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Agricultural Income and Finance Situation and Outlook: 2024 Edition

Carrie Litkowski, Editor

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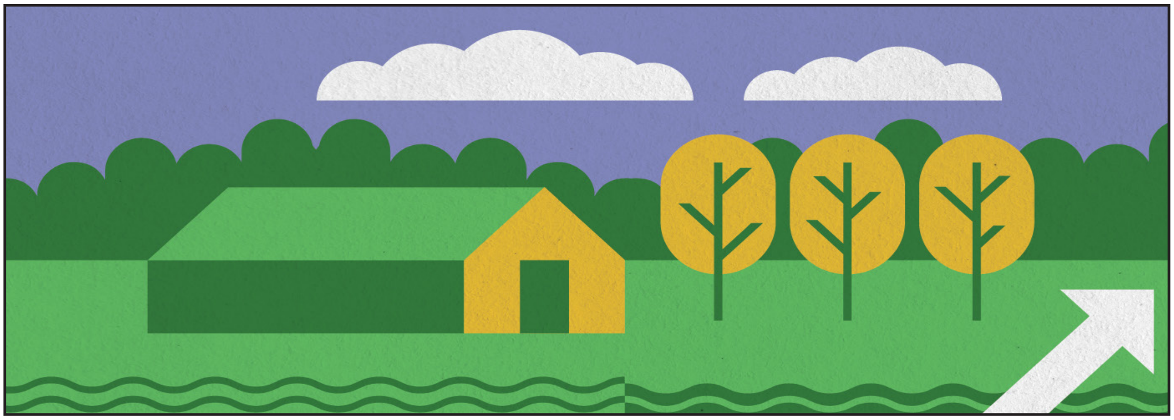

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Abstract

The Coronavirus (COVID-19) pandemic and its associated economic effects had implications for U.S. farms, the households that operate them, and the value of the land being farmed. Farm operations received record-level direct Government payments in 2020 largely due to financial assistance from COVID-19-related programs. Farm households, many of which rely on off-farm employment to supplement their total household income, were susceptible to higher nonfarm unemployment rates in 2020. And, although the pandemic had the potential to adversely affect farmland values, evidence suggests the demand for farmland remained high in 2020 and into 2021. This report examines the distribution of pandemic-related assistance for farm operations, farm household susceptibility and resilience to off-farm unemployment periods, and developments in farmland rental and real estate markets during the first years of the COVID-19 pandemic.

Keywords: farm income, farm households, Government payments, Agricultural Resource Management Survey (ARMS), COVID-19, Coronavirus Food Assistance Program, Paycheck Protection Program, land value, rent, off-farm unemployment

About the Authors

Carrie Litkowski is the editor of this report. This report has three chapters. The first chapter is authored by Anil K. Giri, Dipak Subedi, Christine Whitt, and Tia M. McDonald. The second chapter is authored by Tia M. McDonald, Christine Whitt, Anil K. Giri, and Dipak Subedi, and the third chapter is authored by Noah Miller, Jonathan Law, Scott Callahan, and Clayton Winters-Michaud. There is an appendix related to the reliability of the Farm Income Forecasts which is coauthored by Wilson Collins, Tatiana Borisova, Jonathan Law, and Carrie Litkowski. Christine Whitt was formerly with USDA, ERS. Wilson Collins was formerly an intern with USDA, ERS. All the remaining authors are affiliated with the USDA Economic Research Service.

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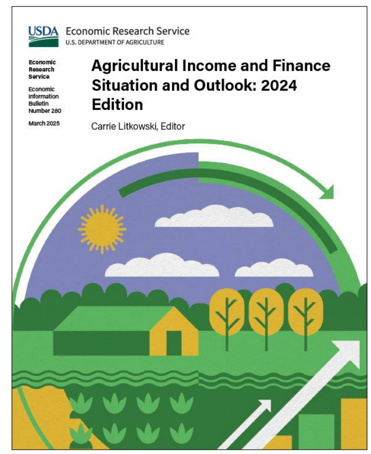


What Is the Issue?

The outbreak of the Coronavirus (COVID-19) pandemic in the United States resulted in significant disruptions to the U.S. economy, including the farm sector. While income levels for the sector as well as for farm households at the median in calendar year 2020 were minimally affected after consideration of receipt of COVID-19 relief, these aggregate statistics mask some notable differences in the financial well-being of farm operations and farm households in the first year of the COVID-19 pandemic. This report presents research on three major farm income and finance topics: COVID-19-related payments to farm operations, farm household susceptibility and resilience to off-farm unemployment, and developments in farmland rental rates and real estate markets.

What Did the Study Find?

In 2020, farm operations received COVID-19-related financial assistance from the Federal Government through the Coronavirus Food Assistance Program (CFAP) and the Paycheck Protection Program (PPP). With these programs, more farm operations received direct Government payments, and average payments were higher in 2020 compared to 2019. In examining how these payments and total Government payments were distributed among farm operations by gross cash farm income (GCFI) category, this study found:

- The program design and payment structure, which included an exception on the adjusted gross income (AGI) limit of $900,000, resulted in larger farm operations (GCFI of $1 million or more), which account for 3 percent of all farms and 61 percent of farm sector gross cash farm income, received more than half of all CFAP and total Government payments in 2020.
- Six percent of farms that received CFAP payments in 2020 would have had a negative net farm income (NFI) in 2020 without those payments.
- While the largest farm operations (GCFI of $5 million or more) account for 57 percent of the sector's total hired labor expense, these farms received only 39 percent of total PPP loans, which was administered by the U.S. Small Business Administration and had certain participation requirements.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

In 2020, farm households experienced levels of off-farm unemployment similar to unemployment levels experienced by nonfarm households. But some farm households saw higher rates of off-farm unemployment and experienced greater income losses in 2020 than other farm households. In particular:

- Farm households in the Midwest and Atlantic regions had the highest rates of off-farm unemployment, and farm households located in metro counties had higher rates of off-farm unemployment than farm households located in completely rural counties.
- Low wage and part-time off-farm workers were more likely to be unemployed compared to high wage off-farm workers.
- Off-farm unemployed households used specific strategies to increase their income in 2020 and compensate for the loss of income due to unemployment of at least one member of the household (like increasing hours worked off-farm and selling an asset for gain); however, the amount of income generated from these activities was greater for more resilient households.

Measures of the farmland market indicate that the COVID-19 pandemic was a period of increased demand for the purchase of cropland and pastureland. In particular:

- Nationally, over the course of the pandemic (2019–21), year-over-year increase in real value of cropland and pastureland averaged 2.2 percent and 0.2 percent, respectively. This represented the first increase in real land values since 2014 (for cropland) and 2015 (for pastureland).
- Real value of cropland and pasture rents decreased over this period by 4.7 and 7.1 percent, respectively, suggesting that this increased demand had not reached rental markets by 2021.
- Price-to-value (PTV) measures suggested farmland values aligned with rents during the pandemic primarily due to low interest rates, while rent-to-value (RTV) measures suggested returns to ownership of farmland remained competitive in a low-interest rate environment.
- A total of 2.9 million acres of cropland and 2.4 million acres of pastureland were sold annually between 2019 and 2020, an increase of 11 percent (cropland) and 12 percent (pastureland) from 2017 to 2018 levels.

How Was the Study Conducted?

The study of the distribution of Government payments was conducted using data from the 2020 Agricultural Resource Management Survey (ARMS). The study on farm households' susceptibility and resilience to off-farm unemployment also used data from the 2020 ARMS, as well as the 2018 ARMS and the Bureau of Labor Statistics 2020 Current Population Survey (CPS). The study of farmland rental and real estate markets used data on historical land values and rents collected by the USDA, National Agricultural Statistics Service's June Area Survey and Cash Rents Survey. The portion of the study examining values, rents, and price-to-value and rent-to-value ratios also used data collected from Federal Reserve Economic Data (FRED). The authors calculated farmland parcel measures with data obtained from CoreLogic's real estate transaction database.

In addition, throughout this report, the data reported on direct Government payment program totals, net cash farm income, and cash receipts agree with USDA, Economic Research Service's Farm Income and Wealth Statistics data product published on February 4, 2022.

Agricultural Income and Finance Situation and Outlook: 2024 Edition

Introduction

The outbreak of the Coronavirus COVID-19 pandemic resulted in significant disruptions to the U.S. economy that affected farms, the households that operated them, and the value of the land being farmed. The COVID-19 pandemic was declared a national emergency on March 13, 2020 (85 FR 15337), which lasted through April 10, 2023 (Public Law No: 118-3). In 2020, total cash receipts for farm commodities fell and production expenses increased, while direct Government payments to farm operations reached an all-time high. Additionally, record-level unemployment in 2020 affected farm households since many farm households rely on off-farm employment to supplement their total household income. But not all farms or farm households were affected the same. The challenges brought on by the pandemic had the potential to adversely affect farmland values, but evidence suggests the demand for farmland remained high in 2020.

Using the most recent survey data through 2020 and other supplemental data, this edition of the Agricultural Income and Finance Situation and Outlook (AIFSO) report examines some of the major financial issues that affected farm operations and farm households in the first year of the COVID-19 pandemic. The report presents research on three major farm income and finance topics: COVID-19-related payments to farm operations (Chapter 1), farm household susceptibility and resilience to off-farm unemployment (Chapter 2), and developments in farmland rental rates and real estate markets (Chapter 3). According to the 2021 Agricultural Resource Management Survey (ARMS), there are 2 million farm operations in the United States on 876 million acres of land. In addition, 4.6 million people live in a household attached to a farm.

AIFSO reports have been produced intermittently since 1984 and compile analyses by USDA, Economic Research Service's (ERS) Farm Income Team and other researchers on pressing agricultural finance issues pertinent to farm operations and households. The reports complement the more frequent Farm Income and Wealth Statistics, which are updated by USDA, ERS three times a year. The U.S. farm income and balance sheet data as of September 5, 2024, including 2024 calendar year forecasts, are presented in appendix A. Appendix B provides information on the reliability of the USDA, ERS farm income forecasts, showing how the initial forecasts generally improve in later data releases. Appendix B also presents a process for producing confidence intervals around the forecasts, providing context on the degree to which forecasts may vary from the final estimates.

Chapter 1: COVID-19-Related Payments to Farm Operations

Anil K. Giri, Dipak Subedi, Christine Whitt, and Tia M. McDonald

Introduction

The farm sector experienced demand and supply shocks, fluctuation in prices, supply chain disruptions, and additional marketing costs because of the Coronavirus (COVID-19) pandemic. Supply shocks were due to bottlenecks in the supply chain of meat products caused by processing plant closures or slowdowns, whereas demand shocks were due to the reduction in food consumed in schools and restaurants following school closures and social distancing rules (Giri et al., 2021a). The pandemic shifted consumers' preferences on where and how food was consumed and changed marketing channels supplied by farm operations. The U.S. Government provided relief and stimulus through multiple programs to lessen the economic effects of the pandemic. This chapter examines the payments from the two largest COVID-19 relief programs to farm operations: the Coronavirus Food Assistance Program (CFAP) and the Paycheck Protection Program (PPP).

CFAP and PPP made a combined payment of $29.5 billion (65 percent) of the $45.7 billion in total direct Government payments to farm operations in 2020 (U.S. Department of Agriculture (USDA), 2022). Total direct Government payments are payments made by the Federal Government to farm operations. They include payments made from the standing Farm Bill programs and programs initiated by the Federal Government using a combination of existing and emergency authorities, such as the Coronavirus Aid, Relief, and Economic Security (CARES) Act. In 2019, total Government payments to farm operations were $22.4 billion, and the average total Government payments for farm operations during 2000–19 were $14.5 billion.

Data

This study used data from the Agriculture Resource Management Survey (ARMS). The 2020 ARMS collected data on Government payments, including from the COVID-19-related programs CFAP and PPP. Although the administrative data from the Small Business Administration (SBA) and Farm Service Agency (FSA) of the USDA have aggregate total payments for COVID-19 programs, the data do not include farm operation financial characteristics, such as gross cash farm income (GCFI) of individual loan recipients. Therefore, this report relied on data collected in the 2020 ARMS.

Direct Government Payments in 2020

Direct Government farm payments are made from the Federal farm programs directly to farmers and ranchers. These are payments from the existing Farm Bill programs and new ad hoc programs designed using authority from different laws. Direct Government payments reached more farm operations, and the average payments were higher in 2020 compared to 2019 because of the COVID-19-related program payments. According to the 2020 and 2021 America's Diverse Family Farms reports, 40 percent of all farm operations received some Government payment in 2020, including COVID-19 relief payments, compared to 31 percent of all farm operations receiving some Government payments in 2019. Furthermore, the average payment for farm operations that received some direct Government payment was higher at $35,646 in 2020 compared to $25,481 in 2019.

Coronavirus Food Assistance Program and Total Direct Government Payments by Farm Sales Class

This report analyzes the distribution of CFAP and total direct Government payments by gross cash farm income categories. Farms are classified based on gross cash farm income (GCFI), a measure of farm revenue that includes Government payments in its calculation but excludes payments made to landlords. It also includes income from production contracts, which are especially prevalent in livestock production. Since the gross cash farm income metric includes Government payments, it is used to classify the farm operations.

The increased Government payment participation rates in 2020 were likely because livestock producers, including cattle and hog producers, were eligible and received payments from CFAP. Giri et al. (2021a) found that 97 percent of commodities, measured in terms of cash receipts, were eligible to receive payments from CFAP.

The Coronavirus Food Assistance Program

There were two rounds of the Coronavirus Food Assistance Program (CFAP) in 2020. The first round of CFAP (CFAP 1) made payments per unit. For nonspecialty crops, CFAP 1 made payments to self-certified unpriced inventory that an eligible producer had vested ownership in on January 15, 2020. Unpriced inventories are those that have not been marketed and, therefore, the value of the crop is at risk to the producer. The second round of CFAP (CFAP 2) made payments for three categories of commodities and included more commodities than round one. Each round of CFAP had a payment limit of $250,000 with some exception for operations with multiple operators. Furthermore, only those operations with an average adjusted gross income of less than $900,000 for the previous 3 tax years (with an exception for those who derived at least 75 percent of their adjusted gross income from farming, ranching, or forestry) were eligible to participate.

Farm operations with a higher gross income are restricted from participating in farm programs. Additionally, there are also payment limitations (per program or in combination) to ensure allocated funds are sufficient to reach the most producers. Generally, operations with an average adjusted gross income[1] of less than $900,000 for the previous 3 tax years were eligible to participate in Government programs, including CFAP. However, with CFAP, there was an exception for those who derived at least 75 percent of their adjusted gross income from farming, ranching, or forestry. There was a payment limit of $250,000 per farm operation for each round of CFAP, with some exceptions for operations with multiple operators.

In 2020, two rounds of CFAP made payments to producers who experienced additional pandemic-related marketing costs, market disruptions, production costs, and reduced farm-level prices, as described in the box (USDA, 2020a & USDA, 2020b). The first round of CFAP payments went to producers who had unpriced inventory as of January 15, 2020. Unpriced inventory consisted of commodities that had not been marketed and were vulnerable to significant price changes. In contrast, producers who had already marketed their commodities were not likely to be affected by price fluctuations. The design of the program likely affected the distribution of payments across operation size. Larger operations were more likely to have unpriced inventory and would also receive higher payments than smaller operations, and this likely resulted in a higher share of larger operations receiving CFAP compared to smaller operations. Larger operations would have the resources, including grain bins, hay barns, bulk tanks, and cold storage facilities, to store inventory and use it as a risk-hedging tool.

[1] Adjusted gross income (AGI) is the individual's or legal entity's Internal Revenue Service-reported adjusted gross income consisting of both farm and nonfarm income.

To capture the variation in the size of farm operations that received CFAP, farms were classified into eight classes based on GCFI. The distribution of Government payments was characterized by the share of each class that received CFAP payments or any Government payment, the share of total CFAP payments received or any Government payments received, and the ratio of Government payments to cash receipts[2] (which do not include Government payments) for each class (table 1.1).

Almost half of the 2 million U.S. farm operations had a GCFI of less than $10,000 in 2020. As the class size increased, the number of farm operations within each class decreased to the extent that less than 1 percent of all farm operations had a GCFI greater than $5 million. The share of agricultural products sold by each size class followed the opposite pattern, with the smallest farms (those with less than $10,000 in GCFI) accounting for less than 1 percent of all cash receipts and the largest farms (those with greater than $5 million in GCFI) accounting for 34 percent of all cash receipts.

The share of farm operations that received Government payments follows a more complex pattern, where neither the smallest nor the largest farm operations had the highest share of operations receiving Government payments. Operations with a GCFI of at least $1 million but less than $5 million received the largest share of Government payments (84.7 percent) in 2020. It is important to note that the adjusted gross income (AGI) limit didn't apply for those operations that derived at least 75 percent of their AGI from farming, ranching, or forestry. Overall, 40 percent of all farm operations received Government payments.

Fifteen percent of all farm operations received CFAP payments despite almost all commodity categories being eligible for payments (Giri et al., 2021a). This was primarily because most farm operations, especially the smallest class of farm operations, were ineligible to apply for the first round of CFAP, and the second round of CFAP didn't begin accepting applications until September 2020. Therefore, some producers who may have received the second round of CFAP payments got them after December 30, 2020, and their amounts are omitted. Less than 5 percent of the smallest class farm operations (comprising almost half of all farm operations) received some CFAP payments. The first round of CFAP made per unit (bushel, pound, etc.) payments to producers on either unpriced inventory[3] as of January 15, 2020, or half of 2019 production, whichever was lower. Consequently, producers who did not have any unpriced inventory could not receive payments from the first round of the program. In 2019 (the only year data on unpriced inventory were collected by ARMS), only 6 percent of farm operations with a GCFI of less than $10,000 had some amount of unpriced inventory. The share of farm operations with unpriced inventory generally increased by farm size. More than 40 percent of farm operations with a gross cash farm income of $500,000 or more but less than $5 million had some unpriced inventory. Fourteen percent of all farm operations reported some unpriced inventory, and this percentage is close to the share of farm operations (15 percent of all farm operations) that received some CFAP payments. In contrast, during the second round, producers were not required to have unpriced inventory to receive payments.

The distribution of Government program payments, including CFAP, increased with farm size, except for the largest class. The largest class (GCFI of $5 million or more) accounted for a smaller share of total Government payments compared to the second largest class (GCFI of $1 million or more but less than $5 million). Farms with a GCFI of $500,000 or more received slightly more than two-thirds (68 percent) of all Government payments and about three-fourths (74 percent) of all CFAP payments (table 1.1). The contribution of each farm class to total GCFI, except the class comprising farms with $5 million or more, was fairly close to the share of total CFAP received and the share of total Government payments received. The farms

[2] Cash receipts for agricultural commodities are defined as the gross income from the sales of crops, livestock, and livestock products during a calendar year.

[3] Unpriced inventory is a harvested commodity held in inventory but not marketed.

with a GCFI of $5 million or more contributed more than 30 percent of total GCFI but only received 19.1 percent of CFAP payments and 15.1 percent of total Government payments. This was most likely because of eligibility to participate in most Government programs, including CFAP, and payment limitations.

