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Theme Overview: Agricultural Market Response to COVID-19

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JEL Classifications: Q02, Q11, Q17, Q18, H12
Keywords: Agriculture, Coronavirus COVID-19, Federal support, Markets, Trade

On March 13, 2020, the U.S. federal government declared a national emergency concerning the novel coronavirus disease (COVID-19). The rapid proliferation of COVID-19 at home and abroad and the subsequent shutdown of entire economic sectors led to unprecedented and simultaneous supply and demand shocks to the global food system and the broader economy. For example, U.S. unemployment rose in 2020, from very low levels not seen since the 1960s to the highest since the Great Depression. The International Monetary Fund revised its projection for the U.S. gross domestic product (GDP) in 2020 downward from a 2.0% annual increase in January to a 4.3% annual decrease in October. The COVID-19 pandemic in the United States and responses to it have affected food markets from multiple directions. Short-run impacts include reduced food-away-from-home (FAFH) consumption due to voluntary and mandated mobility restrictions, supply-chain disruptions for some commodities, shortages of some items at grocery stores, higher retail prices, and lower farm-gate prices. Medium-run impacts may include demand loss due to lower economic growth and shifts in consumer demand to food consumed at home not only due to mobility restrictions and consumer concerns over eating out but also due to income effects.

Articles in a previous *Choices* theme issue—COVID-19 and the Agriculture Industry: Labor, Supply Chains, and Consumer Behavior—focused on agricultural labor markets in the pandemic. As a follow-up, the set of articles in the current issue expands on the impacts of COVID-19 in the food sector by evaluating the main short-term impacts of the epidemic for key food and agricultural markets and discusses potential longer-term implications.

Seth Meyer and Patrick Westhoff provide a big-picture perspective by assessing changes in the outlook for farm income. They report that the pandemic sharply reduced the outlook for crop and livestock cash receipts but that record government payments through traditional government programs as well as new, emergency programs helped to cushion the blow. Still, the COVID-19 pandemic coincided with a drop in estimated 2020 net farm income of more than $7 billion.

Ashley Hungerford, Anne Effland, and Robert Johansson provide an overview of the major emergency actions taken to address food and agriculture needs during the pandemic. They focus primarily on the Coronavirus Food Assistance Program (CFAP), a direct payment program to producers administered by the U.S. Department of Agriculture, highlighting its uniquely broad scope.

Articles in this Theme:

Daniel A. Sumner summarizes the impact of the COVID-19 pandemic on the U.S. supply and demand situation and outlook for the fruit and vegetables that are typically shipped as fresh produce. A key takeaway is that shipment and price data do not support large differences in market conditions between 2020 and previous years, suggesting that U.S. fruit and vegetable markets adapted reasonably well to pandemic disruptions.

Christopher Wolf, Andrew Novakovic, and Mark Stephenson examine the dairy market disruptions and adjustments related to the COVID-19 pandemic. The mix of dairy products consumed at home relative to away from home resulted in shortages for some products and disposal of others. Dairy co-operatives instituted supply management programs to encourage cutting milk production. Existing and new government programs blunted the cash-flow impacts to farms and enhanced dairy product demand.

Joseph Balagtas and Joseph Cooper assess the COVID-19 related disruptions to meat and livestock markets in the United States. They provide a data-based description of the COVID-19 impact, including the shut-down of the food service sector, costs associated with packing plants' efforts to move product across supply chains, and meat-packing plant closings. The disruption to food service combined with plant closings resulted in high meat prices and an increase in the spread between retail meat prices and farm livestock prices. However, packing plant capacity rebounded by summer and retail meat prices returned to within 10% of prepandemic levels.

Shawn Arita, Jason Grant, and Sharon Sydow conduct an early econometric examination of the impacts of COVID-19 on international trade. They find the pandemic reduced global agricultural trade by 4.2% in the second and third quarters of 2020. Agricultural trade was found to be significantly more stable than nonagricultural trade; however, the level of disruption varies substantially across commodities.

Jayson Lusk and Brandon McFadden examine consumer food buying during recessions by exploring data from the Consumer Expenditure Survey, shedding light on how consumer food spending patterns vary with income. They then look back to the Great Recession and review findings that illustrate how food buying changed during that historic economic downturn and its effects on food insecurity. Finally, they discuss how consumer food purchasing behavior under COVID-19 may differ from past recessions.

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Estimates of Farm Income and the Outlook for Program Crops and Livestock, Pre- and Post-COVID-19

Seth Meyer and Patrick Westhoff

JEL Classifications: Q11, Q12, Q13, Q18
Keywords: COVID-19, Coronavirus, Crop outlook, Farm income, Pandemics

The year 2020 started with renewed optimism in the U.S. agricultural sector. In 2019, farm income was modestly higher than the prior year, but well below levels seen from 2011 to 2014. In addition, Market Facilitation Program payments to compensate producers for lost trade opportunities represented nearly 17% of net farm income. Prospects for the sector appeared to improve after the January 15 signing of the Phase One trade agreement with China, which sought to cool the trade tensions that had dominated agricultural markets for much of the prior year and a half. Within this same week, however, the World Health Organization (WHO, 2020) reported the first confirmed case of COVID-19 outside of the borders of China.

The impacts of COVID-19 on the agricultural sector have varied considerably by commodity and by marketing channel. Notable impacts included supply-chain disruptions, shifts in consumer demands reflecting changes in purchasing and consumption habits in the face of widespread shutdown orders, and concerns about a more general economic slowdown.

In this article, we explore the shift in the outlook, based two sets of projections from a large-scale partial equilibrium model used for policy analysis, for farm income and for principal crop markets. The first outlook was prepared immediately after the signing of the Phase One agreement and published in March 2020 (FAPRI, 2020a) and the second was prepared in August 2020, several months into the crisis (FAPRI, 2020b,c). The partial equilibrium model covers program crops (crops covered by the commodity title of the U.S. Farm Bill, including grains, oilseeds and cotton) and livestock in significant detail while addressing specialty crops' contribution to farm income in a more simplistic fashion. For most commodities COVID-19—and the government response to it—was the main driving force for the change in sectoral prospects between January and August. In the final months of 2020, a number of factors unrelated to COVID-19 helped brighten the outlook for crop prices and farm income, as discussed in the final section of the paper.

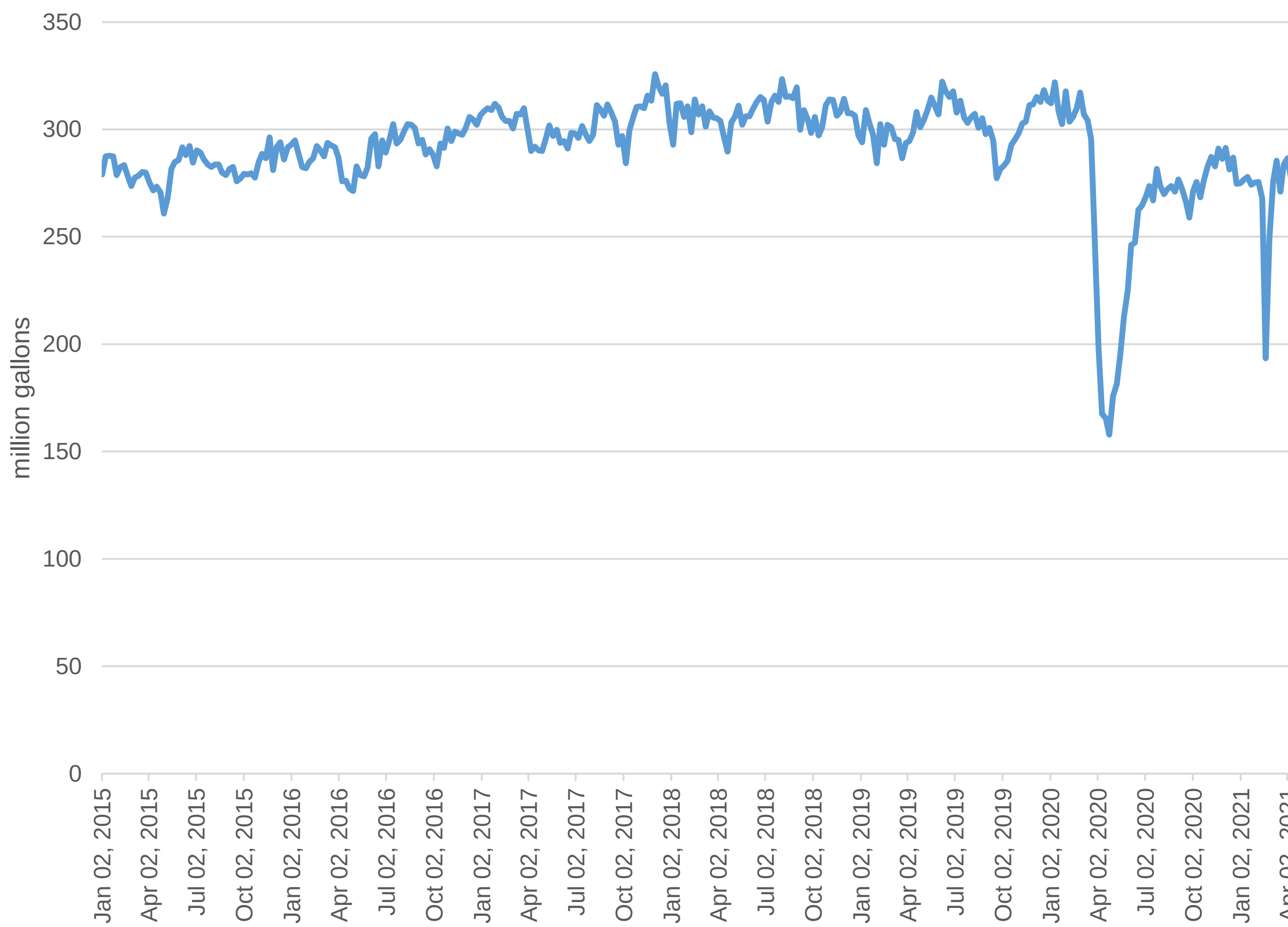
Evolution of the Outlook for Program Crops

In an environment of solid global and U.S. macroeconomic growth, the year 2020 started with a general expectation of a rebound in crop planted area and, with it, supplies of many program crops after widespread precipitation in the spring of 2019 led to record large acres of prevented plantings across the Midwest. The announced Phase One agreement provided a target for the value of bilateral trade between the United States and China and commitments to reduce nontariff barriers, but with several statements in the document that purchases would be made "at the market." Achieving the trade-value targets of the Phase One agreement appeared daunting and ultimately the 2020 targets were not achieved. However, a sharp rebound in trade with China, even if short of the target, seemed both achievable and supportive of crop and livestock prices and set the tone for the outlook for program crop prices for the remainder of 2019/20 marketing year and into the next season.

With the emergence and spread of COVID-19 among the U.S. population and around the globe, the major program crops appeared to suffer fewer supply chain disruptions than did livestock and specialty crop products. They were, however, not entirely insulated from other COVID-19 impacts. While impacts on the production and distribution of the program crops were limited, more notable impacts were observed on demand.

As a result of widespread shutdown orders, miles driven, and—with it—motor fuel consumption, fell sharply in April 2020. Fuel use rebounded in the late spring and summer of 2020, but it remained below pre-pandemic levels (Figure 1). While the Energy Independence and Security Act of 2007 established renewable fuel volumes

Figure 1. Weekly Ethanol Production in Million Gallons per Week



Source: Energy Information Agency

on an annual basis and is a primary driver for ethanol consumption levels, rule implementation by the Environmental Protection Agency (EPA) converts the volume target into a percentage inclusion rate in motor fuel each calendar year. As such, the domestic demand for ethanol, largely made from corn, fluctuates in near lockstep with intra-year motor fuel demand. Lower ethanol demand resulted in lower ethanol prices, reduced ethanol production, a cut in corn use, an increase in expected corn carryover stocks, and lower corn prices (Table 1).

Similarly, the widespread shutdown of retail outlets and work sites, both here and abroad, reduced demand for clothing and cotton products, cutting the global demand for cotton and pushing down the price for the fiber. Soybean prices were also negatively affected, not so much because the pandemic reduced demand but because of concerns that lower corn prices would cause farmers here and in other countries to shift acreage out of corn and into soybeans. In contrast, wheat and rice prices received temporary support as countries rushed to secure supplies in the face of major uncertainty regarding the impact of the pandemic on supply chains and food security.

Falling Expectations for Crop and Livestock Net Receipts

The COVID-19 shocks across the agricultural sector, discussed in depth in this issue of *Choices*, sharply reduced 2020 projected farm cash receipts by 9% between early March and August 2020 (Figure 2, Table 2). Much of the change in expectations for crop and livestock receipts, a decline of 9% in the estimate for their combined receipts for 2020, can be attributed to declines in demand for raw farm commodities and reflected in lower farm-level prices. The shift in demand was a result of supply chain disruptions, reduced travel and mobility, and, more broadly, uncertainty and weakness in the general economy here and abroad.

Prospects for 2020 feed grains cash receipts were reduced by 10%, primarily because of the reduction in ethanol use and corn prices. The reduction in projected

Table 1. The Outlook for Program Crop Prices Prior To and After the Spread of COVID-19

	Pre-COVID-19 Phase One outlook March 2020					Phase One and COVID-19 Outlook August 2020		Change	
Marketing Year	**16/17**	**17/18**	**18/19**	**19/20**	**20/21**	**19/20**	**20/21**	**19/20**	**20/21**
Corn ($/bu)	3.36	3.36	3.61	3.90	3.70	3.60	3.24	-0.30	-0.46
Wheat ($/bu)	3.89	4.72	5.16	4.54	4.84	4.58	4.55	0.04	-0.29
Sorghum ($/bu)	2.79	3.22	3.26	3.71	3.73	3.25	3.22	-0.46	-0.51
Barley ($/bu)	4.96	4.47	4.62	4.70	4.61	4.70	4.46	0.00	-0.16
Oats ($/bu)	2.06	2.59	2.66	2.97	2.88	2.88	2.66	-0.09	-0.23
Soybeans ($/bu)	9.47	9.33	8.48	8.97	8.85	8.55	8.24	-0.42	-0.61
Soybean meal ($/ton)	316.88	345.02	308.28	304.70	303.06	300.00	286.41	-4.70	-16.65
Soybean oil (cents/lb)	32.55	30.04	28.26	33.55	32.47	29.00	29.79	-4.55	-2.68
Peanuts (cents/lb)	19.70	22.90	21.50	20.93	22.18	20.40	20.48	-0.53	-1.70
Sunflowers (cents/lb)	17.40	17.20	17.40	18.08	17.45	19.20	17.77	1.12	0.33
Canola (cents/lb)	16.60	17.50	15.80	14.50	14.97	14.80	15.46	0.30	0.49
Upland cotton (cents/lb)	68.00	68.60	70.30	62.13	61.70	59.50	57.43	-2.63	-4.27
Rice ($/cwt)	10.40	12.90	12.30	13.20	13.09	13.10	12.70	-0.10	-0.39
Long grain ($/cwt)	9.61	11.50	10.80	12.20	12.01	12.00	11.66	-0.20	-0.35
Japonica ($/cwt)	14.10	20.10	20.00	18.30	18.28	18.50	18.13	0.20	-0.15
Other M&S grain ($/cwt)	10.10	11.70	12.30	12.20	12.45	11.70	11.67	-0.50	-0.78
All hay ($/ton)	129.00	142.00	166.00	165.22	165.38	165.00	163.23	-0.22	-2.14
Distillers grains ($/ton)	105.29	149.69	145.90	150.57	143.44	157.81	135.85	7.24	-7.59

Source: FAPRI (2020a,b,c).

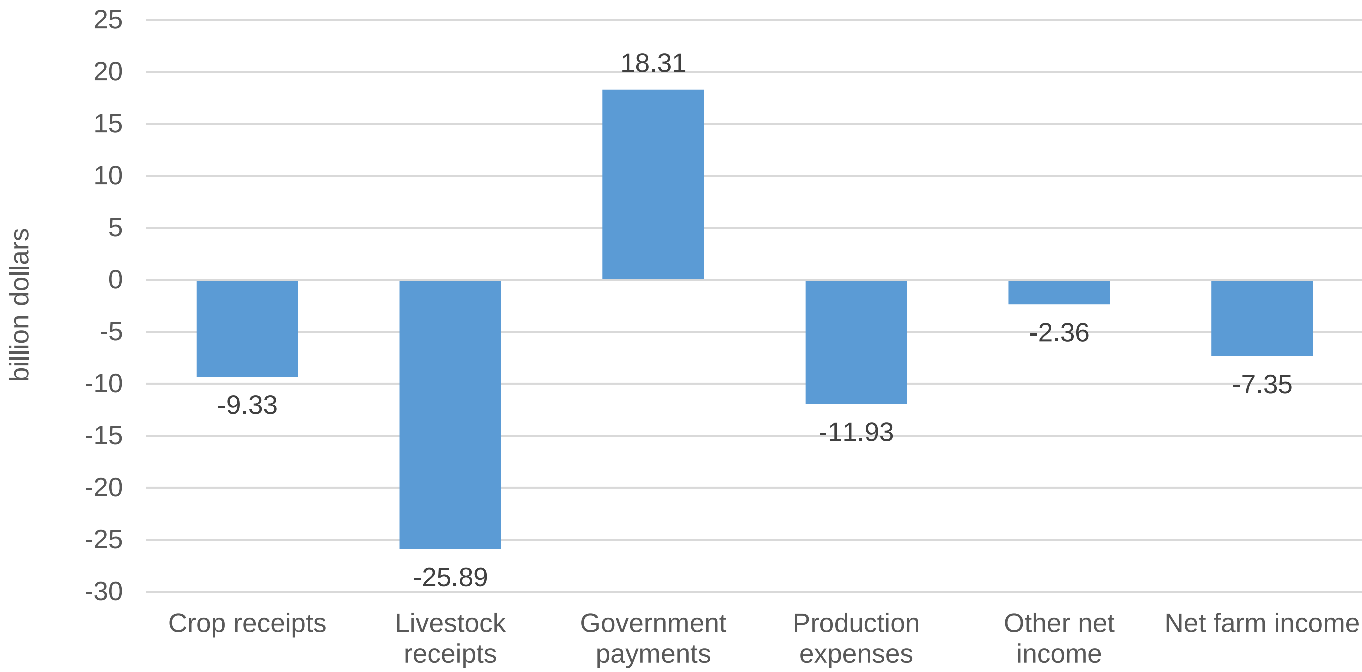
oilseed receipts was a more modest 5%, as the projected reduction in soybean prices was smaller than in the case of corn. Projections of 2020 food grains receipts, such as wheat and rice, actually increased slightly, as those crops benefited from the temporary jump in global demand for food staples and some specific shifts in demand, such as a run on baking flour in the United States (Dunn, 2020).

Livestock packing plant shutdowns and slowdowns had negative effects on both farmers and consumers, reducing prices offered for live animals and increasing wholesale and retail meat prices. Hog, cattle and chicken prices all fell, resulting in large reductions in projected cash receipts. Shifts in demand, with the widespread closure of schools and their large fluid milk consumption, as well as processing capacity limitations, similarly affected fluid milk demand in some locations, leading to localized milk dumping while simultaneously producing scarcity at retail outlets. As a result of these declines, 2020 crop and livestock cash receipts were expected to be $35 billion lower in August than first estimated before the pandemic struck, with the animal sector accounting for most of the reduction.

Declines Partially Offset by Moderating Expenses

As prices and cash receipts prospects declined in the early months of the pandemic, so too did the outlook for production expenses (Table 2). Changes in the outlook for some categories of expenses are a result of a shift in capital demand or indirectly through COVID-19 impacts on the macroeconomy and oil prices. For some categories of expenses, the reduction is a result of falling prices that are a direct input into another commodity. Reduced demand for cattle results not only in lower prices for slaughter-ready animals but also in lower prices for feeder cattle purchased by feedlots, with expected purchased livestock expenses falling 11.0%, or $3.29 billion. Similarly, lower feed grain prices reduce feed costs for those same animals. Projected feed costs, including grains and oilseed meals, fell a more modest 1.2%, or $0.74 billion.

Figure 2. Changes in Estimates of Components of Farm Income for Calendar Year 2020 Prior To and After the Spread of COVID-19



Source: FAPRI (2020a,b,c).

Other expenses that are tied more closely to commodities outside of agriculture, such as oil prices, were pushed lower by falling demand (and were sharply lower for a period from a supply war between Saudi Arabia and Russia). Lower petroleum prices contributed to lower farm energy (fuel and electricity) expenses, with costs falling 1.9%, or $0.35 billion.

A slowing general economy and the Federal Reserve Bank's response to it lowered interest rates, resulting in expected cost savings on farm loans. These and other changes and data revisions reduced the outlook for expenses by $11.93 billion, a change that offset a portion of the decline in farm receipts.

The Government Response to Falling Cash Receipts

The government response to the pandemic also offset expected reductions in cash receipts. Government direct payments were originally anticipated to be $14.5 billion in 2020, down significantly from the prior year, as no new Market Facilitation Payments were assumed with the signing of the Phase One trade agreement with China (U.S. Department of Agriculture, 2020b).

As COVID-19 spread and the outlook for cash receipts worsened, existing government countercyclical payment programs for program crops offset a small portion of the decline in receipts from the market. The vast majority of the increase in projected government direct payments for calendar year 2020 was a result of programs announced as a result of the unfolding COVID-19 crisis.

The Coronavirus Aid, Relief, and Economic Security Act (CARES) provided part of the funding used to create the Coronavirus Food Assistance Program (CFAP), which also tapped the borrowing authority of the Commodity Credit Corporation (CCC). The first round of the program (CFAP1) was to provide up to $16 billion to agricultural producers (U.S. Department of Agriculture, 2020a). The program covered a wide variety of commodities, including program crops, specialty crops, livestock, and dairy. In August, as the program deadline approached, it appeared the funds spent would fall far short of the program authorization of $16 billion in expenditures, and $11 billion in outlays was assumed in the projections of government payments and farm income. Payment limitations, adjusted gross income (AGI) eligibility restrictions, and less than full participation meant that as of late April 2021, $10.6 billion had been paid out, with little additional anticipated.

In addition, forgivable loans from the Payroll Protection Program (PPP) totaling an estimated $5.8 billion were directed toward agricultural producers and, along with increases in ARC and PLC payments, increased the amount of expected direct government payments by $18.3 billion to a record $32.8 billion.

Table 2. Projections of 2020 Farm Cash Receipts, Payments, Expenses and Net Farm Income (in $billions)

	Pre-COVID-19 Phase One Outlook, March 2020	Phase One and COVID-19 Outlook, August 2020	Absolute Change	Percentage Change
Receipts				
Feed grains (corn, sorghum, etc.)	61.64	55.42	-6.22	-10.1%
Food grains (wheat, rice, etc.)	11.44	11.75	0.31	2.7%
Oilseeds (soybeans, peanuts, etc.)	38.86	36.91	-1.95	-5.0%
Cotton (fiber and seed)	7.21	5.89	-1.32	-18.3%
Other crops (fruits, vegetables, etc.)	83.96	83.81	-0.15	-0.2%
Cattle	71.34	61.81	-9.54	-13.4%
Hogs	26.15	18.50	-7.66	-29.3%
Dairy products	43.07	39.07	-4.00	-9.3%
Poultry, eggs (broilers, turkeys, etc.)	41.22	37.23	-3.99	-9.7%
Other livestock (sheep, goats, etc.)	7.28	6.57	-0.71	-9.8%
Total cash receipts	392.18	356.96	-35.22	-9.0%
Total government payments	14.48	32.78	18.31	126.4%
Expenses				
Feed	59.67	58.93	-0.74	-1.2%
Purchased livestock	29.85	26.56	-3.29	-11.0%
Fuel and electricity	18.45	18.09	-0.35	-1.9%
Interest	18.80	17.63	-1.17	-6.2%
All other expenses	229.85	223.47	-6.37	-2.8%
Total production expenses	356.62	344.69	-11.93	-3.3%
Other net farm income	55.87	53.51	-2.36	-4.2%
Net farm income	105.91	98.56	-7.35	-6.9%

Source: FAPRI (2020a; 2020b; 2020c).

The reduction in expenses and the additional direct government payments including CFAP 1 and PPP offset some, but not all, of the decline in crop and livestock receipts, resulting in a farm income outlook for 2020 that was $7.35 billion lower than the pre-COVID-19 estimate but still $14.8 billion higher than farm income for 2019.

What has changed since August 2020?

A lot has changed since the August projections for farm commodity markets and farm income were prepared. Most of the changes that have occurred have supported commodity prices and farm income.

- Estimates of the size of the 2020 corn and soybean crops were sharply reduced. This reduced expected carryout stocks and pushed up grain and oilseed prices. With short-run demand relatively inelastic, the increase in prices was greater than the reduction in the quantities produced and marketed, so estimates of 2020 cash receipts increased.
- China went on a buying spree. While the pre-pandemic estimates of China's purchases of U.S. products turned out to be broadly consistent with actual 2020 trade,

the increase in U.S. exports to China generally did not come at the expense of reduced purchases from other exporters. For example, China greatly increased its imports of corn, not just from the U.S. but from other countries as well, to feed a hog herd that was rebounding from the impacts of African swine fever.

- Further rounds of government assistance boosted consumer buying power and farm income. While the pandemic reduced U.S. GDP in 2020, the large stimulus measures meant that disposable personal income actually increased in 2020, helping to explain a slight increase in per-capita meat consumption in spite of higher retail meat prices. Another round of CFAP payments to producers also provided a further boost to government payments in 2020, which are now estimated to have reached a record $46 billion.
- As a result of stronger-than-expected receipts and government payments, 2020 net farm income estimates increased sharply after August 2020. In February 2021, USDA estimated that net farm income in 2020 had actually increased to $121 billion, $23 billion above the August FAPRI estimate.

COVID-related effects will continue to impact agricultural markets in 2021 and beyond. In early 2021, vehicle miles driven and fuel use remained below pre-pandemic levels, with implications for biofuel demand. Livestock sector responses to the supply disruptions of early 2020 continue to have meat and milk supply impacts in 2021. Additional relief and stimulus packages boost consumer income and provide additional government payments to farmers.

For the most part, though, the impact of COVID-related factors on farm commodity markets and farm income appeared to be fading in early 2021. Once again, the outlook for farm commodity markets will be driven by the "usual" sources of uncertainty, such as the weather. Until, of course, the next once-in-a-lifetime event occurs.

For More Information

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Agricultural and Food Policy Response to COVID-19

Ashley Hungerford, Anne Effland, and Robert Johansson

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Introduction

On March 13, 2020, President Trump declared the U.S. outbreak of COVID-19 a national emergency, authorizing use of emergency authorities and releasing emergency aid to assist in response to conditions created by the disease outbreak, including for food and agriculture (U.S. President, 2020a). Even before the declaration, the Coronavirus Preparedness and Response Supplemental Appropriations Act of 2020 (Public Law 116-123), enacted on March 6, 2020, provided $8.3 billion in emergency funding for federal agencies to prepare for and respond to COVID-19. Further legislative and regulatory actions followed in the coming months, many with a direct impact on food supply chains and agriculture.

In this article, we provide an overview of the major emergency actions taken to address food and agriculture needs during the pandemic, including enhanced flexibility in nutrition programs, deployment of novel distribution channels for government food purchases that tapped into food supply networks disrupted by the pandemic, and implementation of emergency regulatory/discretionary actions that helped to keep critical inputs—such as agricultural commodities, labor, transportation, personal protective equipment, and infrastructure—available to ensure efficient operation of national food and agriculture systems. We focus primarily on the Coronavirus Food Assistance Program (CFAP), a direct payment program to farmers and ranchers administered by the U.S. Department of Agriculture (USDA), highlighting its uniquely broad scope, which was designed to potentially cover an unprecedentedly wide range of commodities, from corn to cabbage to cattle to catfish. We detail the authority, design, and implementation of CFAP and examine the distribution of outlays across commodities. In addition, while recognizing that the policy response to COVID-19 is still evolving, we consider how the landscape for farm and food policy has already changed due to the pandemic.

