wage &amp; salary</td>
<td>1,219</td>
<td>1,501</td>
<td>1,518</td>
<td>23%</td>
<td>1%</td>
</tr>
<tr>
<td>Ag self-employed</td>
<td>893</td>
<td>850</td>
<td>828</td>
<td>-5%</td>
<td>-3%</td>
</tr>
<tr>
<td>Total ag</td>
<td>2,112</td>
<td>2,351</td>
<td>2,346</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Hired share</td>
<td>58%</td>
<td>64%</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Lacey et al. (2017), Table 1. Employment (1000s) by Major Industry Sector.

The National Agricultural Worker Survey (NAWS) has collected data since 1989 on workers employed on US crop farms, and in recent years has found an aging, more settled, and largely unauthorized Mexican-born workforce. According to the most

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4 The 2017 COA reported in Table 7 of state data that 513,137 farms hired 2.4 million workers and paid $31.6 billion in wages. The 36,541 farms that hired 10 or more workers, 7 percent of farm employers, reported 1.3 million or 54 percent of workers hired.
5 Annual employment estimates come from the U.S. Census Bureau’s Current Population Survey.
6 According to the research conducted by Lacey et al. (2017), the US labor force is projected to expand by a million a year, from 159 million in 2016 to 170 million in 2026. GDP is expected to grow 2 percent a year over the next decade, up from 1.4 percent a year over the 2006-16 decade. Employment in 2026 is projected to be 168 million, up from 157 million in 2016. There are expected to be 136 million workers employed in services, 20 million in goods-producing industries, and 2.3 million in agriculture.
7 Agricultural employment includes forestry, fishing, & logging, which collectively account for less than 5 percent of agricultural employment.
8 www.doleta.gov/naws/
recent evidence (2015/2016), the average worker is a 38-year-old male, born in Mexico, and living without proper work authorization in the US for 18 years (Hernandez and Gabbard, 2018). These workers have an average of nine years of schooling, and 70 percent speak at least some English. Unlike stereotypical images of farmworkers moving with their families from one farm to another, the NAWS shows that most farm workers have only one farm employer for whom they work 33 weeks a year, earning about $10.60 an hour or $480 a week for a 45-hour work week (Hernandez and Gabbard, 2018).

No Evidence of Labor Shortages
At the onset of the COVID-19 pandemic, there were fears of farm labor shortages due to COVID-19 spreading rapidly among farm workers (Beatty et al., 2020; Costa and Martin, 2020; Farnsworth, 2020; Peña-Lévano, Burney, and Adams, 2020) and international travel restrictions which would limit reliance on H-2A guest workers (Costa and Martin, 2020; Escalante, Luo, and Taylor, 2020; Martin, 2020b). The expectation was that especially unauthorized farm workers, who are not eligible for most benefits, would work sick, spreading COVID-19 and shrinking the farm workforce, or stay home to care for children with the closure of K-12 schools.

However, even during peak months of agricultural employment there were few reports of farm labor shortages. Instead, evidence from California suggests that the pandemic led to fewer hours of work per farm worker as employers lost customers and sales due to restaurant and other food service operations purchasing less fresh produce (CFBF, 2020; Villarejo, 2020). This is a stark contrast with the well-publicized COVID-19 outbreaks among nonfarm food-processing workers, where the virus spread rapidly in some plants and prompted worker protests in Washington apple and California nut packing plants. Many plants closed temporarily for deep cleanings and to reconfigure workstations and test returning workers. The most publicized COVID-19 outbreaks among farm workers involved H-2A guest workers, who are often housed four to a room in bunk beds in motels.

Monthly California employment data show an 18 to 26 percent decrease in farm employment in 2020 compared to the same months of 2019, with the sharpest drop in June (Figure 2). The reduction in reported agricultural employment could be driven by many factors. First, due to mandated restaurant closures, the COVID-19 pandemic may

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9 Results from a California Farm Bureau survey found that 24 percent of survey respondents reduced their workforce due to COVID-19, 20 percent of survey respondents had employees who were unable to work due to local or state restrictions (including mandatory quarantines if workers contracted COVID-19) and 16 percent of survey respondents reported being unable to undertake normal seasonal activities due to COVID-19-related employee absences. These numbers are substantially lower than early reports hypothesized and appear less substantial than food demand side effects, given that 57 percent of survey respondents reported losing customers or sales due to COVID-19 (CFBF, 2020).
have reduced demand for and thus employment in some farm commodities.\textsuperscript{10} Second, there may have been fewer workers available to be hired in 2020. Third, farm employers may have reported farm employment data late or failed to report entirely (Rural Migration News, August 2020).\textsuperscript{11}

**Figure 2. California Agricultural Employment, 2019 and 2020**

![Graph showing employment data for California agricultural employment in 2019 and 2020.](image)

*Notes: Data are from the California Employment Development Department’s monthly industry employment data. Available at: [https://www.labormarketinfo.edd.ca.gov/data/employment-by-industry.html](https://www.labormarketinfo.edd.ca.gov/data/employment-by-industry.html)*

In the first and second of these plausible explanations, there are clear market conditions that would provide supporting evidence. First, if decreases in agricultural employment were driven by decreased demand for agricultural products, we would expect to observe (1) fewer shipments of all commodities and (2) either stable or decreasing prices depending on how quickly market quantity supplied adjusted to the falling demand. Second, if decreases in agricultural employment were due to a decreased supply of agricultural workers, we would expect to observe (1) fewer shipments of labor-intensive

\textsuperscript{10} This potential explanation aligns with the widespread reports of farmers plowing their fields or donating crops because of plummeting prices and decreased demand. See, for example, the New York Times article: *Dumped Milk, Smashed Eggs, Plowed Vegetables: Food Waste of the Pandemic*: [https://www.nytimes.com/2020/04/11/business/coronavirus-destroying-food.html](https://www.nytimes.com/2020/04/11/business/coronavirus-destroying-food.html)

\textsuperscript{11} California shipments of berries, tree fruits, and melons were similar 2019 and 2020, suggesting that farm employment data are likely to be revised upward when HR offices on large farms reopen.
commodities and (2) rising prices. If both demand and agricultural labor supply shift inward, we would expect to observe (1) fewer shipments of all commodities with the largest decreases for labor-intensive commodities and (2) stable or decreasing prices for most commodities with ambiguous effects for labor-intensive commodities.\textsuperscript{12} Comparatively, in the third case, we should see little or no change in volume or prices of shipments, though it is possible that the heightened use of the H-2A guest worker visa program during the pandemic influences market prices.\textsuperscript{13}

Figure 3 shows market trends for California grapes and strawberries, two of the highest value fruits by production in California, and among the most labor intensive for harvesting. Panel A shows that 2020 weekly shipping-point prices for grapes are slightly above those in previous years, but production volume is slightly lower compared with prior years. Similarly, panel B shows that strawberry prices spiked in early July but were otherwise in line with prices in recent years and production volume is quite similar to past years. These data do not support a major decline in demand for labor or a labor shortage.\textsuperscript{14} We next turn to a discussion of H-2A workers as a driver of higher labor costs and discuss the role of the COVID-19 pandemic as a catalyst for heightened use of the program.

H-2A Guest Workers
The farm workforce in 2020 included more H-2A guest workers than previous years. DOL certified over 13,000 farm employers to fill almost 258,000 jobs with H-2A guest workers in FY19. In the first three quarters of FY20, DOL has certified 11,611 applications to fill 224,290 jobs, reflecting a 7.4\% increase in the number of applications submitted (US DOL Office of Foreign Labor Certification, 2020). In order to be certified to employ H-2A guest workers, farm employers must try and fail to recruit US workers, provide transportation and free housing to the guest workers, and pay them, at minimum, the Adverse Effect Wage Rate (AEWR), which is typically well above the state minimum wage (Martin, 2020a).

H-2A guest workers are 10 to 20 percent more expensive than US workers. A US worker employed in California for the minimum wage of $13 an hour in 2020 typically has labor costs of $17 an hour with payroll taxes. An H-2A worker who must be paid

\textsuperscript{12} The net effect on prices for labor-intensive commodities depends on the relative magnitude of production impacts from demand and labor shortages. Stable or falling prices imply that the demand effects outweigh the labor supply effects.

\textsuperscript{13} Another consideration are the effects from government aid programs like the Coronavirus Food Assistance Program and the USDA Farmers to Families Food Box Program. These programs might reduce the price effects from inward shifts in demand but will not be reflected in volume measurements from shipping point data.

\textsuperscript{14} Martin (2020c) draws a similar conclusion using iceberg lettuce shipments from California.
the AEWR of $14.77 an hour has labor costs of $20 an hour, including the cost of visa fees, transportation, and housing. Both employers and H-2A workers are exempt from Social Security taxes, and the federal portion of unemployment insurance taxes, which narrows the cost gap between US and H-2A workers.

Figure 3. California Grape and Strawberry Markets, 2016 through 2020

Panel A. Shipping Point Prices and Volume for California Table Grapes

Panel B. Shipping Point Prices and Volume for California Strawberries

Notes: Data come from the USDA AMS and are compiled and aggregated by Agronometrics, https://www.agronometrics.com. Shipping point data reflect the prices and volume of commodities traded at prominent points in the U.S. and thus can reflect shifts in production and demand.
Figure 4 shows that the H-2A guest worker program tripled in size between FY12 and FY19, so that the 205,000 H-2A visa holders in FY19, who were in the US an average six months each, filled about 10 percent of the year-round equivalent jobs in US crop agriculture. H-2A workers are especially important in California strawberries, Washington, New York, and Michigan apple harvests, Florida citrus, and North Carolina tobacco and vegetables.