Table 1.1
Farm operations that received some Government payments and share of total Government payments, 2020

Farm class by gross cash farm income	Share of total farm operations (percent)	Share of farms that received Government payments (percent)	Share of total Government payments received (percent)	Share of farms that received CFAP payments (percent)	Share of total CFAP received (percent)	Share of total gross cash farm income (percent)
$9,999 or less	48.9	20.4	1.9	4.8	0.7	0.9
$10,000–$49,999	23.5	48.5	5.0	16.9	3.6	3.0
$50,000–$99,999	7.7	59.6	3.9	20.3	2.5	3.1
$100,000–$249,999	8.3	62.3	9.0	31.8	8.1	7.9
$250,000–$499,999	4.8	74.9	12.4	37.8	11.1	10.0
$500,000–$999,999	3.5	78.4	15.8	43.6	16.0	13.9
$1,000,000–$4,999,999	2.9	84.7	36.9	47.6	38.9	31.0
$5,000,000 or more	0.4	73.5	15.1	47.2	19.1	30.2
All	100	40.2	100	15.4	100	100

CFAP = Coronavirus Food Assistance Program.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Coronavirus Food Assistance Program and Net Farm Income

CFAP was designed to provide financial support to farm operations affected by the pandemic. Giri et al. (2023) found that CFAP payments in 2020 ($23.5 billion) were slightly more than half of the total direct Government payments ($45.7 billion) to the farm sector. The payments from CFAP contributed directly to the net farm income (NFI),[4] a common metric to gauge the economic wellbeing of farm operations. The authors of this chapter examined the average NFI for different farm size categories, which showed the share of farms that would have had a negative NFI without CFAP payments. This analysis highlights an aspect of financial risk where farms with a negative NFI risk not being able to cover the costs of production.

Most farms receiving CFAP (except farms with a GCFI between $10,000 and $100,000, as well as those with a GCFI of $5 million or more) had a higher average NFI compared with farms that did not receive payments in 2020 (table 1.2). The largest difference in average NFI for those that received CFAP payments and those that did not was for farm operations with a GFCI of $5 million or above, with those not receiving CFAP payments having a higher NFI of more than $500,000 dollars. This was likely because many farms in this class that received CFAP payments were eligible to receive a large amount of CFAP (up to the maximum

[4] Net farm income is a measure of farm sector profitability and represents annual income from farm production and farm-related income minus expenses paid during the year. It encompasses cash and noncash income and expenses, including changes in inventories, economic depreciation, and gross imputed rental income.

amount of $750,000) because of their level of production and size. In aggregate, the largest farms received the largest share of CFAP payments as well. Although the average NFI across each class of farm operations was not statistically significant, among all farm operations, the average NFI for those farms that received some CFAP payment was significantly higher ($116,114) compared to those farms that did not receive any CFAP payments ($28,544), and the difference was statistically significant.

There was a small share of farms across each size class that would have incurred a negative NFI without CFAP payments (table 1.2). This share ranged from 2 percent (recipient farms in the $9,999 or less GCFI class) to 8 percent (recipient farms in the $10,000 to $49,999 and $100,000 to $249,999 GCFI classes). A nearly identical share of farm operations, 60 percent, had a positive NFI in 2019 and 2020. Six percent of all farm operations that received CFAP payments and had a positive NFI would have had a negative NFI in 2020 if they did not receive CFAP payments. Some farm operations in each class that received CFAP payments would have had a negative farm income without CFAP. This shows that CFAP payments provided economic relief to some large and small farm operations in 2020. Farm operations that received CFAP payments were a subset of all farms that received Government payments, which are a subset of all farm operations in the country.

Generally, the share of farm operations with a positive NFI in 2020 increased as farm size increased. Almost half of the smallest farms (those with a gross cash farm income of less than $10,000) had a positive NFI. The largest farms (those with a gross cash farm income of $1 million or more) represented the highest share of farms (92 percent) with a positive NFI.

Table 1.2
Net farm income with and without Coronavirus Food Assistance Program payments, 2020

Farm class by gross cash farm income	Average net farm income for those that did not receive CFAP payments (U.S. dollars)	Average net farm income for those that received CFAP payments (U.S. dollars)	Share of farms with positive net farm income 2020 (percent)	Share of farms with positive net farm income in 2019 (percent)	Share of farms that received CFAP payments that would have had negative net farm income without CFAP payments, 2020 (percent)
$9,999 or less	606	2,976	48	48	2
$10,000–$49,999	3,692	85	61	65	8
$50,000–$99,999	15,848	9,924	78**	69**	6
$100,000–$249,999	42,381	42,997	78	78	8
$250,000–$499,999	93,001	103,769	83*	77*	5
$500,000–$999,999	171,899	184,724	82	81	5
$1,000,000–$4,999,999	449,367	496,577	88***	81***	6
$5,000,000 or more	3,215,668	2,641,810	92	87	6
All	28,544 ***	116,114***	60	60	6

CFAP = Coronavirus Food Assistance Program.

***, **, and * indicate the difference is statistically significant at the 1-, 5-, and 10-percent levels, respectively.

Source: USDA, Economic Research Service using 2019 and 2020 Agricultural Resource Management Survey data.

Paycheck Protection Program by Gross Cash Farm Income

The Paycheck Protection Program (PPP), as described in the box below, provided almost $6 billion in forgivable loans in 2020 to the farm sector. Farm operations with either a positive NFI and/or positive hired labor expense were eligible to apply and receive PPP loans. These restrictions placed a strict limitation on participation, along with a cap on the loan amount, and not all farm operations could participate in the PPP program. Giri et al. (2021a) found 72 percent of all farm businesses were eligible to receive a PPP loan.

The Paycheck Protection Program

The Paycheck Protection Program (PPP) was intended to help small businesses, including farm operations, keep employees on the payroll and/or rehire furloughed or laid-off workers. It was administered by the U.S. Small Business Administration and supported by the U.S. Department of the Treasury. To be eligible to receive a forgivable PPP loan, a small business had to have positive labor costs and/or profits in the previous year, which could have limited eligibility of some, especially small farm operations. Furthermore, a maximum PPP loan amount was a function of the previous year's payroll and profit but with limitations, including capping the maximum salary. Therefore, the larger operations could have received larger payments but not proportional to their share of labor costs.

The average hired labor expense and average PPP loan size for those farms that received PPP loans increased as the farm size increased (table 1.3). On average, farms with a GCFI of $5 million or more received the highest PPP loan at $321,358. The other farm sizes received less than $50,000 on average in PPP loans. The smallest farms for which data were available (farms with a GCFI of $10,000 or more but less than $50,000) received $6,101 on average in PPP loans. Among all farm operations, the average PPP loan received was $41,475.

Table 1.3

Average and distribution of hired labor expense and Paycheck Protection Program payments, 2020

Farm class by gross cash farm income	Average PPP (U.S. dollars)	Average hired labor expense (U.S. dollars)	Share of total PPP received (percent)	Share of total hired labor expense (percent)
$9,999 or less	NA	178	0.14	0.05
$10,000–$49,999	6,101	682	1.11	0.17
$50,000–$99,999	10,867	4,108	1.29	0.61
$100,000–$249,999	15,676	6,902	4.77	1.44
$250,000–$499,999	19,663	18,901	7.87	3.41
$500,000–$999,999	22,701	40,853	10.29	6.80
$1,000,000–$4,999,999	48,170	162,028	35.89	30.70
$5,000,000 or more	321,358	1,821,745	38.63	56.81
All	41,475	15,439	100.00	100.00

PPP = Paycheck Protection Program; NA = indicates not enough observations are available to report the value.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

The share of total hired labor expense and total PPP received increased with the size of the farm. However, the largest farm class accounted for more than half of the sector's total hired labor expense (57 percent) but only received slightly more than one-third (39 percent) of total PPP. This shows other classes received relatively more PPP compared with their share of the total hired labor expense. It is important to note that eligibility criteria, as well as limits on salary compensation and total PPP loan amounts, affected the actual loan amounts received by operations.

Conclusion

Larger farm operations (GCFI of $1 million or more) accounted for the highest percentage of CFAP received. Many producers of commodities who were not eligible to receive payments from Farm Bill programs were eligible to receive CFAP payments. The inclusiveness of CFAP can partially explain the increase in participation in Government payments from 2019 (31 percent of all farm operations) to 2020 (40 percent). However, this study shows that despite the increase in eligibility, the distribution of CFAP payments closely followed the distribution of total Government payments among farm types, with the majority of the CFAP payments going to the larger farms that typically receive the bulk of Government payments from standing Farm Bill programs. Without CFAP payments, 6 percent of CFAP-receiving farms would have had a negative NFI in 2020. The share of farms with a positive return from farming because of receiving CFAP ranged from 2 to 8 percent.

This study also found larger farms (GCFI of $1 million or more) received larger average PPP loans. This was mostly because one of the eligibility requirements and the payment calculation were based on payroll expense, and larger farms (on average) have higher hired labor expenses. However, although the largest farm class accounted for more than 57 percent of the sector's total hired labor expense, farms in this class only received 39 percent of the total PPP. This suggests that the hired labor expenses offset by PPP payments were potentially greater for the smaller farms (GFCI less than $1 million) compared with the larger operations.

References

Dubman, R., Key, N., Law, J., Litkowski, C., Mandalay, O., Subedi, D., Todd, J. E., & Whitt, C. (2021). *Agricultural income and finance situation and outlook: 2021 edition* (Report No. EIB-228). U.S. Department of Agriculture, Economic Research Service.

Giri, A. K., Subedi, D., & Kassel, K. (2023). *Distribution and examination of Coronavirus Food Assistance Program payments and forgivable Paycheck Protection Program loans at the state level in 2020* (Report No. AP-116). U.S. Department of Agriculture, Economic Research Service.

Giri, A. K., McDonald, T., Subedi, D., & Whitt, C. (2021a). *COVID-19 working paper: Financial assistance for farm operations and farm households in the face of COVID-19* (Report No. AP-090). 2021. U.S. Department of Agriculture.

Giri, A. K., Subedi, D., Peterson, E. W. F., & McDonald, T. M. (2021b). Impact of the Paycheck Protection Program on U.S. producers. *Choices*. Agricultural & Applied Economics Association.

Hoppe, R.A., & MacDonald, J. M. (2013). *Updating the ERS farm typology* (Report No. EIB-110). U.S. Department of Agriculture, Economic Research Service.

Key, N., Law, J., & Whitt, C. (2021, November 30). Chapter 12 bankruptcy rates have increased in most agricultural states. *Amber Waves*, U.S. Department of Agriculture, Economic Research Service.

Schweitzer, M. E., & Borawski, G. (2021). Which industries received PPP loans? E*conomic Commentary, Number* 2021-08, April 1, 2021. Federal Reserve Bank of Cleveland.

Small Business Administration. 2020. *Paycheck Protection Program*.

U.S. Department of Agriculture, Economic Research Service. (2020). *ARMS farm financial and crop production practices.*

U.S. Department of Agriculture, Economic Research Service. (2022). *Farm income and wealth statistics*. Retrieved February 4, 2022.

U.S. Department of Agriculture, Farm Service Agency. (2020a). *Coronavirus Food Assistance Program 1 data*.

U.S. Department of Agriculture, Farm Service Agency. (2020b). *Coronavirus Food Assistance Program 2 data.*

Chapter 2: Farm Household Susceptibility and Resilience to Off-farm Unemployment

Tia M. McDonald, Christine Whitt, Anil K. Giri, and Dipak Subedi

Introduction

In 2020, the unemployment rate rose sharply in the United States as the public grappled with the best way to curtail the spread of the Coronavirus (COVID-19) pandemic. The U.S. nonfarm unemployment rate increased from 3.5 percent in January 2020 to 14.7 percent in April 2020, which represented the largest recorded 3-month increase since the data series began in 1948 (Bureau of Labor Statistics (BLS), 2022). Farm households[5] are not immune to the effects of increased nonfarm unemployment since many rely on off-farm employment to supplement their total household income. Of the 1.96 million farm households in 2020, 70.4 percent had at least 1 member earning an off-farm wage or salary.

Using data from the 2020 and 2018 Agricultural Resource Management Survey (ARMS) and the Bureau of Labor Statistics' 2020 Current Population Survey (CPS), this chapter examines farm households' experience of off-farm unemployment in 2020 through the lens of susceptibility and resilience. Examining the susceptibility to unemployment means understanding the factors that are associated with an increased likelihood of unemployment. Specifically, this chapter focuses on the national drivers of 2020 unemployment, including geographic location, job type, education, and wage levels to better understand susceptibility to unemployment for farm households.

Resilience characterizes the ability to return to normal after an adverse event. This chapter examines the financial coping strategies for unemployed farm households and whether they maintained their level of household income in 2020 relative to 2019. For farm households with at least one member who experienced off-farm unemployment in 2020, those households that experienced a decrease in total household income were characterized as less resilient than off-farm unemployed farm households that were able to maintain or increase their total household income. More resilient farm households received more income, on average, from the sale of capital assets (e.g., real estate, stock, bonds) and/or from employed household members increasing their hours worked off-farm.

Factors Associated With Unemployment

Research examining unemployment in the United States has identified several factors associated with the increased risk of unemployment in 2020. These factors included geographic location, job type, workers' education and wage level, and whether the worker was part time or full time (Falk et al., 2021; Bateman & Ross, 2021). The following analysis used these results for the United States as a guide to direct the analysis of farm household susceptibility to unemployment related to COVID-19. In addition to these national trends, included in this chapter is an analysis based on the characteristics of farm households that tend to vary with reliance on off-farm income, such as farm size, specialization, and the primary occupation of the principal operator.

[5] Farm households includes members who share dwelling units with the principal farm operator on a family farm. The farm household population excludes the households of farm operators who do not live with the principal operator.

Unemployment by Geographic Location

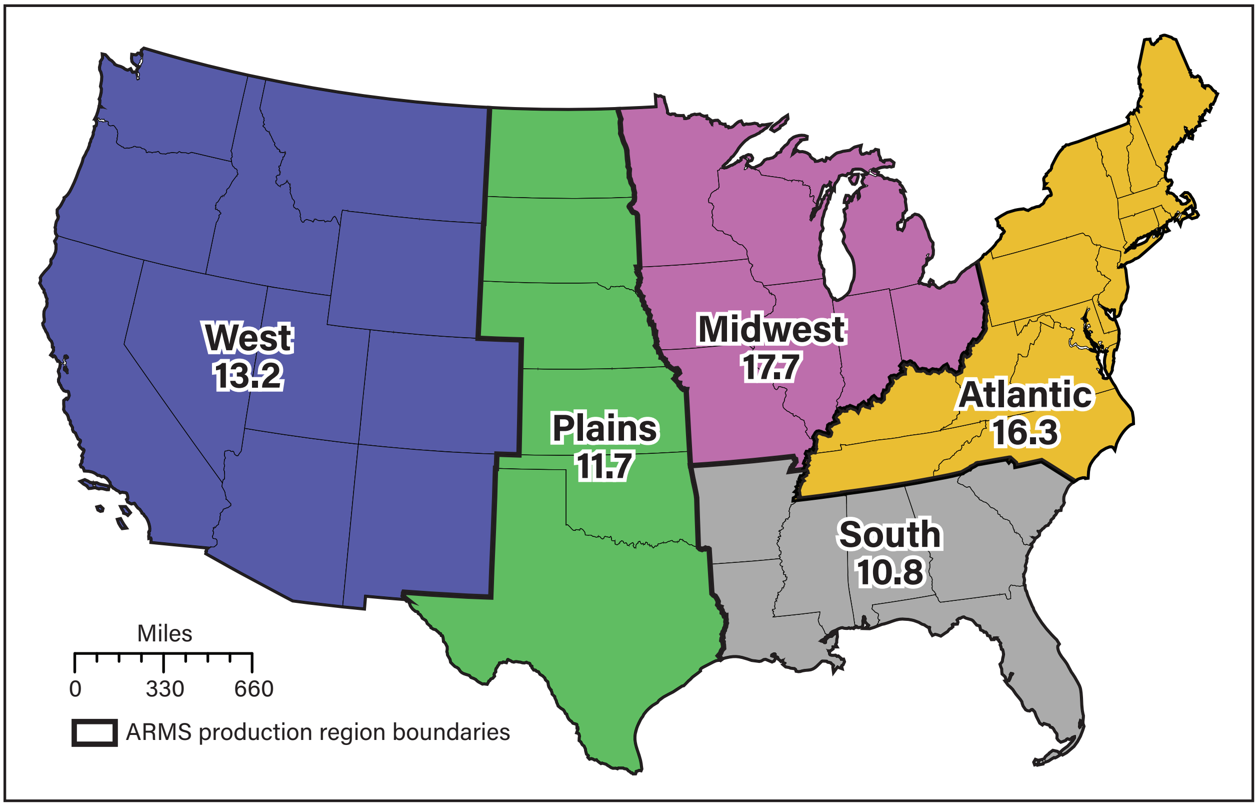
Family farm households experienced similar but slightly higher rates of off-farm unemployment than U.S. households in general in 2020. The Bureau of Labor Statistics (2021) estimated 9.8 percent of all households had at least one household member who experienced unemployment at some point in 2020. Based on the 2020 ARMS data, 11.4 percent of all family farm households reported at least one family member who experienced unemployment or was furloughed due to COVID-19 (hereafter referred to as unemployed in this chapter) at some point in 2020.[6] For the subset of family farm households that reported off-farm wage income (this subset is referred to as wage-earning[7]) in 2020, the share that experienced off-farm unemployment was 15.8 percent. For off-farm wage-earning principal operators, 6.3 percent experienced unemployment. For off-farm wage-earning spouses, 7.2 percent experienced off-farm unemployment. For other household members who worked off-farm, 2.0 percent experienced off-farm unemployment.

Off-farm unemployment rates for family farm households varied by geography, with those in the Midwest having experienced the highest household unemployment (17.7 percent), while family farm households in the South experienced the lowest household unemployment (10.8 percent) (figure 2.1). This trend is similar to the national trend of unemployment where, on average, States in the South had lower rates of unemployment than States in the Midwest and Atlantic regions (Falk et al., 2021).

[6] The ARMS question regarding unemployment in 2020 reads: "During 2020, did the principal producer, principal producer's spouse, or any other member of the household lose an off-farm job or were furloughed due to COVID-19-related disruptions or shut-downs?"

[7] Wage-earning households also include those that reported off-farm unemployment but did not report any off-farm wage income in 2020.

Figure 2.1
Percent of off-farm wage-earning family farm households experiencing off-farm unemployment due to COVID-19-related disruption, by region, 2020



COVID-19 = Coronavirus disease 2019.