Timeline and Provisions of Legislation

Legislative action in response to COVID-19 was unusually swift, with the first two laws each introduced and enacted within approximately one week of each other. The Coronavirus Preparedness and Response Supplemental Appropriations Act (Public Law 116-123) was introduced on March 4, 2020, and enacted on March 6, 2020. The Families First Coronavirus Response Act (FFCRA) (Public Law 116-127) followed, being introduced on March 11, 2020, and enacted on March 18, 2020. While the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) (Public Law 116-136) was introduced on January 24, 2019, as the Middle Class Health Benefits Tax Repeal Act of 2019, the Senate made amendments relating to COVID-19 in March 2020 and the bill was renamed and enacted on March 27, 2020. For context, the 2018 Farm Bill, one of the more rapidly enacted Farm Bills in recent years, took eight months. While the Coronavirus Preparedness and Response Supplemental Appropriations Act of 2020 did not include provisions specific to food and agriculture, the FFCRA and the CARES Act covered much broader swaths of the economy.

Chief among its provisions for food and agriculture, the FFCRA provided additional funding and flexibility for food assistance programs. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) saw an increase in appropriations of $500 million, and the Commodity Assistance Program received additional appropriations of $400 million. FFCRA also established conditions under which states facing school closures of at least one week due to the pandemic could provide assistance to children eligible for free and reduced lunches through the Electronic Benefits Transfer (EBT) system. The law also provided $100 million in grants to U.S. territories for food assistance.

The CARES Act, the last of the three initial responses to COVID-19, addressed the widest range of needs, particularly for food and agriculture. The CARES Act provided funding to programs implemented by the Food and Nutrition Service, including $8.8 billion for child nutrition programs, $15.81 billion in contingency funds for the Supplemental Nutrition Assistance Program (SNAP) in case participation exceeded budget estimates, and $450 million in additional funding for the Commodity Assistance Program, food distribution on Indian reservations, facility and equipment upgrades for food purchases, and additional grant funds for U.S. territories.

The CARES Act also provided the first direct COVID-19 assistance for farmers and ranchers. The act provides $9.5 billion in appropriations to prevent, prepare for, and respond to coronavirus by providing support for agricultural producers impacted by coronavirus, including producers of specialty crops, producers that supply local food systems, including farmers' markets, restaurants, and schools, and livestock producers, including dairy producers.

Loan maturity for marketing assistance loans was extended from 9 months to 12 months, to remain in effect through September 30, 2020, offering producers additional flexibility in marketing decisions. The law also provides $14 billion in replenishment of Commodity Credit Corporation (CCC) borrowing authority to assist in funding necessary programs for pandemic response. USDA agencies received additional funding to assist with implementing the additional measures in response to COVID-19.

Also authorized by the CARES Act, the Paycheck Protection Program (PPP)—administered by the Small Business Administration (SBA) with support from the U.S. Department of Treasury—offered up to $349 billion in forgivable loans to small businesses, those with 500 or fewer employees, to maintain those employees on their payrolls during the pandemic. Farmers and ranchers were eligible to receive loans on the same basis as other employers. The Paycheck Protection Program and Health Care Enhancement Act (Public Law 116-139, enacted April 24, 2020) increased the authorized spending to $659 billion.

Labor Initiatives

In addition to congressional action through legislation, USDA and other executive departments took a number of regulatory and discretionary actions in response to the pandemic, particularly to protect access to the labor needed to support agricultural production. The State Department and Department of Homeland Security relaxed requirements for in-person interviews for visas required for the H-2A program, which authorizes noncitizen seasonal labor for agricultural businesses, by allowing consular officers to waive the interview requirement for first-time and returning applicants if there was no "apparent or potential ineligibility" (U.S. Department of State, 2020). U.S. Citizenship and Immigration Services (USCIS) temporarily amended certain H-2A requirements, including waiving the three-year maximum allowable period for H-2A visas (U.S. Citizenship and Immigration Services, 2020). The White House also issued an executive order to keep meat and poultry facilities operational, accompanied by guidance on maintaining employee safety from the Centers for Disease Control and Prevention and Occupational Health and Safety Administration (U.S. President, 2020b; U.S. Department of Agriculture, 2020p). In May 2020, USDA and the Food and Drug Administration (FDA) established a memorandum of understanding to clarify procedures in order to "prevent interruptions at FDA regulated food facilities," including fruit and vegetable processing facilities (U.S. Department of Agriculture, 2020e).

Program Details

Food Programs

With the funding provided for food and nutrition assistance, the USDA created a food distribution program tailored to the challenges created by the pandemic, such as the difficulties of enforcing social distancing at food banks using traditional on-site pick up systems and the opportunity to tap into the food supplies stranded as a result of food service shutdowns. The USDA announced the Farmers to Families Food Box (FFFB) program on April 17, 2020, using the authority provided under the food assistance authorities of FFCRA (U.S. Department of Agriculture, 2020j). Originally funded at up to $3 billion, an additional $1 billion was added on August 25, 2020, and $500 million on October 23, 2020 (U.S. Department of Agriculture, 2020i,k), with the additional funding also authorized under FFCRA. The USDA designed a new program to distribute food directly to individual households through distributor partnerships, leveraging food supplier networks impacted by COVID-19 disruptions and nonprofit organizations experienced in delivering food assistance to low-income households. The USDA's Agricultural Marketing Service (AMS) managed the competitive bid process for awarding contracts and provided specifications for the food products to be provided, including fresh fruits and vegetables, dairy products, and precooked meats, either in boxes specialized by food type or in combination (U.S. Department of Agriculture, 2020m).

In addition to the FFFB program, FFCRA and the USDA made policy and administrative changes to existing nutrition assistance that made use of existing infrastructure to accelerate access to food programs for individuals and households impacted by the pandemic. The SNAP Online Purchasing Pilot program that had launched in April 2019 quickly expanded to include the eight original pilot states by March 2020 and 46 states and the District of Columbia by October 2020, allowing SNAP recipients the flexibility to purchase food online during the pandemic disruptions (U.S. Department of Agriculture, 2020g). The FFCRA also authorized emergency allotments of SNAP benefits in all states, leading to a 40% increase in SNAP benefits, roughly $2 billion a month (U.S. Department of Agriculture, 2020n). Also under FFCRA authorities, the USDA established the Pandemic EBT Program, which transfers funds through the nutrition assistance EBT system to families who qualify for free or reduced lunches so that they can continue to provide their children with nutritious meals even while schools are closed due to the pandemic. Pandemic EBT has been approved in 50 states along with the U.S. Virgin Islands and the District of Columbia (U.S. Department of Agriculture, 2020l). In addition, the "Meals to You" program—organized as a partnership among the USDA, Baylor University Collaborative on Hunger and Poverty, McLane Global, and PepsiCo—has provided millions of meals directly to children in rural areas where sources of nutritious foods may be more difficult to access (28.5 million meals as of July 16, 2020) in 41 states and two U.S. territories (U.S. Department of Agriculture, 2020o).

Direct Payments to Producers: The Coronavirus Food Assistance Program (CFAP)

The USDA implemented direct payments related to the COVID-19 impact on agricultural producers through two rounds of the Coronavirus Food Assistance Program (CFAP), which we refer to here as CFAP 1 and CFAP 2.

CFAP 1

To facilitate rapid delivery of assistance to farmers and ranchers affected by COVID-19 food system disruptions, the USDA utilized the $9.5 billion in CARES Act appropriations in combination with CCC funding to launch CFAP 1. While the CARES Act authorized an additional $14 billion in CCC replenishment, that replenishment could not be made available until after June 30, 2020, so CFAP 1 used $6.5 billion in already available CCC funding (U.S. Department of Agriculture, 2020c).

CFAP 1 provided payments to producers to prevent, prepare for, and respond to market impacts of COVID-19. Generally, commodity eligibility was determined by whether the weekly average price of the commodity fell more than 5% between the week of January 13, 2020, and the week of April 6, 2020. The exception to this eligibility requirement was that specialty crops could also qualify for payments based on unpaid shipments or crops that remained on-farm due to loss of market. Crops—excluding forage—and livestock, animal products, floriculture, aquaculture, and nursery products could be considered for CFAP 1 eligibility. To make these determinations for inclusion in CFAP 1 required weekly price series, which proved to be a challenge for many commodities. For this reason, the USDA published a Request for Information (RFI) with the Notice of Funding Availability (NOFA) on May 22, 2020, which allowed the public to submit data for agricultural commodities for which the USDA had insufficient data to use for determining whether a 5% price decline had occurred. The initial list of eligible commodities using the 5% price decline determination included swine, cattle, sheep under two years old, milk, wool, canola, corn, upland cotton, malting barley, millet, oats, sorghum, soybeans, sunflowers, and wheat (durum and hard red spring wheat) as well as two dozen fruits and vegetables.

The structure of payments varied depending on the type of commodity. One key feature for payments based on price decline under CFAP 1 is that payments were only made on commodities that were "unpriced" prior to January 15, 2020. "Unpriced" as defined in the CFAP regulations "means any production that is not subject to an agreed-upon price in the future through a forward contract, agreement, or similar binding document."

For nonspecialty crops, the CARES-funded portion of the payment was 55% of the price decline from weekly average prices for the week of January 13, 2020, and the week of April 6, 2020; the CCC-funded portion of the payment paid 50% on the same price decline. Price data was sourced from futures contracts and the Agricultural Marketing Service. Nonspecialty crops were paid based on the unpriced inventory on January 15, 2020, with a maximum of 25% of 2019 production multiplied by the CARES-funded payment rate and the same quantity multiplied by the CCC-funded payment rate, respectively (totaling no more than 50% of 2019 crop production eligible for payment). Therefore, a producer could not receive more than 26.5% (25% x 55%+25% x 50%) of the commodity's price decline on a share of the previous year's production.

The CFAP 1 payments for livestock were calculated using a producer's volume of sales and inventory, where eligible livestock had to be unpriced prior to January 15, 2020. CARES funding was used for payments related to price losses on swine and beef cattle sales volume that occurred between January 15 and April 15, 2020. CCC-funded payments for livestock were made on the highest unpriced inventory of the producer between April 16 and May 14, 2020. Under the CARES funding, owners of hogs and beef cattle were paid on 80% of the estimated price decline using price data from the AMS. While the CARES-funded payments had multiple payment categories for both swine and beef cattle based on weight and use, the CCC-funded payment rates were a flat rate per head for beef cattle and a flat rate per head for swine, regardless of weight or use. The CCC-funded portion was calculated on 25% of estimated losses due to price declines for calendar 2020 second and third quarters with the price decline estimated from futures contracts. This 25% of estimated losses for hogs and beef cattle was distributed across all inventory, not just market inventory. Since the swine life cycle is approximately six months and breeding inventory is a small percentage of the overall inventory (8%), spreading the price loss across all inventory did not have as large an impact on the per animal rate as it did for beef cattle. Not all beef cattle may be sold during a six-month period, and a large percentage (over 40%) of the overall beef cattle inventory is composed of breeding inventory, so spreading the 25% of estimated losses across the entire beef inventory resulted in a much lower rate than if payments had been made only for cattle actually marketed during the six-month period (U.S. Department of Agriculture, 2019, 2020h).

Payment calculations for milk used the all-milk price indicator of futures contracts (60% of class III milk and 40% of class IV milk) for the estimated all-milk price decline, with 80% of the price decline funded under CARES and 25% of the same price decline funded by CCC. Milk payments under CARES funding were paid on first quarter production, from January 1 through March 31, 2020, while the CCC funded portion was paid on second quarter production, estimated as the January through March production multiplied by a factor of 1.014. This factor was determined based on the ratio of the 2020 second-quarter national milk production projection and 2020 first-quarter national milk production estimate in the USDA *World Agricultural Supply and Demand Estimates* available at the time of the program's development.

Unlike nonspecialty crops and livestock, which had one component funded from the CARES Act and one from the CCC, specialty crops had two components funded from the CARES Act and one from the CCC. Like nonspecialty crops and livestock, one share of CARES funded payments were made on crops that experienced a price decline greater than 5% between weeks of January 13, 2020, and April 6, 2020, with the payment rate equal to 80% of the price decline and applied to crops sold between January 15 and April 15, 2020. The second CARES-funded component paid 30% of the value of crops that were shipped but then spoiled in transit (for which producers would forfeit expected payment for purchase) prior to April 15, 2020. The final component, which was funded from CCC, paid roughly 6% of the value of mature crops unsold or unharvested due to lack of buyers by April 15, 2020.

When the CFAP 1 rule was published on May 21, 2020, the public was informed of which crops were eligible for CFAP 1 based on USDA's initial determinations of commodity eligibility. Two additional NOFAs were released later based on price data collected through the RFI. The second NOFA—released on July 9, 2020—added and updated a few dozen payment rates for specialty crops. The third NOFA—announced August 11, 2020—added another several dozen specialty crops eligible for the payments as a result of price declines, along with payment rates for aquaculture, nursery crops and flowers, liquid and frozen eggs, and sheep over two years old (previously, only sheep under two years old had qualified).

CFAP 1 Payment Distribution

For CFAP 1, outlays were originally anticipated at $16 billion in the cost–benefit analysis; however, as of April 8, 2021, outlays stood at $10.55 billion (U.S. Department of Agriculture, 2020d,e). The distribution for CFAP 1 payments differed substantially from other farm safety net programs, such as crop insurance. Roughly half of the payments were distributed to livestock producers, with over $4 billion to cattle producers. Milk payments

Table 1. Outlays by Commodity for Coronavirus Food Assistance Program 1

Rank	Commodity	Total ($millions)
1	Cattle	$4,360
2	Corn	$1,791
3	Milk	$1,778
4	Hogs	$613
5	Soybeans	$513
6	Cotton-Upland	$265
7	Almonds	$129
8	Potatoes-Russets-Fresh-RUS	$92
9	Walnuts	$88
10	Apples	$78
	Other Livestock and Animal Products (excluding milk)	$74
	Other Non-specialty Crops	$106
	Other Specialty Crop	$542
	Other Aquaculture/Nursery/Floriculture	$121
	Grand Total	**$10,551**

Source: U.S. Department of Agriculture Farm Service Agency have almost reached $1.8 billion. For reference, the farm safety net program for milk—the Dairy Margin Coverage Program—disbursed approximately $625 million between January 2019 through March 2021 (U.S. Department of Agriculture, 2020f). While nonspecialty crops in total accounted for roughly one-fourth of the payments, four specialty crops (almonds, potatoes, walnuts, and apples) were among the commodities to receive the most payments (Table 1).

CFAP 2

Given the length of the market disruption, CFAP 2 was implemented on September 21, 2020, making use of the $14 billion CCC replenishment provided by the CARES Act. The payment scheme for dairy, nonspecialty crops, swine, and cattle remained similar to the CCC component of CFAP 1, with a few exceptions. First, breeding stock was excluded from the livestock payments. Second, CFAP 2 payments were generally based on 80% of estimated losses with the price decline calculated from the weekly average price of the week of January 13, 2020, and the week of July 27, 2020. Additionally, nonspecialty crop payments under CFAP 2 are directed at assisting producers in marketing their 2020 crop in calendar year 2020 as opposed to compensating for price declines affecting the 2019 crop under CFAP 1. Given that CFAP 2 was implemented prior to harvest, instead of paying on the producer's unpriced nonspecialty crop production, payments are made on a fixed historical average yield multiplied by 2020 planted acreage, an estimate of the percentage of crop marketed by December 31, 2020, and 80% of the price decline. If a nonspecialty crop had insufficient data for a price decline determination greater than 5% or the commodity did not meet the 5% decline, the crop received a flat rate of $15/acre. Broilers and all table eggs were added under CFAP 2 with payment rates equal to 80% of the estimated price decline multiplied by 75% of 2019 production, where 75% of 2019 production serves as a proxy for 2020 second-quarter through fourth-quarter production of these commodities. Contract producers were not eligible for payment since they do not market the commodity themselves. The owners of the contracted animals/products may receive payment if they meet the adjusted gross income eligibility criteria.

The specialty crop payments under CFAP 2 were redesigned to be calculated using marginal rates at different sized sales classes and applied to 2019 gross sales of specialty crops (Table 2). For example, suppose a producer had $350,000 in gross sales in 2019. Then the producer's payment under CFAP 2 would be

(10.6%) x ($49,999) + (9.9%) x ($99,999 – $50,000) + (9.7%) x ($350,000 – 100,000) = $34,499.70.

As described in the cost–benefit analysis for CFAP 2, these marginal rates were developed using a cost-based approach to capture that larger operations generally face lower variable cost per unit of production compared to smaller operations. (U.S. Department of Agriculture, 2020a). Animal products and livestock other than beef cattle, swine, broilers, and eggs were eligible under the same payment scheme as specialty crops.

Table 2. CFAP 2 Speciality Crop Payment Rates

2019 Sales	Marginal Payment Rate
≤$49,999	10.6%
$50,000-$99,999	9.9%
$100,000-$499,999	9.7%
$500,000-$999,999	9.0%
≥$1 million	8.8%

Source: U.S. Department of Agriculture Farm Service Agency

CFAP 2 sign-up originally closed on December 11, 2020. However, with the change in Administration, the program was reopened on April 5, 2021 to all producers and additional outreach efforts were made to reach socially disadvantaged farmers through $2 million in cooperative agreements with various organizations. Additionally, upon reopening CFAP 2, USDA also implemented some provisions from the Consolidated Appropriations Act, 2021 (Public Law 116-260), which includes payments for beef cattle to mitigate the discrepancy between the rate for sold cattle versus cattle in inventory under CFAP 1 and an additional $20 per acre for nonspecialty crops planted in 2020. Prior to the implementation of these provisions, outlays for CFAP 2 stood over $13 billion (USDA, 2020b).

Concluding Remarks

At the time of this article, the response to COVID-19 is still developing within USDA. Many provisions from the Consolidated Appropriations Act, 2021 have not yet been implemented, including payments to contract growers—who had been excluded from CFAP—and payments for the value of depopulated livestock. Additionally, the American Rescue Plan of 2021 (Public Law117-2), enacted on March 11, 2021, provides $4 billion in assistance related to food supply chain resiliency and pandemic response in agricultural markets, and USDA is still developing how these funds will be delivered.

The relief for COVID-19 along with other recent direct aid programs outside of the Farm Bill—the Cotton Ginning Cost Share Program, the Wildfires and Hurricanes Indemnity Program, the Wildfire and Hurricane Indemnity Program Plus, and the Market Facilitation Programs—have been a departure from the farm policy paradigm of the previous decade (2009–2017), when direct payments to producers were limited to benefits from standing Farm Bill programs. Whether this change represents a long-term shift in agricultural policy as the farm economy faces continued downward pressure on commodity prices in a context of trade tensions and repeated extremes in natural disaster events or a short-term response to unprecedented conditions will likely depend on whether these unusual conditions continue and will certainly influence the debate surrounding the next Farm Bill.

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Impact of COVID-19 and the Lockdowns on Labor-Intensive Produce Markets, with Implication for Hired Farm Labor

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Introduction

As with other farm commodities, fresh fruits and vegetable (produce) crops faced demand and supply impacts from the COVID-19 pandemic that plagued the world in 2020. Shifts in the demand for produce have affected where, how, and which food is purchased and consumed. Supply-side shocks, especially for availability and cost of labor, have affected costs of produce production and distribution.

This paper summarizes the impact of the pandemic on the supply and demand situation and outlook for fruit and vegetables typically shipped as fresh produce. These farm commodities and their markets have some distinguishing features. First, they tend to be labor-intensive: Many are hand-harvested or have other cultural practices that employ labor services that are costly relative to crop value. Second, perishability often implies significant marketing and distribution costs and vulnerabilities. Third, retail packing in the field and direct marketing relationships between farms and retailers shorten the supply chain for many of these commodities. Fourth, in some cases relatively few farms supply a significant share of the market, although, as in other industries, there are many small farms that supply niche or local markets.

The bulk of this paper compares the pattern of produce shipments and prices during the pandemic relative to prior years. To preview results, the data show normal flux similar to what we find in many agricultural markets. We see some evidence of what may be pandemic impacts, but these are relatively isolated and it is hard to assign causation definitively. The data do not reveal strong evidence for a major impact of the COVID-19 pandemic on quantities or prices of fresh fruit and vegetables during 2020 compared to a normal season. That is, given the normal variability, the prices and quantities observed in 2020 are consistent with year-to-year variations in these markets in the recent past. These data are suggestive, but measuring causal impacts is beyond the scope of the data analysis presented. Before digging into those data, we consider first some farm labor market relationships and data.

Hired Farm Labor in Production of Fresh Fruits and Vegetables and the Pandemic

Much of U.S. agriculture has replaced hired labor with mechanized production processes. That is less true for fresh fruits and vegetable industries, where harvest and several other operations are still conducted by hand. This fact has had significant implications for adjustments to the COVID-19 pandemic.

Table 1 summarizes hired farm labor shares of operating costs and total costs for a range of fresh fruit and vegetable products. These data come from recent cost estimates for fruit and vegetable farms that are considered to be “typical, well managed” commercial operations in California. The labor share of costs includes direct farm hires and employees of labor contractor firms that supply labor services to the farms. Costs range from more than 70% of operating costs for peaches to about 25% for broccoli, iceberg lettuce, and spinach, which rely on mechanization for some operations. The importance of farm labor costs for these crops means that the cost and availability of hired labor has the potential to measurably affect produce costs and, therefore, the price of these products.

Hired farm labor in produce industries tends to be low wage and seasonal. Most employees are immigrants, and a significant share do not have full immigration documentation. These conditions affect the supply and availability of hired farm labor. Despite concerns by employers of a “shortage” of labor, wages remain relatively low. Some employers claim that labor supply is inelastic; therefore, they claim that, higher wages do not attract additional workers. Compelling econometric evidence remains scarce on this point.

Table 1. Labor Cost Shre in Farm Production of Representative Produce Commodities

Crop	Labor Share of Operating Costs	Labor Share of Total Costs
Apples	63%	41%
Broccoli	26%	21%
Celery	39%	33%
Cherries	61%	49%
Grapes	60%	50%
Iceberg lettuce	24%	19%
Romaine lettuce	52%	42%
Peaches	73%	46%
Bell peppers	53%	43%
Spinach	24%	20%
Strawberries	43%	39%

Source: Author calculations from University of California Cost and Returns Studies, https://coststudies.ucdavis.edu/en/current/.

The pandemic has had several effects on the market for hired farm labor supply facing produce industries. Most important, locking down segments of the economy reduced nonfarm employment opportunities (for example, in food service and janitorial and cleaning services) that compete for low-wage workers. Some farms found more workers available when nonfarm employment became scarcer. The magnitude of this impact has not been adequately measured, however, and several factors push in the opposite direction.

First, unemployment insurance benefits for those laid off from nonfarm jobs exceed potential farm earnings. The traditional assumption has been that those that have held nonfarm jobs never enter (or re-enter) farm work. In that case, there are no potential recipients that might shift to farm work, so larger unemployment benefits would be irrelevant. Second, school closings and difficulties with childcare reduce availability of workers that would normally work on farms. Third, potential danger and some serious outbreaks of disease in farm worker communities have reduced worker availability. Finally, farm costs of addressing disease prevention and care for ill workers raise costs that do not appear in wage rates, but do affect the cost of production of labor-intensive produce. Unfortunately, measuring the magnitudes of these impacts is still difficult and data sources have not kept up with the pandemic.

Demand Disruption and Income Effects in Produce Markets

On the demand side, several major drivers have affected produce markets. First, government shutdowns of food supply channels, especially of the food service sector, meals at school and work, and many dine-in restaurants, caused severe, immediate disruptions. In addition, some buyers chose to avoid away-from-home food venues and many employees worked from home and thus did not use at-work food service venues. These shifts caused a massive and rapid shift in where, and to a lesser extent which, produce was demanded. The result was an immediate loss of perishable products that could not be repackaged or repositioned rapidly enough, say from salads bagged for institutional cafeterias to packages suitable for grocery store sales.

The other demand-side disruption was sequestration requirements that meant lack of commuting and travel, more time with family, and other changes in patterns of consumption. For example, home baking and “comfort food” became more common in the early days of the pandemic. There were, however, no pervasive behavioral changes affecting produce consumption. The still-incomplete transition back to more consumption of produce away from home has been more gradual than the initial disruption but remains uncertain and depends on both progress in reducing COVID-19 impacts and opaque government choices about what will be allowed. We also do not yet know the extent to which consumption will return to the pre-COVID “normal.”

Finally, the sudden and severe recession reduced consumption of most products. However, most food products, including produce items, are less sensitive than most goods to income declines (a small income elasticity of demand for food). The gradual return of employment and income will cause more consumption; however, the magnitude of the impact on consumption is expected to be small for standard produce items but may be larger for high-priced luxury produce. Even this effect could be muted if luxury meals at home, with exotic fruits and vegetables, substitute for expensive meals away from home.

Data on Weekly Fresh Fruit and Vegetable Shipments and Prices

Weekly quantities of produce shipped and average prices (at the shipping point) are available from the USDA Agricultural Marketing Service (AMS). We gathered quantity data on labor-intensive fruits and vegetables and melons for January 2018 through the second week of September 2020. Fruits include apples, avocados, cherries, grapes, nectarines, peaches, and strawberries. Vegetables and melons include broccoli, cantaloupes, carrots, cauliflower, celery, iceberg lettuce, romaine lettuce, bell peppers, tomatoes, and watermelons. AMS reports weekly shipment and price data on the Saturday ending each week. We selected the week ending March 21, 2020, as the first week of the COVID-19 period. The week ending March 23 is the closest match in 2018, and the week ending March 24 is the closest match in 2019.

The broad magnitude of market-wide differences in the period of the COVID-19 pandemic are derived by comparing shipments and prices of each fruit and vegetable commodity from mid-March through the end of August 2020 with the comparable periods in 2018 and 2019. We consider both season long and week-by-week impacts, and examine individual commodities and sector-wide averages.

To calculate average impacts, we calculate the difference between quantity shipped and price for each commodity in each week in 2020 and the comparison year as a percentage of 2020. We ask if the data in the period starting with the week of March 14–20, 2020 has been measurably different across a variety of fresh fruit and vegetable quantities and prices relative to the prior two years. We use 2020 as the base to make sure we capture all data available for 2020, even if there were zero shipments in the prior years for a week in which there were shipments of that commodity in 2020.

The quantity and price data for each commodity are specific to shipping district. We use California for all these produce items except apples and cherries, for which we use Washington State as the shipping district. California and Washington have large shares of total shipments in national markets. A broader array of shipping districts adds substantial complexity in data interpretation with little gain for understanding the markets. In particular, concerns about mostly local consumption, differences in product characteristics, short seasons, and small quantities would have made comparisons even more complicated.

Economics of Differential Impacts across Fruit and Vegetable Commodities

Every produce crop is different and markets are complicated. For example, some crops—such as cherries—are highly seasonal, with seasons that start and end on slightly different dates each year. This complicaton may cause some large percentage difference in weekly quantities from year to year at the beginning and ends of seasons. Crops also differ by revenue, with the value of shipments of lettuce, strawberries, apples, and grapes much larger than, say, peaches or watermelons. Perishability is high for lettuce or cherries, but much less of an issue for apples. These complications suggest caution in generalizations.

With the exception of strawberries, the fruits are all perennial tree and vine crops with limited harvest seasons. Some, such as apples, are storable and ship year-round. Others, such as peaches and cherries, have relatively short shipment seasons of four or five months. Strawberries are grown commercially as an annual crop and ship from California every week of the year, although shipments are noticeably smaller in December through February. Some vegetables and melons are planted and harvested once per year, others vegetables allow two or three crop cycles per year. Strawberries and several of the vegetable crops are planted several times during the year and shipped year-round. These crop-specific features affect supply flexibility and how readily growers may adjust quantities within the year. For example, because apples are storable, those shipped in the spring of 2020 were harvested in 2019. For many perishable vegetables, such as broccoli or lettuce, growing seasons are short, so that planting adjustments in the spring affect summer shipments, which allowed them supply flexibility in response to COVID-19.