**Figure 4. H-2A Jobs Certified and Visas Issued, FY05-19**

![Figure 4. H-2A Jobs Certified and Visas Issued, FY05-19](image)

**Notes:** Data from US DOL and US Department of State
https://www.foreignlaborcert.doleta.gov/h-2a.cfm

Employers perceive several advantages with H-2A guest workers. First, careful recruitment among Mexican workers eager to earn wages that are 10 to 12 times higher in the US ensures that H-2As are very productive; over 90 percent of H-2A guest workers are men from Mexico, and they are a decade younger than US workers. Second, H-2A workers are bound by contract to their US employer, so they do not switch employers to earn higher wages at critical times. Third, H-2A workers can be provided by labor contractors and other intermediaries, becoming a turn-key labor force for employers who do not have or want personnel offices. Almost half of H-2A workers are brought to US farms by contractors.

Despite, or perhaps because of, early fears of COVID-19 disruptions to the H-2A guest worker program due to international travel restrictions (Costa and Martin, 2020), the US
Departments of Homeland Security and State (DHS and SOS) changed their policies to make it easier to employ H-2A guest workers (Neifach, 2020). DOS waived requirements for in-person interviews for H-2A visa applicants, and DHS allowed H-2A workers who completed one contract to remain in the US and work for another farm employer certified to employ H-2A workers, saving employers recruitment and transport costs (Sparks, 2020).

There are several take-aways from the notable uptick in H-2A usage during the pandemic. First, high unemployment rates in the non-agricultural sectors did not translate to a larger farm workforce. This could be due to the temporary expansion of the unemployment insurance program or the lack of desire to perform farm work. Second, unless there is a sudden surge in worker availability, employers who began using the H-2A program as a result of COVID-19 are likely to continue using the program, accelerating the expansion of the program. Finally, given the high costs associated with hiring H-2A workers, rising labor costs could spur the quest for labor-saving mechanization.

Machines, Migrants, and Imports
The third major impact of COVID-19 is to accelerate three major changes which were occurring before the pandemic: more mechanization, more guest workers, and more imports. Labor-saving mechanization reduces the need for hand labor, while harvesting aids make hand workers more productive. The big five commodities that employ farm workers are berries, apples, tobacco, melons, and hay and straw (Nigh, 2017). There are mechanization and aid projects underway in each commodity to reduce the need for hand workers and to make them more productive.

For example, planting dwarf apple trees and trellising them into fruiting walls makes apples easier to pick by machine or by hand with hydraulic platforms that carry workers who harvest into 1,000-pound bins. Similarly, conveyor belts traveling slowly in front of lettuce and strawberry pickers can increase their productivity by reducing the time required to take harvested produce to a collection point.

The H-2A guest worker program more than doubled in size over the last decade (Congressional Research Service, 2020), as unauthorized Mexico-US migration slowed (Passel and Cohn, 2018) and smugglers raised their fees (Roberts et al., 2010). Increases in border patrol efforts and costs to cross the border have potentially contributed to the increases in the number of migrants seeking year-round employment, rather than engaging in a circular, follow-the-crop employment flow (Massey, Durand, and Pren, 2016). An expanding infrastructure improved the efficiency of H-2A recruitment, and the development of housing for seasonal workers, including the conversion of hotels and motels into seasonal farm worker housing, provided employers with productive and loyal H-2A workers, a form of labor insurance for which more employers appear willing to pay.
The third trend is more imports of fresh fruit and vegetable commodities. Trade in fresh fruits and vegetables has been rising, partially due in part to investments by US producers and marketers in Mexico and other countries with complementary seasons and lower wages. For example, over half of the fresh fruit consumed in the US, and a third of the fresh vegetables, are imported, and Mexico is the source of half of US fresh fruit imports and three-fourths of US fresh vegetable imports (Martin, 2020d).

Figure 5 panel A shows that US imports of agricultural commodities from Mexico have risen faster than US exports, so that the US has had an agricultural trade deficit with Mexico since 2014. Figure 5 panel B shows that the US has had a trade deficit with Mexico in fresh fruits and vegetables over a much longer time horizon, and the deficit has grown significantly— the fresh fruit and vegetable deficit in 2019 ($12,632,244) was nearly 100 times the deficit in 1975 ($131,299).

Most US farm exports to Mexico are non-labor-intensive commodities, including grains, oilseeds, and animal products, but most US imports from Mexico are labor-intensive commodities including vegetables and fruits (Zahniser, 2020). Some imports of fresh fruits and vegetables complement US production, so that US production is stable even as imports rise, as with avocados, while others replace shrinking US production, as with fresh tomatoes. There are long-running disputes between Florida tomato growers and Mexican tomato exporters, and more recent complaints about Mexican blueberry and raspberry exports.15

The import percentage of US fresh fruit consumption rose from 23 percent in 1975 to 53 percent in 2016, and from 6 percent to 31 percent for fresh vegetables (Karp, 2018). Mexico’s success in exporting labor-intensive commodities reflects Mexican and US comparative advantage, and is closely connected to US agriculture, since most of the capital and inputs on Mexico’s export farms are from the US.

Conclusions
The COVID-19 pandemic highlighted the importance of hired workers in food production, leading to exceptions from stay-at-home orders for essential farm workers and exceptions to international travel restrictions that allowed H-2A guest workers to cross otherwise closed US borders. We found no compelling evidence of farm labor shortages and instead document trends in labor-intensive fruit and vegetable markets that are consistent with operations acquiring sufficient labor; trends were similar in 2019 and 2020. The H-2A program expanded in 2020 despite high unemployment rates, suggesting that it will be hard to get jobless local workers into seasonal farm jobs. Finally, fears of future pandemics and rising minimum wages accelerated trends

15 https://crsreports.congress.gov/product/pdf/IF/IF11701
already underway, including labor-saving mechanization and harvesting aids that raise productivity, more guest workers, and more imports.

**Figure 5. US and Mexico Trade of Agricultural Commodities**

Panel A: Trade of all Agricultural Commodities

![Graph showing trade of all agricultural commodities](image)


Panel B: Trade of Fresh Fruits and Vegetables

![Graph showing trade of fresh fruits and vegetables](image)

*Notes: Data from US Department of Agriculture Foreign Agricultural Service’s Global Agricultural Trade System (GATS)
https://apps.fas.usda.gov/gats/default.aspx*
References


COVID-19 and the Renewed Migration to the Rural West

By Christine Dimke¹, Marissa C Lee², Jude Bayham³

Abstract
The COVID-19 pandemic has had broad impacts on American society. As remote work became increasingly common and population density became a liability, many people reconsidered where they live. Using mobile device data, we document the influx of people to rural areas with high scenic and recreational amenities. While an influx of people to these areas led to an early rise in COVID-19 cases and deaths, that effect was short-lived. Since mid-April, these rural areas with high amenities have experienced substantially lower disease burden. We conclude with a discussion of the risks and opportunities posed by this influx to rural communities.

Keywords: COVID-19, social distancing, mobile device, rural migration

Introduction
The COVID-19 pandemic has disrupted almost every aspect of life in the United States (US) since it began in March of 2020. The SARS-CoV-2 virus spread quickly across the country’s urban centers and proceeded to move through the sunbelt over summer, and throughout the West and Midwest during the fall of 2020 (Bosman and Smith, 2020). As policy and fear led many to minimize potentially infectious interactions, businesses suffered, and unemployment soared (Davidson, 2020). An unforeseen consequence of the pandemic has been the rapid shift to remote work (Rose, 2020). Many companies have announced plans to maintain a remote workforce even after the pandemic (Costa, 2020). The seemingly permanent prospect of remote work has prompted many to reevaluate where they live.

The choice of where to live depends on many factors including employment opportunities, cost of living, proximity to friends and family, as well as physical

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amenities. During the COVID-19 pandemic, the risk of infection and population density have influenced peoples’ location decision making rural areas more appealing (Rose, 2020). Moreover, existing employment conditions may be important as people employed in non-essential positions may have more flexibility to work from home (Dingel and Neiman, 2020). Less density and more space in rural areas makes social distancing easier (Rose, 2020). These factors have combined with a growing interest in outdoor recreation to spur migration to rural areas with scenic and recreation amenities.

The objective of this paper is to quantify changes in population across rural regions of the US using near real-time mobile device data. In particular, we identify locations that have experienced population growth and relate that growth with provision of physical amenities. We use anonymized mobile device location data to show population influx to rural areas of the Western United States, specifically to rural counties with high recreational home concentrations. Then, we discuss the consequences of this migration on rural communities in the short and long run.

Western Rural Transformation
The rural Western United States4 is split between the resource dependence of the Old West and the counter urbanization appeal of the New West (Berry, 1980; Beyers and Nelson, 2000). Over time, different economic shocks have driven increases in rural populations. Western areas experienced resource booms, especially in the late 1970s and 1980s, and witnessed significant influxes of oil and gas workers. These “boomtowns” saw massive injections of capital, revenue, and labor, increasing overall economic activity (Jacobsen and Parker, 2014). In the aftermath of resource booms, communities were left with depressed per capita income and increased unemployment payments (Jacobsen and Parker, 2014).

In years after the resource extraction booms, inflows into rural communities were tied to quality-of-life migrants and retirees (Beyers and Nelson, 2000). Dot-com wealth brought out-of-state buyers looking for second homes in the Intermountain West (Burger and Carpenter, 2010). These areas became desirable to the baby boomer generation for its open spaces, natural amenities, and recreational appeal (Burger and Carpenter, 2010). Businesses also saw the appeal and were no longer bound to population centers as technologies continued to change (Burger and Carpenter, 2010). Rural populations varied greatly between communities affected by resource extraction and those rich in natural amenities for recreation. Therefore, we choose to explore the differences in rural communities by their amenity richness.

4 We define the West as including the following states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
Methods and Data
The movement of people to rural areas with high amenities is documented using novel smart device data. We obtain data on the number of smart devices residing in a census block group (CBG) by week from January 2019 through September 2020 from SafeGraph (www.safegraph.com). To enhance privacy, SafeGraph excludes CBG information if fewer than five devices are observed on any day. SafeGraph determines a device’s CBG of residence by calculating the most common evening location over the past six weeks.\(^5\) We aggregate CBGs to the county level and use the weekly counts of the number of devices residing in the county to calculate changes in the population of these areas.