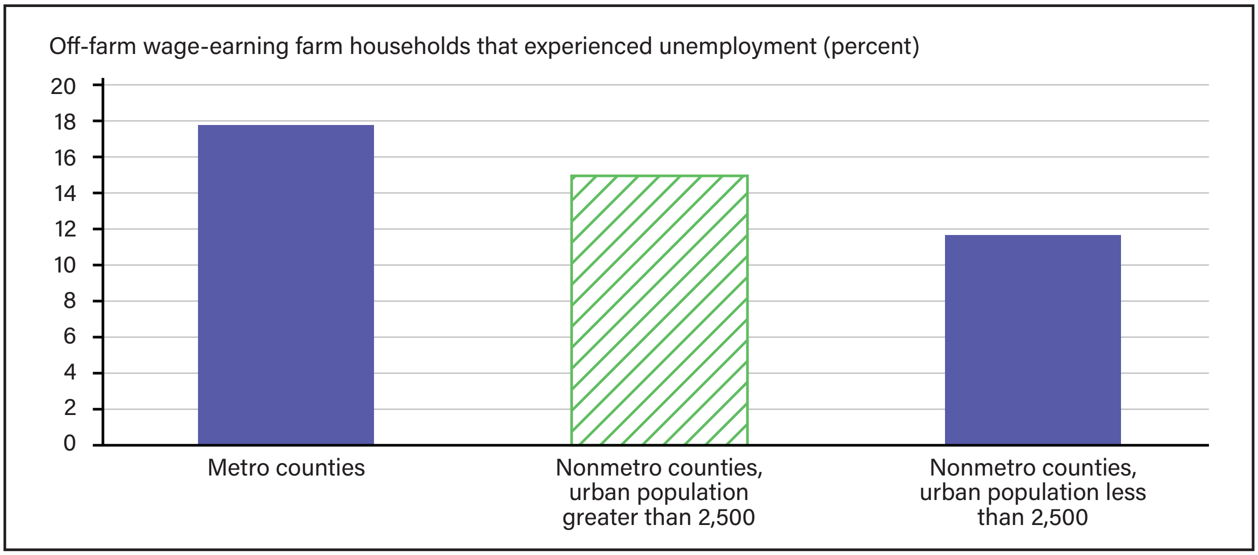
Note: A household experienced unemployment if at least 1 person in the household was unemployed or furloughed due to COVID-19. Regions correspond to the Agricultural Resource Management Survey (ARMS) III Farm Production Expenditure Regions. Alaska and Hawaii data were not included due to data limitations.

Source: USDA, Economic Research Service using 2020 ARMS data.

Rates of unemployment differed for metro and nonmetro counties.[8] Nationally, 2020 unemployment rates were higher in metro counties (Cromartie et al., 2020). Like the national trend, family farm household unemployment was 6.1 percent higher in metro counties than in nonmetro counties with urban populations less than 2,500 (figure 2.2).

[8] USDA, Economic Research Service defines metro counties as counties in metro areas regardless of population, using metro areas identified by the Office of Management and Budget.

Figure 2.2
Family farm household unemployment by metro-nonmetro status and population, 2020



Note: Wald tests were used to test statistical difference between 2 proportions. A statistical difference was not detected between the hashed bar and others (p > 0.10). Nonmetro counties with urban populations less than 2,500 are considered completely rural.

Source: USDA, Economic Research Service (ERS) using 2020 Agricultural Resource Management Survey data and USDA, ERS, 2013 Rural Urban Continuum Codes.

Unemployment by Farm Specialization and Typology

The contribution of off-farm income[9] to total household income for the farm household varies by farm specialization and farm typology, making these key factors to assess the effect of unemployment for farm households. Farm specializations differ in the degree of seasonality and the amount of labor needed to run a farm. Because of these differences across farm specialization, some farm households are more likely to have off-farm employment by one or more household member (Prager et al., 2018). Farm households that specialized in beef cattle, poultry, hogs, and general crops[10] received a higher share of household income from off-farm sources, while those that specialized in dairy, rice, tobacco, cotton, peanut, and cash grains received a lower share from off-farm sources (Todd & Whitt, 2022).

In addition to specialization, another way to categorize farm operations is by size and occupation of the principal operator. To do this, the authors of this chapter used USDA, Economic Research Service's (ERS) collapsed farm typology, which classifies farms as residence, intermediate, or commercial based on the farms' gross cash farm income (GCFI) and the primary occupation of the principal operator (Hoppe & MacDonald, 2013).

Residence farms are smaller, with gross cash farm income less than $350,000, and the principal operator is either retired from farming or has a primary occupation other than farming. The households linked to these residence farms tend to have the highest reliance on off-farm income (Todd & Whitt, 2022; Prager et al., 2018).

Intermediate farms are also smaller, with a GCFI less than $350,000 but the principal operator reports farming as their primary occupation. The households linked to these intermediate farms also tend to have a

[9] Off-farm income includes wages and salaries from off-farm jobs as well as income from dividends, interest, nonfarm businesses, and transfer payments, whereas transfer payments are income from Government sources like Social Security distributions or unemployment compensation.

[10] Operations specialized in general crops produce multiple field crops with no one crop exceeding 50 percent of the operation's total value of production.

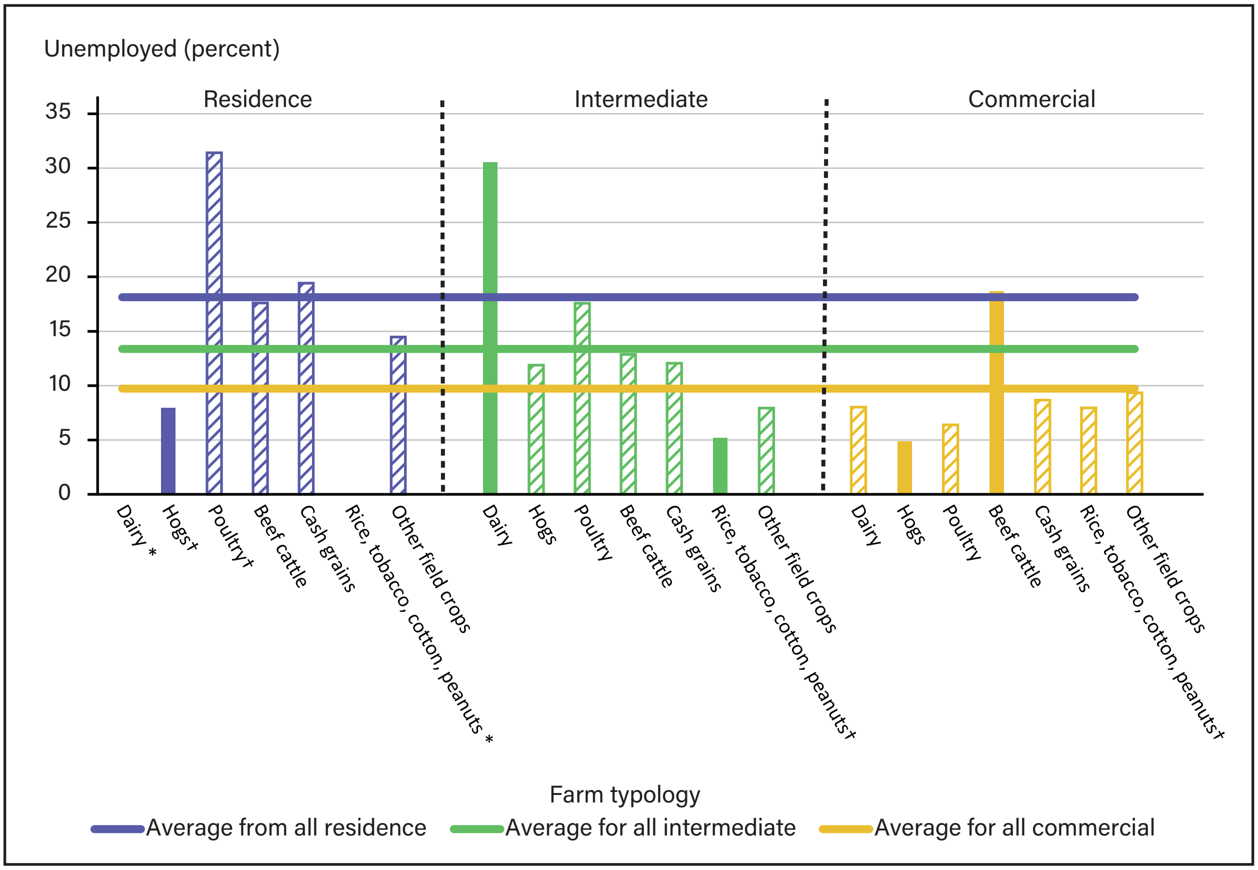
high reliance on off-farm income with off-farm income accounting for more than 50 percent of total household income on average (Todd & Whitt, 2022; Prager et al., 2018).

Commercial farms are the largest with a gross cash farm income greater than or equal to $350,000 regardless of the principal operator's primary occupation, and the associated households tend to have the lowest reliance on off-farm income (Todd & Whitt, 2022; Prager et al., 2018).

The 2020 ARMS data showed that household unemployment varied by the collapsed farm typology and specialization. Wage-earning residence farm households had the highest household off-farm unemployment rate at 19 percent, followed by 13 percent for intermediate and 10 percent for commercial farm households. In terms of specialization, farm households specializing in the production of rice, tobacco, cotton, and peanuts had the lowest household off-farm unemployment, on average, 10-percent lower than all other wage-earning households. Wage-earning farm households specializing in dairy, cash grains, poultry, and beef cattle had higher rates, on average, of off-farm unemployment than farm households with other specializations.

Farm household off-farm unemployment varied widely across farm typology and specialization (figure 2.3). Among residential farm households, those operations that specialized in hogs experienced lower off-farm unemployment compared to the average residence farm household. For intermediate farm households, operations that specialized in dairy experienced higher than average rates of off-farm unemployment, whereas intermediate farm households with operations that specialized in rice, tobacco, cotton, or peanuts experienced lower than average off-farm unemployment. Among commercial farm households, those operations that specialized in beef cattle experienced higher than average rates of off-farm unemployment, and commercial farm households with operations that specialized in hog production experienced lower than average rates of off-farm unemployment.

Figure 2.3
Percent of off-farm wage-earning farm households that experienced off-farm unemployment, 2020



Note: Coefficient of variation is calculated as the standard deviation divided by the mean and measures the amount of variation in the data. Wald tests, a statistical test of differences between 2 proportions, were used to compare percent unemployed in each specialization with the percent unemployed for all farms in the same typology. The hashed bars are not significantly different from all farms in the same typology (p > 0.10). A farm's specialization is determined by the 1 commodity that makes up at least 50 percent of the farm's total value of production. "Cash grains" include corn, soybeans, sorghum, and wheat. "General crops" operations produce multiple crops where no single crop contributes more than 50 percent of the farm's total value of production. Residence farms are those with less than $350,000 in annual gross cash farm income (GCFI) whose principal operator is retired from farming or reports a primary occupation other than farming. Intermediate farms are those with less than $350,000 GCFI whose principal operator reports farming as a primary occupation and is not retired from farming. Commercial farms are family farms with more than $350,000 in GCFI, regardless of the occupation of the principal operator.

* Results suppressed due to disclosure concerns because of too few observations.

† Estimates have a coefficient of variation greater than 50 and are statistically unreliable, consistent with methods used for USDA, Economic Research Service's (ERS) public dissemination of Agricultural Resource Management Survey (ARMS) III data on its Tailored Reports on Farm Structure and Finance web page.

Source: USDA, ERS using 2020 ARMS data.

Some of the observed differences in off-farm unemployment across specialization may be partially driven by geographic concentration of production and unemployment. For instance, the Heartland and Northern Crescent production regions,[11] which comprises the upper Midwest States and New England States, have a higher concentration of dairy production. Farm households in these regions also experienced higher levels of off-farm unemployment, which may explain some of the higher levels of off-farm unemployment seen in intermediate dairy farm households. Conversely, rice, tobacco, cotton, and peanuts are mostly grown in the South, including Texas. The low levels of off-farm unemployment observed for these farm households may be related to the low levels of unemployment in this region.

[11] For more information on production regions, see USDA, Economic Research Service's Farm Resource Regions pamphlet AIB-760 (2000).

Unemployment by Type of Job

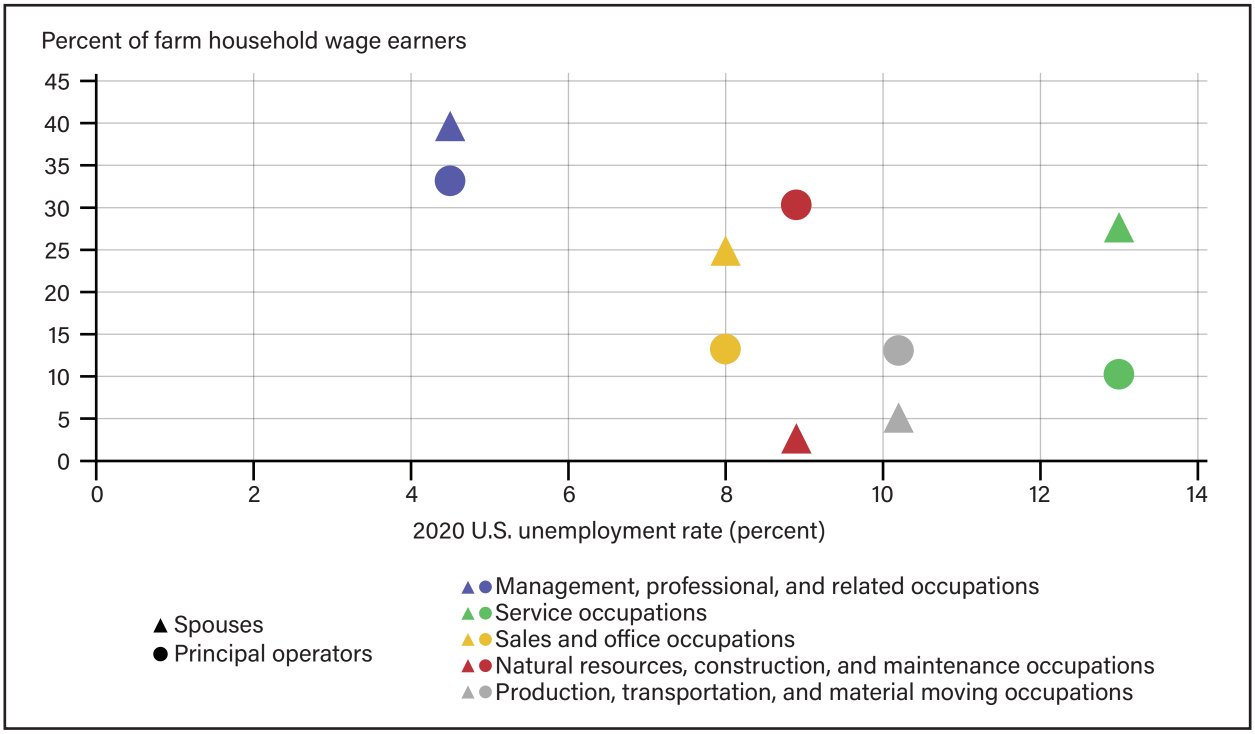
Nationally, there was significant variation in unemployment across job types, or occupational grouping. According to the Bureau of Labor Statistics' (BLS) 2020 Current Population Survey (CPS), job types with the highest levels of unemployment nationally were in the service sector (13.0 percent). Jobs involving production, transportation, and moving materials had an unemployment rate of 10.2 percent (BLS, 2020). Natural resource extraction, construction, and maintenance jobs had an unemployment rate of 8.9 percent. Sales or office work jobs had an unemployment rate of 8 percent (BLS, 2020). The job category with the lowest unemployment rate (4.5 percent) in 2020 were managerial and professional jobs (BLS, 2020).

The 2020 ARMS did not collect data on off-farm employment by job type; however, the 2018 ARMS did collect data on off-farm employment by job type for principal operators and their spouses. The following analysis assumed that there was not a significant change in the job types held by principal operators and their spouses from 2018 to 2020. Therefore, researchers analyzed 2018 ARMS data in conjunction with the unemployment rate by occupational grouping to understand the possible relationship between job types held by principal operators and spouses and off-farm unemployment on farm households.

In 2018, 46 percent of principal operators worked off-farm with 33.1 percent of them working in managerial and professional jobs (figure 2.4). Forty-eight percent of spouses worked off-farm, with 39.7 percent of them working off-farm in managerial and professional jobs. These managerial and professional jobs had the lowest unemployment rate in 2020. This means that most off-farm wage-earning principal operators and spouses were employed in job types with national unemployment rates of 8 percent or greater. These job types include service, sales and office, natural resource, construction, maintenance, material moving, and transportation jobs.

Figure 2.4

Percent of principal operator and spouse off-farm employment in 2018 by job type matched with 2020 unemployment rates for each job type

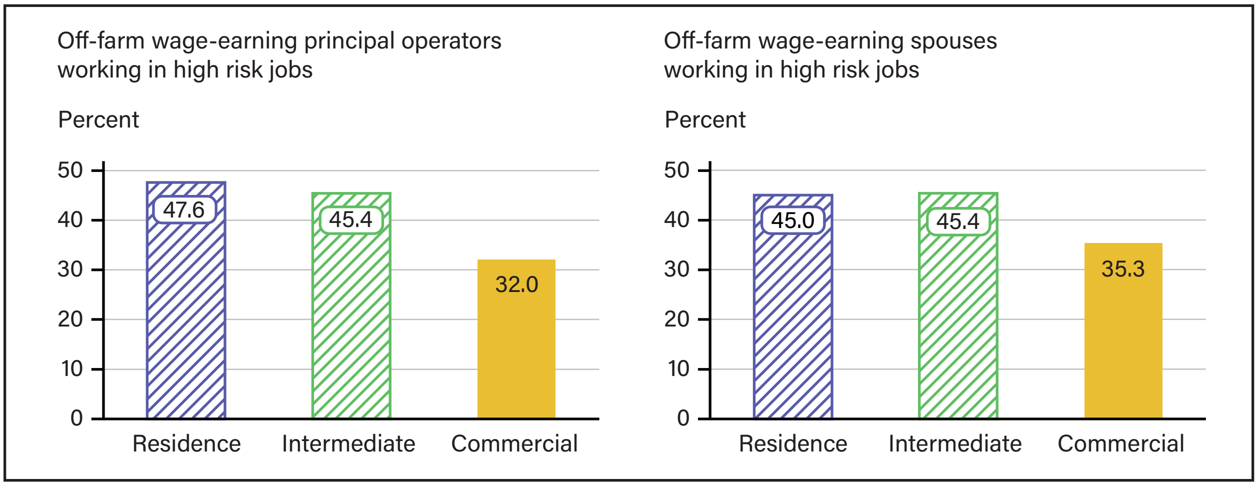


Source: USDA, Economic Research Service using 2018 Agricultural Resource Management Survey (ARMS) data and Bureau of Labor Statistics, Current Population Survey 2020.

To further understand the role of job type in the 2020 experience of off-farm unemployment for farm households, off-farm jobs held by principal operators and spouses (using ARMS 2018 data) were categorized into jobs that had a higher risk of unemployment and those that had a lower risk of unemployment (Gascon, 2020; Falk et al., 2021). Higher risk jobs (defined by the authors as jobs with unemployment rates greater than 5 percent in 2020) include service, sales and office, natural resource, construction, maintenance, production, transportation, and material moving occupations. Lower risk jobs (defined as jobs with unemployment rates less than 5 percent in 2020) include management, professional, and related occupations. There was a lower percent of off-farm wage-earning principal operators and spouses in higher risk jobs from commercial farm households compared with residence and intermediate farm households (figure 2.5).