Has 2020 Been Different for a Variety of Produce Shipments and Prices?

Examining the patterns of shipments and prices for our sample produce commodities helps determine if the COVID-19 period of 2020 has been different from earlier years, in more than just a random way.

Comparing Produce Shipments

Table 2 compares 2020 shipments to those of prior years for each of the commodities. The entries in Table 2 show a wide range of differences in shipments between 2020 and the prior two years across commodities. Ten of 23 commodities had larger shipments in 2020 compared to the average of 2018 and 2019. However, three of those were only up one or two percent. Of the 14 commodities with declines, five had declines of 5% or less. Produce shipments in 2020 were larger than both the prior two years for seven commodities, smaller than both the prior two years for seven commodities, and split for nine commodities.

Shipment quantity was up slightly for broccoli, carrots and cauliflower, and down slightly for iceberg and romaine lettuces, raspberries, and strawberries. Shipments were up by 11% for celery, down by 8% for spinach and down 5% for bell peppers. These are commodities for which quantities are more flexible within a year. Shipments are up among four of the six tree and vine crops, where supplies are hard to adjust and shipments depend mostly on weather, unless disruptions have impeded harvest or shipments. Cherry shipments are down, but the spring forecast was for a smaller Washington cherry crop in 2020. It is not clear that these impacts have been driven by COVID-19. In general, Table 2 reports little evidence of large systematic COVID-19 pandemic impacts.

Table 3 reports estimates of the means (averages) of relative differences in shipments and prices by week for all available weeks for the produce commodities, along with the estimated standard errors. For example, the first

Table 2. COVID-19 and U.S. Produce Shipments from Mid-March through December for 2020 Compared to Prior Years

Crop	Percentage Difference from 2018	Percentage Difference from 2019	(Percentage Difference from Average of 2018–2019
Apples	7%	7%	7%
Artichokes	-25%	7%	-9%
Avocados	6%	42%	24%
Blackberries	16%	17%	17%
Blueberries	44%	25%	35%
Broccoli	-4%	6%	1%
Brussels Sprouts	51%	46%	48%
Cantaloupes	-73%	-39%	-56%
Carrots	0.2%	3%	1%
Cauliflower	-4%	8%	2%
Celery	8%	13%	11%
Cherries	-23%	-5%	-14%
Grapes	-12%	-5%	-8%
Lettuce, Iceberg	-4%	2%	-1%
Lettuce, Romaine	-4%	2%	-1%
Nectarines	24%	-7%	8%
Peaches	-23%	-44%	-34%
Peppers, Bell Type	-3%	-7%	-5%
Raspberries	-4%	-5%	-4%
Spinach	-20%	4%	-8%
Strawberries	-7%	1%	-3%
Tomatoes	-43%	-23%	-33%
Watermelons	-58%	4%	-27%

Source: Author calculations from USDA Agricultural Marketing Service: Custom Reports for 2018, 2019, and 2020 Seasons. Available online https://www.ams.usda.gov/market-news/custom-reports.

entry in Table 3 shows that from mid-March to the end of the year, the average quantity of weekly shipments in 2020 was 12.78% smaller than 2018 shipments, with an estimated standard error of 4.24. A sample of 821 weekly commodity-specific shipments was used in those calculations of means and standard errors. An estimated mean twice as large or more than its estimated standard error is typically considered an indication of statistical significance and high confidence in the precision of the estimated mean. With these data, there is less than a 5% chance that the true difference is outside the range of about -20.5% and -4.3%, so we reject the hypothesis of a nonnegative difference.

The mean size of weekly vegetable shipments (with a sample of 431 observations) was also smaller in 2020 than in 2018 (-5.56%), and the difference has a high degree of statistical significance. However, the difference in mean shipments for fruit (-10.42%), based on a sample of 341 observations, is only slightly larger than its standard error (9.67), so a typical confidence interval would include zero. The estimated means of weekly shipment differences between 2020 and 2019 are all small and small relative to their standard errors. Thus, we have very little confidence that anything other than randomness accounts for the estimated differences between 2020 and 2019 being more or less than zero. The outlier in the shipment data is melons for which shipments were very low in 2020 compared to both the prior years.

Comparing Produce Prices

The bottom half of Table 3 reports estimated mean price differences between 2020 and the earlier years. Produce producers have flexible price contracts with buyers and some produce continues to trade on spot markets. These individual produce prices are often variable from year to year, and even from week to week within a year. Relative prices across produce commodity items move

Table 3. Average Weekly Percentage Changes in Produce Shipment Quantities and Prices for 2020, Compared to the Same Weeks in the Prior Two Years

	Mean (2020 – 2018)/2020	Mean (2020 – 2019)/2020
Mid-March through December Shipments		
All	-12.78%	2.09%
	(4.24)	(1.65)
Fruits	-10.42%	2.61%
	(9.67)	(3.38)
Vegetables	-5.56%	3.51%
	(1.82)	(1.37)
Melons	-92.71%	-13.87%
	(12.02)	(7.91)
Prices		
All	9.58%	-5.79%
	(1.44)	(2.41)
Fruits	5.52%	2.53%
	(2.26)	(2.32)
Vegetables	6.80%	-16.68%
	(1.80)	(3.57)
Melons	57.14%	53.16%
	(5.32)	(6.10)

All shipments, 821; fruit 341; vegetables 431; melons, 49; All prices, 707; fruit 237; vegetables 425; melons 45. Standard errors of the estimates are provided in parentheses for testing hypotheses.
Source: Author calculations from USDA Agricultural Marketing Service: Custom Average Pricing: Shipping Point Average Prices Custom Reports for 2018, 2019, and 2020 seasons. https://www.ams.usda.gov/market-news/custom-reports.

up and down in ways that are consistent with the then current supply or demand conditions. Romaine lettuce may be expensive one week, and a week later celery or broccoli prices have jumped and romaine prices may have dipped. We commonly see price differences of 50% or more between the price in one week to the price a few weeks later for the same commodity. Such variations indicate the importance of using large samples of prices to develop any inferences.

The mean price difference of 9.58% between 2020 and 2018, for the full sample of 707 fruit and vegetable prices, is large and highly significant statistically. So, just as weekly shipment quantities were lower in 2020 than in 2018, the prices have been higher in 2020. The comparison of 2020 with 2019 shows the opposite: Prices are 5.79% *lower* in 2020 compared to the very high prices of 2019. The average prices for vegetables are where the big differences occur. The 2020 average vegetable prices are 6.808% above 2018 and -16.68% below 2019. For fruit, prices in 2020 are above 2018 and 2019, but the difference compared with 2019 is small.

Based on the patterns in 2018, 2019, and 2020, we cannot make a definitive statement about whether 2020 was an abnormal year for produce shipments and prices, at least compared to the most recent two years. We see large differences from one year to the next, but 2018 and 2019 seem to be more different from each other than either are from 2020.

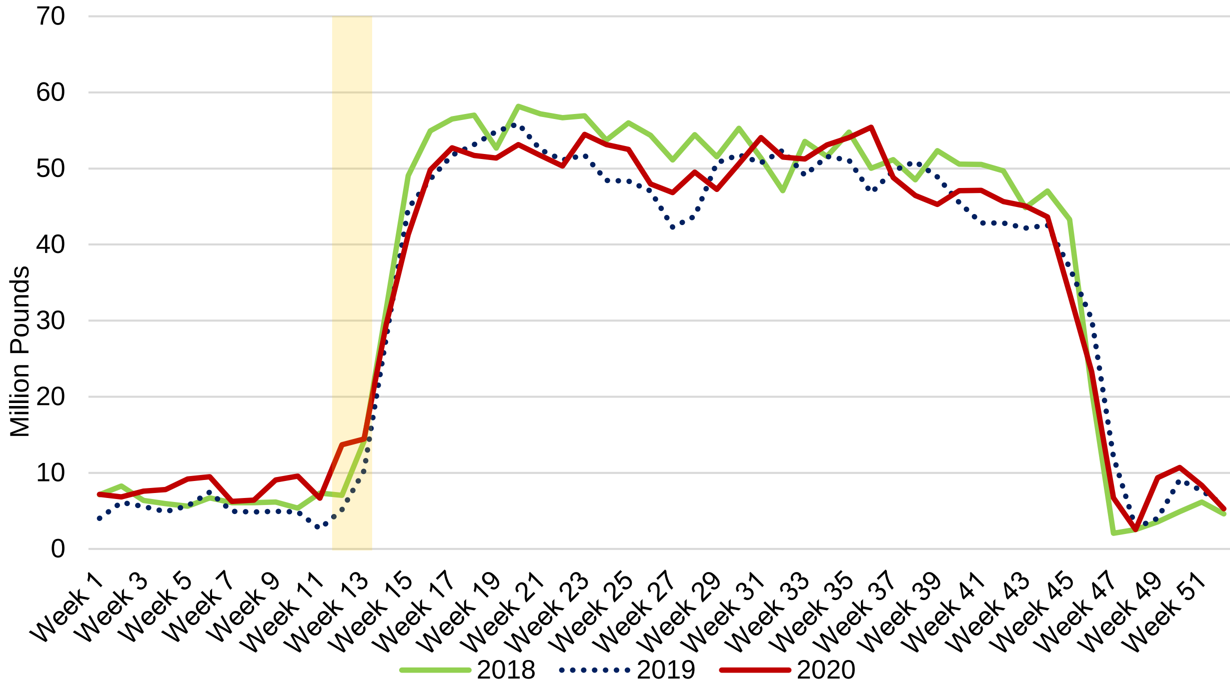
The Path of Shipments and Prices over the Year for Three Important Commodities

To dig a bit more deeply into shipments and prices for 2020 compared to prior years, we turn to data from three representative commodities. Iceberg lettuce and strawberries are high-volume produce items that are shipped throughout the year. They are also significant users of hired farm labor and are staple foods in the diets of many consumers, whether for meals at home or away from home. Sweet cherries represent a major labor-intensive, perishable, and seasonal fruit, and Washington accounts for the majority of shipments.

Shipments

Figure 1 shows the pattern of weekly shipments of iceberg lettuce. Shipments are less than 10 million pounds per week for the first 10 weeks of the year and then ramp up rapidly to exceed 40–50 million pounds starting around week 15 of each of the three years represented. The five-week ramp up begins in the middle of March and is complete by the end of April each year. (Thus, the typical expansion begins just about the time the economic impacts of the pandemic were being imposed on the economy.) From the beginning of May to through the middle of end of October shipments bounce around in a range of about 10% up or down

Figure 1. Iceberg Lettuce Shipments through December, 2018, 2019, and 2020



Notes: The shaded bar around the third week of March represents the beginning of the COVID-19 period.
Source: USDA Agricultural Marketing Service: Custom Reports for 2018, 2019, and 2020 Seasons (California). https://www.ams.usda.gov/market-news/custom-reports.

each year. Shipments are very low at the end of the year.

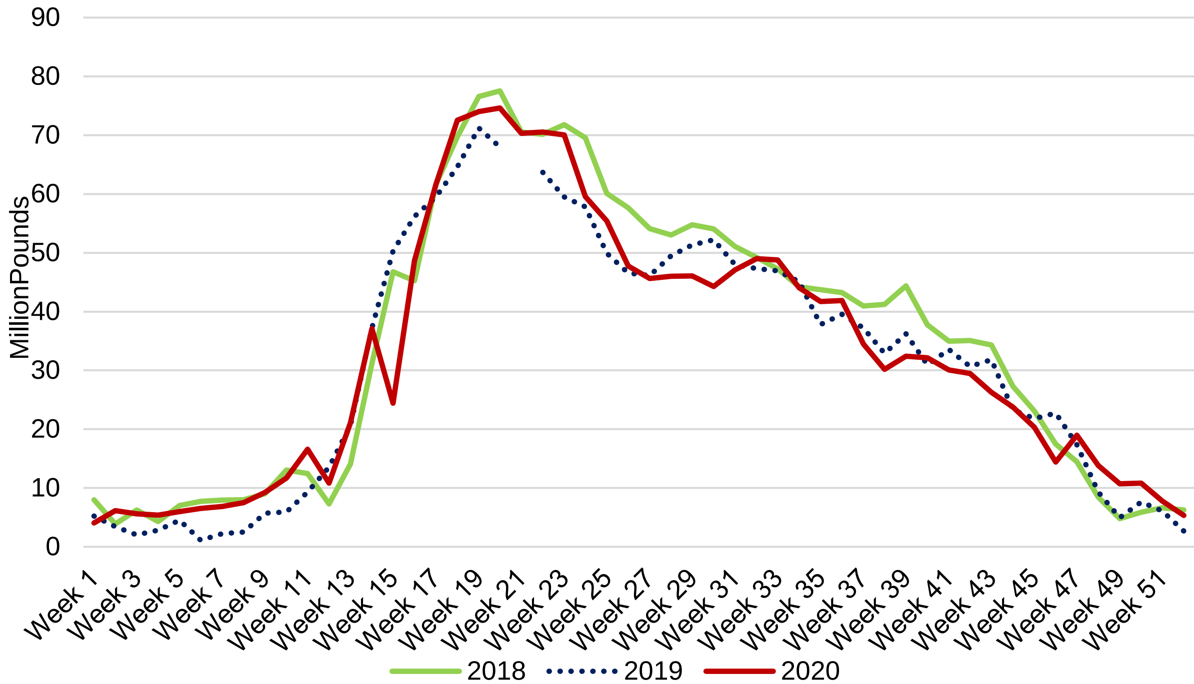
A quick test of the impact of the COVID-19 pandemic on lettuce shipments might be to ask: If there were no labels in Figure 1, could the observer correctly identify which line was 2020? I could not. Data for 2020 (the dark red line) are sometimes above and sometimes below the other two, but mostly the pattern is very similar. Perhaps the pandemic caused shipments to take off a little more quickly in late March than usual and then expand slightly less rapidly than usual from the middle of April through early May. However, that pattern is quite similar to what occurred in 2019 (the dotted blue line) compared to 2018 (the light green line). We know from Table 2 that season-long shipments have been 1% smaller for iceberg lettuce than the average of the prior two years.

The first four months of Figure 2, representing strawberry shipments, are similar to the early months in Figure 1, representing iceberg lettuce. For strawberries, relatively small weekly shipments through the middle of March begin to ramp up, although somewhat more gradually than for lettuce. There is some observable up and down flux in shipments compared to 2019 that occurs during the beginning of the COVID-19 period, shown by shading around the middle of March. However, the 2020 pattern is, in fact, similar to what occurred in 2018. Once again, 2020 shipping patterns are visually not much different from the patterns of 2018 and 2019.

For cherry shipments (Figure 3), the shipping season begins at the first or second week of June and is almost finished by the end of August. Most shipments occur from the middle of June through the beginning of August each year. Figure 3 shows that fewer cherries were shipped over the whole season; from Table 2 we know the total in 2020 was 13% lower than in 2018 and 5% lower than in 2019. The 2018 and 2020 seasons started one week earlier than did the 2019 season. However, 2020 expanded more slowly and, after hitting the same peak of about 75 million pounds in week five of the season, the shipment quantities dropped more rapidly in 2020 and mostly remained below the prior two years. Shipments were below 2018 for just about every week of the season and below 2019 for most of the season, especially during the peak shipment weeks from mid-June through mid-July.

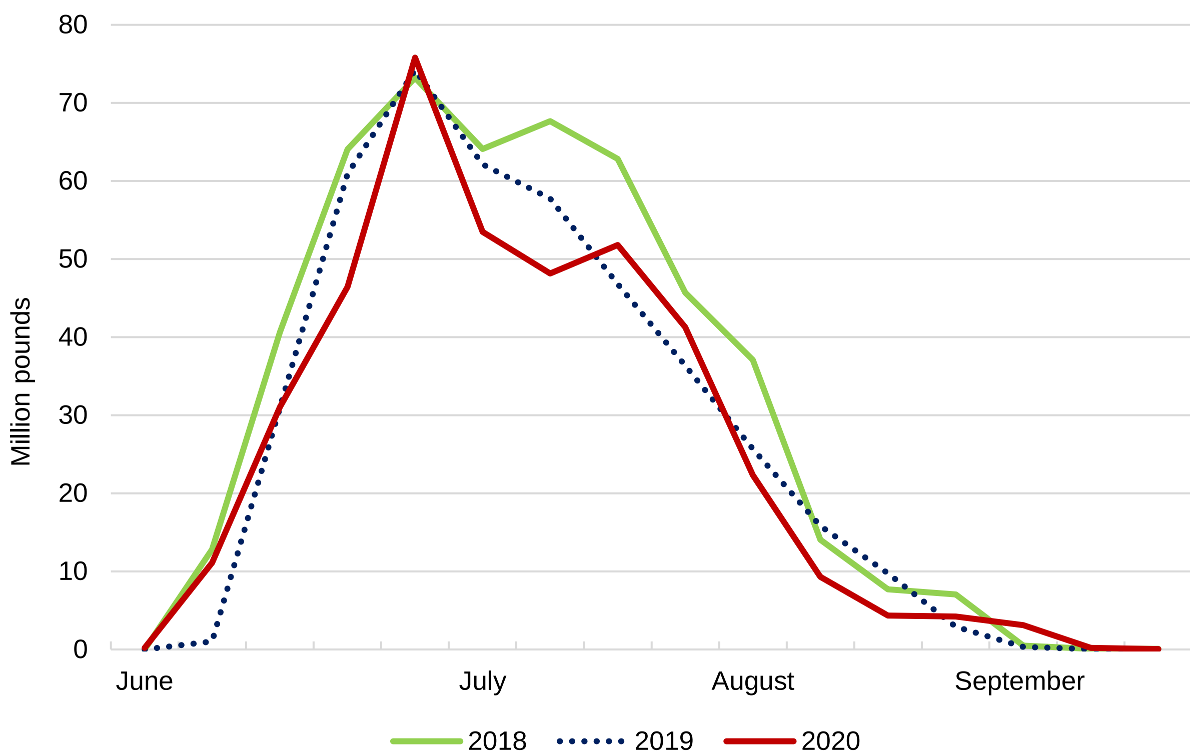
Washington State was hit with a serious and sustained outbreak of COVID-19 among cherry harvest workers that disrupted harvest in several counties. The disease occurred among local residents but was reported to have been severe among immigrant “guest workers,” for which the federal government requires employers to provide housing. Several cherry harvest workers died and hundreds were infected, as reported in local and national news outlets. These terribly sad events

Figure 2. Strawberry Shipments through December, 2018, 2019, 2020



Notes: The shaded bar around the third week of March represents the beginning of the COVID-19 period. Week 21 of 2019 was removed due to concerns about data accuracy.
Source: USDA Agricultural Marketing Service: Custom Reports for 2018, 2019, and 2020 Seasons (California). https://www.ams.usda.gov/market-news/custom-reports.

Figure 3. Cherry Shipments through Mid-September, 2018, 2019, and 2020



Source: USDA Agricultural Marketing Service: Custom Reports for 2018, 2019, and 2020 Seasons (Washington State). https://www.ams.usda.gov/market-news/custom-reports [Compiled September 14, 2020].

concerned everyone in the region and led to adjustments in employment and housing. The timing of the disease outbreak and labor supply disruption is also consistent with low 2020 cherry shipments during what is normally a peak period in July (Figure 3). However, we do not have data to establish how much farm labor health concerns affected the quantities of weekly shipments in July.

Prices

Weekly fresh fruit and vegetable prices are often highly variable in response to disruptions in supply or demand. Figure 4 shows the volatile path of iceberg lettuce prices. There is no obvious seasonal pattern to prices in 2018, 2019, and 2020, other than generally higher prices during parts of March in all three years, but even in March the highest prices are in different weeks. The prices in 2020 peak during the first weeks of the pandemic, but that is also a high-price period in the prior two years. Prices dropped severely in April 2020, but again, that is a low-price period in the prior years too. In the early fall (week 37) lettuce price jumped in 2020 and stayed high relative to the prior years. The 2020 prices did not match the bump in prices that occurred at the end of the year in 2018. Recall these volatile prices occur when, as shown in Figure 1, shipments of lettuce are low. Nothing about the 2020 price path stands out relative to 2018 and 2019.

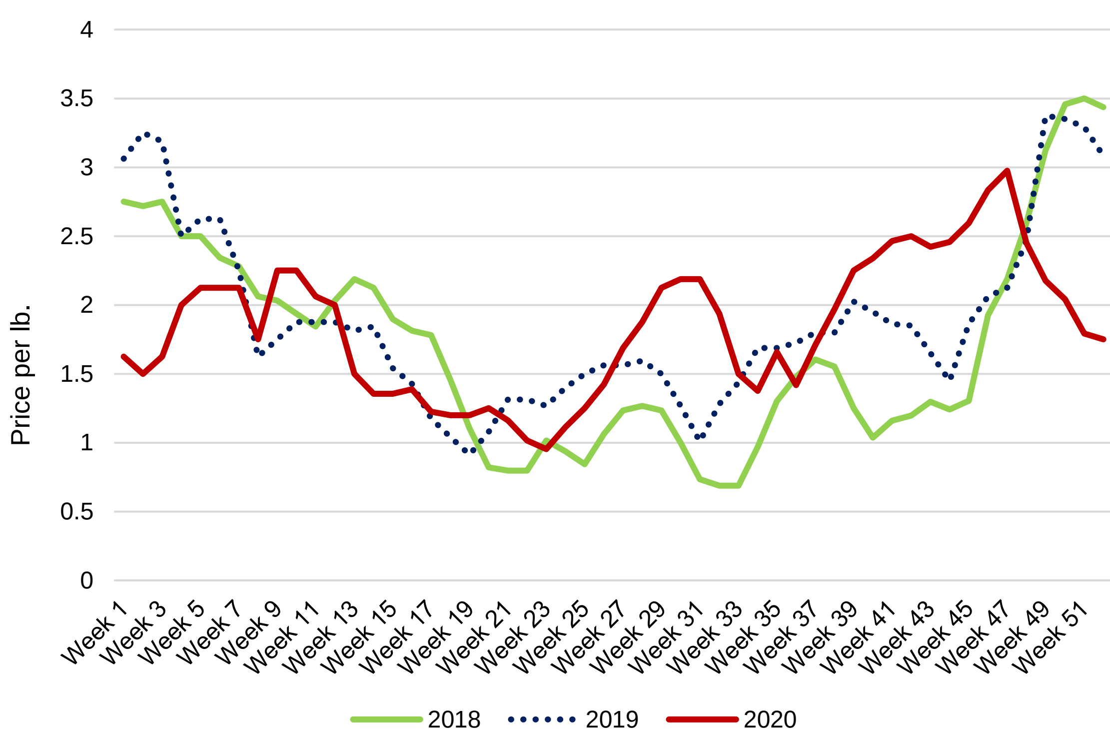
Strawberry prices (Figure 5) follow the classic high-low-high price pattern through the season with lower prices during the peak shipment period of May and June and higher prices during the winter, summer and fall. Prices are usually high in weeks when shipments are low and would likely be even higher but for substantial imports during such periods. For example, the dip in shipments in early August (Figure 2) is accompanied by higher prices during those weeks (Figure 5). Nonetheless, it is hard to see a pattern related to COVID-19 in the time path of strawberry prices in 2020 relative to the prior years.

For cherries, a smaller crop in 2020 was accompanied by substantially higher prices throughout the relatively short season (Figure 6). Perhaps the dip in shipments during some weeks in July, which may have been related to disease among farm workers, caused prices to remain a little higher than otherwise and avoid the slight dip in prices of the prior two years, but the impact seems modest at best.

Export Shipments and Prices

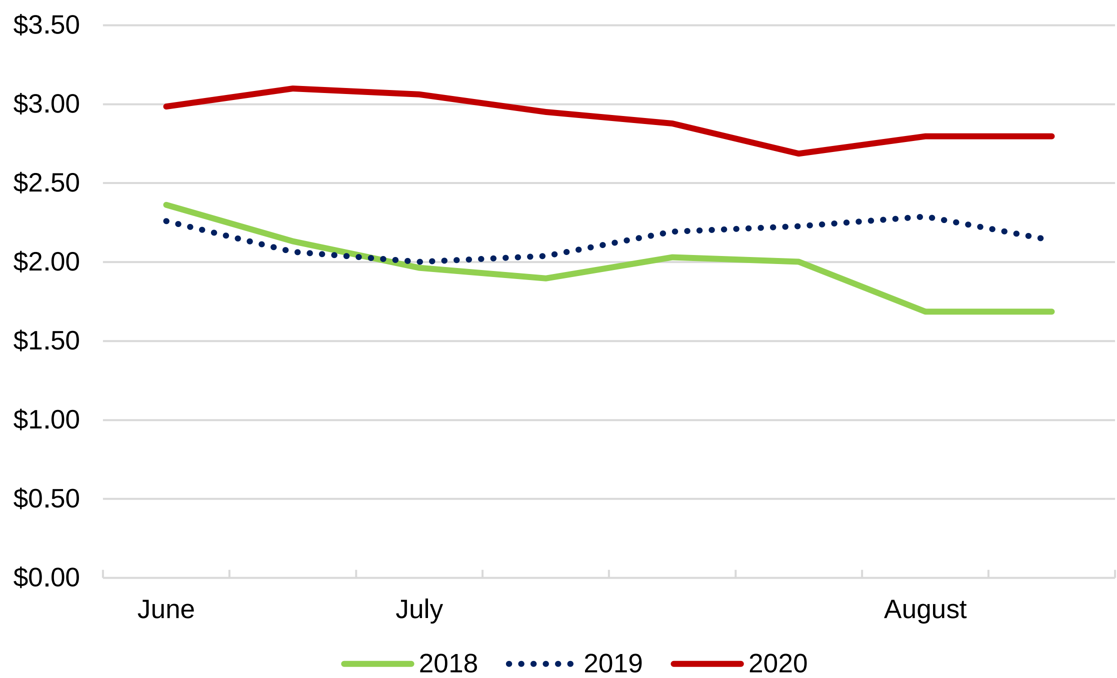
The domestic U.S. market accounts for the large majority of fresh, labor-intensive produce shipments, and most U.S. fresh vegetable exports go to Canada, which is also the major destination for fresh fruit exports. Table 4 shows export quantities and unit values by month

Figure 5. Strawberry Prices through December, 2018, 2019, and 2020



Note: Prices are per “flats 8 1-lb containers with lids.” The shaded bar around the third week of March represents the beginning of the COVID-19 period.
Source: USDA Agricultural Marketing Service: Custom Average Pricing: Shipping Point Average Prices (California). https://www.ams.usda.gov/market-news/custom-reports.

Figure 6. Cherry Prices for January through Mid-August, 2018, 2019, and 2020



Notes: Prices are per pound.
Source: USDA Agricultural Marketing Service: Custom Average Pricing: Shipping Point Average Prices (Washington State). https://www.ams.usda.gov/market-news/custom-reports [Compiled September 14, 2020].

Table 4. Unit Values and Volumes of 2020 Exports of U.S. Produce Crops to Canada Relative to Average of 2017, 2018, and 2019

	Lettuce	Strawberries	Table Grapes	Apples
Volumes				
January–March	1.04	1.07	0.61	1.16
April–June	0.87	0.98	0.52	1.06
July-September	0.88	0.79	0.93	1.01
October-December	0.86	0.86	0.94	1.04
Unit Values				
January–March	1.01	1.04	1.42	0.87
April–July	0.95	0.92	0.98	0.86
July-September	1.17	1.27	1.09	0.93
October-December	1.25	1.10	1.02	1.04

Source: Author calculations from U.S. Department of Commerce, U.S. exports, available from U.S. International Trade Commission. 2020. DataWeb. https://dataweb.usitc.gov/.

relative to the average of the prior three years. Table 4 includes data for apples, table grapes, strawberries, and lettuce. The years are split into two periods, the pre-COVID-19 period (January–March) and the COVID-19 period (April–December). Given monthly data and the somewhat long lead-times for exports, April is the appropriate starting point for pandemic influences.