The SafeGraph data is a sample of approximately 5% of the US population. SafeGraph aggregates timestamped GPS location from various mobile device applications in which people have agreed to share their location data. The data represent both Apple and Android devices. However, SafeGraph does not reveal any personally identifiable information including service carriers or applications that generate the data. The data also include devices believed to reside outside of the US (excluding the European Union because of the General Data Protection Regulation). Squire (2019) suggests that the data is not systematically biased in the representation of socioeconomic and demographic groups.

We explore the relationship between population change (as measured by smart devices) and county characteristics from the 2019 American Community Survey (US Census Bureau, 2019). Specifically, we collect population, the number of households, the number of housing units, and the number of housing units that are labeled as vacant due to seasonal or recreational use. We follow Carson (2020) and use the fraction of recreational and seasonal vacancies and the USDA ERS rural designation codes to characterize high amenity areas. In identifying rural areas with high seasonal housing, we are targeting vacation areas that have high amenity value. These areas are accessible and attractive to urban populations. Counties with high levels of seasonal housing may have played host to urban populations pre-COVID as vacation destinations. These factors make rural counties with high levels of seasonal housing

\(^5\) Excerpt from the SafeGraph documentation “We determine the common nighttime location of each mobile device over a 6-week period to a Geohash-7 granularity (~153m x ~153m).”
https://docs.safegraph.com/docs/social-distancing-metrics
likely targets for urban migration. Following Carson (2020), we define seasonal counties as those with 25% or more of their homes designated as vacant seasonal homes.

We divide counties up into three categories: urban (1,544), rural (1,346), and seasonal rural (322). We obtain a county-level classification of rurality from the Rural Continuum Codes (ERS, 2013). We use these codes to define the rurality of a county. We define rural counties as those not within metropolitan areas and having fewer than 20,000 urban residents (RC codes 6-9). The remaining counties with 20,000 or more urban residents are classified as urban. We define rural seasonal counties as those that meet the rural classification with high seasonal housing.

Then, we compare the progression of the pandemic in urban, rural, and rural areas with high levels of seasonal housing. County-level case and death data is obtained from The New York Times, based on reports from state and local health agencies (The New York Times, 2021). We normalize cases and deaths by the county population and report them in cases per 100,000 people.

Summary Statistics
Table 1 displays key descriptive statistics of urban, rural, and seasonal rural counties. We observe an average of 14,252 devices residing in urban counties, which represent 7.1% of the urban population in 2019. The smart device coverage is slightly higher in rural counties (7.2%) and slightly lower in seasonal counties (6.1%).

Our data corroborate news reports showing that between February 2020 and September 2020 the mean number of devices residing in urban and rural counties fell by approximately 10.39% and 3.91%, respectively. In contrast, the number of devices residing in seasonal rural counties increased by 9.14%. Urban areas tend to have more extensive labor markets, and we find that the mean of the median household income is $59,402 per year. The mean of the median household income in rural areas is considerably lower at $47,922, and slightly higher in seasonal rural areas ($49,636). If urban residents are relocating to seasonal rural communities, they are more likely to bring higher incomes along with them. The income differential may create opportunities and pose challenges that we describe further in the discussion section.

6 The New York Times dataset is one of the reliable data sources updated throughout the pandemic. However, the data are subject to public health conditions and reporting systems in counties across the US. Reported cases include those determined by testing, which may omit cases especially during the early phases of the pandemic. The data are also subject to reporting delays that may vary across time and county. More information on limitations is described on the data source documentation page.
Table 1. County-level Summary Statistics of Smart Device and Census Data

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>St. Dev.</th>
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<td></td>
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<td>14,252</td>
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<tr>
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<td>1,209</td>
<td>1,000</td>
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<td>945</td>
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<td>Percent Change in Devices Residing (February 2020 to September 2020)</td>
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</table>
Results
Our objective is to document the migration of the population to rural areas with high amenities. Using the SafeGraph home device location, we calculate a percent change in devices residing in a county between February 2020 (pre-pandemic) and September 2020.\(^7\) We use this percent change in device count as a migration proxy, recognizing that some of the change in devices per county may be related to device changes such as activation or deactivation. Figure 1 displays the population change aggregated to the county level for the Western US. We find that the population centers have experienced negative population changes, while select rural areas, especially in the west, have experienced positive changes.

Figure 1. County-level Percent Device Change

![Map of percent change smart devices residing in US counties reported at different Standard Deviation (SD) cutoffs. Counties that are labeled as seasonal have a darkened border. An interactive nationwide map with additional amenity labels can be found at https://sites.google.com/view/christinedimke/covid-19-mobility.](image)

Notes: Map of percent change smart devices residing in US counties reported at different Standard Deviation (SD) cutoffs. Counties that are labeled as seasonal have a darkened border. An interactive nationwide map with additional amenity labels can be found at https://sites.google.com/view/christinedimke/covid-19-mobility.

\(^7\) The results are robust to using other pre-pandemic months.
Figure 1 shows a greater percent variation in the number of mobile devices in the western region of the US compared to the east. The migration of individuals by county shows increases in counties near amenities. For example, we find that the number of devices residing in Garfield and Grant Counties in Utah increases by 42% and 76%, respectively. Garfield County is home to Bryce Canyon National Park, while Grant has both Arches and Canyonlands National Parks. In Southern Colorado, the number of devices residing in Hinsdale County, and adjacent San Juan and Mineral Counties increased by more than 250%, representing some of the highest increases in the country. These counties contain multiple ski resorts, including Telluride and Silverton.

Several counties on the east coast also experience an increase in devices. These locations are also considered vacation destinations for eastern metropolitan centers and provide recreational amenities like those in the Rocky Mountain West. We see increases in Martha’s Vineyard (Nantucket and Dukes Counties in Massachusetts) by more than 75%, the Outer Banks of North Carolina (Currituck, Hyde, and Hyde Counties) by more than 40%, and more modest increases in parts of Maine. Device increases are occurring in the upper peninsula of Michigan in counties which have high recreational amenities, like Mackinac and surrounding counties.

Figure 2 displays the relationship between the percent change in the number of devices residing in a county from February 2020 to September 2020 (vertical axis) and the proportion of total homes classified as recreational/seasonal (horizontal axis). Areas with a high proportion of recreational/seasonal homes saw a greater increase in the number of devices residing, showing that the population has increased in these rural counties relative to the pre-pandemic period. This increasing slope is consistent with the idea that vacation destinations and resort towns are seeing larger influxes of devices as a percent. This result aligns with the previously discussed literature that people are moving to areas because of their amenities rather than career opportunities.
Figure 2. Percent Change in Device Number by County

Notes: Scatter plot and fitted line showing the relationship between the percent change in the number of devices residing in a county and the proportion of vacant homes classified as seasonal/recreation homes. Select points with more than 50% vacant seasonal homes are labeled. The linear fit has an intercept of -0.072 with 95% CI (-0.076, -0.067) and a slope of 0.24 (0.226, 0.258).

Our results support anecdotal evidence that individuals are migrating from urban to rural areas across the country using the percent change in device count proxy. One of
the early concerns about this migration to rural areas was that these urban populations might transmit the virus to members of these smaller communities, which tend to have less robust healthcare infrastructure than urban areas. Figure 3 shows some limited evidence that cases and deaths were higher in rural areas with high seasonal and recreation homes early in the pandemic. However, our data do not allow us to identify whether it was the urban population who was responsible for disease transmission. Regardless, the trend quickly changes, and these counties with high seasonal homes have lower case and death rates over the course of the pandemic. Interestingly, the cases and deaths per 100,000 are now higher in rural areas than in urban areas. Other studies have documented the factors that may have led rural areas to experience higher rates of disease (Allcott et al., 2020).

Figure 3. COVID-19 Cases and Deaths per 100,000 People

Notes: Progression of COVID-19 cumulative cases per 100,000 (left panel) and deaths per 100,000 (right panel) over time. The lines represent the mean of counties in each category (Rural, Seasonal Rural, and Urban).
Discussion
The current economic shock caused by the COVID-19 pandemic has renewed the appeal of rural areas with natural amenities. After seeing major spikes in cases in urban areas, rural areas with lower population density have become more attractive. Change of address data from the US Postal Service shows over 15.9 million people moved between February and July 2020 - approximately 4% more than the same time period in 2019 (Bowman, 2020). Temporary and permanent address changes also increased in 2020 with 327,242 requests and 274,813 requests respectively (Bowman, 2020). Our analysis of anonymized mobile device location provided additional evidence that people are relocating to rural areas with high amenities. Smart device location data provide estimates of real-time resident population estimates, though the number of devices residing is only a proxy for residents. These may be extended visitors that plan to return to their urban residences once the pandemic subsides. In any case, people are spending extended periods of time in these rural locations with high amenities.

The movement of populations to rural areas may provide opportunities for established residents. As we document in Table 1, the median household income in rural areas is lower than in their urban counterparts. Those seeking to relocate to rural areas will likely bring higher incomes from jobs in urban areas that can be done remotely. The West experienced similar injections of capital in the resource boom era. These new rural residents may benefit these communities by increasing spending in the community and contributing to the local tax base which can provide improved infrastructure and additional amenities. Some of these communities thrive on the tourism attracted to natural and recreation amenities. New residents with regular incomes may provide more stability within the local economies, especially during the off-season. Amenity-rich communities may have an easier time absorbing the influx of people due to tourism-related infrastructure like lodging and restaurants (Lawson, 2018). Governments can leverage the positive economic impacts to reduce geographic inequality between rural and urban communities (Lawson, 2019).