Figure 2.5

Percent of 2018 off-farm wage-earning principal operators and spouses of farm households working in job types with a higher risk of unemployment in 2020, by farm typology



Note: Job types with a higher risk of unemployment include service, sales and office, natural resource, construction, maintenance, production, transportation, and material moving occupations. The hashed bars are not statistically different from each other (p > 0.10). Residence farms are those with less than $350,000 in annual gross cash farm income (GCFI) whose principal operator is retired from farming or reports a primary occupation other than farming. Intermediate farms are those with less than $350,000 GCFI whose principal operator reports farming as a primary occupation and is not retired from farming. Commercial farms are family farms with more than $350,000 in GCFI, regardless of the occupation of the principal operator.

Source: USDA, Economic Research Service using 2018 Agricultural Resource Management Survey data and U.S. Bureau of Labor Statistics, Current Population Survey 2020.

Unemployment by Worker Characteristics

For the U.S. population, worker-specific factors contributed to an increased likelihood of unemployment: education, part-time versus full-time status, and wage level (Bateman & Ross, 2021; Elka, 2021; Falk et al., 2021). The pattern of unemployment across these characteristics is presented in figure 2.6, giving both the national and farm household perspectives. These comparisons show whether susceptibility to unemployment for farm households followed national trends.

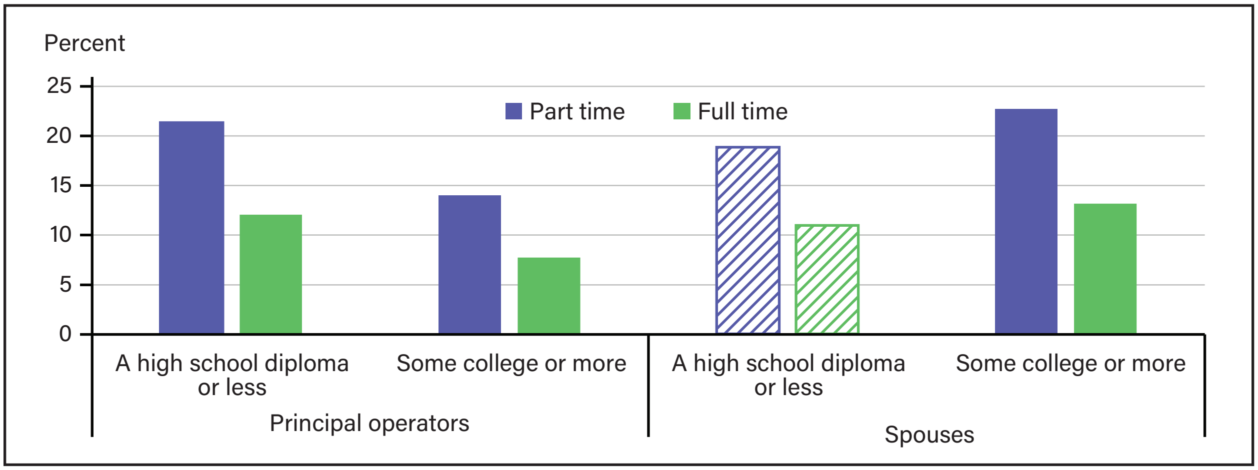
The highest rate of national unemployment (11.7 percent) was experienced by people with less than a high school diploma in 2020 (Elka, 2021). For farm households, this seems to hold true for wage-earning principal operators but not wage-earning spouses. Principal operators with a college degree or more education had a significantly lower share of off-farm unemployment than principal operators with some college education or less. There was no statistically significant difference regarding off-farm unemployment based on education level among wage-earning spouses.

In 2020, the U.S. unemployment rate peaked at 24.5 percent for part-time[12] workers and 12.8 percent for full-time workers (Falk et al., 2021). For farm households, 38 percent of off-farm wage-earning principal operators worked part time, and 62 percent of off-farm wage-earning spouses worked part time. For both principal operators and spouses, part-time status was associated with higher unemployment rates. Unemployment rates for part-time wage-earning principal operators was 18.6 percent compared to 10.6 percent of full-time wage-earning principal operators. Similarly, 20.5 percent of part-time wage-earning spouses were unemployed, whereas only 12.0 percent of full-time wage-earning spouses were unemployed.

[12] The definition for part-time and full-time work comes from BLS where part-time is defined as less than 35 hours worked per week while full-time work is defined as 35 hours or more worked per week.

This pattern of higher unemployment rates persisted for part-time workers by education level (figure 2.6), where off-farm unemployment rates were higher for part-time workers regardless of education level. Differences between part-time and full-time unemployment rates were statistically significant except for spouses with a high school diploma or less.

Figure 2.6
Percent of part-time off-farm and full-time off-farm workers who experienced unemployment, 2020



Note: Part time is considered less than 35 hours worked per week off-farm. Full time is 35 or more hours worked per week off-farm. Adjusted Wald tests, a statistical test differences between 2 proportions, were used to test statistical differences between groups. Statistical differences were only tested within each education category between principal operators by part time/full time and between spouses by part time/full time. The hashed bars are not significantly different from each other ($p > 0.10$).

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

For the U.S. population, low wage workers (wages below the median) were more likely to experience job loss in 2020 (Bateman & Ross 2021). To examine if susceptibility to unemployment is associated with low hourly wages among farm households, median wages were calculated using first quarter hours worked in 2020 and wages earned for each member of the household working off the farm. For off-farm wage-earning principal operators, the median wage was approximately $27 per hour. For off-farm wage-earning spouses, the median wage was approximately $20 per hour. For other off-farm wage-earning household members, the median wage was $6 per hour.[13] Off-farm unemployment for farm households seems to follow the national unemployment trend. On average, principal operators, spouses, and other household members who earned less than the median wage were more likely to have experienced unemployment in 2020.

[13] Wages for other household members are calculated as the difference in total wage income for the household minus wage income from the principal operator and spouse, which are both enumerated in ARMS. This leads to an hourly wage of zero for many other household members who are working off-farm. For these household members, it may mean that they work in-kind (where they may have received payment for their labor in the form of goods or services in lieu of wages) or that their wages are not included in total household income.

Table 2.1
Percent of high and low wage off-farm workers unemployed

	Median wage (U.S. dollars per hour)	Percent unemployed for wage-earners above median wage (percent)	Percent unemployed for wage-earners below median wage (percent)	Statistical difference detected
Principal operators	26.9	4.8	12.5	Yes
Spouses	19.7	3.4	16.9	Yes
Other household member*	6.1	1.7	10.9	Yes

*Wages for other household members are calculated as the difference in total wage income for the household minus wage income from the principal operator and spouse, which are both enumerated in Agricultural Resource Management Survey (ARMS). This leads to an hourly wage of 0 for many other household members who are working off-farm. For these household members, it may mean that they work in-kind (where they may have received payment for their labor in the form of goods or services in lieu of wages) or that their wages are not included in total household income.

Note: Adjusted Wald tests, a statistical test of differences between 2 proportions, were used to detect statistical significance ($p < 0.10$) between groups. Half of wage-earners in each category have wages above the median and half of them have wages below the median.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Resilience to Unemployment

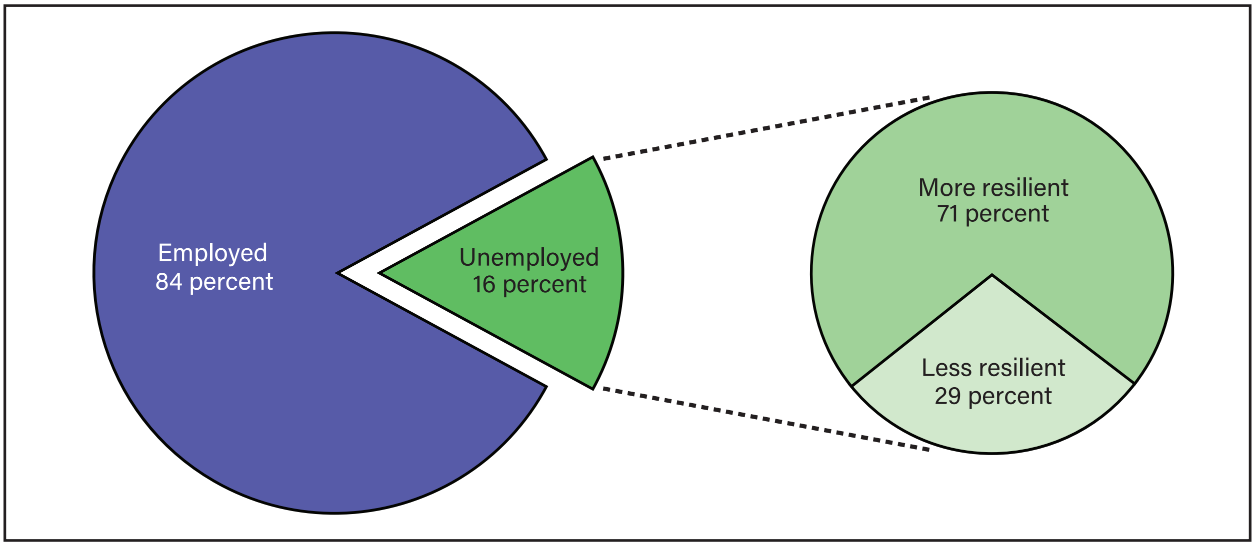
The term resilience describes the ability of an individual, family, or community to return to normal operation after an adverse event. Farm households that were able to maintain or increase their total household income relative to last year, despite experiencing off-farm unemployment, were characterized as more resilient, while unemployed farm households that experienced a decrease in total household income were characterized as less resilient. This measure of resilience is a snapshot of household financial status from 2019 to 2020 and should not be thought of as describing resilience generally. This is one perspective of how farm households withstood the financial strain of unemployment. By examining the differences in the experiences, available compensation, and financial position of these two groups of farm households, the factors that contribute to household resilience to off-farm unemployment can be better understood.[14]

To measure change in total household income, the following analysis used 2020 and 2019 total household income reported in the 2020 ARMS. Total household income includes farm income, off-farm wages, investment income, retirement income, and payments received from Federal programs and capital gains. Among off-farm unemployed households, 71 percent were found to be more resilient (total household income was the same or increased in 2020 relative to 2019) and 29 percent were found to be less resilient (total household income decreased in 2020 relative to 2019) (figure 2.7).

[14] Paired t-tests were performed to assess statistical differences between the two groups.

Figure 2.7

Percent of family farms that were more resilient to off-farm unemployment, 2020



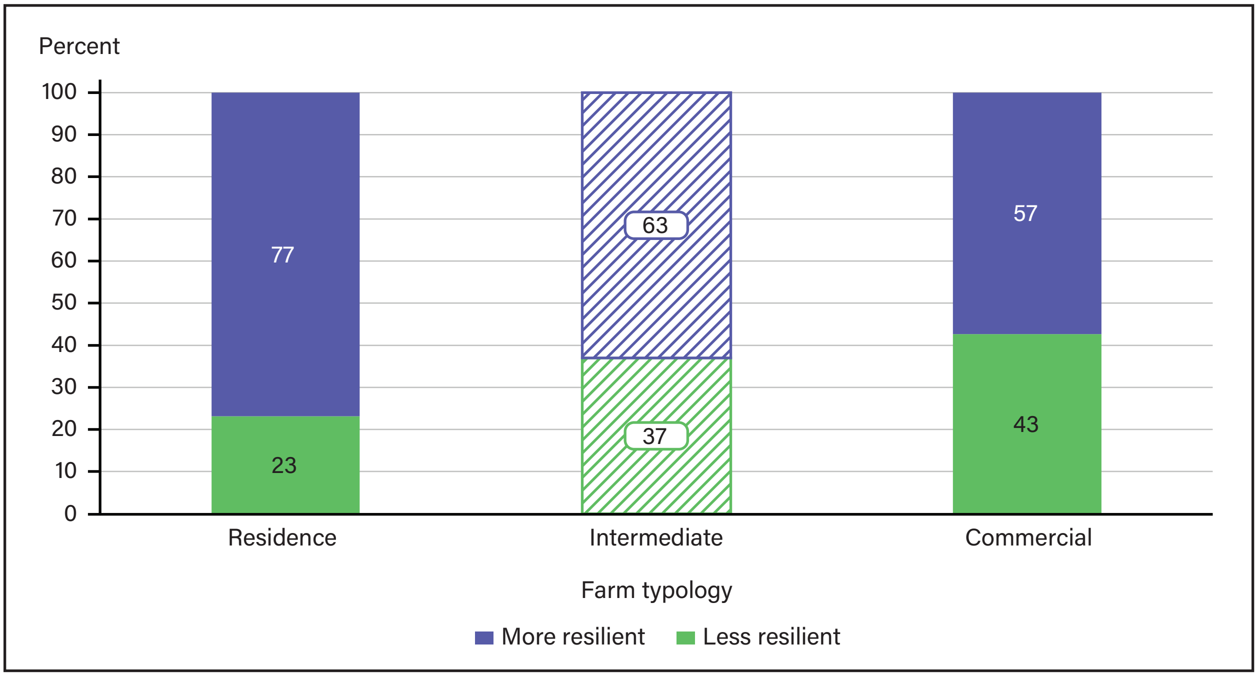
Note: Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Farm household resilience differed by farm size in 2020 (figure 2.8). Commercial farm households rely more on farm household income and less on wage and salary off-farm income sources. Most residence farm households have negative returns from farming, and off-farm income sources contribute the most to total household income. However, in 2020 a greater share of residence farm households (77 percent) was more resilient to off-farm unemployment, compared to commercial farm households (57 percent). Sixty-three percent of off-farm, wage-earning intermediate farm households were more resilient. This percent of intermediate farm households was not statistically different from their commercial or residence farm household counterparts.

Figure 2.8

Farm household resilience to off-farm unemployment, by farm typology, 2020



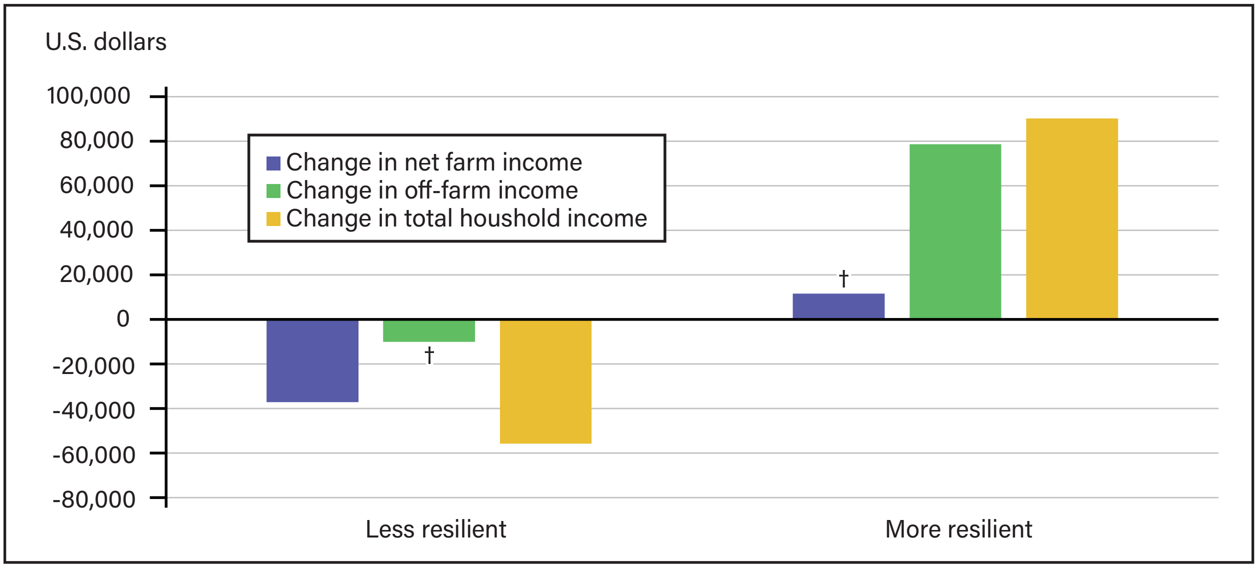
Note: Adjusted Wald tests, a statistical test of differences between 2 proportions, were used to detect statistical significance. The hashed bar was not significantly different from others ($p > 0.10$). Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income. Residence farms are those with less than $350,000 in annual gross cash farm income (GCFI) whose principal operator is retired from farming or reports a primary occupation other than farming. Intermediate farms are those with less than $350,000 GCFI whose principal operator reports farming as a primary occupation and is not retired from farming. Commercial farms are family farms with more than $350,000 in GCFI, regardless of the occupation of the principal operator.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

An examination of total household income shows that, on average, less resilient households experienced a decrease in total household income of $56,768 from 2019 to 2020, whereas more resilient households experienced an increase in total household income of $90,125 in the same period (figure 2.9). In addition to experiencing off-farm unemployment, less resilient farm households experienced a significant decrease in farm income, suggesting that these households may have experienced multiple shocks in 2020.[15] In contrast, more resilient households had an increase in off-farm income, although they experienced off-farm unemployment. Since off-farm income includes sources such as off-farm business income, interest income, dividend income, and off-farm wage income, this increase suggests that more resilient households experienced an increase in one or more components of off-farm income.

[15] It is also possible that farm households experienced health-related events, and for those members who worked on the farm in 2020, a decline in health may have contributed to decreased farm income. While information on the health of farm household members was not collected in 2020 ARMS, the authors analyzed two variables that may be associated with health events: out-of-pocket health expenditures and hours worked on the farm. Neither variable showed an association with decreased farm income, so the authors are unable to determine if decreases in health contributed to decreases in farm income.

Figure 2.9
Net farm income for more resilient, less resilient farm households, 2019–20



Note: Coefficient of variation is calculated as the standard deviation divided by the mean and measures the amount of variation in the data. Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income. Total household income includes farm and off-farm sources of income. Net farm income is income from all farm sources minus production costs and depreciation. Off-farm income includes off-farm wages, dividends, interest, retirement, and income from nonfarm businesses.

† Estimates have a coefficient of variation greater than 50 and are considered to be statistically unreliable, consistent with methods used for USDA, Economic Research Service's (ERS) public dissemination of Agricultural Resource Management Survey (ARMS) III data in its Tailored Reports on the Farm Structure and Finance web page.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Characteristics of More and Less Resilient Farm Households

Losing income due to off-farm unemployment is likely related to the length of the unemployment, the household's reliance on off-farm wage income, and the ability of the household to access alternate sources of income. While off-farm unemployed households did not report the duration of their unemployment in the 2020 ARMS, the authors were able to summarize the characteristics of off-farm unemployed household members as well as the household's reliance on off-farm income and access to alternative sources of income.