These export data are total U.S. shipments to Canada and, while most shipments come from the domestic shipping locations examined above, the data include exports from all U.S. production districts. For lettuce, exports include all lettuce, not just iceberg lettuce and romaine lettuce. The export data used for comparison includes 2017. The export data are thus not strictly comparable to the U.S. domestic shipments.

Shipments in the pre-COVID-19 periods in 2020 are up for apples, strawberries, and lettuce and down substantially for table grapes. For the April–December period, 2020 shipments are up for apples and down for the other three commodities. The January–March shipments of apples are likely to have been harvested in the prior year, and that may also be true for most shipments through the spring months as well. For grapes, 2020 domestic shipments were relatively low, but export shipments are even lower compared to prior years. Notice that exports are more than 90% of the prior years for July-December when most of the 2020 crop is being shipped. For strawberries and lettuce, the export data show that the COVID-19 period had lower shipments despite normal shipments in the domestic market. This may indicate some diversion of product from exports to domestic buyers.

Apple export prices are slightly lower in the pre-COVID-19 period, consistent with higher volumes. Apple prices in the April–September period are lower than in prior years and prices are up during the last month of the year despite slightly higher volumes. For table grapes, export prices are much higher in the pre-COVID-19 period of 2020 when export shipments were very low and roughly equal to the average of prior years in the April–December period. Prices for strawberries are higher than prior years except in the April–July period. For lettuce, export prices are down in the April–July period despite lower export volumes in 2020. Overall, more export data are needed to reveal clear patterns of pandemic influence, if any, on export volumes or prices.

Concluding Remarks

This article has reviewed the ways the pandemic has influenced fresh produce shipments and prices with an emphasis on how farm workers have been affected by the pandemic and may affect produce supplies. Temporary disruptions caused by the rapid shift from food consumed away from home to food consumed at home were widely reported and caused some perishable produce to be lost. Some farms and shippers certainly experienced losses during the transition, and some of those that had specialized in supplying restaurants experienced sustained losses. Nonetheless, the major conclusion is that it has been hard to isolate broad and compelling evidence that markets in 2020 are distinctly different than produce quantities and prices in prior years. There is always lots of volatility in produce markets, so even if the COVID-19 pandemic had some significant, specific market impacts, it would be hard to see those impacts in available data. Overall, consumers, producers and shippers were able to transition rapidly from purchasing produce in food service settings away from home, to purchasing produce for home consumption. As with other food markets, we do not know how much of this change will be long-lasting as the direct effects of the pandemic fade.

In this situation, specific commodity profiles and case studies are especially effective tools. For example, the COVID-19 outbreak among cherry harvest workers in Washington State was devastating for workers and their families, with loss of life for several workers and loss of livelihood for many more. Hired farm workers are especially vulnerable to disease and to income loss, and the events of July 2020 were terrible for many. That said, the data are not clear that widespread or lasting market impacts were a result.

One bottom line is that shipment and price data do not document clear market differences between 2020 and earlier years. But that does not mean that individual workers did not suffer losses or that the individual farms or industries have not experienced higher costs or lower revenues due to the pandemic.

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COVID-19 and the U.S. Dairy Supply Chain

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Introduction

The U.S. dairy industry entered 2020 with an optimistic farm milk price outlook that had been largely missing for the previous five years. When the COVID-19 pandemic struck the United States in March and April 2020, some of the more compelling images were of dumped milk on farms and discussion about “broken” supply chains. This paper examines the dairy market disruptions and adjustments related to the pandemic.

Pandemic Demand Effects

While much has been made in recent years of declining fluid consumption, total U.S. dairy product consumption per capita has actually increased—led by increases in cheese and butter consumption. Cheese sales have been steadily increasing for decades. Italian style cheeses, in particular mozzarella, have grown impressively in volume, but recent growth also traces to more exotic, specialty cheeses ranging from Camembert to queso blanco, Grana Padano, and feta. Butter and other cream-rich products have enjoyed more recent growth as health concerns around fat consumption have moderated and many consumers choose to indulge themselves from time to time. Coffee shops have boosted cream sales, and whole milk and full-fat ice cream have gained market share. Until recently, these domestic consumption shifts have fueled increasing prices for the butterfat component of milk relative to nonfat components. Indeed, the primary growth market for skim milk and whey powders has been international markets. While foreign customers have been a welcome source of demand, international markets are highly price competitive around dairy commodities.

A major driver of domestic consumption has been food away from home (FAFH). The growth in mozzarella (pizzas) and processed cheeses (burgers and sandwiches in quick or limited-service restaurants) can be traced to the explosion in “fast food” dining beginning in the 1970s. After long trending to that result, in 2009, expenditures on FAFH exceeded at-home food consumption, although the quantity of food eaten at home remains larger (U.S. Department of Agriculture, 2020b).

People eat differently away from home, both in terms of quantities and types of foods. For dairy products, there are several important differences. First, fluid milk is primarily consumed at home but not in restaurants, although school and other institutional cafeterias are an important outlet away from home. Second, butter is more favored, particularly in full-service restaurants. Third, although ice creams remain a popular dessert in both full service and limited-service formats, as well as for take away consumption, total consumption for these products has been in mild decline. Finally, many cheeses—including mozzarella and other Italian styles, feta, and blue—are more favored in restaurants; others, such as processed or American slices, provolone, and Swiss are popular deli or sandwich cheeses. Anecdotal industry estimates suggest that about 50%–60% of cheese and 45%–55% of butter were consumed away from home prior to the pandemic (Allied Market Research, 2020).

In late March and into early April 2020, as the scope and seriousness of the COVID-19 pandemic became clear, food service establishments shut down in large numbers and U.S. consumers in many states sheltered at home. Table 1 displays the monthly change in 2020 food expenditures compared to a year earlier. FAFH expenditures declined 26% in March and more than 49% in April compared to 2019 before experiencing smaller, but still significant, year-over-year declines in May and June (U.S. Department of Agriculture, 2020b). At the same time, food at home (FAH) expenditures surged by 20.6% in March over 2019 levels with 7%–9% increases in April–June. Total food expenditures declined 4% in March and 22%, in April in part because FAFH includes a higher percentage of taxes and tips. Total food expenditures recovered in late summer but then fell again YOY as COVID cases rose around the holidays. For 2020 as a whole, FAH expenditures were +8.1% over 2019, FAFH expenditures were -18.4% YOY, and total food expenditures were -5.6% compared to 2019.

Table 1. 2020 Monthly Food Expenditures Percentage Change Year-over-Year, Leap Year Adjusted, Includes Taxes and Tips (relative to 2019)

Month	Food at Home	Food Away from Home	Total Food Sales
January	2.5	4.5	3.5
February	3.9	2.6	3.2
March	20.6	-26.2	-4.0
April	7.3	-49.4	-22.4
May	9.0	-35.6	-14.3
June	7.0	-22.2	-8.4
July	9.6	-17.3	-4.5
August	5.6	-16.0	-5.7
September	9.3	-11.5	-1.5
October	9.0	-10.2	-0.9
November	6.2	-16.2	-5.0
December	7.5	-18.2	-5.2

Source: U.S. Department of Agriculture (2020c).

The sudden decline, and in many cases outright stoppage, of food service sales shifted the products that were consumed, but the results were nuanced and fairly short-lived in some cases. Sales of fluid milk had been declining since 2010. This trend continued in 2020, with January consumption 4.4% below 2019. Fluid milk was one of the major products hit with panic buying, despite being a highly perishable product. By February, the decline had slowed and in March it spiked by +7.5% YOY (year over year). As was true for other “hoarded” products and grocery sales in general, the first wave spike was followed by a decline, but fluid production spiked to 7.3% YOY growth again in June, this time more in response to food donations. The U.S. Department of Agriculture only reports “domestic disappearance,” a proxy for consumer purchases, for two large cheese categories—American cheeses (primarily cheddar and similar styles) and other cheeses (primarily mozzarella but also including all other styles). With such large aggregate categories, it is difficult to discern the larger ups and downs for individual styles. In total, American-style cheeses, which play a big role in food service but also enjoyed lively sales in grocery stores, saw a modest spike in March but retreated almost 10% in April YOY (U.S. Department of Agriculture, 2020b). Other cheeses followed a similar pattern, with an 11% drop in April despite a stronger start earlier in the year. Thus, the net effect of food service closures and higher retail sales proved to be negative for the cheese category, but clearly there were offsets between the two channels. This sector also serves as a good example of the fact that restaurants that had a strong takeout and/or delivery model fared much better among all restaurants, and the perfect example is pizza parlors. Hence, mozzarella sales were unusually strong. Butter also proved to be an example of a product that benefited to a degree from food service closures despite its strong presence in that channel. Sales spiked 18% YOY in March and were unusually high in the summer of 2020 as well (U.S. Department of Agriculture, 2020b).

The varied impacts for different dairy foods also meant very different impacts to processors and their ability to respond. Dairy manufacturing plants tend to be highly specialized, and this extends to packaging equipment. Small-scale plants, including some farmstead processors, who produced specialty cheeses for restaurants suddenly found themselves with no sales whatsoever. Large plants that were designed to produce shredded mozzarella for pizza parlors or bulk processed cheeses for quick-service restaurants typically often do not have the equipment to manufacture consumer packages required for retail sales. Larger companies, including co-operatives, may have a suite of processing plants, but this does not always mean that it is easy or even feasible to move milk from a plant with low product demand to a plant with high product demand. This is especially true during spring flush months, when milk production is seasonally high and plants tend to be running at or near full capacity. Additionally, nutrition labelling and similar packaging requirements for retail do not apply to bulk packages used in food service. This means that even if consumers are willing to buy a 25-kg box of butter or a 5-lb loaf of processed cheese, these packages often cannot be legally sold at retail. FDA did allow some waivers on packaging requirements, but bulk packaging still remained the wrong size for most consumers. Thus, the disruption to food service outlets had consequences that varied by product type as well as by the structure of the processing business.

In recent years, the dairy supply chain, as many others, has focused on efficiency and cost minimization, exemplified by lean manufacturing techniques and just-in-time delivery. Under the assumption that transportation systems are very robust, these strategies seek to minimize operating, procurement, and distribution costs, and a key strategy is minimizing storage of either inputs or outputs. One result of the emphasis on lean, efficient supply chains is that it is difficult to respond to a dramatic and sudden demand shift. The current descriptor is to say these systems are lean but brittle. This was evident in the dairy sector. Nevertheless, very-short-term voids in retail spaces notwithstanding, it is our opinion that the dairy supply chain proved surprisingly resilient.

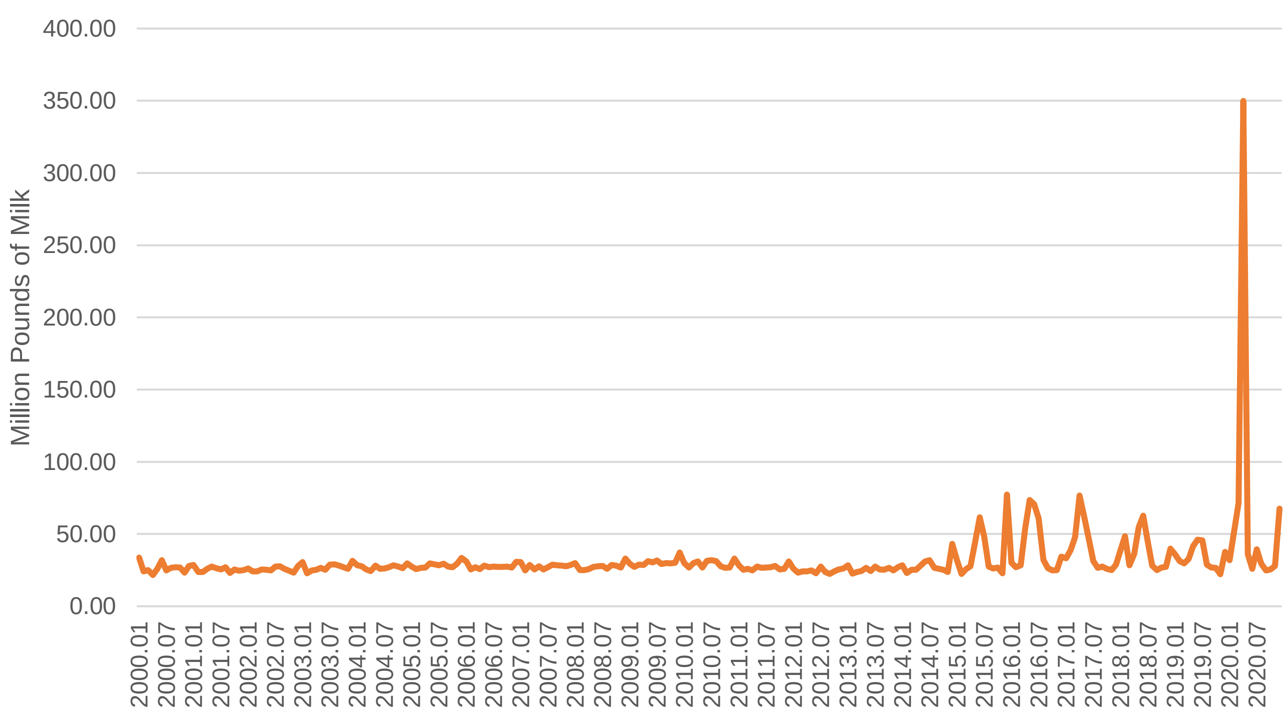
Pandemic Supply Response

U.S. farm milk prices have followed a roughly three-year cyclical pattern since the mid-1990s (Novakovic and Wolf, 2016). Following an extreme high in Fall 2014, a host of national and international market factors resulted in farm milk prices being stuck at a relatively low-level equilibrium for about five years, until the second half of 2019. This period resulted in increased farm consolidation and exit while the lack of payments made under the existing 2014 Margin Protection Program for Dairy created a favorable environment to revamp that program in the 2018 Farm Bill. The resulting Dairy Margin Coverage Program, with more generous protection on the first 5 million pounds of covered milk production, has proven to be much more likely to result in significant income subsidies, especially for dairy farms of average size or smaller.

The market characteristic that led to the prolonged period of below average returns—even in 2017, which was a modestly better farm milk price year—was that growth in milk production was slightly above trend and growth in dairy product demand growth was slightly below trend. Growing production accompanied by slowed demand growth resulted in occasions of milk being dumped in certain regional markets that lacked manufacturing to make storable dairy products and balance markets (Novakovic and Wolf, 2018).

The amount of milk that is dumped, which means that milk was disposed of in a manure lagoon or fed to livestock rather than entering a market outlet, may be reported to and recorded by Federal Milk Marketing Orders (FMMOs). There are pricing advantages to doing this, as the milk earns a price under order regulations rather than having no value, but reporting or "pooling" is by no means automatic or required. A small amount of milk is dumped in each month in every milk marketing order due to weather, plant closures, and other issues (Novakovic and Wolf, 2018). In spring 2020, milk dumping increased across all orders as the aforementioned food consumption and demand shocks occurred. The amount and extent of local milk dumping depended on the market supply and processing situation but FMMO statistics can capture the aggregate picture. Figure 2 displays the amount of milk dumped monthly in all Federal Milk Marketing Orders January 2000 through December 2020. While the past five years witnessed an increase in seasonal dumping, generally during the Spring flush months, nothing compared to the April 2020 amount of 349 million pounds (approximately 40.6 million gallons) dumped nationally. The largest regional quantity dumped was 131 million pounds in the Northeast FMMO.

Figure 1. Milk Dumping Federal Milk Marketing Orders



Source: U.S. Department of Agriculture (2020a).

Table 2. U.S. Milk Production Monthly Change and All Milk Price, 2020

Source: USDA, 2020d.

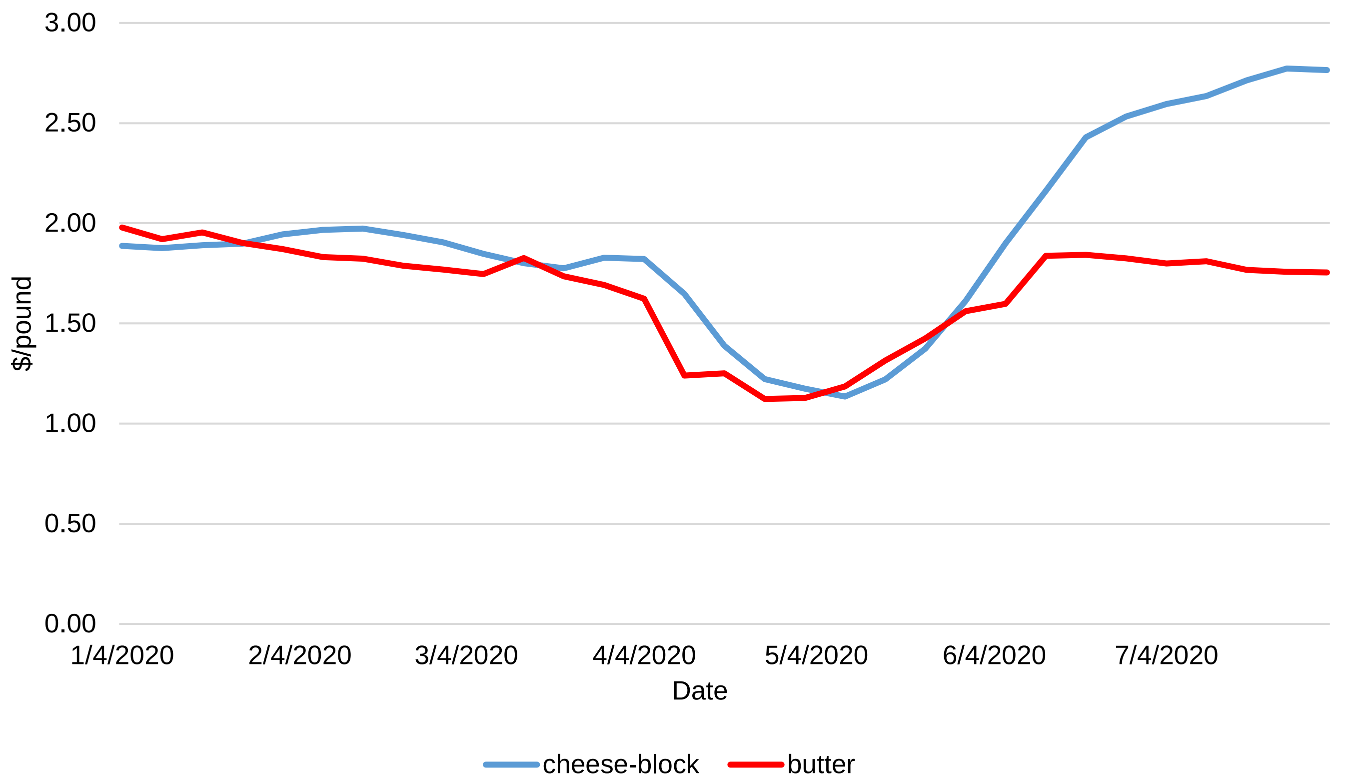
Table 2. Percentage of Milk Dumped in Federal Milk Marketing Orders, 2020

Order	January	February	March	April	May	June	July
Northeast	0.40	0.21	0.87	5.14	0.48	0.31	0.25
Appalachian	0.65	0.65	0.56	1.47	0.50	0.67	0.57
Florida	0.53	0.57	0.51	14.31	0.52	0.49	0.53
Southeast	0.83	1.73	0.81	4.24	0.76	0.78	0.70
Upper Midwest	0.07	0.07	0.07	1.42	0.11	0.20	0.16
Central	0.28	0.30	0.25	1.45	0.16	0.34	0.36
Mideast	0.12	0.09	0.07	1.37	0.11	0.14	0.37
California	0.10	0.13	0.13	0.80	0.30	0.10	0.73
Pacific Northwest	0.04	0.02	0.02	0.10	0.03	0.01	0.02
Southwest	0.30	2.83	2.75	3.82	0.40	0.44	0.42
Arizona	0.01	0.02	0.80	4.01	0.03	0.06	0.09
All orders	0.23	0.41	0.52	2.51	0.27	0.26	0.38

Source: U.S. Department of Agriculture (2020a).

Typically, 0.2 %–0.5% of milk is dumped. Table 2 summarizes the percentage of milk dumped in each of the 11 FMMOs as the pandemic hit in 2020. In aggregate, the total amount of milk dumped accounted for 2.5% in April, which was the highest amount dumped in 2020 in every order. The table demonstrates that the amount dumped varied widely across orders. In percentage terms, the most dumping occurred in the Florida order (14.3%) with large relative amounts of milk also dumped in the Northeast (5.1%), Southeast (4.2%), Arizona (4.0%), and the Southwest (3.8%) orders. Dumped milk levels in May returned to baseline levels and held at those levels for the remainder of 2020.

Figure 3. Weekly Wholesale Cheese and Butter Prices, 2020



Source: USDA, 2020e.

There are several reasons for the short-lived milk dumping period, although they are not without their own consequences. First, dairy co-operatives, in particular but not exclusively, accepted more “distressed milk” (that is, milk moving from distant locations at discounted prices) that was manufactured into storable products, including bulk cheeses, butter, and milk and whey powders. Cheese and butter production spiked notably in April, and ending stocks relative to monthly domestic use spiked 20%–30% for butter, American cheese, and other cheese. Clearly, the industry chose to produce storable products wherever possible rather than dump milk, even if this meant carrying higher levels of stocks whose final disposition was uncertain. Second, whenever possible, export markets were leveraged to move dairy products. Consistent with historic export patterns, this was especially the case for milk and whey powders, which saw below-average export sales in the first quarter but increased to well above seasonal averages in the second quarter. Third, dairy co-operatives took aggressive actions to either implement existing programs or create new pricing programs to discourage milk production. Farm markets for milk are famously price inelastic in both supply and demand. Rigidity in short-run supply and demand response is a key reason for enduring cyclical behavior with amplitudes of price changes that can have profound impacts on short-term profitability. This characteristic is further compounded by pervasive milk price regulation built around a concept of market pooling, where farmers receive a market average price with adjustments for milk composition. In addition, dairy co-operatives tend to pay price differentials, usually premiums but sometimes discounts, that are also pooled or averaged across all members. The result is a habitual blurring of marginal price information. Dairy co-operatives have increasingly made two decisions designed to achieve greater coordination between member production and commercial sales opportunities. One is that farmers whose milk production is growing beyond a simple trend rate are the ones culpable when supply is long. The second is that such “excess” production should be assigned a price that is punitive, which provides a clear signal that this “excess” is more likely to be unprofitable. Even some co-operatives whose members were not previously supportive of these kinds of “base-excess” or “two-tier” pricing plans were persuaded to at least allow their co-operatives to create the outlines of such a plan during the protracted low milk prices from 2015 to 2019. The anticipated and perceived severe imbalance between current production and commercial demand beginning in late March led many co-operatives to aggressively implement these “base-excess” pricing programs. Whether they did or not hinged entirely on the particular co-operative situation, both in terms of member production growth and the extent of changes in commercial sales and the region of the country.

Table 3. 2020 All Milk Price, DMC and CFAP Payments ($/cwt)

Quarter	All Milk	Net DMC	CFAP	Total
Q1	18.83	-0.03	6.20	25.00
Q2	15.37	2.38	1.20	18.95
Q3	19.07	-0.12	1.20	20.15
Q4	20.00	-0.15	1.20	21.05

Note: DMC assumes signup for coverage at $9.50/cwt minus a $0.15 premium which would apply to a maximum of 4,167 cwt per month which is about 200 average U.S. cow production. CFAP includes CFAP2 for the last three quarters assumes that payment limit of $250,000 per individual or $750,000 per corporation is not exceeded and is based on the milk production it applies to rather than when payment was received.

Co-operatives had various parameters to their plans but generally a base level of milk production was set at some farm-specific historic level (a percentage of milk marketed in some recent month or quarter—often 85%–95%). Any milk sold in excess of that amount received a lower “overbase” or “excess” price that was designed to cover the estimated costs of managing the “excess.” Typically, this meant offering the milk to a reluctant customer who needed a deep discount and often also required increased transportation costs. To what extent this restrained growth or even resulted in production declines on specific farms or in total can only be surmised, but the fact is that total U.S. milk production slowed in April, declined in May, and followed higher All Milk prices to increasing production in the second half of 2020 (Figure 2). Normally, monthly milk production change shows virtually no correlation to contemporaneous milk prices. However, as Figure 2 illustrates, they were correlated in 2020 with annual lows in May and strong prices and production increases for the remainder of the year.

Market prices for farm milk were severely impacted as well. Entering the year at around $20 per hundredweight (cwt), a favorable price, the “base” farm price slid in January and February and dropped precipitously in March and April, hitting $13.60/cwt in April. With an “overbase” price applied to milk in excess of the farm-specific adjusted base production level, that was 50% or more below the price paid for “base” milk production; little wonder that there was a significant short-run supply response. The May decline in milk contributed to farm prices, increasing to $18/cwt in June and $20/cwt in July, when industry reports indicate the “overbase” farm milk deduction disappeared or the co-operative supply management plan was suspended.

As is generally true, these farm milk price changes were not mirrored in wholesale and retail markets. The result of food service demand destruction was a 39% decline in wholesale cheese price and 36% decline in wholesale butter price from March to May (Figure 3). This has important implications for farm prices as wholesale cheese and butter prices are primary drivers of the farm milk price (Novakovic and Wolf, 2016). At the retail level, prices generally rose and the rate of increase was higher in the second quarter but tended to moderate in the summer months. Increases in retail fluid milk prices were more pronounced (+11% YOY in September 2020), retail butter price changes were more subdued (+1.9% YOY in September), and cheese prices fell in between (+3.8% YOY in September) (BLS, 2020).

Policy Responses

The U.S. federal government reacted to the pandemic with large stimulus investments. Some of this occurred through existing programs. SNAP benefits increased 73% in April YOY, while the Emergency Food Assistance Program (TEFAP) was up 34%. New programs—primarily the Coronavirus Food Assistance Program (CFAP)—also played a role. CFAP had two components. The first offered direct income subsidies to dairy farmers, with payment limitations and income qualification rules. The budgeted payments are considerable and represent a sizable opportunity for the dairy farmer whose farm size does not exceed the payment limitation border. All dairy operations with milk production in the first quarter, as well as all dumped milk in the first quarter of 2020, were eligible for CFAP payments. The initial payment was $4.71/cwt multiplied by first-quarter milk production, funded by the CARES Act. The second CFAP payment was based on an adjusted first-quarter production multiplied by $1.47/cwt, coming from CCC funds. In total, the initial CFAP dairy payment was $6.20/cwt on first-quarter milk production (Table 3). A second version of the program—CFAP 2, with sign-up from September through December—added another $1.20/cwt in payments for the last nine months of 2020 (Table 3). In total, most farms that sign up will have received an average annual income contribution of $2.45/cwt from CFAP payments.

Existing dairy farm programs and crop insurance also provided support for operations that had signed up or purchased these tools. The Dairy Margin Coverage (DMC) program provides a payment when the margin between the U.S. All Milk price and an average U.S. feed cost index falls below trigger levels. The highest margin that can reasonably be protected is $9.50/cwt on the first 5 million pounds of annual production history for each operation (equivalent to the production of about 200 average cows). In 2020, DMC payments for a

$9.50/cwt coverage level reached $3.47/cwt for April and $4.13/cwt for May (Table 2). National payments to date, and likely for the year given expected margins, totaled $196 million. Farms that purchased coverage at the $9.50 level will have averaged a net benefit of about $0.67/cwt on their covered annual historic milk production. Unfortunately, expectations of low payouts resulted in only 51% (13,482) of operations with established production history and 36% of all herds participating in 2020. Further, the size coverage limits mean that those payments apply to a relatively small percentage of total milk production. In other words, farms of larger than average herd sizes are receiving payments on only a portion of their overall sales, thereby diluting the average net price benefit as size increases.