New residents also create challenges. A rapidly increasing population can lead to more traffic congestion, strain local schools, and other public services. These newcomers will also purchase or rent housing, which may drive up the cost of housing. Housing prices in Bozeman, Montana have been pushed to record levels with new transplants from major cities (Rein, 2020). While rising housing prices are beneficial to current homeowners, it may create obstacles for residents reliant on local wage rates for income. The increase in migration to amenity-rich counties compared to rural, low-amenity counties may also create a larger income gap between county types. Rural counties with no amenities will not receive the same income injections.
Though this migration likely benefited individuals leaving urban areas, it may have come at a cost to year-round residents of rural communities through increased risk of contracting COVID-19. A lack of health services limits the ability of rural areas to effectively manage COVID-19 spread (Peters, 2020). Rural areas may be more susceptible to COVID-19 due to older and health-compromised populations with limited access to physicians, mental health services, and telemedicine (Peters, 2020). Rural areas with no amenities may be more susceptible to COVID-19 than amenity-rich counties because of smaller populations that lower incentive to increase the number of healthcare providers. Additionally, a lack of social capital may also hinder pandemic recovery in these areas (Peters, 2020).

As the pandemic continues, rural and urban populations will continue to face economic and public health challenges (Farrell et al., 2020). Western US communities have often adapted to changing economic and environmental conditions. The pandemic will likely alter the composition of rural western communities, and they will need to balance the potential benefits and costs.
References


Squire, R.F. 2019. “What about Bias in the SafeGraph Dataset? Quantifying Sampling Bias in SafeGraph Patterns.” Available online at https://colab.research.google.com/drive/1u15afRytJMsizySFqA2EPIXSh3KTmNTQ#offline=true&sandboxMode=true.


What Do Our Students Think? Perceptions of Transitioning to Remote Learning During the Pandemic at Land-Grant Universities

By Kristin Kiesel¹, Mariah D. Ehmke², Kathryn Boys³, Bhagyashree Katare⁴, Jerrod Penn⁵, and Jason Bergtold⁶

Abstract
The COVID-19 pandemic sparked the rapid transition of 1.9 million university students from in-person to remote learning during the spring of 2020. Popular press and recent research reports highlighted serious challenges many students faced during this time. Yet, some students had a good or even very good remote learning experience. The purpose of this research is to analyze student perspectives of their remote learning experiences in the early phase of the pandemic to provide valuable insights to instructors, inform instructional design, and discuss policy implications. We surveyed students from colleges of agriculture at six land-grant universities, generating a sample of 2,690 completed responses. Students described their academic experience; learning environments (living situations, internet access, etc.); health, safety and family concerns; and emotional stressors. Opportunities for active student engagement, being able to connect with the instructor, and the inclusion of reflective assignments all contributed to an improved learning experience in a specific course. We found that a positive prior online experience and differences in learning environments explained observed differences in overall learning experiences. Students who felt discriminated against in their university settings reported a more negative experience during these tumultuous times, and experiences varied significantly across universities. Contrary to the experiences of women in the labor market, students identifying as female and students living with children reported better overall experiences during the first month of the pandemic.

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Keywords: undergraduate students, learning outcomes, COVID-19, agriculture, online learning

Introduction
The COVID-19 pandemic had an unprecedented impact on students in higher education across the United States, forcing universities and colleges into a sudden transition from in-person to remote learning. Early evidence suggests a significant impact on student educational experiences, as well as learning, social, health, economic, housing and other outcomes (Cohen et al., 2020; Chirikov and Soria, 2020; Soria et al., 2020a). Certain student groups, including first-generation students, experienced more financial hardship and other forms of insecurity (Soria et al., 2020b), and international students (Chirikov and Soria, 2020) experienced unique challenges. The disruptions to learning during this time likely reduced learning outcomes and educational experiences in general and worsened or introduced new forms of insecurity into many students’ lives (Jaggers et al., 2020). It is further assumed that remote learning will exacerbate already existing student opportunity and achievement gaps. Yet, anecdotal evidence suggests some students had good and even very good experiences while transitioning to remote learning.

Studies examining the impact of COVID-19 in U.S. educational settings are quickly emerging. The majority of studies focus on COVID-19 impacts on students in specific courses or programs (Engelhardt et al., 2020; Unger and Meiran, 2020), or at a single university or college (Aucejo et al., 2020; Jaggers et al., 2020; Murphy et al., 2020). To date, relatively few studies include comparisons of students from multiple institutions, and these studies utilize general recruitment approaches such as social media (Cohen et al., 2020) or a consumer panel from a market research firm (Means and Neisler, 2020). We are aware of only one systematic and coordinated effort to collect data concerning COVID-19 impacts on student experiences from multiple institutions, but have found no study that considers student outcomes with respect to campus characteristics and response.

We examine students’ class-specific and overall remote learning experiences as well as enrollment decisions during the pandemic using data collected by the Applied Economics Research Consortium on Student Remote Learning and Resilience. This research group includes faculty from six Land-Grant Research I Institutions: Kansas State University (KSU), Louisiana State University (LSU), North Carolina State University (NCSU), Purdue University (PU), University of California-Davis (UCD), and

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7 The Student Experience in the Research University (SERU) is a consortium of U.S. and international universities who collaborate on generating institutional, comparative and longitudinal data to examine student experiences in these settings. This consortium conducted a special survey on the impact of COVID-19 on student experiences at 10 US public universities in May-June 2020 (SERU, 2020). Several reports have been generated based on this data.
University of Wyoming (UWYO).^{8} We analyze observed differences in student experiences and learning outcomes to answer the following questions: (a) What specific course design and teaching techniques were most effective in supporting positive student learning outcomes? (b) What role did student perceptions play when observing differences in student experiences? (c) To what extent and in what ways did student experiences vary across different student subpopulations? Here, we provide a first look at data collected in our initial wave of surveys which were distributed during the summer of 2020. A more detailed analysis of the spring 2020 data, including an examination of the extent the disruption from COVID-19 affects students’ likelihood of re-enrolling, and an analysis of a second wave of surveys sent after the conclusion of the fall 2020 term are currently underway.

In our data collection, we focus on students enrolled in majors within colleges of agriculture, because students from agricultural or rural communities may have faced an especially challenging transition to remote learning. As campuses closed, these students returned home where they likely faced pressure to assist with family businesses (e.g., farming or other enterprises). In addition, poor internet connectivity in many rural areas (Sents, 2020) and limited access to alternative internet service locations (e.g., public libraries) may have compounded challenges faced by students living in these communities. Our goal is to inform instructor efforts, instructional design, and university policy during this time of crisis and beyond. We provide insights about changes in learning outcomes and experiences, overall student welfare and the likelihood of degree completion. We further explore whether learning outcomes differed for historically underrepresented and under-resourced subpopulations (e.g., students from different racial, ethnic or socio-economic backgrounds) to provide guidance regarding more targeted assistance that can ensure positive learning outcomes and academic success for all of our students.

**Survey Design and Data Collection**

We designed and distributed a survey to students from colleges of agriculture at six universities with a combined enrollment of approximately 17,000 students. These universities are diverse in their size, geographic locations, student population, and the predominant type of agricultural production in each state. The study design and survey procedures were approved by the Internal Review Board at each participating university. In the summer of 2020, each investigator distributed a comprehensive online survey organized in four sections via Qualtrics®.^{9} In the first section, we asked

^{8} The Carnegie Classification of Institutions of Higher Education describes Research I universities as doctoral universities with very high research activity.

^{9} Two universities provided incentives by entering participating students in a lottery for small cash prizes (e.g., five $50 and twenty $50 gift cards). If students opted out of participating in the survey, they were still able to enter the lottery after contacting the PI at their respective school.
students about academic experiences, including questions about students’ perceptions about their spring 2020 remote learning experience, characteristics of the course that influenced them the most, and their general attitude toward remote instruction. In the second section, we asked the students about their current family situation, health and safety concerns, and current living conditions. This section included questions about student emotional health, mental well-being, concerns about their own and their family’s safety and health, as well as health risk preferences. In the third section, students were asked about financial and personal obligations that may affect re-enrollment decisions as well as their plans for the fall. A final section consisted of questions about student background and demographic information, including political preferences and student attitudes towards and experiences with implicit bias and discrimination. While our survey design predates many of the new COVID-19 studies referenced here, we are able to relate our findings to what has already been reported and hope to add additional insights.

**Descriptive Survey Statistics**
Our final sample consists of 2,690 mostly complete survey responses received. This represents an overall response rate of 15.22%, ranging from 3.08% to 30.78% across universities as reported in Table 1. Most universities were able to promote the survey with the support from the Dean’s office and distributed it with an official email from the Dean or Dean of Undergraduate Education to send to each student in the college individually. However, PU sent emails from their Agricultural Economics Department to all students in the College of Agriculture. Additionally, differences in academic calendars, campus policies that resulted in students returning home under different schedules, and the fact that many universities were already surveying their students likely contributed to the observed differences in response rates across universities.

**Table 1. Summary of Respondents by University Location**

<table>
<thead>
<tr>
<th>University</th>
<th>Number of Students Contacted</th>
<th>Number of Respondents (Response rate)</th>
<th>Percent of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purdue University (PU)</td>
<td>2,803</td>
<td>110 (3.08%)</td>
<td>4.09%</td>
</tr>
<tr>
<td>Louisiana State University (LSU)</td>
<td>1,432</td>
<td>133 (9.29%)</td>
<td>4.94%</td>
</tr>
<tr>
<td>University of Wyoming (UWYO)</td>
<td>967</td>
<td>240 (24.82%)</td>
<td>8.92%</td>
</tr>
<tr>
<td>North Carolina State University (NCSU)</td>
<td>2,660</td>
<td>500 (18.80%)</td>
<td>18.59%</td>
</tr>
<tr>
<td>Kansas State University (KSU)</td>
<td>2,326</td>
<td>716 (30.78%)</td>
<td>26.62%</td>
</tr>
<tr>
<td>University of California-Davis (UCD)</td>
<td>7,485</td>
<td>991 (13.24%)</td>
<td>36.84%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,673</strong></td>
<td><strong>2,690</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*a The number of students contacted corresponds to the most recent undergraduate student numbers (2019-20) for the colleges of agriculture.*
We provide additional select summary statistics in Table 2. Our sample includes both newly enrolled freshmen intending to start in fall 2020, and students who had just completed the spring 2020 term.