In 2020, less resilient farm households resembled more resilient households in terms of who was unemployed in the household (table 2.2). Fifty-nine percent of less resilient farm households and 51 percent of more resilient farm households reported an off-farm unemployed principal operator. Almost half of farm households reported an off-farm unemployed spouse, regardless of resilience. For less resilient farm households, 16 percent had multiple household members unemployed; for more resilient farm households, 17 percent had multiple household members unemployed.

Education levels and whether the primary occupation of the principal operator was farming were further analyzed. The results show that the education level of the unemployed farm household member was similar for less and more resilient farm households. In 2020, there also was no statistical difference detected between farm household groups based on whether the off-farm unemployed principal operator's primary occupation was farming or something else. For less resilient farm households, 65 percent of off-farm unemployed principal operators were primarily employed in a nonfarm job, where the share for more resilient farm households, was 68 percent.

Table 2.2
Characteristics of farm household members who experienced off-farm unemployment in 2020, by resilience

Share of unemployed family farm households where:	Less resilient	More resilient	Statistical difference detected
Principal operator was unemployed	59	51	No
Spouse was unemployed	48	48	No
Other family members were unemployed	10	18	No
More than one family member were unemployed	16	17	No
Unemployed principal operator had high school diploma or less	49	43	No
Unemployed spouse had high school diploma or less	25	27	No
Unemployed principal operator's primary occupation was nonfarming	65	68	No

Note: Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income. Adjusted Wald tests, a test of statistical difference between 2 proportions, were used to detect statistical significance ($p < 0.10$).

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Income Sources for More and Less Resilient Farm Households

In 2020, less resilient households averaged total household income of $72,475 and more resilient households averaged total household income of $168,507. In 2019, average total household income levels were largely reversed. Less resilient households averaged $130,844 total household income and more resilient households averaged $84,529 total household income. The change between 2019 and 2020 average total income for more and less resilient households highlights the volatility in farm income that many farm households' experience.[16] Regardless of these farm households' experience with volatile farm income, less resilient households had a decrease in average off-farm income while more resilient farm households had an increase in off-farm income despite experiencing off-farm unemployment. The following analysis suggests differences in the amount of income received by these households, particularly off-farm sources.

An examination of the components of total household income for 2020 showed a similarity in sources of income for more and less resilient farm households but also differences in the amounts of income from these sources (table 2.3). A similar share of more and less resilient farm households had wage income in 2020, but average wage income for less resilient households was lower than more resilient households. This difference in total wage income may be partially driven by differences in average hourly wage earned by principal operators working off-farm. Principal operators from more resilient households earned an average of $61 per hour, while principal operators from less resilient households earned an average of $34 per hour in 2020. Hourly wages for off-farm wage earning spouses were similar for more and less resilient households ($32 per hour and $25 per hour, respectively).

In terms of other sources of income, despite a similar share in each group with passive income (income from interest, dividends, and retirement), less resilient households averaged approximately $13,000 less in passive income than more resilient households. Less resilient households also had lower farm income than the more resilient households. Farm income for less resilient households was negative, on average, which may indicate the severity of the shock to farm income for these farm households. One source of farm income was Federal programs. In 2020, these Federal programs included Farm Bill programs like the Agriculture Risk Coverage

[16] For more information about farm household income volatility, see Key et. al (2017) and Key et al. (2018).

(ARC) and Price Loss Coverage (PLC) programs and ad hoc programs like the Market Facilitation Program (MFP), Paycheck Protection Program (PPP), and Coronavirus Food Assistance Program (CFAP). Less resilient households were more likely to receive payments from these Federal programs.

Table 2.3
Sources of income for unemployed farm households, 2020

	Less resilient	More resilient	Statistical difference detected
Total household income			
Share with household income (percent)	100	100	No
Average total household income (U.S. dollars)	72,475	168,507	Yes
Off-farm income			
Share with off-farm wages (percent)	83	92	No
Average wages (U.S. dollars)	65,022	119,983	Yes
Share with off-farm business income (percent)	29	31	No
Average income from off-farm business (U.S. dollars)	16,729	48,314	No
Share with passive off-farm income (percent)	99	96	No
Average passive off-farm income (U.S. dollars)	17,043	30,244	Yes
Share with other off-farm income (percent)	33	43	No
Average amount of other off-farm income (U.S. dollars)	5,113	8,438	Yes
Farm household income			
Share with farm household income (or losses) (percent)	100	100	No
Average amount of farm household income (U.S. dollars)	-4,969	10,955	Yes
Share with income from land rental (percent)	34	35	No
Average income from land rental (U.S. dollars)	3,750	4,223	No
Share receiving payments from Federal programs (percent)	53	32	Yes
Average amount of payments from Federal programs (U.S. dollars)	23,110	19,511	No

Note: Passive off-farm income includes income from interest, dividends, or retirement accounts. Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income. Paired t-tests were used to detect statistically significant differences in averages, while adjusted Wald tests for 2 proportions were used to detect statistically significant differences in shares between groups ($p < 0.10$).

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Compensating Income for More and Less Resilient Farm Households

For households facing income loss from off-farm unemployment, there were several possibilities to help compensate. Two possible sources of compensating income (increased hours worked off-farm and the sale of a capital assets) are income-smoothing strategies (ways to even out fluctuations in earned income) that a farm household could have employed to ease hardships caused by off-farm unemployment. Another two sources of compensating income were from Government sources in the form of unemployment compensation and Economic Impact Payments (EIPs), or stimulus payments. While the amounts of unemployment compensation and EIPs received were similar for less and more resilient households, there were differences in hours worked and capital sales.

Increasing hours worked off-farm can be a viable source of supplementary income for some households. Using off-farm hours worked in the first quarter (prepandemic) to establish expected hours worked in subsequent quarters, the authors estimated the extent that hours increased in the remaining quarters relative to expectation for wage-earning principal operators and spouses.[17] The value of these additional wages was estimated using reported wage income for each household member. In unemployed farm households, a small share from each group was able to increase their hours worked in quarters 2, 3, or 4 (table 2.4). For those farm households that could increase their hours worked, the average increase in such hours was similar for both groups. Less resilient households that increased their hours were able to increase 427 hours on average, and more resilient households were able to increase 407 hours on average. The amount of income generated by these additional hours worked was considerably higher for more resilient farm households. For the less resilient farm households, the increased hours resulted in an increase in average wage income of $3,457, compared with an increase in average wage income of $19,740 for more resilient farm households.

The sale of a capital asset is another possible income-smoothing strategy. While a person owns a capital asset, the value of a capital asset can increase or decrease, and if the selling price is higher than the purchase price, than this is considered a positive capital gain. Statistical analysis did not find a difference in the share of farm households that had positive capital gains. There was a difference, however, in the amount of gain generated by the sale. For less resilient farm households, the average gain was $2,846; for more resilient farm households, the average gain was $4,268.

The last aspect of compensating income that was examined was the combined effect of these sources of income. A similar share of less resilient (96 percent) and more resilient (93 percent) farm households received income from at least one aforementioned compensating source. A notable difference between these farm households is the share that received compensating income from multiple sources. For less resilient farm households, only 41 percent received compensating income from multiple sources, compared to 66 percent of more resilient households. More resilient households received compensation from multiple sources which may have been a factor in their higher average total compensation; less resilient households averaged $5,139, whereas more resilient households averaged $8,670.

[17] Since hours worked off-farm tend to be the highest in the first quarter, this method may underestimate the impact of increased hours worked.

Table 2.4

Compensating income for resilient and less-resilient farm households, 2020

	Less resilient	More resilient	Statistical difference detected
Compensating effect of increased hours worked			
Share with increased hours worked off-farm (percent)	2†	3	No
Average estimated increase in hours worked off-farm (U.S. dollars)	427	407	No
Average estimated income resulting from increased off-farm hours (U.S. dollars)	3,457†	19,740	Yes
Compensating effect of positive off-farm capital gains			
Share of capital sales with positive off-farm capital gains (percent)	29	32	No
Average positive off-farm capital gains (U.S. dollars)	2,846	4,268	Yes
Compensating effect of unemployment compensation			
Share received unemployment compensation (percent)	28	39	No
Average reported unemployment compensation (U.S. dollars)	5,637	8,706	No
Compensating effect of EIPs (Economic Income Payments)			
Share receiving EIPs (percent)	83	92	No
Average estimated EIP (U.S. dollars)	2,465	2,651	No
Total compensating income			
Share with at least one source of compensating income (percent)	96	93	No
Share with more than one source of compensating income (percent)	41	66	Yes
Average amount of total compensating income (U.S. dollars)	5,139	8,670	Yes

Note: Coefficient of variation is calculated as the standard deviation divided by the mean and measures the amount of variation in the data. The average income from sources is calculated for those households that receive the income source only. Less resilient farm households experienced off-farm unemployment and a decrease in total household income. More resilient farm households experienced off-farm unemployment and no decrease in total household income. Paired t-tests were used to detect statistically significant differences in averages, while adjusted Wald tests for 2 proportions were used to detect statistically significant differences in shares ($p < 0.10$).

† Estimates have a coefficient of variation greater than 50 and are considered to be statistically unreliable, consistent with methods used for USDA, Economic Research Service's (ERS) public dissemination of Agricultural Resource Management Survey (ARMS) III data in its Tailored Reports on farm structure and finance web page.

Source: USDA, Economic Research Service using 2020 Agricultural Resource Management Survey data.

Conclusion

The analysis of susceptibility to off-farm unemployment identified factors that were associated with farm household unemployment. Farm household unemployment, like national unemployment rates, were related to the geographic location, education level, part-time status, and wage level of the workers. Geographic location was associated with unemployment of off-farm workers in the Atlantic and Midwest regions, which experienced higher rates of unemployment. Workers in metro counties had significantly higher unemployment rates than less populous nonmetro counties. Geographic considerations may have played a role in the higher rates of off-farm unemployment among dairy-producing farm households and lower rates of off-farm unemployment among peanut-, rice-, and tobacco-producing farm households. Wage earners who worked part time off the farm had higher unemployment than those earners who worked full time. Lower education was associated with higher rates of unemployment for principal operators, but that relationship was not detected for wage-earning spouses. Wage rates seemed to be a critical factor in determining unemployment rates, where low wage (lower than the median) off-farm working principal operators and spouses had significantly higher rates of unemployment compared with high wage (higher than the median) off-farm working principal operators and spouses.

The analysis of resilience examined differences in financial characteristics between off-farm unemployed households that maintained or increased their total household income (characterized as more resilient) and off-farm unemployed households that experienced a decrease in household income (characterized as less resilient). Changes in the components of total household income suggest that less resilient households experienced a dual shock of off-farm unemployment and a decrease in net farm income (NFI) relative to 2019. This is especially true for less resilient intermediate farm households that experienced a decrease in off-farm and NFI. More resilient farm households, on average, experienced an increase in off-farm income despite also experiencing unemployment. Access to off-farm income from sources in addition to off-farm wages, as well as other sources of compensating income, seem to contribute to household resilience.

More and less resilient farm households tended to be similar in terms of who in the households was unemployed, the education level of the unemployed worker, and the number of people unemployed in a household. There were differences between more and less resilient farm households in terms off-farm income sources and amounts. More resilient households had, on average, more passive forms of income, such as investments, dividends, or retirement accounts. Additionally, two resilience strategies showed differences between less and more resilient households. The first strategy involved members of an unemployed household who maintained their employment increasing their hours worked off-farm. A similar share of less and more resilient households engaged in this strategy, but income generated for more resilient households was approximately five times more than less resilient households, even with a similar number of hours worked. Another resilience strategy that was examined was the sale of capital assets for gain (positive capital gains). A similar share of less and more resilient farm households had positive capital gains in 2020, but the return for more resilient households was higher than the return for less resilient households.

Historically, off-farm employment has provided farm households with an additional and stable source of income. In years with increased unemployment in the general economy, some farm households can be vulnerable to losing off-farm employment that normally would have offset any farm losses. The research presented in this chapter suggests that there may be additional ways how farm households can bolster their resilience to employment-based income shocks like those experienced during 2020. In addition to traditional reliance on off-farm wage income, expanded off-farm investments may provide additional off-farm income, such as dividends and interest, as well as income from nonfarm business.

References

Bateman, N. & Ross, M. (2021) The pandemic hurt low-wage workers the most—and so far, the recovery has helped them the least. *Research.* Brookings Institute, July 2021.

Bureau of Labor Statistics, U.S. Department of Labor. (2022). *Current Population Survey*, Unemployment rate, LNS14000000. Retrieved February 23, 2022.

Bureau of Labor Statistics, U.S. Department of Labor. (2020). *Current Population Survey*, Unemployment rate by job type, LNU04032215 - 28. Retrieved March 2, 2023.

Bureau of Labor Statistics, U.S. Department of Labor. (2021, April 21). *Employment Characteristics of Families—2020,* USDL-21-0695 (news release).

Cromartie, J., E. A. Dobis, T. Krumel, D. McGranahan, & J. Pender (2020). *Rural America at a Glance: 2020 edition* (Report No. EIB-221). U.S. Department of Agriculture, Economic Research Service.

Falk, G., J. A. Carter, I. A. Nicchitta, E. C. Nyhof, & P. D. Romero. (2021). *Unemployment rates during the COVID-19 pandemic*. Congressional Research Service.

Gascon, C. (2020). *COVID-19: Which workers face the highest unemployment risk? St. Louis Fed on the Economy, 24.* Federal Reserve Bank of St. Louis.

Hoppe, R. A., & MacDonald, J. M. (2013). *Updating the ERS farm typology* (Report No. EIB-110). U.S. Department of Agriculture, Economic Research Service.

Key, N., Prager, D., & Burns, C. (2017). *Farm household income volatility: An analysis using panel data from a national survey* (Report No. ERR-226). U.S. Department of Agriculture, Economic Research Service.

Key, N., Prager, D. L., & Burns, C. B. (2018). The income volatility of U.S. commercial farm households. *Applied Economic Perspectives and Policy*, 40, 215–239. https://doi.org/10.1093/aepp/ppy006.

Prager, D. L., Tulman, S., & Durst, R. (2018). *Economic returns to farming for U.S. farm households* (Report No. ERR-254). U.S. Department of Agriculture, Economic Research Service.

Todd, J., & Whitt, C. (2022). *Farm household income estimates*. Topic Page. U.S. Department of Agriculture, Economic Research Service.

Torpey, E. (2021). *Education pays, 2020.* Career outlook. U.S. Bureau of Labor Statistics, June 2021.

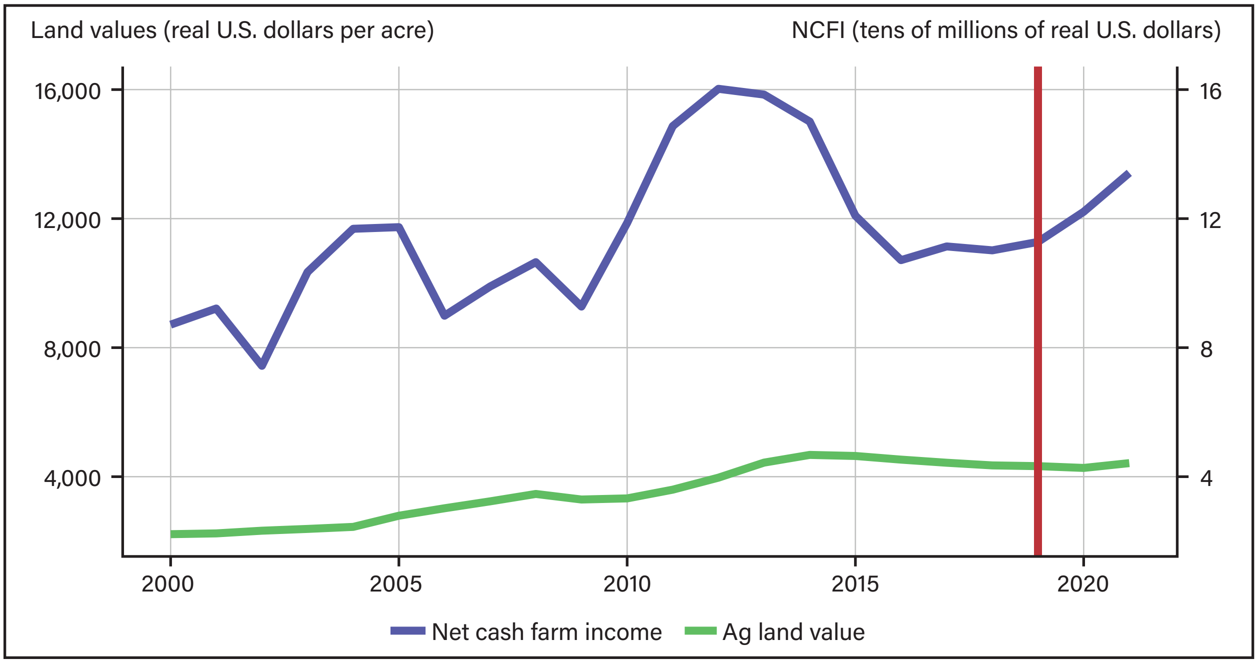
Chapter 3 : Developments in Farmland Rental and Real Estate Markets Pre- and Post-COVID-19

Noah Miller, Jonathan Law, Scott Callahan, and Clayton Winters-Michaud

Introduction

Farmland comprises 82 percent of U.S. farm sector assets in 2021, which makes the value of farmland an important determinant of producer financial wellbeing (USDA, 2022). Historically, returns to farming and ranching have been the driving force in changes in farmland values. However, since 2012, values have proven largely unresponsive to returns. Between 2009 and 2012, real net cash farm income, or NCFI (gross cash income less cash expenses), increased 73 percent (from $92.7 billion to $160.2 billion), and real per-acre agricultural land values increased 21 percent (from $3,292 to $3,969) (figure 3.1). Between 2012 and 2019, real NCFI decreased 30 percent (from $160.2 billion to $110.3 billion), while real per-acre agricultural land values did not reflect the downturn, rising by 9 percent (from $3,969 to $4,327) and declining only slightly after 2014.[18] In 2020 and 2021, real NCFI and real agricultural land values both increased 9.9 percent and 3.5 percent, respectively); however, the magnitude of the growth rates were more muted than in the 2009–12 commodity boom (figure 3.2).