Another policy that may have provided significant payments for dairy farmers was the Dairy Revenue Protection (DRP) program, a crop insurance program that offers subsidized bundles of put options for milk price based on Class III milk, Class IV milk, or butterfat and protein prices at the Chicago Mercantile Exchange. Because 2020 milk prices were projected to be relatively high prior to the pandemic, crop insurance contracts purchased earlier would have provided large payments to offset the loss in milk price caused by the pandemic. The results of these programs were an increase in cash flow for dairy farmers and an increase in demand for dairy products, which contributed to a dramatic increase in cheese prices.

Table 3 summarizes net DMC and CFAP payments by quarter along with the U.S. All Milk price to proxy market price. Note that the All Milk price does not deduct promotion or hauling. The table assumes DMC signup for coverage at $9.50/cwt minus a $0.15/cwt premium, which would apply to a maximum of 4,167 cwt/month, which is equal to the production of about 200 average U.S. cows. The CFAP column in Table 3 includes CFAP 2 for the last three quarter assumes that payment limit of $250,000 per individual or $750,000 per corporation is not exceeded and is based on the milk production it applies to rather than when payment was received. With these assumptions, the highest gross farm milk returns since 2014 were achieved in 2020 (Table 3). However, it is important to recognize that the market effects of the COVID pandemic were highly variable both across regions and over time. The result is that actual cooperative and farm returns were also highly variable.

The second component of CFAP is the Farmers to Families Food Box Program. Under this program, the USDA finances the purchase of food items, including dairy products, for direct distribution to needy Americans through local soup kitchens, food pantries, and similar nonprofit organizations. There were four rounds of the program completed in 2020. The first round purchased $1.2 billion of products between May 15 and June 30. The second round purchased up to $1.47 billion between July 1 and August 31. The third round of the program made an additional $1 billion available on August 24, 2020, for deliveries through October 31, 2020. The fourth round, announced on October 23, 2020, will purchase up to $500 million worth of food and deliver between November 1 and December 31, 2020. (U.S. Department of Agriculture, 2020c). To date, this program purchased more than $4 billion in 2020. With more than $600 million spent to purchase dairy products, the Farmers to Families Food Box Program has contributed in particular to strong demand for fresh cheese and fluid milk and is believed to be the primary reason for a dramatic spring rebound of cheese prices to above $2.50/lb (Figure 2).

Lessons and Conclusions about U.S. Dairy Supply Chain Resiliency

With the length of the pandemic unknown at this point, it is worth considering some of the lessons that we have learned to date about the U.S. dairy supply chain. Impacts will no doubt continue as long as the pandemic disrupts markets and consumer and producer behaviors. Even after the pandemic emergency can be declared over, there is much speculation about lasting impacts and changes to what had been considered normal dairy business strategies and tactics. Clearly the fundamental effect is in a seriously revised assessment of production and market risks and the need for practices and structures to mitigate those risks. What is entirely uncertain is the extent to which consumers will be able to detect and choose to reward businesses that adopt otherwise costly practices in order to ameliorate potential but uncertain future risks.

Insofar as the pandemic is fundamentally about human health, a primary short-term impact and management challenge was to protect employees and manage the workforce to minimize disruptions from farm to processing plant to delivery. Moreover, the pandemic required employers to consider issues not only within the confines of the workplace but also in the nonwork environment. Unlike the meat industry, there were no widespread outbreaks in dairy processing plants that affected national markets, likely because most dairy plants are much less densely populated by workers. Possible lasting implications may be (i) stricter health protocols in the workplace, including health checks and protective equipment, and (ii) a change in culture that rewards sick workers for staying home as opposed to shaking it off and coming in even if they have a fever or do not feel well.

Another compelling change might be in using greater precautionary inventories to create a cushion for both procurement and sales. This strategy could make for a nimbler operation, or less brittle supply chain, in the event of severe and irregular demand disruption or failures in the transportation system.

With respect to policy, it is tempting to wonder whether the US dairy industry will re-engage in conversation about disaster assistance versus ongoing risk management or insurance programs. The failure in existing programs for dairy was not in their design or execution but rather in dairy farmers' underutilization of them. The same might be said of food assistance programs. The CFAP food box program had the virtue of targeting farm commodities in particularly dire straits as well as helping food insecure families. Existing programs have different mechanisms and effects. TEFAP distributes food items, but the outlets are more typically food banks as an intermediary distributor. Also, TEFAP is not ordinarily specific about acceptable items. SNAP is entirely different in that it provides cash that can be spent rather broadly on food rather than food items themselves. The CFAP donations program, arguably, created win–win opportunities for hard-hit producers of perishable foods and newly food-insecure consumers, but this came at the expense of a new set of regulations and infrastructure that delayed implementation. In addition, it used new and untested vendors who may well have contributed to price spikes due to their lack of experience in dairy product procurement.

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The Impact of COVID-19 on United States Meat and Livestock Markets

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Outlook for United States Livestock and Meat Markets Prior to the Pandemic

After a run of low prices for livestock and meat dating back to 2014, 2020 was shaping up to be a bull market for United States livestock interests. African swine fever continued to decimate China's pig population. As a result, China—the world's leading meat importer—was poised to increase purchases dramatically through 2020. Moreover, in January 2020 the United States government signed the Phase One trade agreement with China, which promised to end a two-year trade war and dramatically expand China's imports of United States agricultural products, including pork and beef. At the consumer end of United States meat markets, a strong economy and record low unemployment pointed to increased demand for meat (Badau, 2020). The net result was that, early in 2020, analysts were forecasting increased United States exports of beef and pork as well as high prices for livestock and meat.

Effects of the COVID-19 Pandemic on United States Livestock Markets

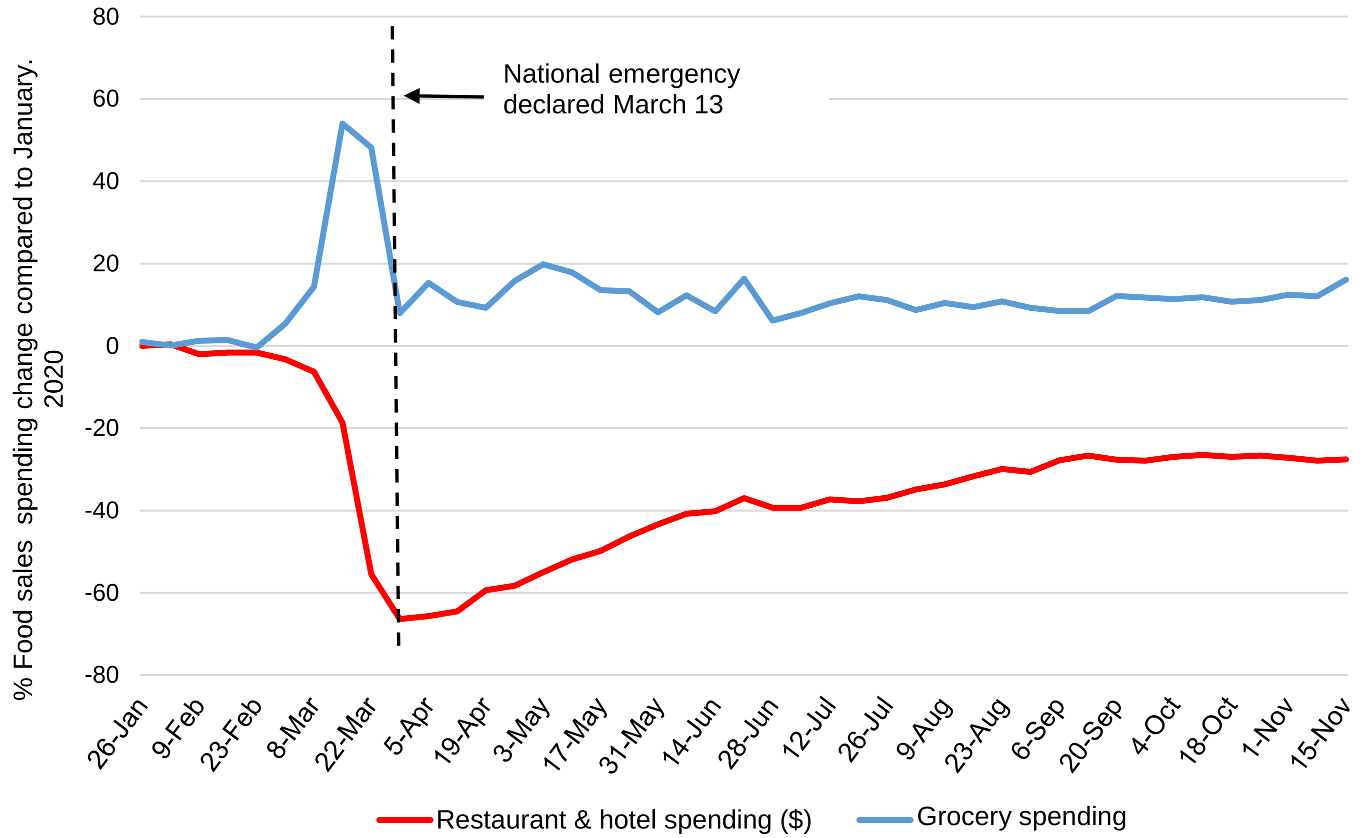
The COVID-19 pandemic started in the Wuhan province of China in late 2019 and eventually spread through the rest of the country. The first known cases of COVID-19 in the United States appeared in Seattle, Washington, in January 2020, and cases were dispersed throughout the country by March 2020. The United States government declared a national emergency on March 13, 2020. The pandemic disrupted United States livestock and meat markets in several ways. First, global merchandise trade fell 14% in the second quarter of 2020 compared to the same time last year (WTO, 2020), and we can surmise that much of this is associated with the economic response to COVID-19. As a net exporter of meat, reduced global trade amounted to a reduction in demand for United States meat exports and downward pressure on prices of United States meat and livestock. Second, although United States pork exports rose in the first half of 2020 compared to 2019, driven by a huge spike in Chinese demand associated with the African swine fever in that country, exports likely would have been even larger if China had not been affected by COVID-19. Through July 2020, year-to-date United States exports of beef were down 8% compared to 2019 (United States Department of Agriculture, 2020a).

The spread of the virus throughout the United States caused additional, more acute disruptions to livestock and beef markets. Starting in March 2020, private precautions taken by people and firms to protect themselves from the virus, together with mandated closings of schools, businesses, and much of the retail sector, led to a sudden and dramatic reduction in demand for food service meals and an increase in demand for food in grocery stores (see Figure 1). With children staying home from school and workers staying home from work or losing their jobs, fewer people were eating meals at school and work. State and local governments took emergency measures to close retail businesses, including full-service restaurants and bars (fast food restaurants were not permitted to open dine-in facilities but were allowed to continue drive-thru and delivery service). In contrast, grocery stores were designated as essential businesses and remained open through the pandemic.

The combined effect of these events was to dramatically and suddenly alter retail demand for food, reducing demand for food served by commercial food service institutions, known as food away from home (FAFH), and increasing demand for food purchased in grocery stores, known as food at home (FAH). Figure 1 shows that spending in restaurants and hotels fell by more than 60% in March, while grocery spending spiked by more than 50%, as people prepared more meals at home.

The pandemic also affected United States meat supply chains. Starting in early March 2020, meat-packing plants and processors of poultry, pork, and beef were forced to scale back production or temporarily close as COVID-19 spread through the workforce (Bunge, 2020).

Figure 1. Spending Changes Have Moderated after the Initial March 2020 Shock, but Grocery Spending Remains Above Pre-COVID Levels and Restaurant Sales Below



Source: Opportunity Insights (2020).

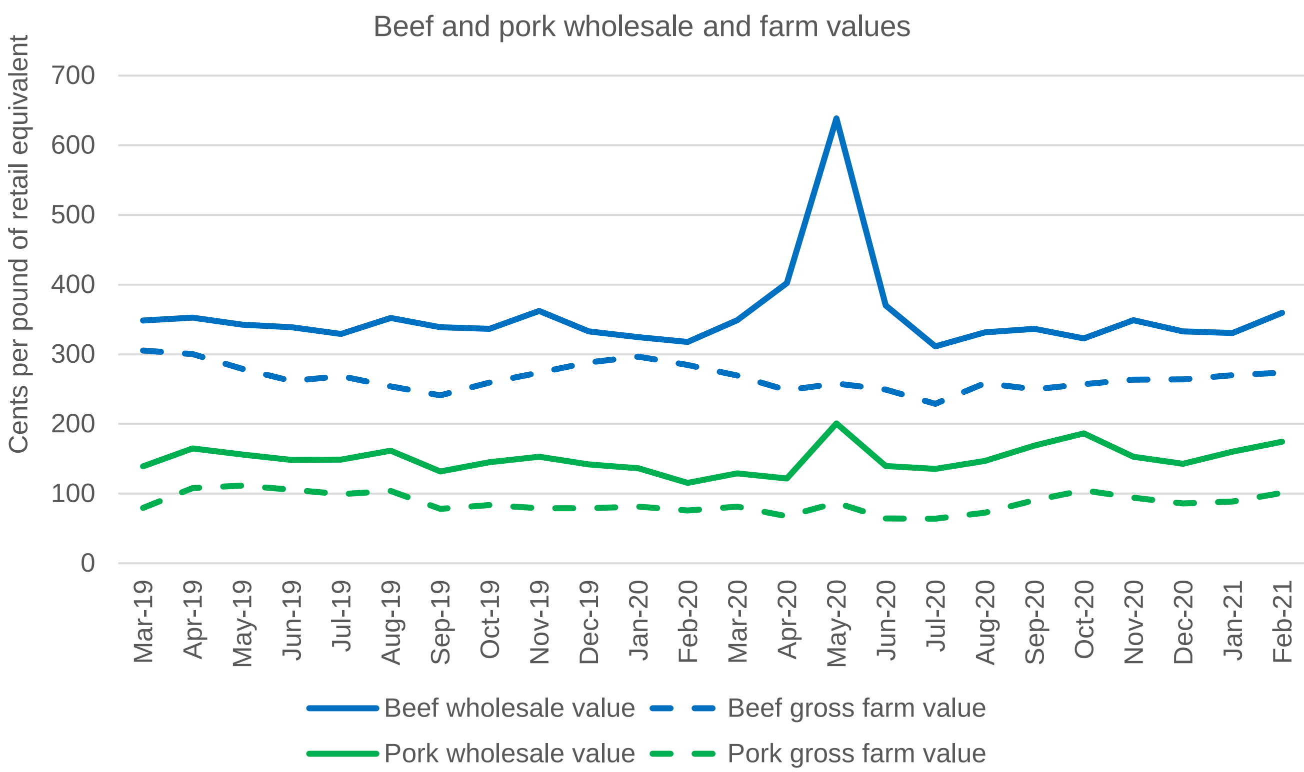
The resulting illness, or fear of illness, contributed to absenteeism among plant workers (Polansek and Sullivan, 2020). Some plants were forced to temporarily close to prevent spread of the pandemic. Plants remaining open slowed production lines in in order to comply with public health guidelines for reducing COVID-19 spread (Parshina-Kottas et al., 2020; CDC, 2020). As plants were idled or forced to limit operations, daily capacity at cattle and hog facilities declined as much as 45% in May 2020 (Cowley, 2020), with others citing similarly dramatic declines (Muth and Read, 2020; Haley, 2020). Muth and Read (2020) cite estimates of the loss of production capacity because of plant closures ranging up to 25% for beef slaughter plants, 43% for pork slaughter plants, and 15% for chicken slaughter plants. The disruption of meat-packing plants reduced production of meat destined for retail outlets and created a backlog of livestock destined for the closed plants.

On April 28, 2020, President Trump issued an executive order invoking the Defense Production Act to keep meat-packing plants open (United States Department of Agriculture, 2020c). The executive order exempted plants from state and local orders to close nonessential businesses but did not solve plants' problems with sick workers. COVID-19 outbreaks among the workforce continued to force plants to close and slow down even after the Executive Order.

Meat supply chains also struggled to transition their production lines and distribution networks in response to the pandemic events in the retail sector that reduced demand from food service and increased demand in groceries. FAFH meat is differentiated from FAH meat, and specialized production processes and distribution networks serve these separate marketing channels (Bittle, 2020). The rapid shift of demand from FAFH to FAH, combined with a costly transition of supply chains, contributed to higher prices and at times stockouts for some meat products in grocery stores in the spring of 2020 (Riley, 2020).

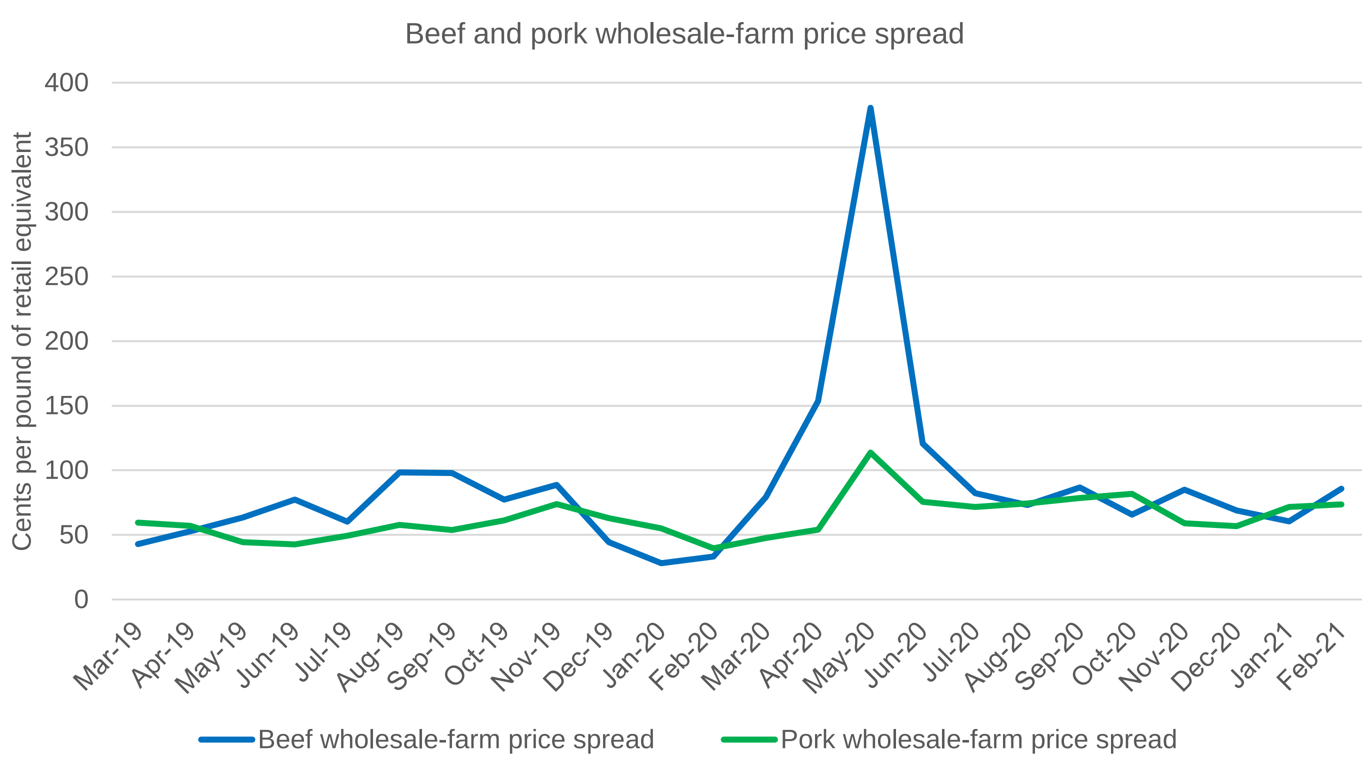
As discussed in more detail below, from approximately early April to early June 2020, capacity utilization fell significantly at pork and beef packing plants due to shutdowns and slow downs related to COVID-19. Reduced production capacity meant decreased supplies of meat products entering wholesale and retail markets. At the same time, the packing disruption caused reduced demand by packing plants for live animals. The net effect of these COVID-19 impacts was to increase wholesale and retail meat prices, decrease upstream

Figure 2. In First Half of 2020, Wholesale Values for Beef and Pork Increased Sharply and Farm Prices Fell



Source: U.S. Department of Agriculture (2020b).

Figure 3. COVID-19 is Associated with a Spike in the Wholesale-Farm Price Margins for Beef and Pork



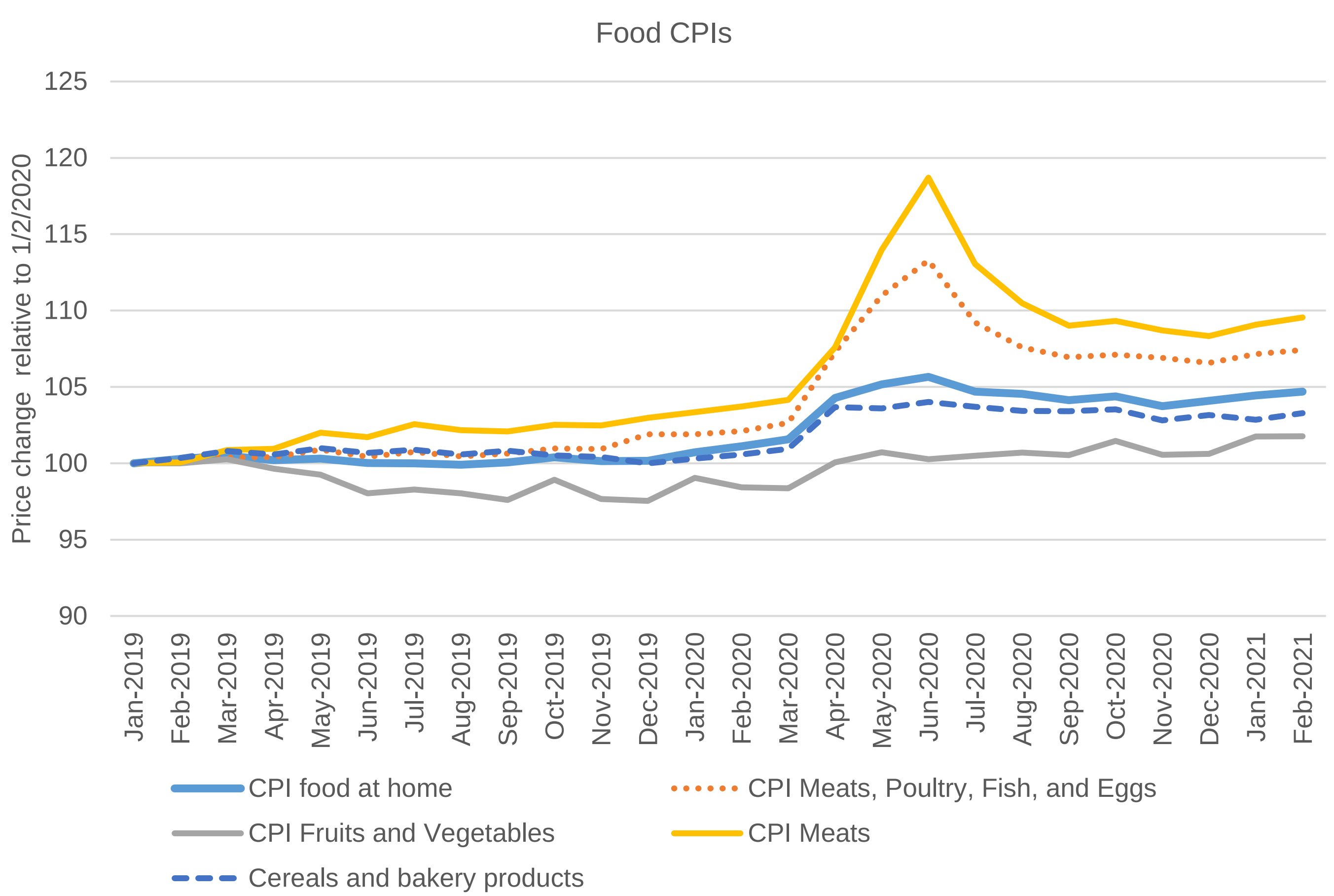
Source: U.S. Department of Agriculture (2020b).

prices of livestock, and thus increase the price spread between meat and livestock (Figures 2 and 3).

The market disruptions starting in March 2020 are evident in the food consumer price indices (Figure 4). Between February and June 2020, the food at home CPI increased by 3.5%. While CPIs for all food categories in the chart increased over this period, by far the largest increase was the meat CPI, at 9%. The CPI started to fall around June 2020, with the meat CPI falling almost 5% between June and July. Reductions in meat processing capacity associated with COVID-19 outbreaks were a likely cause of the increase in the meat CPI. For example, on April 29, 2020, pork packing plant capacity utilization bottomed out at 54%, compared to 100% in early April (Haley, 2020). By mid-June, capacity utilization in pork processing plants rebounded to near 95%; consumer prices for pork were falling. Other disruptions in the food chain were caused by the precipitous drop in FAFH and the associated increase in FAH, given differences between product types and production and distribution processes targeted at FAFH versus for FAH and the efforts needed to rechannel goods. Overall, even after the decrease in the CPI for food consumed at home from its peak in June, in July it was still 3.5% higher compared to February 2020. In contrast, the headline CPI for all goods—the CPI-U—actually fell from February to May 2020, and as of July was 0.1% lower than in February 2020. The gasoline CPI fell 23% from February to May 2020, likely driving much of that decrease in overall CPI.

Table 1 reports the USDA's projections for 2020 average annual livestock prices, as produced in the January, May, and September *World Agricultural Supply and Demand Estimates* reports (WAOB, 2020). Between January and May 2020, USDA's projected prices fell by 11.4% for steers and 20.9% for barrows and gilts. Between May and October 2020, prices for steers had begun to rebound, while prices for barrows and gilts were flat. Figure 5 shows a similar pattern in futures contracts for cattle but considerably more fluctuation in hog futures, with the latter rallying considerably higher starting in February 2021.