Table 2. Select Summary Statistics for Overall Remote Learning Experience, Select Demographics, and Learning Environment Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Remote Experience (1=Very poor)</td>
<td>1,515</td>
<td>3.56</td>
<td>1.04</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Spring 2020 Remote Experience (1=Very poor)</td>
<td>1,748</td>
<td>2.93</td>
<td>1.18</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Female</td>
<td>2,299</td>
<td>0.74</td>
<td>0.44</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>White</td>
<td>2,690</td>
<td>0.59</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2,690</td>
<td>0.11</td>
<td>0.32</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Black</td>
<td>2,690</td>
<td>0.03</td>
<td>0.16</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>2,690</td>
<td>0.17</td>
<td>0.38</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>2,690</td>
<td>0.02</td>
<td>0.13</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Living with Children</td>
<td>2,690</td>
<td>0.06</td>
<td>0.25</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Secure Housing (1= Strongly disagree)</td>
<td>2,325</td>
<td>4.53</td>
<td>0.74</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Adequate Place to Study (1= Strongly disagree)</td>
<td>2,341</td>
<td>3.68</td>
<td>1.21</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Computer (1= Strongly disagree)</td>
<td>2,342</td>
<td>4.73</td>
<td>0.57</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Reliable Internet (1= Strongly disagree)</td>
<td>2,340</td>
<td>3.89</td>
<td>1.14</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Initial Spring 2020 GPA</td>
<td>1,674</td>
<td>3.29</td>
<td>0.58</td>
<td>0</td>
<td>4.41</td>
</tr>
</tbody>
</table>

*The number of observations for the variables listed here vary due to completeness of survey responses and the fact that freshmen who would begin attending in Fall 2020 were included in the survey sample. These students were not shown questions related to Spring 2020 university experiences.*

The majority of students (74%) who completed the survey identify as female (n=2,299), with a small number of students identifying as non-binary or self-identified (n=18), or who preferred not to reveal their gender identity (n=13). At NCSU’ College of Agriculture and Life Sciences, 47.9% of the students were female compared to 77.7% of the students in UCD’s College of Agriculture & Environmental Science who identified as female. While falling within this range, greater survey participation by female students has been repeatedly documented in traditional and online formats prior to and during the pandemic (e.g., Smith 2008).

Across all universities, the majority of our student respondents were white (59%). The largest minority group of students identified as Asian (17%), and the
smallest group identified as American Indian or Alaskan Native (1.7%). Eleven percent of students identified as Hispanic. A small group of students (6.4%) were living with children in their household during the initial pandemic period and living with children in the household was slightly positively correlated with American Indian and Alaskan Native (\(\rho=0.01\)) and Black identities (\(\rho=0.03\)), and slightly negatively correlated with White (\(\rho=-0.02\)) and Hispanic (\(\rho=-0.02\)) identities.

We asked students a variety of questions regarding their study and learning environment including a ranking of their access to “good” or reliable internet (on a scale from 1=strongly disagree to 5=strongly agree). Student respondents’ mean rating was 3.89, suggesting they generally agreed that they had reliable internet access. However, we acknowledge two things: (i) due to online survey distribution, respondents with poor or no internet access may be under sampled; and (ii) variation in responses for this measure (i.e., \(\sigma=1.14\)) was larger when compared to many of the other ratings summarized in Table 2. Although the average student rated secure housing as “Very Good” (\(\mu=4.53\)), they rated their access to a good place to study significantly lower or as “Good” on average (\(\mu=3.68\)). Only 64% of respondents agreed or strongly agreed that they had access to a good place to study, and this rating is the only rating with more variation (\(\sigma=1.21\)) than the internet access rating. Students’ ratings of access to an adequate place to study was highly correlated with ratings of good internet access (\(\rho=0.50\)) and moderately correlated with agreement about having a secure place to live (\(\rho=0.29\)). Furthermore, the presence of children in the home was slightly negatively correlated with having an adequate place to study (\(\rho=-0.02\)).

In addition to demographic information, socio-economic background, and learning environment, we also asked students about their previous online learning experiences. Eighty six percent of respondents had experience learning online prior to the COVID-19 pandemic. As we report in Table 2, the average student rating for their prior online experience is 3.56, and significantly higher than their average rating of their pandemic online learning experience (2.93). There is little variation in the mean of pre-pandemic remote learning experiences across universities. Students at LSU rated their pre-pandemic experience with remote learning the highest (\(\mu=3.8\)), while students at PU rated it the lowest (\(\mu=3.5\)). We see greater variation in student ratings of remote learning across universities during the pandemic, but average ratings fell across all universities relative to non-pandemic experiences. At four of six universities, students with prior online learning experience reported greater dissatisfaction with remote learning than those without prior online learning experience. The only locations where students without prior online learning experience found pandemic remote learning to be worse than those students with prior online learning experience were LSU (\(n=27, \mu=2.81\)) and PU (\(n=9, \mu=2.22\)).
Differences in Course-specific Learning Experiences
We begin our regression analysis by examining student experiences in a specific course during the pandemic in order to draw conclusions about what instructors can do to improve student experiences and offer support while teaching remotely. Prior to the pandemic, the use of “chalk and talk” remained the preferred teaching style in most Economics classes (Engelhardt, 2020). Empirical evaluations of technology innovations, including introductions of online tools, concluded that no type of technology use was consistently associated with learning gains. However, previous studies did not detect harmful effects either (Johnson and Meder, 2020), and select studies indicate the potential for improvements in learning outcomes, especially in course designs, described as blended or hybrid approaches that assign and test for the completion of specific tasks such as watching videos or reading assigned chapters prior to attending problem-based class sessions (e.g., Swoboda and Feiler, 2016). The existing literature provides no clear prediction regarding the effect of the transition to a remote teaching and learning environment. Many instructors likely struggled with the rapid transition to teaching online during the spring 2020 term and a variety of factors might explain observed differences in student learning outcomes.

In order to be able to gain specific insights into what instructors can do to support student learning moving forward, we asked students to think about a course they took in the spring that was the most influential (good or bad) in shaping their perception of remote learning during the pandemic. We then asked specific questions regarding this class including how they would rate their learning experience in this course compared to the other courses they took. Students rated their experience in the specific course as 3.15 on average or “neither better or worse”. The highest percent of students (28.19%) chose this average rating, followed by 26.64% who indicated their experience in this particular course was “better”. Only 10.53% of students felt that the experience in the course that shaped their perception of remote learning was “a lot worse” than their experience in other classes, while 14.82% felt that their experience was “a lot better”. We began our analysis of these differences in students’ reported specific learning experiences by running regression specifications that included student behaviors, motivations, perceptions, and specific course components. We then added student demographics, grades received, and variables that were meant to capture differences in individual circumstances and learning environments. We also included university-fixed effects to capture unobserved differences across the six universities. However, none of the student-specific variables were statistically significant in our regression analysis. Similarly, university fixed effects were not statistically significant, suggesting that course design and teaching style, as well as student perceptions are key determinants of better learning outcomes across all student groups and campuses in this remote environment. Table 3 reports results of ordered Probit regressions with
robust standard errors (Wooldridge, 2002) that include student behaviors, motivations, course design, and key course components as explanatory variables.

Table 3. Regression Results of Specific Course Experiences During the Pandemic
(1=A lot worse...5=A lot better)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Student Perceptions</th>
<th>Student Perceptions (Worse: 1,2, 3)</th>
<th>Student Perceptions (Better: 3,4,5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live lectures</td>
<td>-0.052</td>
<td>-0.258</td>
<td>0.153</td>
</tr>
<tr>
<td>Attendance of remote lectures (1=strongly disagree)</td>
<td>-0.025</td>
<td>-0.013</td>
<td>-0.040</td>
</tr>
<tr>
<td>Completion of remote assignments (1=strongly disagree)</td>
<td>0.030</td>
<td>-0.024</td>
<td>0.088</td>
</tr>
<tr>
<td>Interest in course (1=strongly disagree)</td>
<td>0.051</td>
<td>0.006</td>
<td>0.101*</td>
</tr>
<tr>
<td>Gained knowledge (1=strongly disagree)</td>
<td>0.406***</td>
<td>0.392**</td>
<td>0.190**</td>
</tr>
<tr>
<td>Connected with instructor (1=strongly disagree)</td>
<td>0.175***</td>
<td>0.221**</td>
<td>0.060</td>
</tr>
<tr>
<td>Felt that others cheated (1=strongly disagree)</td>
<td>0.013</td>
<td>0.009</td>
<td>0.016</td>
</tr>
<tr>
<td>Active student engagement</td>
<td>0.491***</td>
<td>0.476**</td>
<td>0.284***</td>
</tr>
<tr>
<td>Online take-home/open book exams</td>
<td>0.222***</td>
<td>0.173</td>
<td>0.170*</td>
</tr>
<tr>
<td>Online closed book exams</td>
<td>-0.246***</td>
<td>-0.123</td>
<td>-0.199*</td>
</tr>
<tr>
<td>Graded participation</td>
<td>0.063</td>
<td>-0.056</td>
<td>0.111</td>
</tr>
<tr>
<td>Collaborative work outside of class meetings</td>
<td>0.061</td>
<td>0.094</td>
<td>0.040</td>
</tr>
<tr>
<td>Graded group assignments</td>
<td>-0.051</td>
<td>0.126</td>
<td>-0.152</td>
</tr>
<tr>
<td>Regular quizzes</td>
<td>0.074</td>
<td>0.093</td>
<td>0.035</td>
</tr>
<tr>
<td>Final paper or project</td>
<td>0.047</td>
<td>0.122</td>
<td>-0.012</td>
</tr>
<tr>
<td>Reflection assignments</td>
<td>0.378***</td>
<td>0.326**</td>
<td>0.255**</td>
</tr>
<tr>
<td>University fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.143</td>
<td>0.155</td>
<td>0.059</td>
</tr>
<tr>
<td>Observations</td>
<td>1475</td>
<td>810</td>
<td>1025</td>
</tr>
</tbody>
</table>

Note: Ordered Probit regressions with university fixed effects (UCD as base) and robust standard errors. Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001
In Table 3, column (1) reports results for the entire range of possible responses, and column (2) and (3) report the results for worse or better experiences only. Whether lectures were taught live or pre-recorded did not affect student experiences significantly during this first remote teaching term. Although, when a course incorporated active student engagement during online class sessions (e.g., questions and polls), student experiences improved significantly. Instructors that created these opportunities for active engagement likely helped students to keep focused and maintain interest in the material covered, and thus significantly improved the learning experience. This effect was significant and larger when focusing our analysis on students who rated their experiences lower. It was significant, but smaller in regressions focusing on higher ratings as well. Notably, individual student characteristics, including the grade a student received in this specific class, were not significant and did not explain differences in student learning experiences.