Figure 3.1
U.S. real agricultural land values and net cash farm income, 2000–21

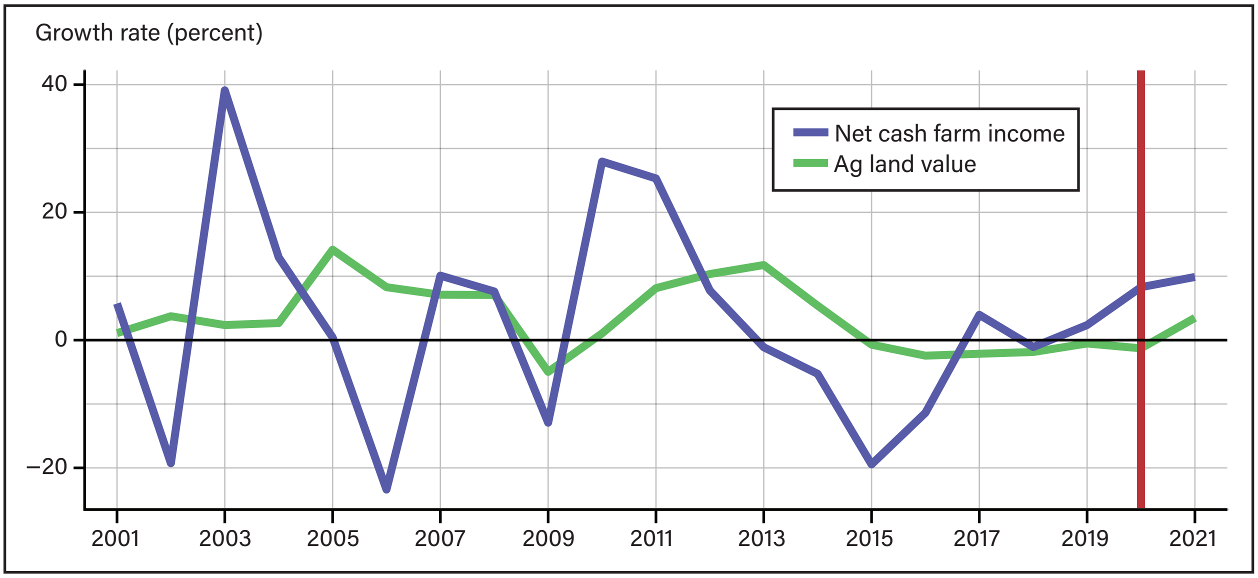


Note: Values are adjusted for inflation (i.e., real U.S. dollars) using the U.S. Department of Commerce, Bureau of Economic Analysis gross domestic price index and rebased to 2021 (2021 = 100) by USDA, Economic Research Service. The red line separates the pre-pandemic and pandemic periods.

Source: USDA, Economic Research Service using land values from USDA, National Agricultural Statistics Service, and net farm income from USDA, ERS Farm Income and Wealth Statistics as of May 9, 2022.

[18] The average annual growth rate in real net cash farm income (NCFI) between 2009 and 2012 equaled 20.3 percent; the average annual growth rate in real agricultural land values between 2009 and 2014 equaled 7.3 percent. The average annual growth rate in real NCFI between 2013 and 2016 (the last year of decreasing NCFI) was -9.3 percent; the average annual growth rate in real agricultural land values between 2015 and 2020 (the last year of decreasing land values) was -1.5 percent.

Figure 3.2
Growth rates in U.S. agricultural land values and net cash farm income (NCFI), 2001–21



Note: The red line separates the prepandemic and pandemic periods.

Source: USDA, Economic Research Service using land values from USDA, National Agricultural Statistics Service and net farm income from USDA, ERS Farm Income and Wealth Statistics as of May 9, 2022.

Several factors may be responsible for the discrepancy between incomes and values. A monetary policy characterized by low interest rates (relative to the historical past) has prevailed since the 2009–13 commodity boom, encouraging demand for and investment in real estate. Direct Government payments, which have become a larger proportion of farm income in recent years, may have also played a role (Farm Income and Wealth Statistics, 2022). These payments include $23.1 billion paid under the Market Facilitation Program from 2018 to 2021 to compensate producers for losses incurred from retaliatory tariffs (Dubman et al., 2021; Farm Income and Wealth Statistics, 2022). More recently, payments from the Coronavirus Food Assistance Program (CFAP) and the Paycheck Protection Program (PPP) were provided to producers to offset market- and labor-related losses resulting from the COVID-19 pandemic. By 2021, producers received $14.7 billion from PPP and $31.3 billion from all USDA (including CFAP) pandemic assistance programs (Farm Income and Wealth Statistics, 2022).

There are two objectives of this chapter: to provide analysis and discussion of key statistics from the farmland market in the early years of the COVID-19 pandemic era (2019–21) and to show how market dynamics in this period differed from those observed from 2000 to 2018.[19] Data from USDA, National Agricultural Statistics Service (NASS) and the U.S. Federal Reserve were used to compare capital gains of cropland and pastureland for these two periods (2019–21 and from 2000 to 2018). The degree that State-level farmland and pastureland rental rates tracked values during these two time periods were also determined. Previous literature examined to what degree the Farm Bill program payments are capitalized into rents and values (Kirwan & Roberts, 2016; Floyd, 1965). Since 2018, ad hoc payments have comprised an increasingly large share of total government payments to U.S. farm operations, from 7 percent in 2018 to 73 percent in 2021 (USDA, 2022).

[19] Due to data availability and the timing of this report, this analysis does not include data drawn from 2022 and 2023 (i.e., more recent pandemic years).

However, it remains unclear how these ad hoc payments have affected land rents and values. State and national price-to-value and rent-to-value ratios were calculated to compare returns to farming and ownership relative to underlying values over these two time periods. Finally, farmland market sales using data on annual farmland sales at the State, regional, and national levels were also examined. A comprehensive, parcel-level transactions database was used to analyze the average cropland and pastureland acreage sold and transaction rates (the amount of acreage sold as a percent of total available agricultural land in a given location). These analyses cannot provide conclusive evidence of the effect of the COVID-19 pandemic on farmland rents and values; however, they can illustrate changes observed in the farmland market during this period.

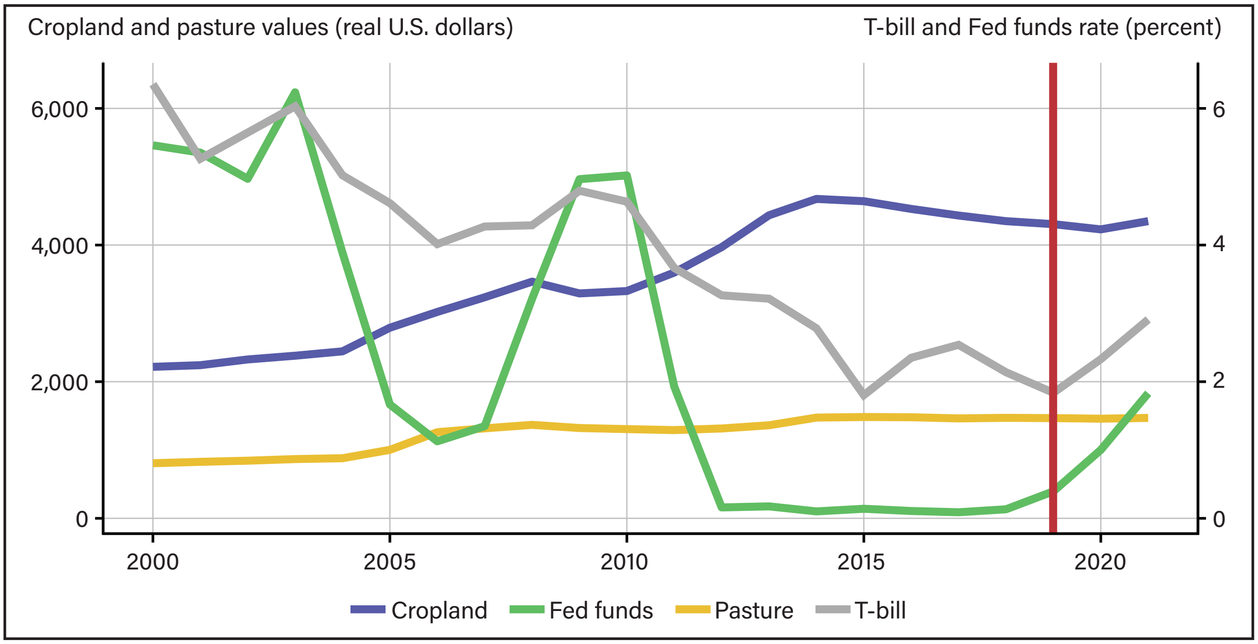
Trends in Land Values and Rents

In August, USDA's National Agricultural Statistics Service (NASS) publishes information on State-level land values in its June Area Survey and supplemental sources and cash rents from its Cash Rents Survey.[20] These data can be used to examine national and regional trends in cropland and pasture values and rents. During the early years of the COVID-19 pandemic (2019–21), real cropland values and pastureland values increased by 2.2 percent (from $4,327 to $4,420 per acre) and 0.2 percent (from $1,477 to $1,480 per acre), respectively (figure 3.3). This represented the first increase in real values since 2014 for cropland and since 2015 for pastureland (when real values peaked at $4,675 per acre and at $1,483 per acre for cropland and pastureland, respectively). Between 2000 and 2018, growth in real pastureland values lagged real cropland values, but the gap was not as sizeable as during the pandemic period. During the 19-year period, the increase in the real value of pastureland was 85.7 percent of the increase in the real value of cropland compared to 9.4 percent during the pandemic years. Changes in real values, and real cropland values in particular, during the longer period (2000–18) were negatively correlated with changes in the 3-year-lagged Federal funds rate (which anchors, among other things, the rates banks set on farmland mortgages) and the 3-year-lagged 10-year Treasury bill (T-bill) rate.[21] Periods of low (high) interest rates were followed by periods of increased (decreased) growth in farmland values. Although the Federal funds rate has risen since 2022, they were still within bounds of historical levels, which suggests that increases in farmland prices may continue in the near term.

[20] The farmland values data collected in the June Area Survey are based on responses made by farmers on the value of their cropland and pastureland if sold under current market conditions.

[21] A 3-year lagged federal funds rate (or T-bill) equals the level of the rate 3 years prior to the current year.

Figure 3.3
U.S. real cropland and pastureland values, 2000–21



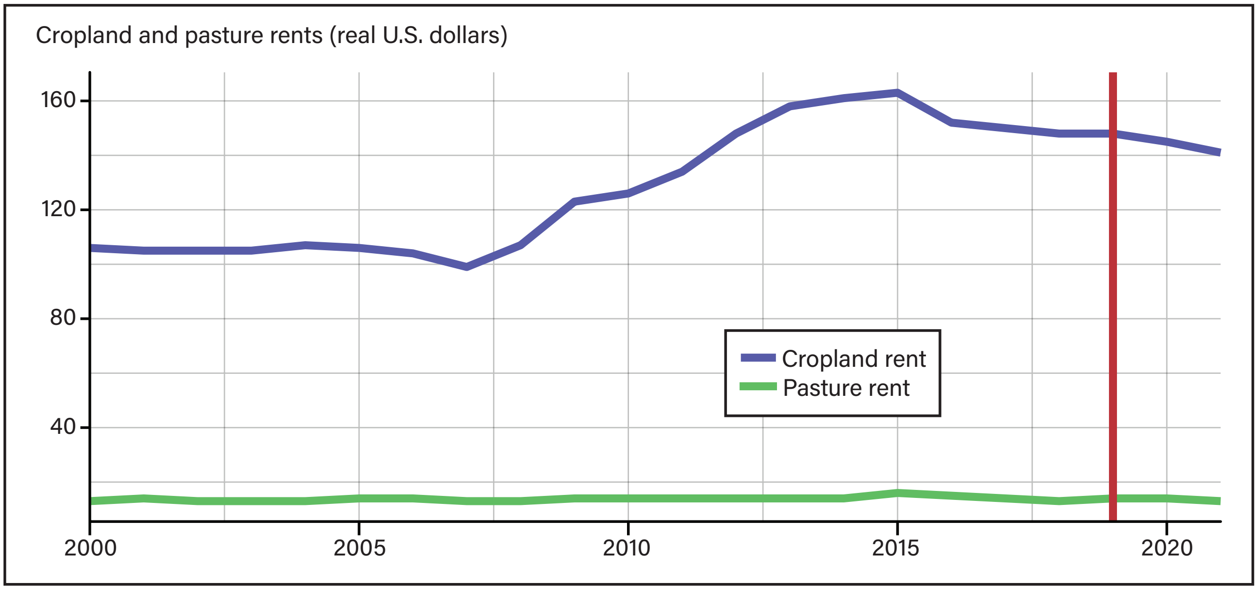
T-bill = Treasury bill.

Note: Cropland and pasture values (U.S. dollars per acre) are relative to the 3-year lagged Federal funds rate (percent) and 10-year Treasury note. Values are adjusted for inflation (i.e., real U.S. dollars) using U.S. Department of Commerce, Bureau of Economic Analysis gross domestic price index rebased to 2021 (2021 = 100) by USDA, Economic Research Service (ERS). The red line separates the prepandemic and pandemic periods.

Source: USDA, ERS using land values from USDA, National Agricultural Statistics Service and the Federal funds rate from the St. Louis Federal Reserve.

While cropland and pasture values were rising, average cash rents (which represent returns to farming) decreased during the COVID-19 pandemic period. Cropland rents decreased 4.7 percent (from $148 per acre in 2019 to $141 per acre in 2021), while pasture rents decreased 7.1 percent (from $14 to $13 an acre) (figure 3.4). Over the last 20 years, however, cropland rents followed values but by a lag of between 1 to 2 years. Cropland and pasture rents peaked in 2015, with national cropland rents at $163 per acre and pasture rents at $16 per acre. If previous trends prevail, it suggests that recent increases in cropland values will be passed through to rents in the near term. Pasture rents were generally flat on average between 1999 and 2021, with the 2021 average pasture rent (of $13 per acre) only slightly lower than that paid at the start of the period ($14 in 1999).

Figure 3.4
Price of U.S. real agricultural land rents per acre, 2000–2021



Note: Cropland and pasture rents comprise the agricultural land rents. Values are adjusted for inflation (i.e., real U.S. dollars) using the U.S. Department of Commerce, Bureau of Economic Analysis gross domestic price index rebased to 2021 (2021 = 100) by USDA, Economic Research Service (ERS). The red line separates prepandemic and pandemic periods.

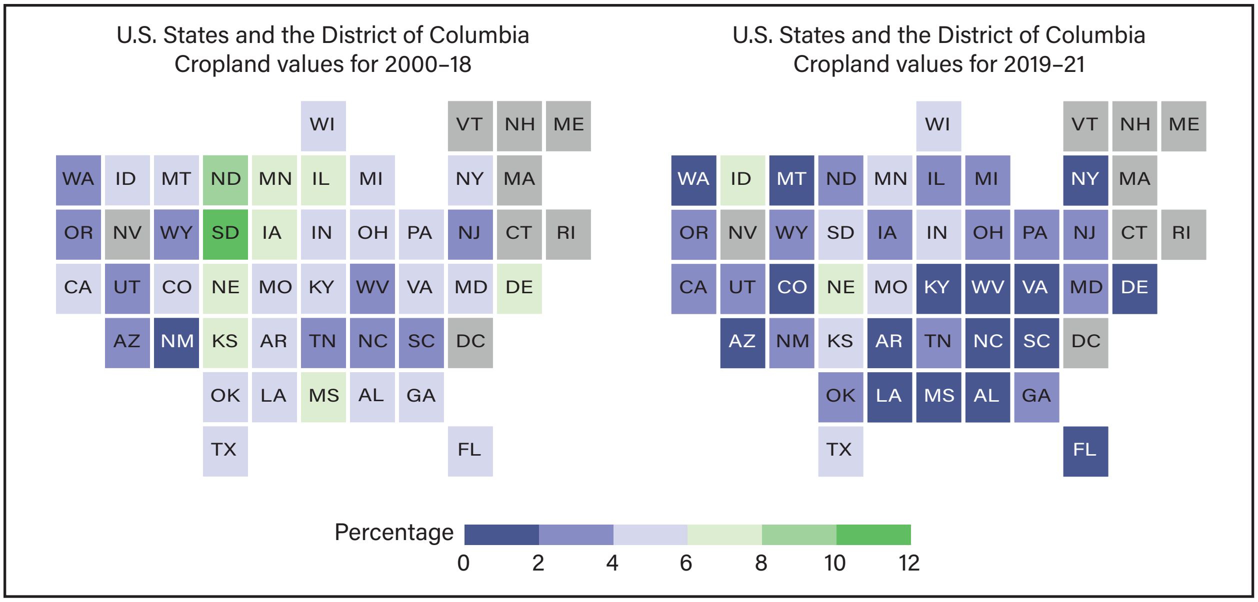
Source: USDA, ERS using land rents data from USDA, National Agricultural Statistics Service.

Aggregate-level statistics are valuable in identifying general farmland market trends, but they can mask regional and local heterogeneities. States experienced average annual percentage changes, or unrealized capital gains, in cropland and pasture values during the prepandemic and pandemic time periods (figures 3.5, 3.6).[22] The prepandemic period is defined as 2000 to 2018, and the pandemic period is defined as 2019 to 2021 (the most recent year's data). States located in the West saw some of the largest cropland capital gains during the pandemic period, with Idaho, Oregon, and California posting annual gains of 8.5, 5.5, and 5.5 percent, respectively. Pennsylvania also experienced high cropland capital gains (5.0 percent annually), but this was not representative of the Mid-Atlantic region, where Delaware ranked last in terms of average annual capital gains (-1.0 percent). Other States with relatively low annual capital gains included Virginia, Arizona, and Michigan which all had cropland capital gains of less than 1 percent. The national average during the pandemic was 3.1 percent.

[22] The capital gains are unrealized in that the data reflect the underlying change in value rather than the price that farmland was sold for. Also note that differences among State-level data may be due to underlying heterogeneities present in the amount and quality of farmland for sale. Values and rents on cropland pastureland were not observed in all years, and these data should not be interpreted as changes from 2000–18.

Figure 3.5

Average annual capital gains, U.S. cropland values, 2000–18 (left panel) and 2019–21 (right panel)

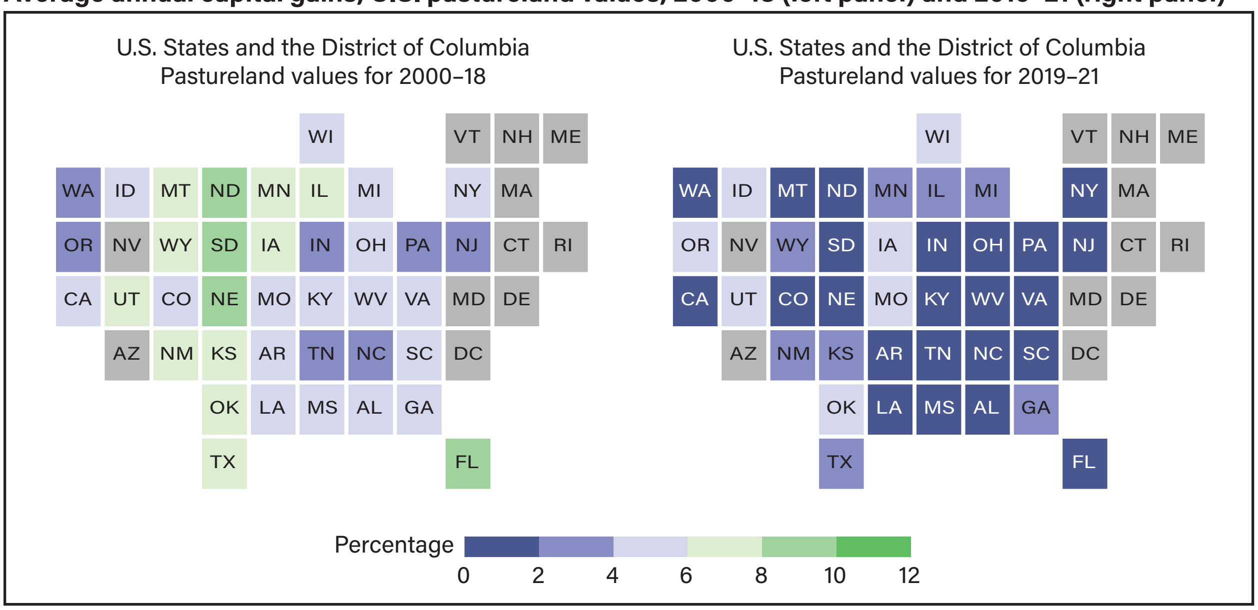


Note: Alaska and Hawaii are omitted in each panel because these data are not reported at the State-level by the USDA, National Agricultural Statistics Service (NASS). Gray shading indicates States where data is unavailable.