Figure 4. Food CPIs Up Sharply from March to May 2020, but Slowing or Decreasing in June 2020 and Back to Pre-Pandemic Trends in Early 2021



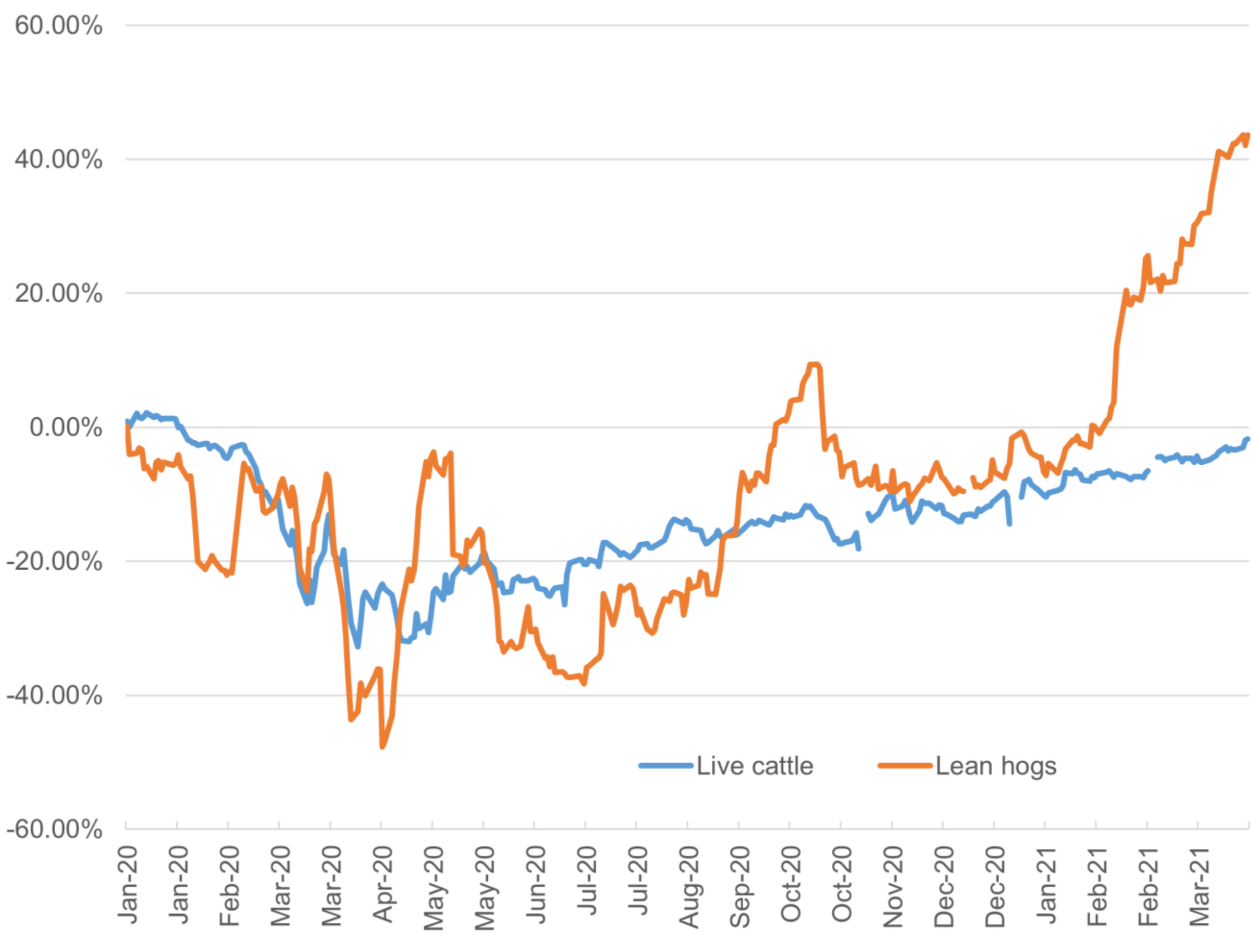
CPI=Consumer Price Index
Source: U.S. Bureau of Labor Statistics (2021).

Table 1. Comparison of January, May, September, and October Projections for Annual 2020 Prices

	Jan. Proj.	May Proj.	Sept. Proj.	Oct. Proj.	Percentage Change Jan. vs. May	Jan. vs. Sept.	Jan. vs. Oct.
Steers ($/cwt)	117.50	104.10	107.30	108.71	-11.40%	-8.68%	-7.48%
Barrows and gilts ($/cwt)	54.50	43.10	39.40	43.25	-20.92%	-27.71%	-20.64%
Broilers (cents/lb)	86.50	71.40	70.90	70.80	-17.46%	-18.03%	-18.15%
Turkeys (cents/lb)	92.50	104.60	105.80	106.10	13.08%	14.38%	14.70%
Eggs (cents/dozen)	95.50	129.50	114.90	116.70	35.60%	20.31%	22.20%
Milk ($/cwt)	19.25	14.55	17.75	18.00	-24.42%	-7.79%	-6.49%

Source: USDA, World Agricultural Outlook Board (2020, January and September).

Figure 5. Hog and Cattle Futures Prices (percentage change, 1/1/20-4/7/21)



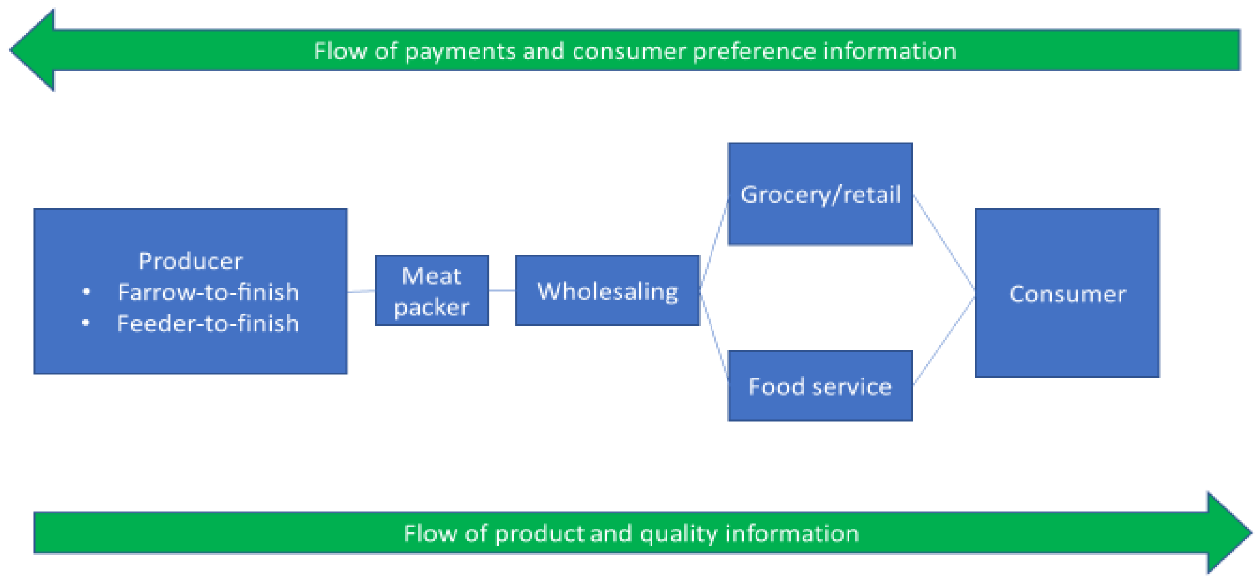
Source: Generic first cattle and lean hogs (live) futures contract, Bloomberg.

A Simple Model to Understand United States Livestock and Meat Prices in 2020

Figure 6 contains a flow chart of a meat marketing channel, using the example of hogs. Payment and consumer preference information move upstream from the consumer, and product and quality information move downstream from the producer.

Lusk, Tonsor, and Schulz (2020) posit a simple theoretical model of a meat supply chain to help illustrate the impact of COVID-19 on meat and livestock markets. In the model, the retail market for meat (e.g., beef) is linked to the market for livestock (e.g., fed cattle) by a "marketing" sector that includes meat processing, wholesale services, and retail services. Under some simplifying assumptions, the demand for livestock is

Figure 6. Stages of the Hog Marketing Channel



Source: Adapted from Rhodes, Dauve, and Parcel (2015) and Marchant (2020, p. 7).

obtained by subtracting the costs of these marketing inputs from the retail demand for meat. Similarly, the retail supply of meat is obtained from adding the costs of marketing inputs to the marginal cost (or supply) of livestock.

The model produces an intuitive equilibrium relationship between meat prices and livestock prices:

(1) $P_{meat} = P_{livestock} + M$,

where P_{meat} is the retail price of meat (in dollars per pound), $P_{livestock}$ is the price of livestock (in meat-equivalent units), and M is the marketing margin. The simple interpretation of this relationship is that retail meat prices have two components: the packing plants' cost of the livestock in the meat, $P_{livestock}$, and the cost of the marketing input, M. The marketing costs drive a wedge between the price of meat on the animal and the price of the meat at retail.

COVID-19 affects meat-packing plants by raising their costs of production, initially by making the workforce sick and thus less productive, and eventually by forcing processors to incur costs to protect workers from the virus. The effects of higher processing costs are distilled in the equilibrium pricing relationship displayed above, in the form of higher M. Higher processing costs increase the wedge between meat prices and livestock prices, so that meat prices must rise or livestock prices must fall. Higher processing costs cause a decrease in the meatpackers' demand for livestock and a decrease in the retail supply of meat. As a result, downstream meat prices rise and upstream livestock prices fall.

The magnitudes of these price changes depend on the responsiveness (elasticities) of livestock supply and retail demand. Because both meat demand and livestock supply are quite inelastic in the short term, we expect to see relatively large changes in prices and relatively small reductions in quantity.

Implications for Policy

While the COVID-19 pandemic continues to play out, livestock and meat markets have begun to recover (Figure 5). But the events of the past 14 months have raised questions about the performance of United States food supply chains generally and of United States meat supply chains in particular. While these questions deserve more careful consideration, we provide some initial reactions based on the data and simple model presented above.

Meatpacker Market Power

The news media and other observers of agricultural markets have speculated that meatpackers took advantage of COVID-19 to increase margins (e.g., Hagemann, 2020). At issue is meat-packing plants' ability to exercise market power to earn super-competitive profits. The question arises in part because of the high degree of concentration in meat-packing. The CR4—a common measure of industry concentration of the four largest firms in the industry—was 85% for livestock/beef and 64% for hogs/pork in 2012 (Saitone and Sexton, 2017), up from 36% and 56%, respectively, in 1980 (Crespi, Saitone, and Sexton, 2012). In addition, the industry is characterized by large capital investment that prevents new firms from entering, at least in the short term. Indeed, a large body of empirical work by agricultural economists has investigated the question over the past decades and has tended to find that meat-packing plants do not exercise market power to harm livestock suppliers or consumers. We do not specifically assess market power here and thus cannot rule it out. But we do note that the observed price patterns that are of concern—high retail prices and low livestock prices—are not themselves evidence of market power, as they are consistent with the model described above, which assumes a perfectly competitive meat-packing sector. Also, capacity constraints may reduce the incentives for plants to reduce production; Lusk, Tonsor, and Schulz (2020) found that plants are better off trying to run near full capacity than voluntarily restricting output. They also found that, in general, changes in the stock prices of companies with significant packing operations do not suggest substantial windfalls corresponding to COVID-19.

Resilient Meat Supply Chains

Another concern related to the industrial organization of meat-packing plants is whether concentration makes the sector less resilient to the pandemic and speculation that localized supply chains have been more resilient to COVID-19*.* Resilience to a particular risk depends on susceptibility to the risk and the ability to manage the risk if realized (Johansson, 2020). On the question of susceptibility, smaller, more localized meat-packing plants may not have been less susceptible to the pandemic. If smaller plants are less susceptible, then more resilience via smaller and more localized packing plants comes at the cost of efficiency, as larger plants capture economies of scale that result in lower meat prices and higher livestock prices. It is possible there is a trade-off between efficiency in meat-packing and ability to quickly pivot to operating under a pandemic or more quickly changing marketing channels. For instance, at least initially, business was reportedly brisk at some small packing plant in the initial days of the COVID-19 outbreak (Huffsturrer and Nickel, 2020; NPR, 2020).

Trade

In early summer 2020, as the COVID-19 pandemic caused high prices and stockouts in the meat section of grocery stores, United States pork producers were expanding exports to China (Braun, 2020), causing some observers to wonder whether trade exacerbated the problems caused by COVID-19 in livestock and meat markets. Some countries restricted agricultural exports in an effort to protect domestic consumers (Reuters, 2020). Similar policies were implemented by some countries during the global commodity price spike of 2008–2011. While such policies may appear to help domestic consumers in the short term, the restriction of trade can actually exacerbate the local shortages that the trade restrictions are intended to prevent (Hendrix, 2020). First, export restrictions reduce domestic prices of restricted goods and thus create a disincentive to increase production and economize on consumption. Moreover, export restrictions disrupt the ability of markets to move product to places most in need. Currently, the United States does not restrict exports of meat or other agricultural commodities.

Conclusion

In this paper we provide an overview of the ways in which the COVID-19 pandemic upset United States markets for meat and livestock. Around the time that the United States government announced a national emergency in mid-March 2020 and state and local officials began to close schools and some businesses, demand for meat and other foods shifted dramatically away from food service and toward retail grocery. The COVID-19 demand shock, combined with some difficulties in reorienting meat supply chains, resulted in a spike in retail meat prices in the spring and occasional grocery store stockouts of some meat products. The pandemic also disrupted meat supply chains in the United States as the virus spread through the workforce in meat-packing plants, causing some plants to temporarily close and all plants to slow production to inhibit the spread of the virus. The resulting reduction in demand for livestock and supply of beef and pork caused lower livestock prices and higher meat prices in the spring and summer of 2020.

By late summer, the public health precautions taken by meat-packing plants appear to have been successful, as the number of COVID-19 cases at meat-packing plants from August through September is considerably lower than in May through July (Douglas, 2020) and steer and hog futures prices have returned to prepandemic levels. Food demand patterns have moved toward normalcy, but in Fall 2020 demand for FAFH remained more than 20% below prepandemic levels and demand for FAH approximately 10% higher than prepandemic levels. By late August 2020, the CPI for meat was declining but remained 10% above prepandemic levels.

The COVID-19 pandemic raises several questions and issues related to meat supply chains that warrant further research. We see a need for economic research into the incentives of meat-packing plants to run at full capacity and the trade-off that they face between profits and costly measures to manage the public health risk. More generally we see resilience, and in particular potential trade-offs between resilience and efficiency, as a fruitful area for additional research.

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Has COVID-19 Caused a Great Trade Collapse? An Initial *Ex Post* Assessment

Shawn Arita, Jason Grant, and Sharon Sydow

JEL Classifications: F14, F13, Q17, Q18
Keywords: Agricultural Trade, COVID-19, Coronavirus, Pandemics, Trade Shocks

Introduction

Disruptions to food and agricultural trade are not new. The Great Recession of 2007–2009 had marked one of the most significant collapses in trade, with global agricultural trade plummeting almost 20% (almost 30% for nonagricultural exports), yet the economic expansion period that followed was one of the longest on record. In 2018, a trade dispute between the United States and China and several other trading partners led to a significant escalation in applied tariffs and a resulting decline in agricultural and merchandise trade (Bown, 2018, 2019; Amiti, Redding, and Weinstein, 2019; Crowley, 2019; Grant et al., 2019). In 2020, the COVID-19 pandemic challenged the global economy, spreading to 216 countries and regions around the world, decreasing and even shuttering economic activity, and threatening the lives of 7.6 billion people.

In response to the pandemic, national governments imposed unprecedented measures to thwart the spread of COVID-19, including lockdowns, shelter-in-place orders, and the promotion of remote business and education. Many of these policies led to significant economic damage by discouraging large gatherings and outright closures of nonessential businesses including restaurants, bars, shopping centers, and attractions. Recent evidence suggests that lockdowns have worked to slow the spread of the virus but came at considerable economic costs (Fajgelbaum et al., 2020).

Short-term economic indicators are suggestive of a major economic contraction in the United States due to the pandemic not seen since the Great Depression (Orden, 2020). Unemployment burgeoned in just a few weeks from less than 5% to nearly 15% as firms laid off or furloughed workers, and second quarter U.S. GDP estimates showed a contraction of 9.5% (31.4% on an annualized basis).

Given the lag in data availability, we are only beginning to observe some of the impacts of COVID-19 on international trade. Table 1 presents data on imports of vehicles and parts, aircrafts, electronics (i.e., TVs and cell phones), and agricultural products, globally and individually for the top three trading nations—the United States, European Union (EU), and China during calendar year 2020 relative to 2019. For all goods (agricultural and nonagricultural), global imports are down 8% year-over-year, or $1.1 trillion in 2020 relative to 2019. For context, the loss of over $1.1 trillion from global trade in 2020 is equivalent to the value of Japan and the United Kingdom’s world imports in any recent year. Total U.S. and E.U. imports are down 6.6% and 10%, respectively, whereas China’s total imports are down 1.1%. Some sectors, however, have been more exposed to the pandemic. For example, the pandemic essentially halted global air travel. Not surprisingly, global imports of aircrafts and related parts are down 33%, or $61 billion, compared to 2019. Notably, China’s aircraft imports in 2020 are down 51%, declining from $19.3 billion in 2019 to $9.5 billion in 2020. Global trade in motor vehicles and parts has also been impacted by the pandemic, as transportation has slowed and the economy has declined, with global imports down 16%, or $160 billion, in 2020 relative to 2019. U.S. imports of motor vehicles are down 18%, compared to 14.5% in the E.U. and 1.5% in China.

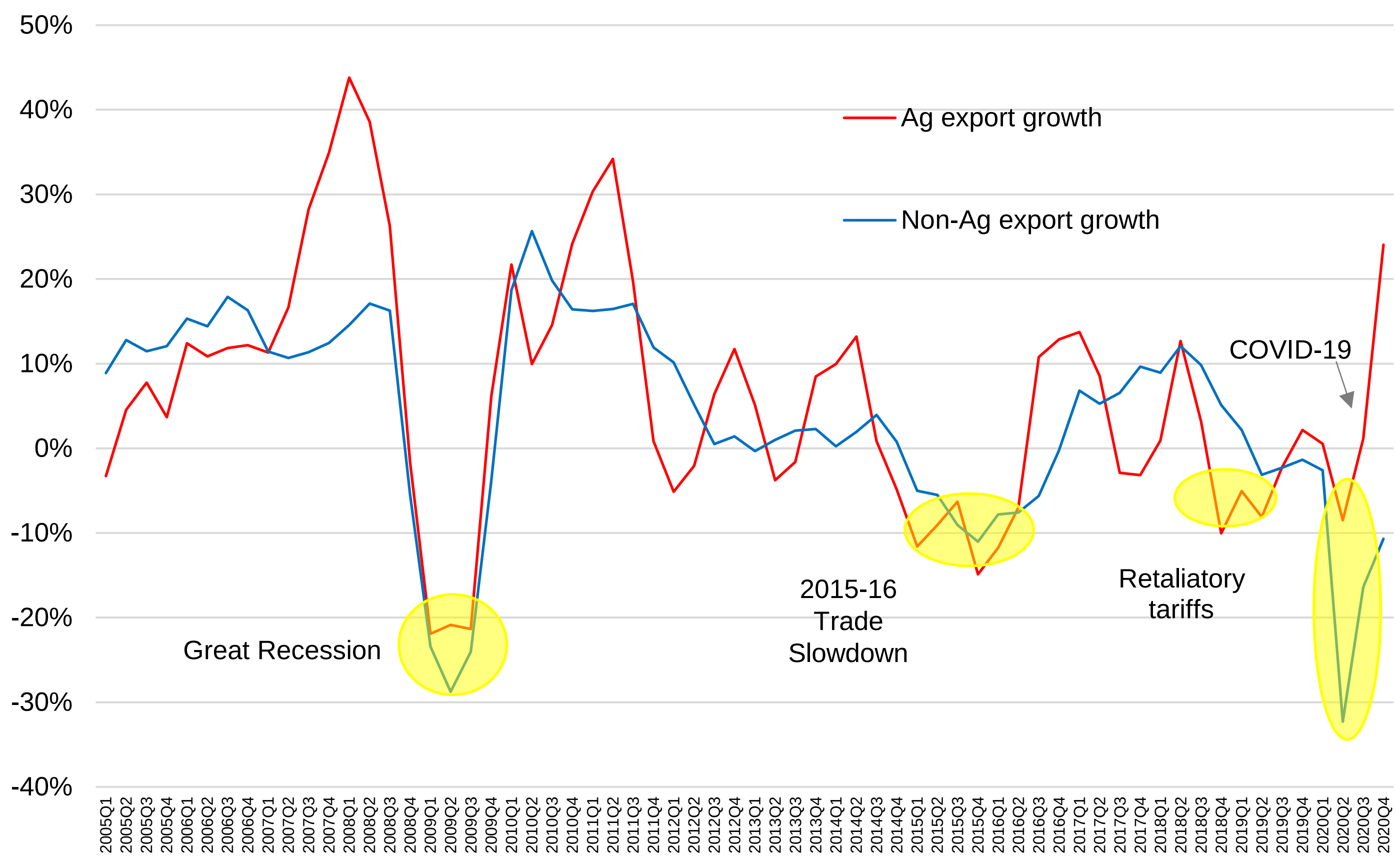
Conversely, imports of discretionary electronic items such as TVs, cell phones, monitors, and others are down only 2% year-over-year, or $39 billion. The lower decline of consumer-based electronic products may reflect the fact that consumers can purchase these items online without the need to visit a retail store. Imports of food and agricultural products is one of the bright spots in Table 1, with global trade actually up 3.5% in 2020 compared to 2019. As indicated in Table 1, the overall increase in agricultural imports is driven in part by an 18.2% increase in China’s agricultural imports in 2020. Much of the increase in China’s agricultural imports came initially from Brazil as the real depreciated significantly during the first six months of 2020, followed

Table 1. Year-to-Date Percentage Changes in Selected Merchandise and Agricultural Products, 2020 Relative to 2019

	All Products	Vehicles and Parts Thereof	Aircraft and Parts Thereof	Electronics	Agriculture
Global Imports (January-December)					
2020 % Change in Imports Relative to 2019	-8%	-16%	-33%	-1.6%	3.5%
Value Change ($billions)	-$1,121	-$160	-$61	-$39	$35
% Change in U.S. Imports	-6.6%	-17.7%	-19.3%	-3.4%	2.3%
% Change in E.U. Imports	-9.9%	-14.5%	-31.2%	0.65%	3.4%
% Change in China Imports	-1.1%	-1.5%	-50.7%	10.3%	18.2%

Source: Authors' calculations from Trade Data Monitor.

Figure 1. U.S. Exports Quarterly Growth (change over same quarter, previous period)

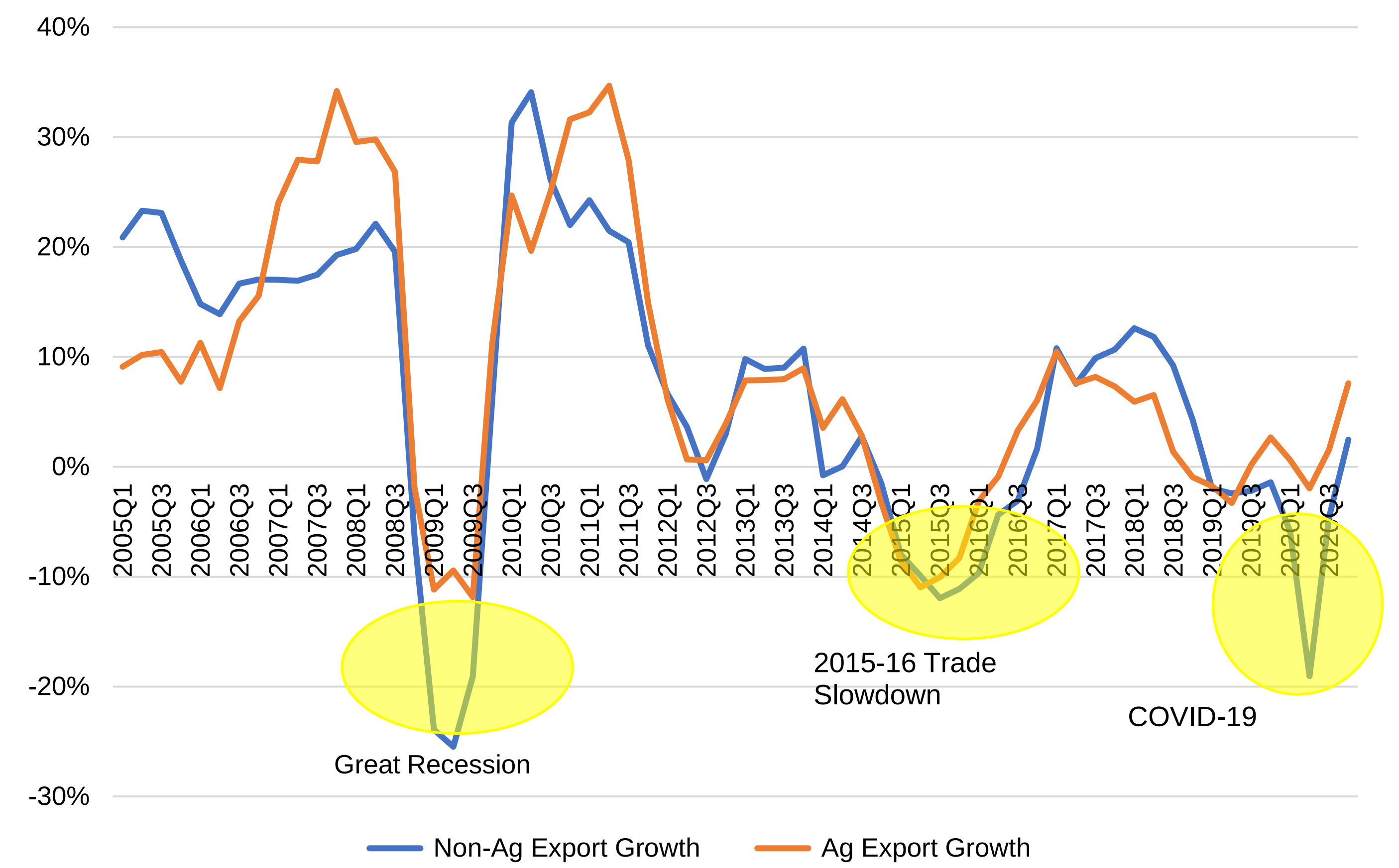


Note: Agricultural export growth reflects products included in USDA definition of agricultural goods. Data are from Trade Data Monitor.

by significant imports from the U.S. in the fourth quarter of 2020.

In summary, the total trade numbers in 2020 are broadly consistent with an initial outlook the WTO released in April, which forecast declines in the value of global trade in 2020 of -8.1%, -16.5%, and -20.4% under a V- (optimistic), U- (less optimistic), and L-shaped (pessimistic) set of economic recovery scenarios, respectively (WTO, 2020a). In October, the WTO updated the outlook for global trade to fall 9.2% in 2020, with trade growth of 7.2% in 2021 (WTO, 2020b).

Figure 2. Global Exports Quarterly Growth (change from same quarter, previous year)



Note: Agricultural export growth reflects products included in USDA's BICO definition of Agricultural and Agricultural related goods. Non-agricultural trade includes all other HS codes. Data are from Trade Data Monitor.

However, overall declines in global trade mask significant heterogeneity at the country and sector level. For example, the WTO also forecast a significant reduction in the value of agricultural exports by -6.5%, -11.2%, and -12.7% across the three scenarios. Table 1 shows that agricultural trade has not fallen as originally predicted.

The purpose of this article is to conduct an initial *ex post* examination of the impact of the COVID-19 pandemic on U.S. and global agricultural trade. Specifically, this article addresses the following empirical questions:

i) What year-to-date changes have been observed in U.S. and global agricultural exports under the pandemic? How do these trade flow changes compare with previous trade shocks?

ii) Are there particular sectors or countries within the global agricultural trading system that are relatively more susceptible to global health shocks of this magnitude?

iii) What is the quantitative impact of COVID-19 on agricultural versus nonagricultural trade, and to what extent do COVID-19 cases and mobility trends associated with shutdowns explain changes in agricultural and nonagricultural trade?

This article provides a preliminary econometric examination at how COVID-19 has affected agricultural trade and outlines key impacts that can be observed thus far. As the pandemic is ongoing, the study aims to provide initial evidence of the effects on agricultural trade while pointing to areas requiring more rigorous empirical investigation.

Impacts on U.S. and Global Agricultural Exports

Growth of U.S. and Global Agricultural Trade Slowed under COVID-19 but Remains Relatively Stable

While U.S. agricultural exports during the first half of the year fell relative to the same period in 2019, the decline was not extreme by historic standards, nor in comparison with the steep fall in nonagricultural exports. Following the emergence of COVID-19, agricultural export growth began to slow in first quarter of 2020 with a growth rate of less than 1% relative to the same quarter in 2019 (see Figure 1). As U.S. outbreaks accelerated and lockdowns ensued, second quarter agricultural exports declined much further, 9% relative to the second quarter of 2019. In comparison, U.S. nonagricultural exports plummeted 32% in the same quarter. U.S. agricultural exports experienced a significant surge during the latter half of 2020 under strong import demand from China. Factors external to COVID-19, most particularly the U.S.-China Phase 1 agreement and China's pig herd rebuilding that fueled feed import demand led to U.S. agricultural exports hitting record levels in the fourth quarter. In contrast, non-agricultural export growth only slightly recovered, but remains down over 10% relative to the fourth quarter of 2019.