Whether students felt that they gained knowledge contributed significantly to a more positive student experience on average. The difference between a better and a lot better experience was further explained by whether a student was interested in the course. Finally, when students felt they were able to connect with their instructor, their learning experience significantly improved.

Not surprisingly, take home or open book exams improved students’ learning experience during these anxious times, and closed book exams decreased it. While this might also be true in in-person classes, the effect might be even more pronounced in this remote environment as proctoring requirements increased student anxiety and raised privacy concerns. In terms of additional specific class components, only the incorporation of reflection assignments—opportunities for students to reflect on the covered material and their performance—significantly improved learning experiences. The inclusion of regular quizzes and opportunities for collaborative work outside of class further improved student experience in some specifications, although the regressions reported here do not return a significant effect.

**Differences in the Overall Learning Experience**

To add context, we asked students about their overall learning experience during this early stage of the pandemic. We report the distribution of students’ rankings of their overall learning experience during the spring 2020 term in Figure 1. We observe that students were more likely to rate their remote learning experience as either “very good” and “good” or “poor” and “very poor” than “neither poor nor good” (i.e., average). While the mean overall ranking was 2.92, and 21.45% of students chose this average ranking.10

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10 The “neither better or worse” (3) response is included in both regressions and can be viewed as a neutral response or base.

11 We are not aware of any studies that allow us to compare this response to student perceptions prior to the pandemic.
option, 41.88% rated their experience more negatively (11.50% as “very poor”) and 36.67% had a more positive impression (8.58% as “very good”). The graphical representation and percentages indicate that overall student experiences varied considerably. While many students struggled, some students also had a good or even very good experience.

**Figure 1. Distribution of Student Rating of their Spring 2020 Remote Learning Experience During the Pandemic**

We explore possible explanations for these striking differences in ordered Probit regressions once more and report the results for four alternative regression specifications in Table 4.

In Table 4, columns (1) and (2) report regression results focusing on academic controls only, while column (3) adds student demographics and differences in learning environments. Finally, in column (4), we add additional and more specific controls as proxies for additional challenges students might have faced during the pandemic.

The estimates reported in Table 4 indicate that while having had a prior online learning experience did not explain differences in the experience during the pandemic, a positive prior experience did result in a better experience during the pandemic. Differences in GPA among students entering the spring term and student status (e.g., senior standing) did not significantly contribute to observed differences, although many instructors reported that seniors had an especially hard time with the transition. These students saw many of their job prospects disappear, at least temporarily. Overall learning experiences further varied significantly across universities. Students at KSU, PU, and UWYO reported more negative experiences than students at UCD and LSU on average.
Table 4. Regression Results of Overall Student Experiences with Online Learning During the Pandemic (1=Very poor…5=Very good)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Academic Controls</th>
<th>Academic Controls (2)</th>
<th>Demographic Controls</th>
<th>Detailed Demographic Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior online experience (1=yes)</td>
<td>-0.064 (0.071)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior online experience (1=very poor)</td>
<td></td>
<td>0.254***</td>
<td>0.226**</td>
<td>0.224***</td>
</tr>
<tr>
<td>Initial GPA</td>
<td>0.077 (0.047)</td>
<td>0.045</td>
<td>-0.068</td>
<td>-0.066</td>
</tr>
<tr>
<td>Senior standing</td>
<td>0.017 (0.093)</td>
<td>-0.001</td>
<td>-0.022</td>
<td>-0.014</td>
</tr>
<tr>
<td>KSU</td>
<td>-0.342*** (0.064)</td>
<td>-0.372***</td>
<td>-0.362***</td>
<td>-0.388***</td>
</tr>
<tr>
<td>LSU</td>
<td>-0.031 (0.126)</td>
<td>-0.027</td>
<td>-0.000</td>
<td>0.009</td>
</tr>
<tr>
<td>NCSU</td>
<td>-0.197* (0.086)</td>
<td>-0.252**</td>
<td>-0.162</td>
<td>-0.161</td>
</tr>
<tr>
<td>PU</td>
<td>-0.248* (0.113)</td>
<td>-0.186</td>
<td>-0.227</td>
<td>-0.234</td>
</tr>
<tr>
<td>UWY0</td>
<td>-0.244* (0.098)</td>
<td>-0.316***</td>
<td>-0.305**</td>
<td>-0.324**</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td>-0.223</td>
<td>-0.119</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td>-0.106</td>
<td>-0.079</td>
</tr>
<tr>
<td>Asian</td>
<td>0.035 (0.088)</td>
<td>0.052</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to computer (1=strongly disagree)</td>
<td>0.015 (0.063)</td>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to stable internet</td>
<td>0.109** (0.031)</td>
<td>0.113***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to adequate place to study (1=strongly disagree)</td>
<td>0.267** (0.029)</td>
<td>0.265***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.211* (0.070)</td>
<td>0.198**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with children</td>
<td>0.248* (0.121)</td>
<td>0.254*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went home</td>
<td>-0.073 (0.061)</td>
<td>-0.089</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went home (international)</td>
<td>-0.350 (0.233)</td>
<td>-0.361</td>
<td></td>
<td></td>
</tr>
<tr>
<td>International student</td>
<td></td>
<td></td>
<td>-0.004</td>
<td></td>
</tr>
<tr>
<td>Working on farm or in family business during pandemic</td>
<td></td>
<td></td>
<td></td>
<td>0.114</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.083)</td>
</tr>
</tbody>
</table>
We are not able to detect statistically significant differences for Black, Hispanic, and Asian students compared to students identifying as White. However, students who felt that they experienced discrimination at their universities did report a worse overall learning experience on average. Contrary to the widely reported disproportionate negative impact of the pandemic on women in the workplace overall (e.g., McKinsey, 2020; Gallup, 2021) and in academia (e.g., Deyugina et al. 2021), female students reported an overall better learning experience than male students on average. Similarly, students living with children during the pandemic also reported a better experience overall. These effects are robust to alternative specifications not reported here, including focusing on young children only and interaction terms for female students and students living with children. While these students might have had higher opportunity costs of time and needed to multitask during the pandemic, the added flexibility of being able to attend classes from home, as well as already established study habits, schedules and strong motivations to succeed might have contributed to this effect. Prior to the pandemic, female students tended to earn better grades in college classes than male students (e.g., DiPrete and Buchmann, 2013), and at least one other study confirms that this trend continued during the initial phase of the pandemic (e.g., Engelhardt et al. 2020). It remains to be seen if the pandemic changed learning experiences and learning outcomes once these learning situations and additional stresses became more permanent. We will test for differences by gender when analyzing enrollment and re-enrollment decisions and embark on a more detailed analysis of the effects of the pandemic on subpopulations of students based on additional socio-demographic variables and economic stressors (e.g., loss of income, food insecurity, family obligations, and mental health) experienced over several terms.

When analyzing differences in students learning environments, we detected the largest effect for differences in student ratings of whether they have an adequate place

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12 We asked students how much they agreed or disagreed with three specific statements related to discrimination: “I have been personally affected by racist acts, discrimination or implicit biases against racial groups and other minorities.”, I am discriminated against at my university.”, and “I urge my university to addresses racial injustices and discrimination against minorities on campus and in their curricula.” Differences in student responses to the second statement are included in the reported regression. Differences in responses to the other two statements were not significant.

13 Due to the small number of students that identify as non-binary or chose other options, we do not include other gender identities in our analyses.
to study. An increase in this rating significantly increased the likelihood of reporting a good experience. The effect of differences in internet access, while also significant, is smaller in magnitude. However, as we already pointed out, these variables are correlated, and we may be underestimating the effect of reliable internet due to sample selection. Finally, as our analysis focuses on students in colleges of agriculture, we wanted to control for potential differences in learning experiences for students that helped at farms and in business operations after returning home. While we might be under-sampling these students once more as they have faced more severe time constraints, and hence were less likely to respond to our survey, we do see a significant increase in the percentage of students who work on farms or in businesses during these early stages of the pandemic in our data. Only 7.36% of students reported working on a farm or small business prior to the pandemic, and this percentage almost doubled to 13.42% during the spring 2020 term. Nevertheless, we do not detect a significant difference in overall experience among students who reported working in these operations during the early stages of the pandemic. It is worth noting that we detect significant differences in the overall student experience across schools, and that these differences might be an indication of socio-economic differences and additional hardships that we have not been able to accurately capture in our analysis so far.

Discussion and Further Research Directions
This first look at our comprehensive and longitudinal survey data collected since the start of the pandemic in March 2020 suggests that student learning experiences at the beginning of the pandemic varied significantly. However, commonly used demographic controls were not able to adequately explain the observed differences. Moreover, contrary to the overwhelming evidence of the disproportional hardships experienced by women during the pandemic and its implications for performance and labor force participation across a wide range of professions, female students and students living with children had a better rather than worse experience than other students. These observed positive experiences during the early stages of the pandemic confirm what previous studies have reported even prior to the pandemic: female students tend to perform better in college than male students. What remains somewhat unclear is how the pandemic will affect gender differences longer-term. For instance, female students might have postponed their studies more often than male students, and trends might reverse once new learning modalities and experienced hardships became more permanent.