Source: USDA, Economic Research Service using cropland values from USDA, National Agricultural Statistics Service.

Figure 3.6

Average annual capital gains, U.S. pastureland values, 2000–18 (left panel) and 2019–21 (right panel)



Note: Alaska and Hawaii are omitted in each panel because these data are not reported at the State-level by USDA, National Agricultural Statistics Service (NASS). Gray shading indicates States where data is unavailable.

Source: USDA, Economic Research Service using pastureland values from USDA, National Agricultural Statistics Service.

How do these numbers compare to the average gain in the prepandemic period (2000–18)? In general, capital gains during the pandemic period were much lower than capital gains in the prepandemic period—the national average of prepandemic cropland capital gains was 5.1 percent. Regional trends were broadly similar, however, with Great Plains States seeing the greatest appreciation in capital gains during the prepandemic period (South Dakota, North Dakota, and Nebraska had capital gains at 10.0, 8.6, and 7.8 percent, respectively). Those States with the lowest capital gains during this period were from the South and Appalachia (North Carolina and Tennessee had capital gains of 3.2 and 3.4 percent, respectively) and the West and Northwest (New Mexico, Utah, and Washington had capital gains of 1.2, 2.8, and 3.5 percent, respectively).

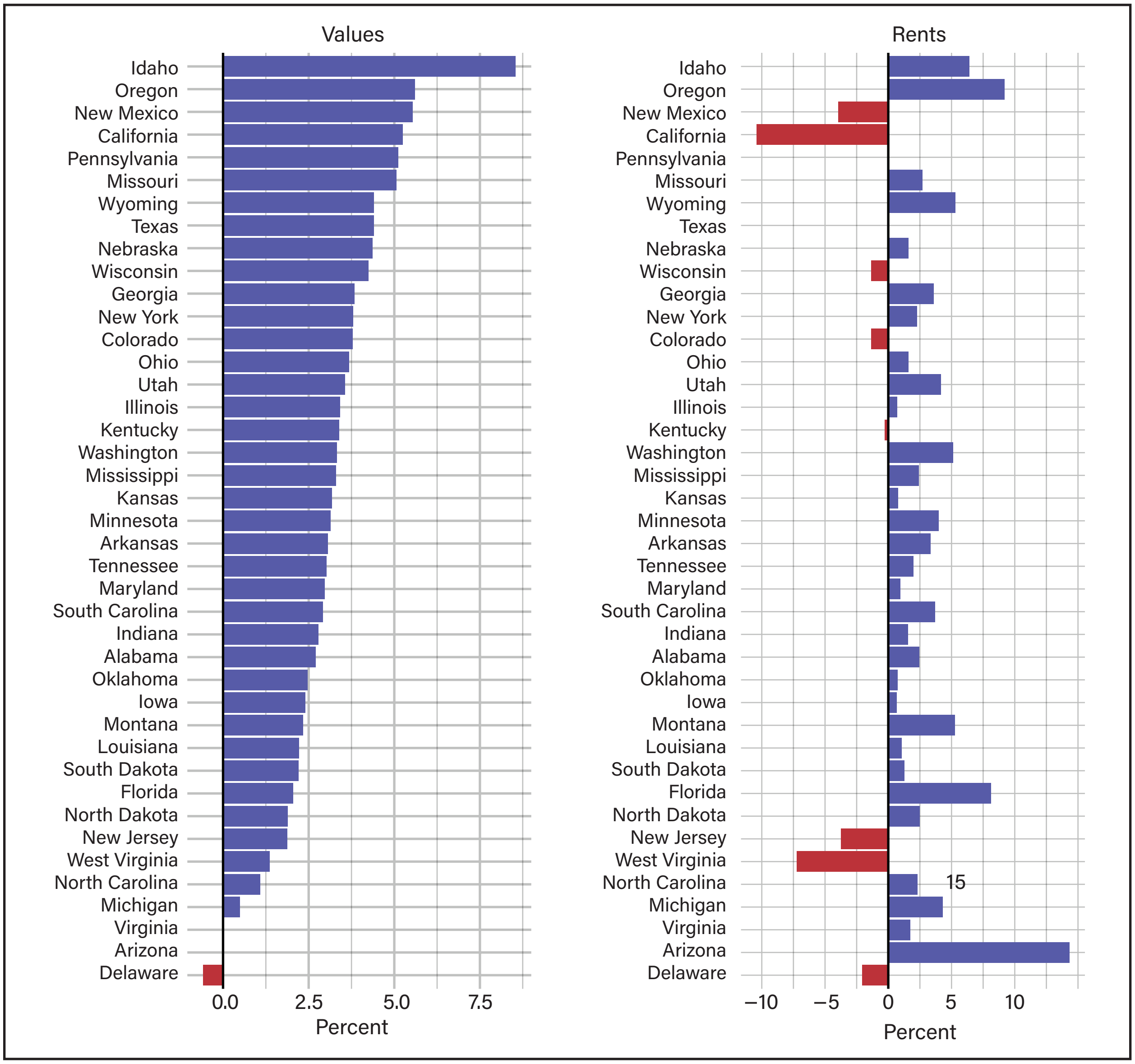
The national average capital gains on pastureland during the pandemic was, like cropland, relatively small at 2.4 percent, but State-level pastureland capital gains did not completely adhere to the same regional patterns as cropland. Many of the States with the lowest cropland capital gains during this period also saw little or no pastureland capital gains. Nebraska, for example, experienced -0.5 percent capital gains for pastureland during the pandemic, indicating that nominal values in the State had fallen. Southern States also saw minimal capital gains on pastureland, with North Carolina and Virginia having capital gains of less than 1.0 percent. However, those States with the largest (more than 5 percent) pastureland capital gains were not from the Great Plains but spread across different regions. Idaho, Oregon, and Utah saw the largest pastureland capital gains at 6.5, 7.0, and 7.0 percent, respectively.

A regional pattern of pastureland capital gains exists for the prepandemic period, and it conforms to the heterogeneity seen in cropland capital gains for the same time. The Great Plains saw the greatest average appreciation in pastureland values, with capital gains higher than 7 percent for all States in the region except Texas. Several States in the western Corn Belt also reported high values (including Iowa and Illinois at 8.1 and 6.9 percent, respectively); however, States in the eastern Corn Belt reported some of the lowest average pastureland capital gains (such as Ohio and Indiana at 4.2 and 2.9 percent, respectively). The national average value was 6.0 percent. Other regions with relatively low average pasture capital gains for this period were the Northwest (Oregon and Washington had capital gains of 3.3 and 2.5 percent, respectively) and portions of the Mid-Atlantic (Pennsylvania and New Jersey had capital gains of 3.8 and 2.1 percent, respectively).

Increases in rental rates should be passed through to land values (Burt, 1986; Featherstone & Baker, 1988). So, are there easily discernible patterns between cropland rents and values for either the pandemic or prepandemic periods? A clear correspondence between changes in rent and cropland values does not exist for either period (figures 3.7 and 3.8). For example, during the pandemic, Arizona's annual cropland capital gains were the second lowest in the Nation at 0 percent, yet the State led the nation in terms of annual appreciation in rents at 14.3 percent. The national average of annual appreciation in rents was 1.8 percent. At the other extreme, California ranked fourth highest in annual cropland capital gains at 5.3 percent but had a 10.4 percent depreciation in rents. A similar disparity was found in the prepandemic period, where New Mexico ranked last in terms of annual cropland capital gains at 1.3 percent but ranked second in terms of appreciation of rents at 8.1 percent.

Figure 3.7

Average annual change in nominal cropland values and rents, by percent, 2019–21

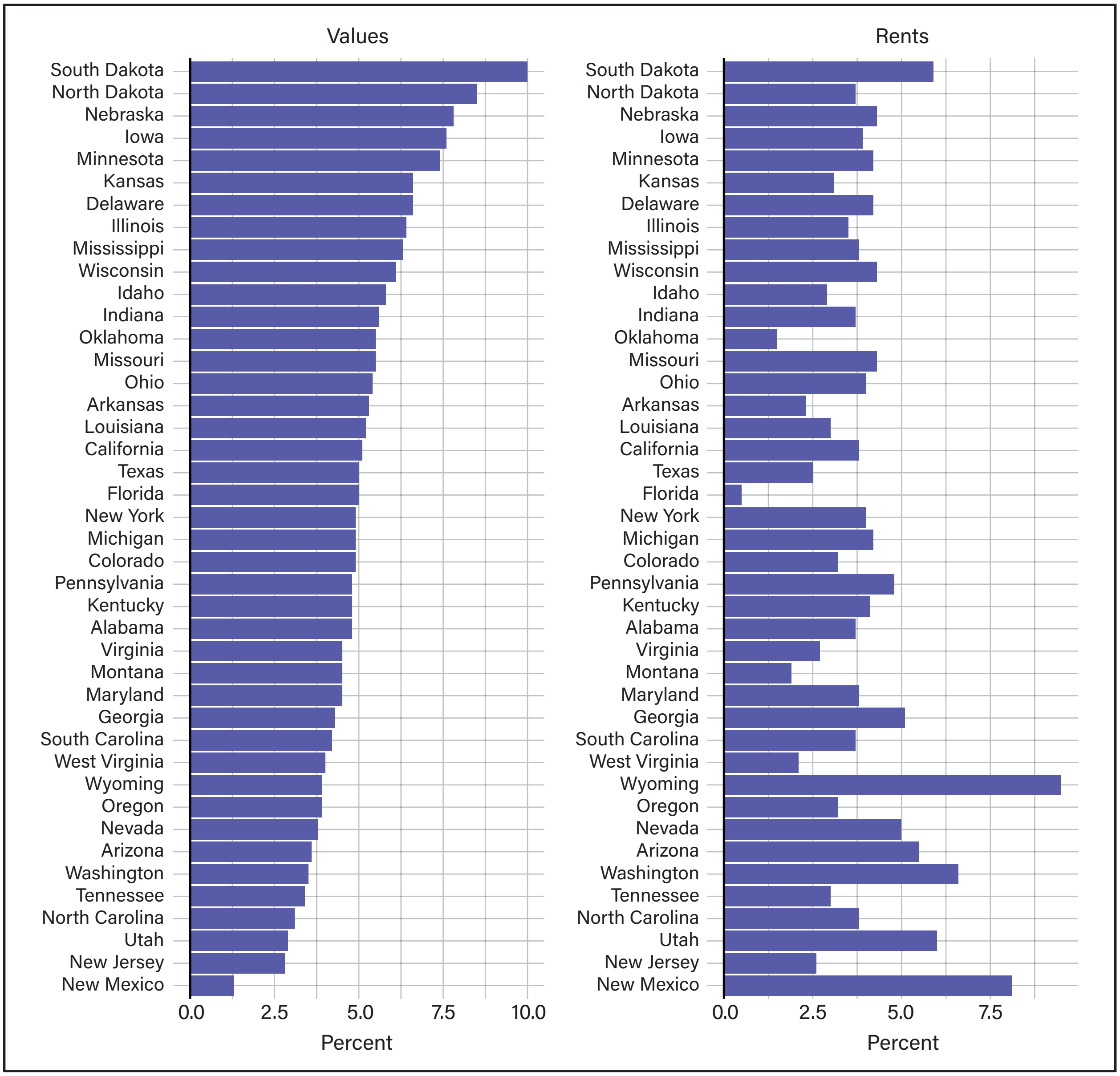


Note: Some States are not shown because USDA, National Agricultural Statistics Service does not provide estimates for these States.

Source: USDA, Economic Research Service using cropland values and rents data from USDA, National Agricultural Statistics Service.

Figure 3.8

Average annual change in nominal cropland values and rents, by percent, 2000–18



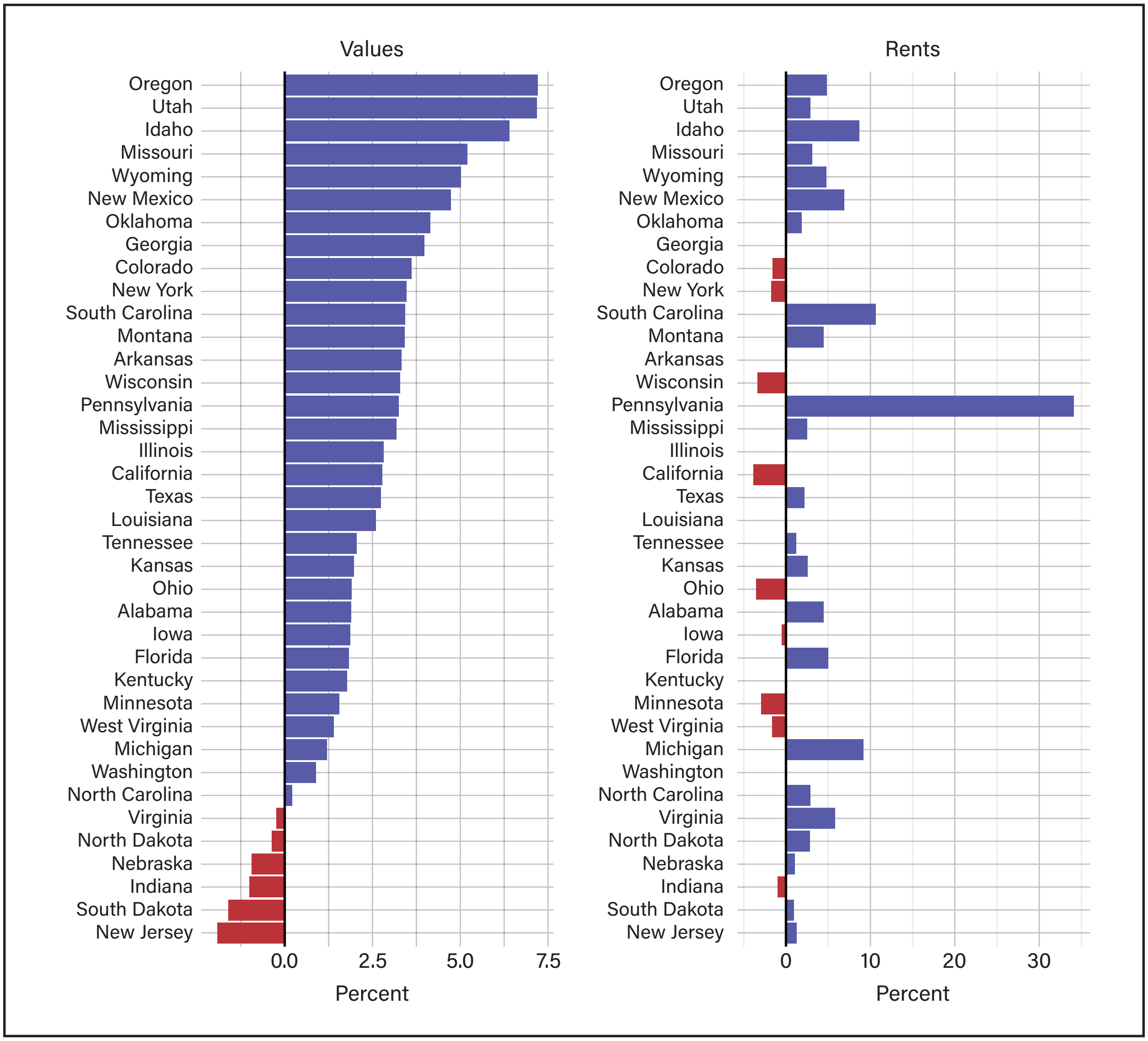
Note: Some States are not shown because USDA, National Agricultural Statistics Service does not provide estimates for these States.

Source: USDA, Economic Research Service using cropland values and rents from USDA, National Agricultural Statistics Service.

Changes in pastureland values and rents in the pandemic and prepandemic periods show a similar lack of correspondence (figure 3.9). Colorado and New York, for example, represent the States with some of the largest increases in nominal pastureland values at 3.6 percent and 3.5 percent respectively, but they both showed negative growth in pastureland rents at -1.6 and -1.8 percent, respectively. Pennsylvania showed below average growth (i.e., 2.5 percent) in pastureland values, yet it experienced explosive growth in rents at 34.1 percent. How does this compare to the prepandemic period? During 2000–18, the national average change in pastureland values was 6.0 percent, and the average change in pastureland rents was 0.8 percent, with States with the largest increases in pastureland values seeing rents change by both below and above the national average (figure 3.10). Nevada ranked first in terms of average change in pastureland values at 13.1 percent but saw rents increase 8.1 percent. Third-ranked Arizona experienced a 5.5-percent decrease in rents.