The smaller impact on agricultural trade may reflect the relatively lower income elasticity of food demand, particularly for staple food items, and the structure of agricultural global value chains which is less fragmented than manufacturing and other merchandise trade. Additionally, agricultural trade, which occurs more substantially through bulk marine shipments, is likely to be less susceptible to disruption to transport restrictions in other sectors that require more human interaction (WTO, 2020c). Growth of global agricultural trade has been relatively more stable than growth in U.S. agricultural exports. Growth in global agricultural exports had been positive for most of 2020. Agricultural trade slowed slightly in quarter two, recovered quickly in quarter three, and picked up significantly in quarter four due to Chinese demand. In comparison, growth in global non-agricultural trade fell as low as 19% in the second quarter and subsequently experienced a recovery by quarter four (see Figure 2).

Impacts on Agricultural Trade Low Compared to Previous Trade Shocks

How does the COVID-19 disruption on agricultural trade compare with other major economic crises over the past two decades? Figures 1 and 2 highlight changes in quarterly export growth under COVID-19 relative to three other signifiant trade shocks: (i) the Great Recession (or global financial crisis); (ii) the 2015–2016 international trade slowdown; and (iii) the 2018–2019 retaliatory tariffs.

The Great Recession

In 2008–2009, the global economy suffered a deep recession resulting from the global financial crisis. Sudden drops in demand and supply, credit constraints, and disruptions to global value chains led to one of the sharpest trade collapses ever recorded (Baldwin, 2009). At the peak of this crisis, quarterly U.S agricultural exports plummeted over 21% and global agricultural exports fell over 10%. The much larger reduction in trade that occurred in 2009 was quite stark, particularly when compared to the magnitude of the respective GDP shocks. U.S. quarterly GDP contracted 4% at the height of the Great Recession. In comparison, second quarter GDP in 2020 fell 31.4%, the steepest drop ever recorded, before recovering 33.1% in the third quarter. However, the subsequent drop in U.S. agriculture exports under COVID-19 was much more modest (Figure 1).

2015–2016 Trade Slowdown

Beginning in 2015, commodity prices began to fall from their recent highs, the U.S. dollar appreciated, and the International Monetary Fund (IMF) and others lowered their forecasts for global economic growth. These macro factors led to a significant slowdown in global trade (UNCTAD, 2016), with U.S. and global agricultural exports falling more than 10%, a steeper contraction than that currently observed under COVID-19 (Figure 1).

2018–2019 Retaliatory Tariffs

Beginning in 2018, U.S. agriculture was impacted by unprecedented trade retaliation by China and other key trading partners. In total, over $30 billion of U.S. agricultural exports were subject to retaliatory tariffs imposed in 2018 (Grant et al., 2019). At the lowest point of the trade conflict, U.S. quarterly agricultural exports fell 10% (2018Q4) (Figure 1), which has exceeded the decline in U.S. agricultural exports under the COVID-19 pandemic thus far.

Sectoral and Regional Trade Impacts

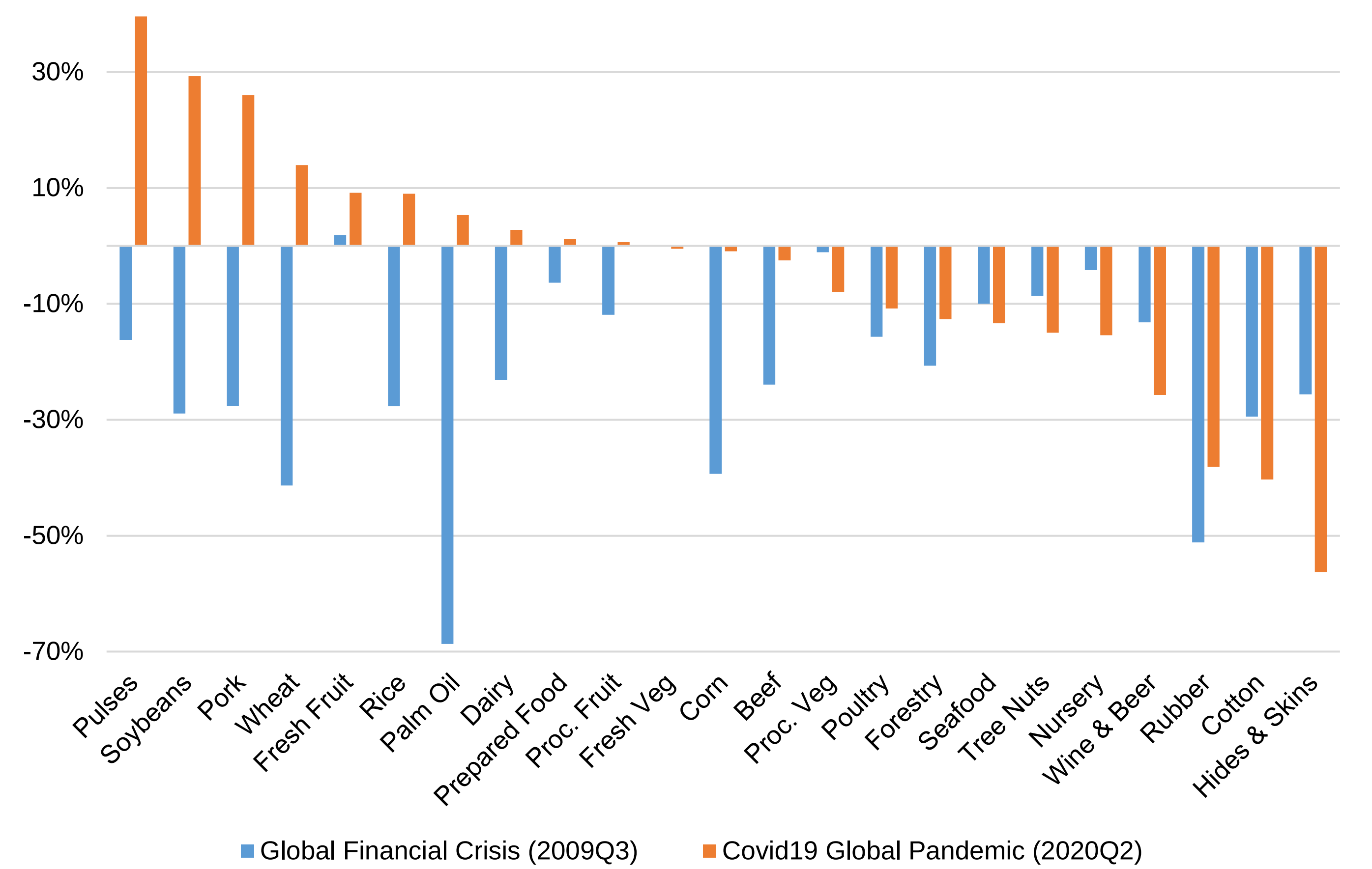
Level of Trade Disruption Is Highly Sectoral within Agriculture

The impact of COVID-19 on agricultural trade across sectors has been uneven. The sectoral differences are noticeably sharp when one compares the sector-by-sector impacts to the 2008–2009 global financial crisis (Figure 3). Unlike the across-the-board declines observed during the financial crisis, there are clear differences across sectors owing to the unique way in which COVID-19 has disrupted demand and supply chains.

First, nonfood agricultural trade has declined significantly more than food products. In particular, hides and skins, cotton, rubber, and nursery products are among the sectors hardest hit by the COVID-19 pandemic. These sectors are more likely to have a higher income elasticity of demand. Further, they are more susceptible to the demand-side shocks of COVID-19 lockdowns. For instance, world retail sales of clothing and textiles plummeted under the weight of closures of apparel stores, weaker demand for purchases due to stay-at-home orders, and lower incomes as unemployment increased or workers were furloughed.

Second, there is a clear dichotomy between food products more likely to be consumed at home versus those consumed away from home. For example, trade in sectors characterized by high restaurant or food-away-from-home consumption—such as seafood, poultry, and beef products (Binkley and Liu, 2019)—has declined globally. In comparison, trade in staple cereal and

Figure 3. Quarterly Change in Global Agricultural Trade Following the Great Recession and COVID-19 Pandemic



Note: Selected agricultural and related sectors. Quarterly trade changes are from the same quarter in the previous year: 2019Q2 for COVID-19, and 2008Q3 for the Financial Crisis. Data are from Trade Data Monitor.

Figure 4. Change in Exports under COVID-19, Change in Q2 2020 Exporters Relative to Previous Quarter

Exporter	Pulses	Soybean	Pork	Wheat	Fresh Fruit	Rice	Palm Oil	Dairy	Prep Food	Proc Fruit	Fresh Veg	Corn	Beef	Proc Veg	Poultry	Forestry	Seafood	Tree nuts	Nursery	Wine & Beef	Rubber	Cotton	Hides & Skins
Brazil	14%	48%	45%		-20%	171%	51%	16%	-1%	-9%	180%	-87%	30%	15%	-21%	-9%	-6%	-5%	12%	-28%	-35%	-12%	
Russia	-12%	46%	173%	30%	-35%	-73%	9%	10%	1%	50%	41%	54%	65%	13%	92%	-10%	-12%	72%	-50%	-16%			-97%
Kenya	374%				27%		95%	-57%	34%	74%	-6%		-14%	17%		-34%	-51%	-46%	-30%	-53%	10%		
Turkey	94%	624%			23%	44%		-14%	17%	5%	8%	69%	-18%	-1%	-15%	-12%	-13%	18%	-13%	-26%		-3%	
Argentina	109%	62%	258%	-35%	9%	6%		28%	1%	-64%	37%	16%	-4%	-44%	-23%	-4%	10%	-42%		-14%	-93%	-63%	8%
Mexico	16%		36%	226%	10%	63%	-11%	7%	15%	-6%	2%	66%	42%	10%	60%	-2%	-21%	-17%	-17%	-29%		-31%	
Japan			29%		7%	9%		26%	27%	-2%	171%		-20%	-5%	27%	-4%	-16%	-1%	13%	-38%			14%
Thailand	11%		112%		57%	0%	-75%	29%	6%	0%	-20%	15%		-4%	1%	-13%	6%	-48%	-53%	-55%	-41%		21%
Indonesia					88%		9%	34%	32%	16%	-26%			43%		-2%	5%	7%	0%	-25%	-41%		
Canada	60%	-6%	14%	11%	-37%	25%		17%	-4%	7%	22%	-49%	-5%	-15%	0%	-16%	-23%	-6%	-8%	-15%	-71%		-69%
China	11%	-25%	-13%		52%	-15%	31%	-40%	9%	-3%	5%	-97%	-34%	-7%	-17%	-5%	-15%	8%	-3%	-28%	-8%	-70%	-34%
Colombia					-16%		27%	50%	23%	-18%	-21%		49%	-25%		-46%	-4%		-16%		-58%		-66%
South Africa	48%		-41%	187%	16%	14%	-19%	-19%	-15%	5%	-26%	193%	61%	-24%	-32%	-49%	-26%	16%	-42%	-51%		-44%	-33%
Switzerland			40%			19%		-6%	-3%	-15%	0%		-12%	2%	-50%	0%	-76%	-37%	-7%	-44%			-37%
Ukraine	-15%	-69%	5%	21%	-66%			-25%	10%	-3%	-36%	-24%	-14%	-8%	-16%	-13%	11%	-37%	-5%	-7%			-14%
New Zealand	33%		-50%		2%			4%	-13%	20%	-13%		-5%	1%	-61%	-31%	-33%		-24%	-5%			-15%
EU	4%	-65%	34%	55%	-9%	0%	-16%	8%	3%	0%	7%	-20%	-3%	-13%	-9%	-5%	-12%	-27%	-19%	-27%	-27%	-62%	-72%
Chile	0%		42%		-11%			13%	1%	9%	-4%		38%	-3%	-5%	-15%	-7%	-22%	-9%	-17%			-38%
USA	27%	-27%	11%	-9%	-1%	3%	-12%	12%	-6%	-7%	-15%	11%	-26%	-16%	-7%	-18%	-10%	-17%	-17%	-21%	-29%	-35%	-35%
Uruguay		-5%		63%	36%	132%		-4%	54%				-23%			-2%	-25%			-37%			48%
Singapore			111%		-15%	50%	11%	20%	-3%	-24%	78%		-18%	15%	53%	-63%	-26%	31%	-44%	-49%	-46%		-85%
Malaysia			-18%		-16%	-12%	1%	-28%	-18%	54%	1%		-42%	-17%	-27%	-39%	-6%	-4%	-51%	-56%	-39%	-89%	-93%
Hong Kong			49%		35%	-6%		-50%	51%	-46%	-54%		-65%	-33%	-3%	-38%	-46%	-69%		-28%	-85%		0%
Cote d'Ivoire					-10%	148%	-21%		15%					-40%		-23%	-9%	-16%			-10%	-73%	
Morocco					1%			-34%	-21%	-10%	-23%			-33%		-37%	-18%	47%	-24%	-55%			
Australia	26%		37%	3%	-2%	-47%		-12%	1%	-20%	-12%	5%	-5%	21%	17%	-29%	-20%	-38%	-41%	-11%		-76%	-36%
Taiwan			96%		-7%	216%		66%	-8%	-29%	-13%		-37%	5%		-24%	-30%	-6%	-23%	-33%			
Peru	-31%				1%	8%	-39%	-73%	-14%	-2%	-13%	3%		-5%		-58%	-53%	-25%	6%	-80%			
Senegal					-11%	-89%			15%		43%					-10%	-20%	-78%				-10%	
Mozambique	-60%	82%			5%		-29%									-91%	-18%	-15%				-85%	
Zambia								-34%	-36%			-29%			-13%	11%			-20%			-75%	-95%

Note: Selected Agricultural & Related Sectors. Data from Trade Data Monitor.

protein crops, which are more likely to be consumed at home or serve as intermediate inputs for processing, has increased. Third, the role of workers falling ill in meat-packaging plants and plant closures in the United States, Brazil, and other major meat exporting countries may also weigh on exports due to temporary supply disruptions; however, external from COVID-19 shocks, international trade in pork has been stimulated heavily by the outbreak of African Swine Fever (ASF), which has increased demand from China and other outbreak countries.

Regional impact is heterogeneous

Figure 4 presents a sector-by-country matrix of the changes in 2020Q2 trade under COVID-19. The changes in trade across sectors are sorted left to right from sectors experiencing the highest positive global trade growth (pulses) to those impacted with the sharpest decline (hides and skins). Similarly, changes across countries are sorted from countries experiencing the highest overall positive growth (Brazil) under COVID-19 to those suffering the overall steepest contractions (Mozambique). Green indicates positive growth is and red indicates negative growth.

Overall, the changes in trade under COVID-19 are highly variable across both markets and sectors. The matrix seems to suggest that the disruption caused by COVID-19 permeates relatively more across sectors rather than across countries. We can see this in the figure by the higher clustering of trade contractions (highlighted in red) being more concentrated on the right side of the table than on the left side. Further, there does not appear to be a clear relationship between the regional variation in the severity of COVID-19 outbreaks relative to observed export changes. For instance, Brazil, which has been one of the countries hardest hit by the coronavirus, experienced the strongest export growth, whereas Mozambique had fairly limited outbreaks despite experiencing the largest contraction. The patterns behind the variation across exporters are not clearly evident but likely depend on the production composition in a given exporting country.

Quantitative Assessment of the Impact of COVID-19 on Agricultural Trade

The previous findings were based on the delta or simple change of agricultural exports before and after the coronavirus pandemic. However, percentage changes cannot tell us whether the coronavirus pandemic has had a statistically significant impact on agricultural and nonagricultural trade, nor can it tell us the extent to which agricultural trade varies with changes in different pandemic-related indicators including cases, deaths, and resident mobility within countries. Further, percentage changes do not control for other potential confounding factors influencing agricultural trade such as exchange rate movements, income and GDP shocks, trade agreements (e.g., the U.S.–China Phase One trade deal), or pest and animal disease outbreaks (e.g., ASF or Fall armyworm).

Here, we conduct a straightforward *ex post* econometric evaluation of the impact of the COVID-19 pandemic on agricultural exports using a quarterly agricultural import model of total (i.e., not bilateral) agricultural and nonagricultural imports from the world market using the latest data available. Specifically, because the COVID-19 pandemic has affected countries at different points in time—beginning in China, spreading to Europe, the United States, and eventually most other countries—we exploit variation in coronavirus case incidence rates per 100,000 individuals.

Specifically, we estimate the following model of total agricultural and nonagricultural imports:

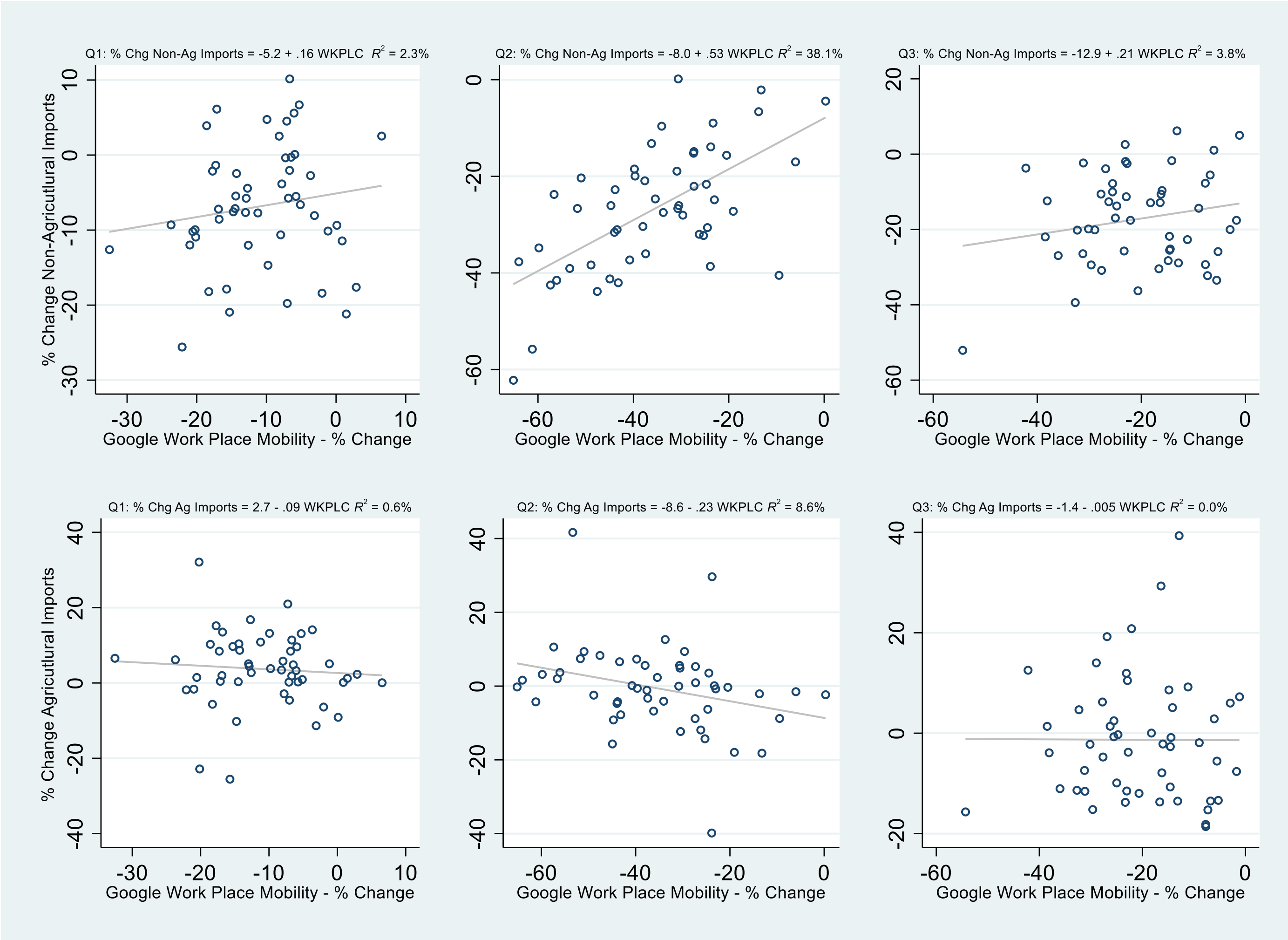
(1) $$\Delta M^{S}_{jqt,t-1} = FE_j + \theta_1\left[\Delta COVID_{jqt,t-1}\right] + \varepsilon_{iqt},$$

where ΔM_{iqt} is the change in the value of imports in quarter *q* and year *t* between *t = 2020* to *t-1 = 2019* by importer *j* in sector *S* (*S = agriculture* or *nonagriculture*), and FE_j are importer fixed effects (FE) capturing heterogeneity of country-specific import growth. Note that since the dependent variable is differenced across years, time-invariant unobserved effects specific to each importing country are removed. The main variable of interest is $\Delta COVID_{jqt}$, denoting the increase in the number of coronavirus cases or deaths reported in importing country *j* per 100,000 people. Since the COVID-19 pandemic started in 2020, these variables take on positive values in Q1–Q3 of 2020. The coefficient of interest is θ_1.

While COVID-19 cases and deaths measure the incidence and spread of coronavirus cases throughout a country, a more direct measure of the economic restrictions imposed by COVID-19 is the degree to which workplace mobility was halted during the pandemic. To explore this association, we make use of Google Mobility data, which track the change in resident mobility trends associated with grocery and pharmacy, parks, transit stations, retail and recreation, places of residence, and places of work on a percentage change basis (Google, LLC). Google maintains these data for over 130 countries worldwide (excluding China).

These data are measured in percentage changes relative to the median baseline value for the corresponding day of the week, during the five-week period from January 3 through February 6, 2020. We aggregate the mobility data to the quarterly level to match the periodicity of the trade flow data. We then computed the percentage change in agricultural and nonagricultural imports for each country for Q1-Q3 2020 relative to the same period in 2019, so that both Google Mobility data and trade flows are expressed as percentage changes (i.e., ΔM_{iqt}, equation 1).

Figure 5. Quarterly Changes in Nonagricultural and Agricultural Trade versus Lockdowns in 2020 (relative to same quarter of previous year)



Note: Figure presents scatter plots of the percentage change in nonagricultural (Non-Ag) and agricultural (Ag) imports against percentage changes in Google's workplace mobility trend. A linear line of best fit is added and the equation Q1, Q2 and Q3 denote quarters one, two, ad three of 2020, respectively.

Figure 5 provides a scatter plot of the relationship between the percentage change in the value of nonagricultural and agricultural imports relative to 2019 against Google's workplace mobility trends (also measured as a percentage change). Also plotted is the linear fit equation (i.e., line of best fit) of the scatterplot. *A priori*, if COVID-19 has disrupted trade through reduced workplace mobility, then we would expect to see a positive association between trade and mobility (that is, trade is increasing with increasing mobility). The scatterplots in Figure 5 indicate that the positive relationship between imports and mobility only holds for nonagricultural trade. The correlation between agricultural trade and workplace mobility, on the other hand, is weak and in some cases negative (Q2, Figure 5). It appears that agriculture trade has by and large remained robust during the pandemic. For nonagricultural trade, the effect is particularly pronounced in Q2 of 2020 relative to the same quarter in 2019. Across all importing countries, we find that nonagricultural imports are 5.3% lower, on average, for every 10% reduction in workplace mobility due to lockdowns imposed during the global pandemic. The R^2 implies that mobility explains 38.1% of the variation of nonagricultural trade changes in Q2, compared to just 8.6% for agricultural trade.

The econometric analysis attempts to isolate the impact of the pandemic on trade by controlling for other confounding factors using fixed effects. Table 2 presents the econometric results after estimation of equation (1) by agricultural and nonagricultural sector. Country-level fixed effects are included in all specifications but not reported. The first set of specifications shows that the

Table 2. Estimated Effect of COVID-19 on Agricultural and Nonagricultural Trade

	Ag 1	Non-Ag 2	Ag 3	Non-Ag 4	Ag 5	Non-Ag 6	Ag 7	Non-Ag 8	Ag 7	Non-Ag 8
New cases per 100k	-0.001**	-0.002***								
	(0.00)	(0.00)								
New deaths per 100k			-0.035***	-0.054***					-0.025**	-0.023**
			(0.00)	(0.00)					(0.01)	(0.01)
Mobility-retail					0.075	0.509***				
					(0.06)	(0.04)				
Mobility-workplace							0.129*	0.641***	0.089	0.605***
							(0.07)	(0.05)	(0.07)	(0.05)
No. of obs.	162	162	162	162	150	150	150	150	147	147
R^2	0.462	0.503	0.458	0.499	0.453	0.754	0.462	0.771	0.482	0.778
COVID-19 effect on trade for Q2 and Q3 2020	-2.7%	-4.3%	-2.4%	-3.6%	-2.5%	-16.8%	-2.5%	-17.1%	Mobility: -2.5% Deaths: -1.7%	Mobility: -17.1% Deaths: -1.6%

Note: Dependent variable is the percentage change in quarterly imports from the same quarter of the previous year. Agricultural sector as defined by USDA. Data include 2019Q1–2020Q3. 2020Q3 includes only July and August. Estimation includes country fixed effects (not reported) and standard errors are in parentheses and robust to clustering by country. Single and double asterisks (*, **) denote statistical significance at the 10% and 5% levels, respectively. Mobility indices are the percentage change in people traffic as reported by Google using a January–February 2020 baseline, averaged by quarter. COVID-19 effect is calculated as the estimated coefficient of the case, death count, or mobility index projected at the mean level of the indicator for 2020Q2 and 2020Q3, averaged across importers.

effect of COVID-19 on trade as captured by the number of confirmed case and death counts is significant but very small. Projecting the estimated coefficients in columns 1 and 3 on the mean levels of case and death counts for the second and third quarters of 2020, implies a quantitative effect of -2.7% and -2.4% reduction of agricultural trade, respectively. The implied impact is likely driven by commodity price changes, which have fallen significantly for many agricultural sectors during this period. The impacts of COVID-19 case and death counts on the value of nonagricultural trade are larger in magnitude, at -4.3% and -3.6% (columns 2 and 4, respectively).

The estimates based on COVID-19 incidence likely understate the impact on trade since they do not reflect the overarching economic repercussions of the pandemic. As explained earlier, the actual economic impact of COVID-19 may be better represented through its lockdown effect on the economy. Using Google retail and workplace mobility traffic as proxies for the economic and trade impacts of COVID-19, we find stronger impacts induced by the pandemic. Estimated coefficients are generally positive and statistically significant—indicating that a decreased mobility is more strongly associated with reductions in imports. The impacts implied by the estimated coefficients on agricultural imports (columns 5 and 7) are similar in magnitude to the COVID-19 case and death counts—implying a 2.5% reduction of imports. However, we find much larger impacts of mobility on nonagricultural trade, with retail and workplace mobility reducing nonagricultural trade by 16.8% and 17.1%, respectively.

As a final note, columns 7 and 8 present the effect of workplace mobility on agricultural and nonagricultural imports while controlling for COVID-19 morbidity. Although the resulting impact of workplace mobility on nonagricultural trade is slightly lower, at 16%, the results underscore the importance of lockdowns and constrained mobility on international trade compared to incidences of COVID-19 deaths. The varying lower results across different proxies suggests COVID-19 involves complex channels in terms of its effects on trade. Despite this complexity, initial estimations suggest a more significant impact on nonagricultural trade; the evidence for agricultural trade is less robust. The resulting aggregate impacts of both indicators on agricultural and nonagricultural trade are -4.2% and -18.7%, respectively.

Conclusion

COVID-19 is affecting global agricultural markets in sharp and unexpected ways. To date, we have observed a slowdown in agricultural trade, but to a much lower degree than nonagricultural trade. Global agricultural trade ended calendar year 2020 up 3.5% compared to global trade in all products which fell 8%. Further the changes in agricultural trade have been more moderate compared to the contraction experienced during the 2008–2009 Great Recession and other recent global trade shocks. The level of disruption is very sectoral in nature—nonfood trade products and food products consumed more intensely away from home have slowed or contracted more significantly than food products consumed at home.