14We did not detect any significant differences in student responses to this question across female and male students. The correlation between this variable and the female indicator is only moderately negative (ρ=-0.08).
We further find that students who felt discriminated against in their university reported worse overall experiences. This suggests lack of statistical significance when considering race and ethnicity might not be an indication that opportunity gaps for historically underrepresented and under-resourced minorities did not persist during this rapid transition. Rather, it serves as a powerful reminder that identifying heterogeneous effects across subpopulations of students will require a more thorough investigation of socio-economic stressors, family responsibilities, as well as physical and mental health factors. The significant and sizable effects of whether students had an adequate place to study and a reliable internet connection, as well as significant differences across universities are an additional indication that explaining which of our students struggle more than others will require an in-depth understanding of their individual circumstances.

In contrast to our results for the overall student experience, when analyzing differences in student experiences in a specific course, student experiences were similar across all six universities and among different groups of students. Thoughtful course design and an emphasis on effective teaching were just as important during these unusual times as they were prior to the pandemic, although it might have required even more effort and time commitment as instructors had to adapt to this remote learning quickly. Students valued courses that created opportunities for active engagement via polls and clicker questions. They also had a better experience when they were able to connect with their instructors. Instructors were able to further improve students learning experience by creating reflective assignments for their students. In general, making the material relevant to students and allowing them to feel that they expanded their knowledge contributed to a better learning experience in a specific course even during these challenging times. Finally, and perhaps less surprisingly so, student experiences in a specific course were influenced by the type and format of exams given. Preliminary results not reported here further suggest that students strongly desired hybrid instruction as an alternative to purely remote classes. However, we observed a high degree of variability in hybrid instruction course design among and within institutions. We will continue our analysis in this regard. While instruction was almost exclusively offered online during the spring 2020 term, we observed significant differences in learning modalities starting in fall 2020. We will continue our analysis of factors that affected students’ enrollment decisions and actual enrollment for the fall 2020 term. In addition to considering differences in students’ risk perceptions, attitudes towards social distancing, mask wearing and quarantining; we are incorporating students’ willingness to get vaccinated. Finally, extending our analysis to include official student records will allow us to examine how behaviors and experiences changed over time and what implications differences in student experiences have for more immediate and longer-term learning outcomes. One trend that is already clearly visible in the data is that grade distributions have shifted towards a larger share of
students receiving an A. It is likely not just in this regard that the rapid transition to remote learning and teaching will have a long-lasting impact even once we return to a new normal. We hope that our continued analysis of this data will inform both instructional design and university policy during these unprecedented times and offer more insight when attempting to address existing opportunity and achievement gaps in higher education.

References


Pedagogical Pivot - Faculty Reflections on the Rapid Transition to Virtual Teaching During COVID-19

By Roger Brown¹, Lynn Hamilton², Kristin Kiesel³, Julianne Treme⁴, and Na Zuo⁵ ⁶

Abstract
In March 2020, faculty across the nation were forced to suddenly transform their in-person classes to virtual platforms as a result of COVID-19 university closures. Virtual offerings continued throughout the 2020-21 academic year for most universities. We share our own observations gathered from biweekly meetings of AAEA’s Teaching, Learning, and Communication (TLC) section, where participants discuss best practices for remote instruction. Our paper addresses several themes, including the challenges of teaching in a virtual environment, the positive outcomes of the pivot to remote teaching, and perspectives regarding how university education may be forever altered when we return to the classroom.

Key words: COVID-19 university challenges, pedagogy, remote instruction, student collaboration, student engagement, teaching with technology, virtual learning

Introduction
The rapid university closures in Spring 2020 created both new challenges and opportunities for higher education. In response to COVID-19, instructors at 1,388 U.S. colleges and universities across all 50 states were suddenly forced to transition their courses from mostly in-person to fully online learning according to tracking by the College Crisis Initiative (2021). The same source estimates that, in Fall 2020, 44% of institutions offered fully or primarily online instruction, 21% used a hybrid approach, and 27% offered fully or primarily in-person instruction. By comparison, the latest data from the National Center for Educational Statistics shows that, prior to COVID-19, only

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⁵ Assistant Professor of Practice in the Department of Agriculture and Resource Economics at the University of Arizona.
⁶ Authors are listed in alphabetical order rather than in order of contribution.
16.6% of students were enrolled exclusively in distance education courses (2019). The pandemic has spared few instructors from these disruptive changes, including most instructors of agricultural economics/agribusiness classes who have had to transition their courses from primarily in-person to mostly online, virtual instruction. Instructors had to re-examine their teaching and learning approaches, quickly adjust course materials for remote modalities, develop new teaching material and assessment tools, and learn how to maneuver new technology.

To support its members, the leadership of the Agricultural & Applied Economics Association (AAEA) quickly formed a task force and created an Online Learning and Teaching Portal in March 2020. This portal provides resources and guidance to help transition to online learning and teaching in our discipline. All materials are accessible to the public and instructors are encouraged to submit recorded lectures, online videos, case studies, online active learning exercises, notes, and links. Members of the task force organized a best practices workshop. Starting in September 2020, the leadership of the Teaching, Learning and Communication (TLC) section of AAEA organized biweekly Teaching Conversations via Zoom. During these hour-long meetings, instructors from both research and teaching-focused institutions all across the U.S., and occasionally from Europe, discussed ongoing challenges and shared their successes when teaching in this new virtual learning environment. Instructors were able to submit questions or endorse already submitted questions via a Google Sheet. Then, the section leadership selected one to two questions as the main topic of discussion during each meeting. Possible solutions, additional ideas and overall meeting notes were added to the Google Sheet after each session.

As some universities returned to in-person instruction in Fall 2020, we further discussed challenges when teaching synchronously, asynchronously, and in a hybrid setting (simultaneously teaching face-to-face while some students participate remotely via technology). During the last meeting of 2020, we reflected on our personal experiences and shared perspectives. In this paper, we share our reflections on the unique challenges of teaching in a virtual environment during the pandemic, new opportunities that can support learning even after we return to in-person instruction, and our thoughts of how higher education may be affected post-pandemic.

Notable Challenges
Every faculty member experienced some significant downsides to the sudden and widespread transition to remote teaching. Many conversations during Fall 2020 revolved around the massive investment of time required by virtual and mixed-modality teaching, both in the initial phase (e.g., recording lectures, learning new technologies, and finding more effective and ergonomic ways to set up our virtual office spaces) as well as the ongoing production of weekly classes, assignments, assessments, and student communications. Lessons, classroom activities, quizzes, and homework
assignments at minimum had to be adjusted to fit a new modality, and in some cases, completely re-invented. Many instructors noted higher email traffic from students and needed to be available at odd hours to accommodate international students. Face-to-face communication, even with synchronous classes, was greatly reduced and subsequently required additional effort to communicate clearly via slides, additionally posted instructions, emails or discussion boards. Many instructors felt overwhelmed by the increased email volume and requests for special accommodations. For instructors who historically did not allow students to use electronic devices during their in-person classes, the inability to limit such distractions during class was especially frustrating.

While the pandemic provided an opportunity to explore alternatives to scheduling classes in often overbooked and expensive on-campus computer labs, some faculty noted that students’ lack of access to suitable computers or software was a major educational hurdle and likely exacerbated existing opportunity and achievement gaps. Classes requiring Excel or other analytical software seemed to be the most difficult to manage remotely, as some students with very basic computers (e.g., Chrome books or worse) could not access these programs or were only able to work with limited functionality. Though many universities had on-campus laptop lending programs, that assistance was inaccessible after many students returned home. In addition to basic computer issues, many students were negatively impacted by limited broadband access. Students in our (and other agricultural) disciplines experienced more severe connectivity challenges than students in other disciplines because they are more likely to reside in rural areas. While many schools scrambled to create hotspots in public places, students were still required to travel to a hotspot to download and submit assignments. Faculty noted spending much more time dealing with these types of infrastructure hurdles than during a normal term.

In addition to the technical and time management struggles, a major loss to many instructors was the lack of in-person connections or, as one faculty member noted, “the reduced joy of connecting with students.” Many of us chose positions with a teaching emphasis (and higher teaching workloads) because of our desire to work with students and to share our love of learning. Creating meaningful connections over multiple Zoom screens was extremely challenging, even with our most engaged students. Faculty teaching asynchronously had an even more difficult time effectively engaging with their students.

Students’ overall wellbeing and mental health remains another major concern for us. While some students were thriving in this new learning environment (Engelhardt et al., 2020; Kiesel et al., 2021), many struggled with time management and motivation in dispersed and physically-isolated learning environments. Many faculty received emails from students who, citing stress and mental health issues, needed extensions on assignments, or in some cases, withdrew from the class. In addition, uncertainty, health
and financial difficulties related to the pandemic also contributed to heightened student anxiety (Brown et al., 2021; Cohen et al., 2020).

A common concern discussed in nearly every TLC conversation during Fall 2020 was academic dishonesty. Virtual learning environments have unleashed new opportunities for students to creatively (or in some cases, rather crudely) avoid doing their own work. Faculty efforts to subvert such academic dishonesty required even greater investments of time in creating assignments less prone to plagiarism and developing online assessments with large question banks to enable randomization of questions. Many times, the types of reflective or research-based assignments that were most resistant to cheating subsequently required increased grading efforts. The rapid rise in cheating created many unwelcome pedagogical challenges.

As faculty struggled to adapt to the difficulties of remote teaching, the pandemic also upended most other routines of our lives. Schools and daycare services closed, as well as spouses’ and partners’ workplaces. Faculty noted much higher levels of stress with trying to balance new and elevated teaching demands along with juggling additional, unexpected duties at home with children, care for older relatives, negotiating new work and learning spaces and servicing wi-fi needs, among a host of other challenges.