Using data up until August of 2020, we provided a preliminary econometric analysis of the impacts of the pandemic. Controlling for other factors, we estimated that COVID-19 may have reduced agricultural trade by 4.2% in the second and third quarters of 2020. In contrast we found nonagricultural trade was reduced by 18.7%. Our findings provide initial evidence that agricultural trade has been relatively steady amid the global pandemic; however we also note several caveats behind our results and identify areas for ongoing research. First, as the pandemic is still ongoing and vaccination efforts are progressing, the full extent of COVID-19 impacts on agricultural trade are not clear and further empirical analyses would benefit from a longer time span of data. Second, while agricultural trade has been holding up in aggregate, the level of disruptions across commodities and regions is highly uneven and requires further investigation at the disaggregated level. Third, our empirical approach employed a non-bilateral estimation strategy that could not identify demand vs supply shocks nor control for some of the country level effects. Ongoing research currently undertaken by the authors of this study is employing bilateral trade observations and gravity-based econometric techniques with a longer time period of data in an effort to unpack the complex, multidimensional and heterogeneous nature of the pandemic's effects across regions and commodities.

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Consumer Food Buying during a Recession

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JEL Classifications: D12, D31
Keywords: COVID-19, Engel curve, Food security, Food spending, Great Recession

Introduction

COVID-19 caused significant disruptions in food supply chains and altered consumer buying behavior. The impacts of COVID-19, most notably in the restaurant and food service sectors, are still being realized in food markets months after the initial shutdown. COVID-19 is a unique event with idiosyncratic effects on food consumption. Nonetheless, there are likely longer-term effects of the pandemic that are perhaps more predictable. The pandemic has caused a recession and spike in unemployment during the first quarter of 2020 (NBER, 2021), and there is much that has been learned about consumer food spending and buying behaviors during prior economic downturns that can be leveraged to gain insights about consumer food spending during the pandemic.

There are many differences between the present pandemic-induced recession and the Great Recession, which was associated with a deterioration of the housing market. The Great Recession's impacts on food spending operated almost exclusively through changes in income and unemployment, whereas the COVID-19 impacts on food spending include these channels and more, including consumer demand shocks (increase in demand for food at grocery and reduction in demand for food away from home) and supply shocks (regulations affected the supply of food service options and temporary slowdown in meat processing from worker illnesses). Additionally, government support during the pandemic actually caused aggregate personal income to increase (FRED, 2021a), and along with a fall in spending on entertainment and travel, aggregate savings rates to increases as well (FRED, 2021b), although the effects are highly heterogeneous across households (Chetty et al., 2020). Despite these differences, understanding the impacts of changes in income, unemployment, and time availability that accompany recessions remains relevant to the current environment.

How Food Demand Changes with Income

Economists' understanding of the relationship between consumers' food spending and income stems from the work of nineteenth-century German statistician Ernst Engel. The so-called Engel curve relates the share of spending on a good to a consumers' income. For food, the relationship between income and food is so strong and consistent across countries and across peoples within a country that it has been deemed "Engel's Law." Engel's Law asserts that consumers with higher incomes spend a smaller share of their income on food than lower-income consumers. This relationship implies that food is a so-called economic necessity, with food spending rising less than proportionally with increases in income. The implication is that a recession or loss of income will increase the importance of food in consumers' overall budget.

Whether and to what extent consumption of particular foods increases or decreases with income is a matter of some debate in the literature. Most prior research suggests that food consumption in most categories increases with income, but in many cases, there is little relationship between the two (e.g., Beatty and LaFrance, 2005; Nelson et al., 2017; Ferrier, Zhen, and Bovay, 2018). Differences in periods studied, the way foods are categorized, and the statistical methods used make it difficult to compare income-consumption relationships across previous studies. As a result, we turn to data reported by the Bureau of Labor Statistics that stems from their annual Consumer Expenditure Survey (U.S. Bureau of Labor Statistics, 2020). We explore spending patterns of households averaged across the five most recent of years available (2015–2019) for five quintiles of income before taxes. Expenditures and incomes are adjusted for inflation using the consumer price index, and reported data are in 2019 dollars.

Table 1 shows the differences in spending patterns for different food items for households at different income levels. As incomes rise, households spend more on both

Table 1. Consumer Food Spending Patterns by Before-Tax Household Income Quintile (average of 2015-2019 based on Bureau of Labor Statistics Consumer Expenditure Survey)

Category	Lowest 20%	21%-40% Lowest Income	Middle Income	21%-40% Highest Income	Highest 20%
Before-tax income	$11,862	$31,422	$54,944	$90,483	$205,403
Annual spending on …					
Total food	$4,201	$5,688	$6,968	$9,106	$13,574
Food at home	$2,720	$3,596	$4,089	$5,085	$6,889
Food away from home	$1,481	$2,092	$2,879	$4,021	$6,684
Percentage of income spent on …					
All food	35.4%	18.1%	12.7%	10.1%	6.6%
Food at home	22.9%	11.4%	7.4%	5.6%	3.4%
Food away from home	12.5%	6.7%	5.2%	4.4%	3.3%
Percentage of food at home spending on …					
Meat	18.2%	18.2%	17.3%	17.3%	16.8%
Beef	6.0%	6.0%	5.9%	6.0%	5.6%
Pork	4.6%	4.7%	4.2%	4.0%	3.6%
Poultry	4.4%	4.4%	4.1%	4.2%	4.0%
Fish and seafood	3.1%	3.1%	3.1%	3.1%	3.5%
Eggs	1.6%	1.5%	1.4%	1.3%	1.3%
Dairy	10.0%	9.9%	10.1%	10.1%	10.3%
Fresh milk and cream	3.7%	3.5%	3.4%	3.3%	3.1%
Cereal and bakery	13.1%	13.0%	13.0%	12.8%	12.5%
Fats and oils	2.8%	2.8%	2.7%	2.6%	4.1%
Sugar and other sweets	3.4%	3.5%	3.5%	3.5%	3.8%
Fruits and vegetables	18.6%	18.9%	18.9%	19.1%	19.7%
Fresh fruit	6.6%	6.8%	6.9%	7.1%	7.5%
Processed fruit	2.7%	2.6%	2.6%	2.6%	2.6%
Fresh vegetables	6.0%	6.1%	6.2%	6.2%	6.6%
Processed vegetables	3.4%	3.4%	3.3%	3.2%	3.0%
Beverages[a]	15.1%	12.8%	11.8%	11.3%	10.1%
Non-alcoholic beverages	10.6%	10.2%	9.9%	9.7%	8.9%

Note: [a]The Bureau of Labor Statistics also reports sales of alcoholic beverages as a separate category from both food at home and food away from home.

food at home (FAH) and food away from home (FAFH). For example, for total food spending across FAH and FAFH, the highest-income households spent $13,574/year, whereas the lowest-income households only spent about $4,201/year on average over 2015–2019. Despite the fact that higher-income households spend more income on food, their food spending as a *share* of income is smaller than that of lower-income households, a finding consistent with Engel's Law. For example, the highest-income households only spend about 6.6% of their income on all food, whereas the lowest income households spend 35.4% of their income on food. Engle's Law holds for both FAH and FAFH, but the decline in spending on food with increased income is much steeper for FAH (i.e., food bought at a grocery store) than for FAFH (i.e., food at restaurants). The lowest income households spend 35% of their food budget on FAFH ([$1,481/$4,201] x 100%), whereas the highest income households spend almost 50% of their food budget on FAFH ([$6,684/$13,574] x 100%).

Table 1 also shows the FAH budget allocated to specific food items (unfortunately, there are no spending data for specific FAFH items). For some items (i.e., fats and oils, sugar and sweets, fresh fruit, and fresh vegetables), the FAH budget share increases with income. By contrast, the FAH budget share falls with income for other foods (i.e., beef, pork, poultry, eggs, milk, cereal and bakery items, processed vegetables, and beverages).

The key question relevant to this paper is how spending and consumption of specific food items vary with income. Figure 1 reports the estimated changes in spending and consumption anticipated to occur with a 10% drop in income, which might occur in a recession.[1] A 10% decrease in income is associated with a slight increase in spending and consumption of eggs, pork, milk, and nonalcoholic beverages. However, expected spending on the majority of food categories is adversely affected by a negative income shock, and the categories most negatively affected include fresh vegetables, fresh fruit, FAFH, and alcoholic beverages.

Because of the general Engel-curve relationship that exists with all food categories (i.e., the share of spending on food falls with income), it is logical to expect that a fall in income will be associated with an increase in the share of income spent on food. These relationships are illustrated in Figure 2. We estimate that a 10% reduction in income with be associated with a roughly 10% increase in the share of income spent on eggs, pork, milk, and nonalcoholic beverages. We previously demonstrated (Figure 1) that falling income disproportionately affected spending on FAFH, alcoholic beverages, and fresh fruits and vegetables; accordingly, Figure 2 shows that the share of income allocated to these items does not rise as fast as other foods as income falls. Still, the fact that the estimated values in Figure 2 are all positive illustrates that a recession-induced income drop would be expected to increase the importance of food in consumers' total budgets. This further illustrates that food is a necessity, meaning consumption of the good changes less than proportionately with income, at least for middle-income consumers. For the highest-income consumers, we actually find that most food categories (besides FAFH and alcoholic beverages) are inferior goods, which means that a fall in income for this group would actually increase their spending on most FAH categories, likely resulting from a budget reallocation of FAFH to more FAH.

An important caveat to the preceding discussion is that the food categories are broad and represent many different types of products. For example, consider the beef category, which includes pricey steaks and affordable hamburger. Lusk and Tonsor (2016) show that as incomes rise, demand for beef steaks increases; by contrast, rising income is associated with lower demand for ground beef. In addition to switching between goods with a category, it is also possible to substitute higher- for lower-quality (or branded vs. generic branded) foods (Griffith et al., 2009) or by choosing less convenient versions of the same food, such as unprocessed versus bagged salads as incomes fall (Kuchler, 2011).

Eating during the Great Recession

While the current recession has different causes and features than the Great Recession, they share the common feature of rising unemployment. As a result, it is instructive to explore how consumers changed food consumption habits during the last economic downturn.

Food service, and particularly restaurants, also suffered during the Great Recession (Saksena et al., 2018). From 2007 to 2010, total household food spending fell 7% and did not fully recover until 2015. Most of this reduction in food spending occurred as a result of consumers spending less eating out. The average household spent 40.5% of their FAFH budget in 2005, a figure that fell to 36.3% in 2010 (Saksena et al., 2018). These findings have been confirmed by numerous data sources. For example, grocery scanner data reveal that during the Great Recession, spending at groceries and supermarkets increased across the board as consumers reallocated spending that from FAFH toward FAH (Cha, Chintagunta, and Dhar, 2015).

In the Great Recession, fast food performed better relative to more expensive substitutes like full-service restaurants (Youn and Gu, 2009). The implication is that options with a smaller income elasticity are positioned to fare better during recessions. However, there is some evidence that there was not a difference between income elasticities across restaurant formats during the Great Recession and that fast-food restaurants performed better due to implementing more effective cost controls (Koh, Lee, and Choi, 2013).

Using county-level unemployment data, Cha, Chintagunta, and Dhar (2015) found that, in response to higher unemployment in a county, most household types increased the quantity of food purchased at grocery stores, presumably because consumers substituted away from FAFH. This effect was largest for older, more educated, and middle-income consumers. Overall,

[1] These estimates are based on five years of data for each income quantile for each food (i.e., 25 observations for each food category). Working–Leser models are estimated where the log of income and yearly fixed effects are regressed against the share of income spent on each food (Working, 1943; Leser, 1963). These estimates are used to calculate income elasticities and share elasticities, both evaluated at the middle-income spending shares.

lower-income households had the largest decline in spending on FAFH from 2007 to 2009, while middle-income households experienced the slowest recovery in FAFH spending after the Great Recession (Saksena et al., 2018). However, after controlling for income, decrease in FAFH consumption was only observed in working-age adults, implying that falling opportunity cost, likely associated with increased unemployment, was more responsible for the decrease than income (Todd and Morrison, 2014).

Figure 1. Estimated Change in Spending and Consumption of Various Foods Associated with a 10% Fall in Income for Middle Income Households

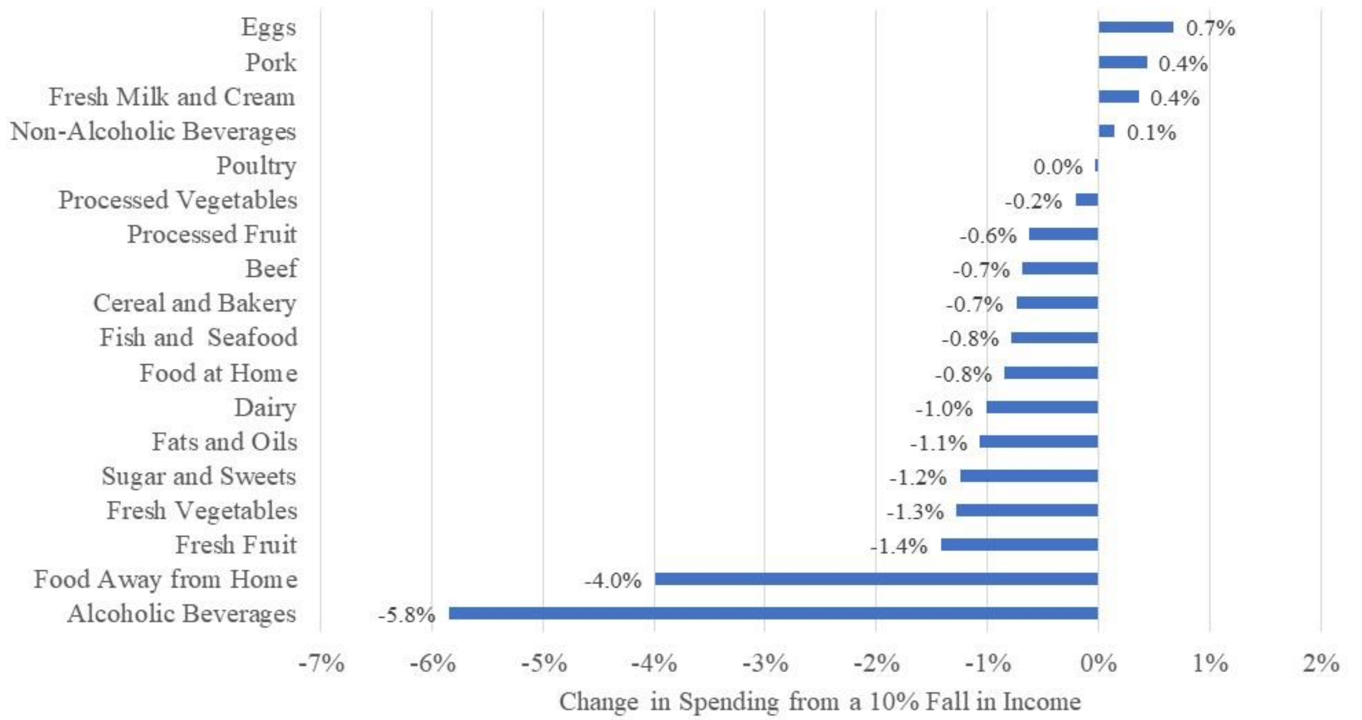
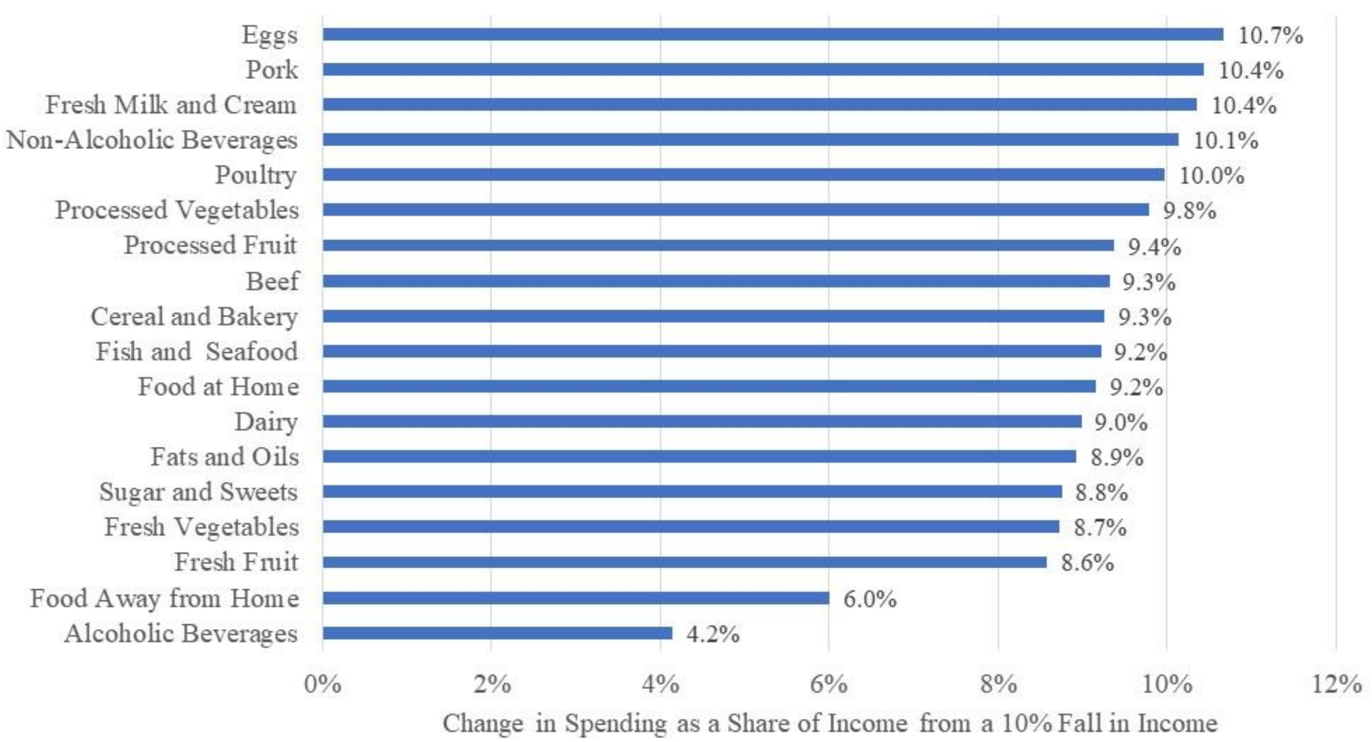


Figure 2. Estimated Change in Share of Iconome Spent on Various Foods Associated with a 10% Fall in Income for Middle Income Households



A factor observed during the Great Recession that is even more relevant in the current environment is the significant reduction in average hours worked across consumers. Data indicate that during the Great Recession, of the increase in time available from forgone work, about 50% went to leisure activities (e.g., watching TV and sleeping) and 30% went to home production (e.g., cooking and cleaning) (Aguiar, Hurst, and Karabarbounis, 2013). In addition to having more time for cooking and cleaning, people also have more time to invest in shopping. For example, Griffith, O'Connell, and Smith (2016) found that U.K. consumers reduced their food expenditures during the Great Recession but did so without reducing the number of calories or nutrients consumed. They found that this was primarily accomplished by consumers expending greater time and effort in shopping by taking greater advantage of sales, switching to generic products, etc. These findings are consistent with those in Nevo and Wong (2019), who found that during the Great Recession, U.S. consumers adopted a variety of tactics to economize on food shopping, including greater use of coupons, more purchases on sale, and more bulk and generic purchases, behaviors which the authors attributed to substitution of time spent at paid work for time spent in home production and shopping.

While firm data do not yet exist during the COVID-19 era, it is possible to imagine an even greater increase in time available for home production over the recent months than during the Great Recession; like the Great Recession, there is an increase in unemployment and underemployment, but there has also been a reduction in commuting times and time spent away from home. These trends would suggest that, like in the Great Recession, the opportunity costs of time have fallen, which may lead to home production (i.e., cooking) and greater time spent searching for lower-cost options. At the same time, consumers may spend less time inside grocery stores if they are concerned about exposure to the coronavirus.

Food Insecurity during the Great Recession

Individuals and households who lost employment during the Great Recession were more likely to be food insecure (Birkenmaier, Huang, and Kim, 2016; Huang, Kim, and Birkenmaier, 2016). Food insecurity increased similarly for households with and without children during the Great Recession; however, the increases for households with children was proportionally larger and reached 21% in 2008 (Andrews and Nord, 2009). Female-headed households with children had higher food insecurity compared to married households across all residence areas (Coleman-Jensen, 2012). Moreover, compared to males within the same household, females have higher levels of perceived food insecurity because of relatively higher levels of involvement in food procurement and preparation (Carney, 2012).

Many families live in the suburbs, and there is evidence that residents of suburbs experienced similar levels of food insecurity as urban residents and that both had higher food insecurity than rural residents during the economic downturn (Coleman-Jensen, 2012). Additionally, food pantry usage grew at similar rates in urban and nonurban areas, increasing 44% between 2007 and 2009, and government spending on nutrition assistance programs increased 27% in 2009 (Andrews, 2010). SNAP caseloads increased 56% during the Great Recession (Saksena et al., 2018), and increased use occurred in areas with pronounced home foreclosures and unemployment and not areas with high SNAP participation prior to the Great Recession (Slack and Myers, 2014). When the economy began to recover in 2009 and unemployment fell, low-income households continued to struggle with food insecurity due to rising inflation and higher food prices so that food insecurity remained relatively high through 2013 (Coleman-Jensen and Gregory, 2014; Cha, Chintagunta, and Dhar, 2015).

While the Great Recession and the pandemic are similar in that they both led to income loss and unemployment, the latter introduced additional barriers that might affect food security including the closure of school cafeterias and restaurants. Preliminary research about the effects of COVID-19 on food security in the United States is mixed. Some research finds virtually no change in food insecurity (Ahn and Norwood, 2020) in the wake of COVID-19, while other research indicates food insecurity has increased by 12 percentage points (Bitler, Hoynes, and Schanzenbach, 2020); however, all results point to households with children being disproportionately impacted and suffering from higher rates of food insecurity. While it will take more time and data to fully understand the impact of COVID-19 on food insecurity, it is clear that households were seeking additional resources. Data indicate that food banks distributed 20% more food than normal between the beginning of March and end of June (Feeding America, 2020).

Time Allocation, Income, and Food Spending

As previously described, the Great Recession affected time availability, and thus shopping and food spending. The findings linking time availability and opportunity cost of time on consumer shopping behavior, however, are broader than those related to the Great Recession and include impacts of income and retirement. We now turn to this additional literature for additional insights on how COVID-19 might affect food spending.

In general, one expects retirements to be associated with an increase in free time and a decrease in disposable income (Attanasio and Weber, 2010). While these changes are largely anticipated, previous research has found a much larger reduction in consumption than would be expected given the reduction in earnings, particularly as it relates to food (Bernheim, Skinner, and

Weinberg, 2001; Battistin et al., 2009; Aguila, Attanasio and Meghir, 2011; Stancanelli and Van Soest, 2012). These effects appear primarily for food but not other items such as spending on durables (Aguila, Attanasio and Meghir, 2011). The so-called "consumption puzzle" seems to be primarily explained by the substantial increase in time available during retirement. Given the lower opportunity cost of time, retirees spend more time in cooking, shopping, and other activities, which lowers the monetary costs of food. For example, Stancanelli and Van Soest (2012) find that among a sample of French consumers facing a mandatory retirement age, retirement increases the amount of "housework" by about three hours per weekday relative to otherwise identical individuals just below the retirement age cutoff. Using variation in pension eligibility as an identification strategy among Italian consumers, Battistin et al. (2009) find that, upon retirement, spending on meals away from home falls more than 40%, while food at home spending remains relatively constant. Taken together, these results suggest more time at home during COVID-19 is likely induce more home production of food; these effects are likely above and beyond whatever impacts were caused by the shutdowns of food service establishments.

Income also affects the opportunity cost of time, and it is generally thought that lower income households face lower opportunity costs of time than higher-income households. Previous research has found that low-income consumers pay less for the same foods than wealthier consumers (Broda, Leibtag, and Weinstein, 2009). Comparing purchases of products with the exact same Universal Product Code (UPCs), Broda, Leibtag, and Weinstein (2009) find a 10% increase in income is associated with a 0.1% increase in price paid per item. This occurs both because lower-income households shop in different locations than their wealthier counterparts and also expend greater time searching for better deals. Other research shows that lower-income households are more likely to find food savings through bulk buying and choosing economy brands than higher-income households (Griffith et al., 2009). While COVID-19 has led to rapid overall food price inflation at grocery stores (Mead et al., 2020), there were likely opportunities for consumers with lower opportunity costs of time to economize. Moreover, to the extent that there was an aggregate shift in time availability during COVID-19, this might have helped keep food price inflation lower than it might otherwise had been without such a shift.

Conclusions

Negative income shocks, like those typically experienced during recessions, result in decreased spending on FAH and FAFH, but particularly on FAFH. Results presented here indicate that some FAH categories (e.g., eggs) might benefit slightly from falling income but that spending decreases for most food categories. While overall food spending typically decreases during a recession, food becomes a more prominent portion of consumers' total budgets. There is heterogeneity across income groups, perhaps because of differences in budget allocation between FAH and FAFH prior to a negative income shock. For example, consumers with the highest income may actually increase spending on FAH during a recession as they stop eating out as much and consume more at home. Further, there will likely be nuanced changes within a food category during a recession, as categories are aggregated by types of food, and different foods within a category (e.g., beef steak and ground beef) may have very different income elasticities.

During the Great Recession, fast food was better positioned to weather the storm than full-service restaurants. As was the case during the Great Recession, fast-food restaurants might be able to implement more effective cost controls during the downturn caused by COVID-19 and capitalize and selling relatively affordable food away from home. Of course, the situation with COVID-19 is different because of the explicit restrictions on restaurant dining in many locales and the voluntary actions on the part of consumers to avoid restaurants to minimize exposure from others. Even if there hadn't been any explicit prohibitions against eating out or voluntary actions to avoid exposure, the evidence presented here suggest that that restaurant spending would have taken a hit for those who experienced falling incomes. We can also expect a need for additional food resources for households with children and particularly for female-headed households. Also, variation in macroeconomic characteristics (e.g., unemployment) across geographic regions is likely an indicator of increased need for food assistance.

Unemployment and the falling income that typically follows also reduce opportunity costs of time. The, likely unwanted, new-found free time during a recession allows consumers to search for deals and lower-priced substitutes. This may allow households to decrease the overall food budget without reducing the number of calories or nutrients consumed. COVID-19 is an unusual recession in the sense that aggregate personal disposable income has remained high because of massive government crisis relief payments and increases in unemployment benefits. Nonetheless, it remains the case that many households have faced adverse economic shocks during COVID-19 and others have faced shifts in their time allocation.

While this paper discussed how food spending may change due to recessions, we do not touch on behavioral responses to negative income shocks or the health implications of the changes in food spending. Prior research has found that meals eaten away from home tend to be higher in calories and lower in diet quality than those eaten at home (Todd, Mancino, and Lin, 2010). Thus, it is possible that the reduction in eating out during COVID-19 may have some health benefits, although it has also been argued that COVID-19 could lead to increases in sedentary behavior, increased caloric consumption, and weight gain (Bhutani and Cooper, 2020). These are lines of research that will likely gain more attention during and after the COVID-19 recession compared to the Great Recession. For example, negative shocks to income may exacerbate behavioral biases such as hyperbolic discounting and increase the likelihood that an individual will exhibit present bias and unduly discount future health outcomes (Haushofer and Fehr, 2013). In an experimental setting, negative income shocks have been linked to preferences for immediate reinforcements, including fast food (Mellis et al., 2018). Food insecurity, in general, has been observed to decrease fruit and vegetable consumption (Kendall, Olson, and Frongillo, 1996). Thus, it is not just the spending that may change during a recession but also our relationship with food and both have societal implications.

For More Information

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