The COVID-related economic downturn also reduced job security overall across faculty and lecturer ranks. Administrators used the pandemic as a means to reduce or amend tenure or eliminate non-tenured positions (Belkin, 2020), although schools allowed faculty going up for tenure and/or promotion in 2020/21 to extend their probationary period without penalty for an additional year. Faculty in some cases were able to exclude their Spring 2020 teaching evaluations from their personnel files. Nevertheless, instructors with heavy teaching loads noted additional anxiety over performing well as their student evaluations weigh heavily on retention, tenure, and promotion decisions. Faculty morale ebbed as the pandemic wore on. Some faculty who taught during the 2008/09 recession were predicting pay, sabbatical, and hiring freezes and furloughs that we are already starting to see.

**Positive Pivots**

The TLC participants were thrilled to recognize that for the first time ever, *everyone* who taught in a university classroom had to reconsider how to deliver their course materials. While most Teaching Conversation attendees agreed that the Spring 2020 semester was completed in survival mode, the forced transition from in-person to remote teaching required faculty to learn new skill sets in a matter of weeks. Such dramatic course revisions usually take months to master but under this new “survive and advance” mentality, instructors repeatedly learned by doing. Fortunately, the summer gave us all time to recharge, reflect and innovate.
Those reflections and innovations formed the basis for our Teaching Conversations: a clearinghouse by which to focus on best practices for virtual teaching and learning across institutions. Besides establishing a community of support and learning, it became clear that increased communication, new technological tools, flexibility, and improved course mapping of assignments and materials were all positive outcomes of virtual teaching.

Prior to the pandemic, few instructors communicated with students ahead of the term. We simply came to class the first day, confident that students would do the same, and we reviewed the syllabus and course expectations. For the Fall 2020 semester, many universities allowed faculty to choose their mode of instruction (e.g., synchronous, asynchronous, in-person, or hybrid-flexible models that combined one or more of these). Faculty recognized a need not only to clearly communicate course policies and expectations to students ahead of the start of the term, but also to help students understand new strategies for success in these unfamiliar delivery modes. While establishing such communication patterns are well-known best practices, they were not universally employed pre-pandemic. Clear and timely communication became a lifeline for both faculty (to avoid multiple emails from confused students) and students (to reduce anxiety and avoid multiple missed deadlines). Many faculty noted that they will continue to employ their newly honed communication practices when in-person instruction resumes.

Developing more effective means of organizing course materials using the universities’ learning management system (LMS) is paramount for both synchronous and asynchronous instruction. Previously, many faculty used the LMS primarily to post readings and assignments; now the LMS contains the entirety of the course. Faculty’s rapid efforts to post their learning objectives and develop a clear progression and schedule for course materials, assignments, and recordings was critical to student success when teaching remotely, as was consistency involving due dates. Hanson and Wachenheim (2020) noted that revising course assignment deadlines to the same time and date each week maintained consistent expectations for both students and faculty. As one TLC contributor noted, “Until you teach an online class, you never realize how disorganized your face-to-face class was!” Faculty reported that the organizational effort required to effectively plan virtual classes would carry over to in-person courses.

Faculty also found creative and effective ways to engage students using new technologies and platforms. In asynchronous courses, interactive instructor videos with embedded questions (e.g., the PlayPosit application) were used to increase student engagement and accountability with course materials. Those who used Zoom or Microsoft Teams for synchronous classes found improved student participation with integrated or iClicker polls and in virtual breakout rooms if activities were well designed. For example, to best achieve the collaborative learning environment
established in her in-person classes, Dr. Na Zuo, of the University of Arizona, developed Google file templates to couple with the Zoom breakout rooms in facilitating in-class group activities. Google files, such as Slides, Jamboard, or Sheets, with explicit instructions and designated group workspaces were prepared and shared. Students typed in discussion summaries or solved modeling or spreadsheet problems on the Google file in their breakout rooms, then discussed the deliverables with the whole class. By monitoring the Google file, the instructor was able to see all groups’ progress and leave comments in real time. Dr. Julianne Treme, of North Carolina State University, found Google Jamboard to be an effective alternative to Zoom’s white board option. Students could draw and label their own graphs during synchronous Zoom sessions, as well as refer back to their work even as the class moved on to new material. The use of collaborative documents allowed both instructors and students to view work in progress and provide real-time feedback.

The switch to remote instruction also required faculty to develop techniques for more rapid and effective feedback, an aspect already described by Zhosar and Smith (2008) and Hanson and Wachenheim (2020) as a necessary component of virtual instruction. While effective feedback is also consistent with quality in-person instruction, it may not have seemed as imperative before the pandemic. During virtual instruction, faculty developed new projects, incorporated case studies, and added reflective assignments accompanied by extensive, specific rubrics. These rubrics not only ease the burden of grading, but also give students better insight on how to develop their work. One of the authors heard this from a first-year student, “I read the rubric first and THEN I read the assignment,” which validated the efforts spent in developing these new materials. Grading features built into LMS platforms, new apps such as Gradescope, tablets, iPads, and Apple Pencils were all valuable tools to efficiently give feedback on students’ work. Some instructors even experimented with video and voice recordings for feedback mechanisms via their LMS systems.

Remote instruction also broadened the horizons for guest speakers in a variety of classes. Distance was no longer an obstacle, and students in synchronous classes maintained similar, if not higher, levels of engagement when guest speakers joined regular lectures. Our experiences suggest that because students were able to post their questions throughout the presentations without having to interrupt the speaker, the number of student questions increased. Recording guest speaker lectures allowed students to revisit concepts or provided increased flexibility within the variety of instructional modes.

Outside of the classroom, remote office hours or “student hours” provided more accessibility and flexibility for students and additional opportunities for personal interactions for both students and faculty. Some instructors reported higher numbers of attendees, as those that would have traditionally been unable to attend office hours because of family and work responsibilities had expanded access to faculty. The “share
"screen" function allowed for more direct and timely feedback on student work. Using the last minutes of live lectures for questions and allowing multiple students to simultaneously attend office hours enhanced efficiency, as many students arrived with similar questions and were able to “free ride” – but in a productive way.

Perhaps one of the greatest advantages of remote instruction is the increased flexibility it afforded both faculty and students. No one needed to be anywhere in particular except in a place with a good wi-fi connection. Depending on the university, students could be on campus, off-campus, in different time zones, and in some cases on different continents. Students joined classes from farms, airports, buses, trains, bedrooms, kitchen tables, sunny porches; we saw a lot in the background! Even when faculty taught in-person, students sometimes elected to join their classes remotely. Students could access material easily and catch up if they missed a lecture. Some instructors are planning to offer livestream and/or recorded lectures, even when in-person instruction resumes. The perennial “What did I miss?” question from absent students was answered by posting a link to the recorded lecture. Some classes actually benefited from students being at home. For example, North Dakota State University students were encouraged to invite their parents to participate in a farm business planning class in which the topic was farm succession (Wachenheim, 2020). In that course, about 36 of the students invited parents to attend, making the lesson far more effective than if the students relayed their learning to their parents second-hand.

**Going Forward**

We have learned important lessons, as well as discovered new opportunities, from this unexpected experiment with remote teaching and learning, and some of the practices will carry forward post-pandemic. New tools and technologies which support collaborative learning and increase accessibility will likely improve in-person instruction. Zoom and other video conferencing interfaces will continue to provide additional options for bringing distant guest speakers to our students. Clear, concise assignments with consistent due dates which are aligned with learning outcomes as well as specific rubrics to guide student effort will also be welcome improvements to in-person teaching.

Some remote teaching strategies may actually replace or reinvent in-person activities, even with full on-campus instruction. While the flipped or hybrid classroom has been a popular notion for the past two decades (Lage, Platt, and Treglia 2000), the transition costs and lack of resources may have prevented faculty from implementing this modality, even though early adopters found clear benefits. Now that many faculty were forced to adapt and create new materials, their library of recorded lectures and other materials might make these transitions less costly. Even if faculty return to traditional in-person classes, their teaching will surely benefit from the many innovative applications of course concepts, new group or team-based learning exercises,
discussions, and case studies created in the past year. Some faculty also noted that they will continue to offer virtual office hours, either exclusively or simultaneously with in-person office hours. The attributes of convenience and accessibility are hard to argue against, especially if it also allows flexibility for the instructor.

In addition, one of the most rewarding outcomes of the unexpected massive transition to remote learning in our profession has been the wide-spread interest and discussions about effective teaching and learning, as well as a renewed focus on equity and inclusion in higher education. We were invigorated by our colleagues’ renewed interest in teaching at the beginning of the pandemic and continue to be uplifted by regular Zoom meetings that allow us to share our stories from the trenches while learning from each other.

Future iterations of these virtual gatherings will provide instructors an outlet to informally present their scholarship of teaching findings and demonstrate new educational technology. Most importantly, the conversations allow us to continue to build a thriving teaching community that provides connection and support to passionate educators, and ultimately generate new teaching and learning research to be shared at the AAEA and WAEA meetings and published in AETR and other outlets, and better serve our discipline as a whole.

Many of us wonder how the future of university education will change in light of the rapid transition to online and remote instruction. Bogost (2020) noted that American universities have evolved such that the experiential and cultural aspects of university life eclipse the educational mission. The experiential component for students was completely altered with campus closures, reduced dormitory capacity, and social distancing across public spaces. If the out-of-class experiences of U.S. collegiate life are primary to students, we are still not in danger of transitioning completely to Massive Open Online Courses (MOOCs) that – even before the pandemic – some pundits rang as the pending death knell of collegiate education (Billington and Fronmueller, 2013). Nonetheless, this unexpected teaching experiment has posed numerous fascinating questions for on-going and further investigations. For example, what are some key opportunities and challenges that distinguish synchronous online teaching with asynchronous delivery? How will this sudden transition affect already existing inequalities and biases in higher education, and whether new opportunity and achievement gaps will persist? Though it took a pandemic for many of us to seriously examine how we teach, how students learn, and how to best connect the two, the silver lining is that it highlighted this important work, and we hope the conversation will continue.


Kiesel, K., M. D. Ehmke, K. Boys, B. Katare, J. Penn, and J. Bergtold. 2021 “What do our students think and value? Perceptions of transitioning to remote learning during the pandemic at land-grant universities” Western Economic Forum, forthcoming