Figure 3.9

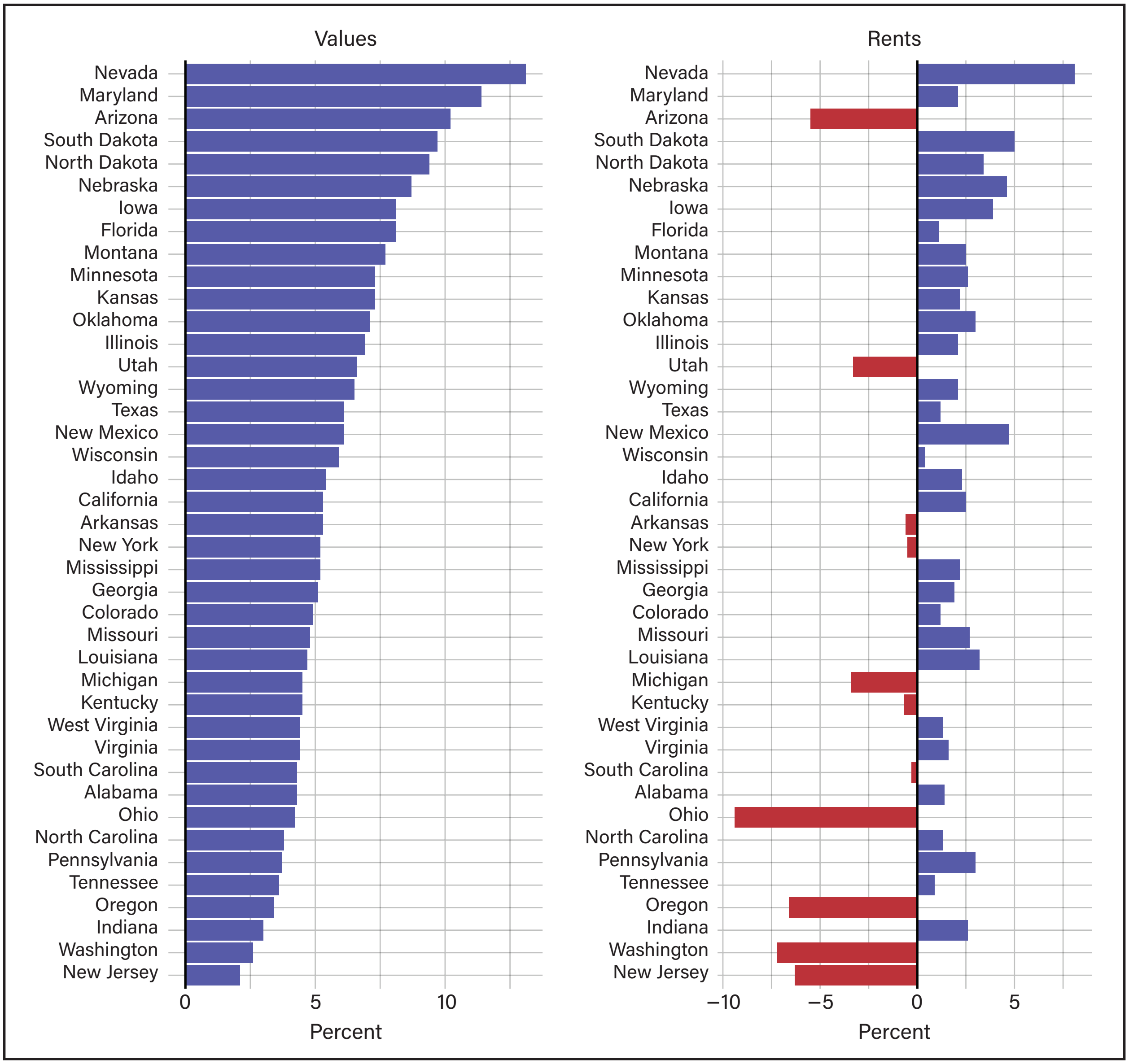
Average annual change in nominal pastureland values and rents, by percent, 2019–21



Note: Some States are not shown because USDA, National Agricultural Statistics Service does not provide estimates for these States.

Source: USDA, Economic Research Service using pastureland values and rents from USDA, National Agricultural Statistics Service.

Figure 3.10
Average annual change in nominal pastureland values and rents, 2000–18



Note: Some States are not shown because USDA, National Agricultural Statistics Service does not provide estimates for these States.

Source: USDA, Economic Research Service using pastureland values and rents from USDA, National Agricultural Statistics Service.

One explanation for the lack of correspondence between values and rents may be that rental contracts are slow to adjust to changes in cropland and pastureland values, which may make a real-time comparison (as opposed to a lagged in-time comparison) difficult (Featherstone et al., 2017). Alternatively, the discrepancy in cash rents, which represent the financial return of farming and ranching, and values may indicate that changes in farmland values are not being driven solely by fundamentals in the agricultural economy. To consider this point in more detail, the following analysis of price-to-value and rent-to-value ratios was performed.

Price-to-Value and Rent-to-Value Analysis

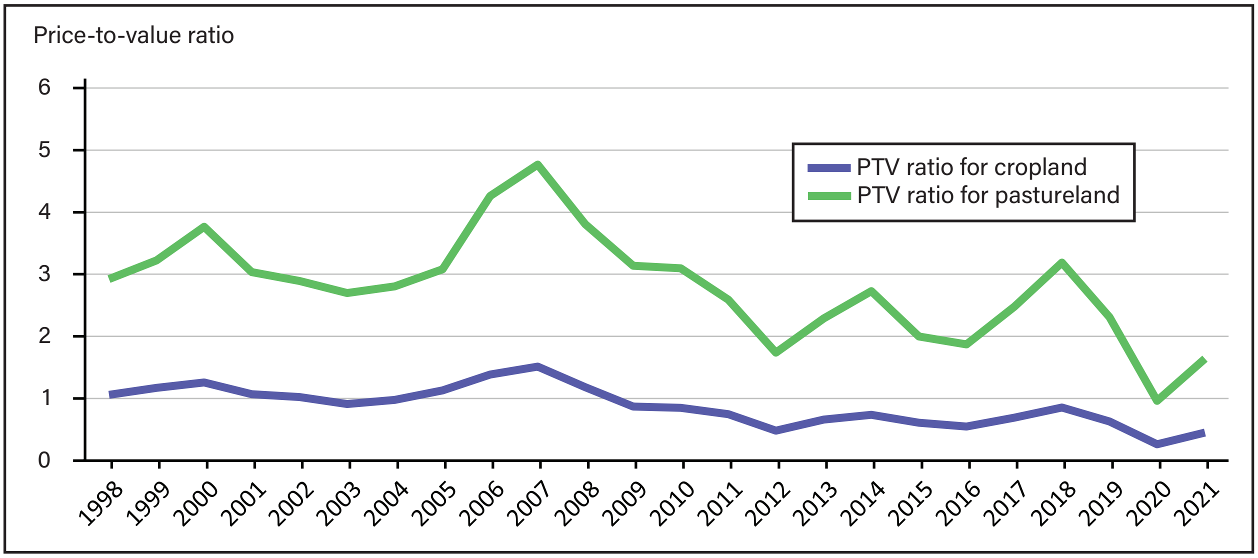
The capitalized value, defined as the ratio of cash rent per acre to the 10-year T-bill rate, represents an estimated total of future discounted cash flows to owning an acre of farmland. The price-to-value (PTV) ratio, which is the ratio of land price per acre to capitalized value, in turn indicates whether cash returns per acre fully support farmland value (Burns et al., 2018). A PTV ratio below 1 indicates that returns support land values, while a PTV ratio above 1 indicates that they do not. The rent-to-value (RTV) ratio, defined as the ratio of cash rent per acre to land price per acre, is an indicator of the rate of return to owning land and can be directly compared with the rates of return on other investments, such as T-bills.

Previous studies established the effects of other, nonagricultural uses on agricultural land values. Proximity to urban areas or population centers, access to recreational (including hunting) or natural amenities, or mineral rights are some farmland characteristics that can affect values. Therefore, returns to agricultural production likely do not account for all of the value of any given agricultural land parcel, although the proportion of value accounted for by other uses varies depending on the parcel's location and characteristics. Borchers et al. (2014) found, using data from the contiguous 48 States, that agricultural use value, on average, accounted for less than half of a parcel's value—a 1-percent increase in rent explained a 0.25-percent increase in cropland value and a 0.14-percent increase in pastureland value. Hardie et al. (2001) also found that farmland values in the mid-Atlantic region were inelastic with respect to changes in farm revenues. With all other things being equal, areas for which more of a given parcel's value is accounted for by nonagricultural factors will have higher PTV ratios and lower RTV ratios.

The price-to-value ratio for cropland in the United States has generally been on a downward trend since 2007, which suggests that farmland has become more undervalued as an investment. This trend continued in the first 2 years of the COVID-19 pandemic (2020 and 2021). In 2020, the first year of the pandemic, the PTV for cropland fell from 0.63 to 0.26, its largest drop during the study period. It rose to 0.45 in 2021, albeit from the lowest level seen during the study period (figure 3.11). It has remained below 1 since 2009, suggesting that rents (and therefore farmland earnings) support land values. While the PTV ratio for pastureland has exhibited a similar downward trend during this period, it has been significantly higher than the cropland PTV ratio and remained well above 1 most years, suggesting that rents alone do not support land values for pastureland. In many areas, pastureland may be more suitable for development than cropland and may be more sought after for exurban[23] development due to certain characteristics, such as having more tree cover (Doye & Brorsen, 2011). In addition, pastureland is more often sought by small or retired farmers, who tend to derive most of their income from off-farm sources and may therefore be willing to pay higher prices. On average, earnings from (and rents for) pastureland were lower than for cropland; in 2020, the average value of production per acre for corn farms was $600, while the average value of production per acre for cattle farms (the largest livestock commodity by far in terms of acreage) was $141 (USDA, 2020). Lower rents would result in higher PTV ratios, holding all other factors equal.

[23] An exurb is a sparsely populated area adjacent to a suburban development.

Figure 3.11
Price-to-value ratios for cropland and pastureland, 1998–2021



PTV = Price-to-value.

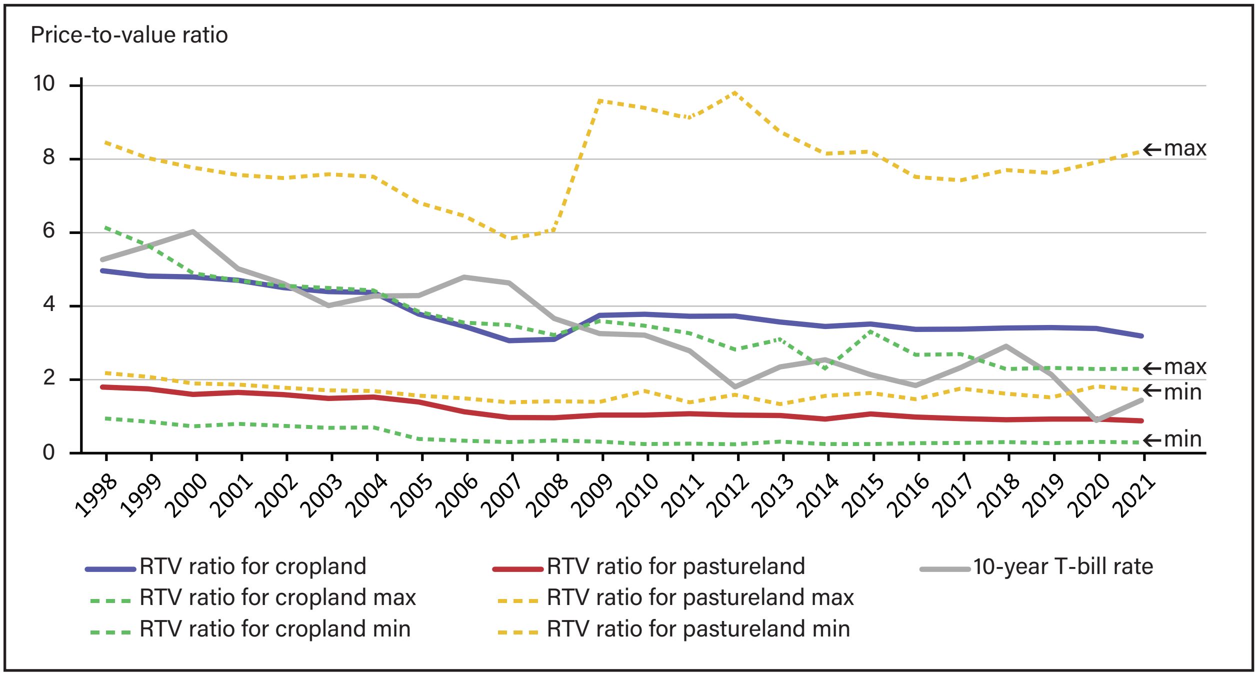
Source: USDA, Economic Research Service using cropland and pastureland values data from USDA, National Agricultural Statistics Service and 10-year Treasury bill data from Federal Reserve Economic Data.

The RTV ratio in 2021 was 3.19 and 0.88 percent for cropland and pastureland, respectively (figure 3.12). The ratios for cropland and pastureland have only fallen slightly since 2008 (14.93 and 15.36 percent, respectively), while the 10-year T-bill rate (and interest rates in general) has fallen significantly (55.71 percent). As the ratio of rents-to-prices had not fallen considerably during this period, much of the drop in PTV ratios at the national level during this period was due to the fall in the T-bill rate. Notably, much of this decline in the T-bill rate and associated interest rates has happened since the onset of the COVID-19 pandemic, as the T-bill rate fell from 2.14 percent in 2019 to 0.89 percent in 2020 and only somewhat recovered in 2021. RTV for cropland did not fall appreciably in 2020 or 2021, the first 2 years of the pandemic. The gap between cropland RTV ratios and 10-year T-bill rates widened significantly in 2020 and only slightly narrowed in 2021. As a result, in 2021, the 10-year T-bill rate remained 1.73 percentage points lower than the average RTV ratio for cropland, suggesting there was a higher rate of return to investment in cropland that year.

Prior research has found that returns to farmland were positively correlated with 10-year T-bill rates and generally with interest rates (Sherrick, 2018). While rising interest rates would increase the cost of ownership of assets (with all other factors being equal) and thus negatively affect farmland values, higher inflation would likely also increase earnings of farmland, thus increasing rates of return to owning farmland. Moreover, Sherrick (2018) also identified possible explanations for cropland having higher returns than T-bills in recent years, including the still relatively limited amount of institutional investment in farmland and the difficulty of acquiring farmland due to its very limited turnover. However, the net effect of rising inflation and interest rates on RTV ratios (and implicit rates of return) is unclear.

Figure 3.12

Rent-to-value ratios for cropland and pastureland and 10-year Treasury bill rates, 1998–2021



Min/max = minimum/maximum; RTV = rent-to-value; T-bill = Treasury bill.

Source: USDA, Economic Research Service using land values and rents data from USDA, National Agricultural Statistics Service and 10-year Treasury bill data from Federal Reserve Economic Data.

RTV ratios for both cropland and pastureland vary significantly among States, as indicated by the State-level minimum and maximum RTV ratios (figure 3.12). Since 2016, the highest RTV ratios for cropland have generally been found in Washington, Nebraska, Arkansas, Minnesota, and Georgia, while RTV ratios for pastureland have been highest in Nebraska, Iowa, Wisconsin, and Missouri. The lowest RTV ratios for cropland have been found in Florida, North Carolina, and Texas. These same three States and California have had the lowest RTV ratios for pastureland since 2016.

A State like Nebraska may consistently exhibit high RTV ratios due to most of the State being sparsely populated and most land having little value beyond its agricultural use, which may be relatively high. Similarly, Arkansas cropland for rice and Washington cropland for specialty crops may not be very suitable for urban development and/or may not lie near populated areas.

Conversely, much of Florida's pastureland and cropland is likely situated near populated areas, and so the potential for any given agricultural parcel's development there is higher than in most States. Florida has 14.3 percent of its land area classified as urban land, compared to just 3.1 percent of U.S. land as a whole (USDA, ERS, 2012). In Texas 3.5 percent of land is classified as urban, and the State is home to multiple large metro areas. In addition, higher proportions of farms in Texas also receive payments tied to energy production from wind and/or oil and natural gas, and most counties in Texas produce oil, natural gas, wind energy, or some combination of the three (Winikoff & Maguire, 2024). These are indications that farmland in Texas is more likely to have use value pertaining to energy production in general.

Trends in Parcel Sales of Agricultural Land

An examination of statistics and trends regarding the amount of cropland and pastureland sold between 2000 and 2020 can help determine whether the transaction (turnover) rate of agricultural land has changed over time and whether the COVID era (with historically low interest rates, increasing land values, and greater overall economic uncertainty) results in a new trend during the early stages of the COVID pandemic. This study was unable to analyze 2021 and include it in the pandemic period due to incomplete transaction data for that year. Agricultural land markets are historically categorized by low sales volume (Sherrick & Barry, 2003; Bigelow et al., 2020). In the 20 years preceding this study (1979–1999), the transaction rate for Illinois farmland ranged from a high of 1 percent in 1994 to a low of 0.38 percent in 1982, with a 20-year average of 0.73 percent (Sherrick & Barry, 2003). This compared to 3.5 percent for all rural lands in 1989 (USDA, ERS, 1989). The analysis was divided into three intervals: 2019–20, which represents the COVID-19 pandemic period; 2017–18, which represents a short-run pre-COVID period; and 2000–18, which represents a long-run pre-COVID period.

A Market-Based Data Approach

To calculate the average annual turnover (transaction) rate, data were constructed using transaction data purchased from CoreLogic. CoreLogic provides a comprehensive real estate transaction database that contains records of all property sales in the United States. These data comprise individual sales data for individual parcels and contain the sales year, sales price, property size, and location of each transaction. To classify agricultural land uses into cropland and pastureland, transaction data were merged with the 2020 USDA, National Agricultural Statistics Service's Cropland Data Layer (CDL).[24] The CDL uses satellite imagery to classify vegetation as crop, pasture, or some other type of natural vegetation. Latitude and longitude of the centroid of the transacted parcel were matched to the geocoordinates in the CDL. By using the 2020 CDL, parcels were classified into cropland and pasture based on how they were being used in 2020 and not necessarily at the time of sale. There is therefore an implicit assumption that parcel land types had not changed post-transaction. As a final step, all non-arms-length transactions (e.g., sales to family members) and transactions from Alaska and Hawaii were excluded from this dataset and the analysis.

The merged data were then used to calculate the annual transaction rate, which represents how much land was sold in a year relative to the total amount of land available. The transaction rate can also be interpreted as the number of times an acre of land can be expected to be sold in a 100-year period. For example, if cropland had an annual transaction rate of 1 percent, then a typical acre of cropland would sell once every 100 years, on average. To calculate the total amount of cropland and pastureland available for each year, State-level data from the USDA, NASS Census of Agriculture (COA) for 1997, 2002, 2007, 2012, and 2017 were used.[25] Data for intercensus years were calculated as weighted averages of the proceeding and following COA, while estimates for 2018–20 were calculated based on the linear trend for 2012–17.

[24] Since the authors only know the centroid of each property, they assigned a land use code from the CDL by determining the most common land use within a buffer, consisting of a circle with area equal to the parcel acreage.

[25] Specific data items used were "AG LAND, CROPLAND – ACRES" and "AG LAND, PASTURELAND, (EXCL CROPLAND & WOODLAND) – ACRES."

In 2019–20, an average of 2.9 million acres of cropland and 2.4 million acres of pastureland were bought and sold in the conterminous United States each year. These 2019–20 estimates for cropland and pastureland were up roughly 11 and 12 percent, respectively, from their corresponding short-run, prepandemic (2017–18) estimates of 2.6 million acres and roughly 2.2 million acres, respectively. Compared to the longer-run average since 2000, 2019–20 acres bought and sold were up 56 percent for cropland and 35 percent for pastureland from their 2000–18 estimates (tables 3.1 and 3.2).

Table 3.1

Regional statistics on cropland transactions, 2000–20

	Annualized number of transactions			Mean acreage transacted			Annualized acreage transacted			Annualized transaction rate (percent)		
Region	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20
Northeast	1,661	2,307	2,446	58.1	54.4	53.9	96,443	125,574	131,725	0.74	0.99	1.03
Lake States	5,709	9,441	10,377	57.7	53.4	53.1	329,138	504,461	550,951	0.82	1.27	1.37
Corn Belt	8,275	13,300	14,814	45.4	45.5	47.1	375,654	605,756	697,080	0.41	0.67	0.77
Northern Plains	2,960	3,370	4,617	120.4	117.5	116.0	356,234	395,899	535,536	0.36	0.40	0.53
Appalachian	1,929	3,077	3,396	64.2	63.8	62.1	123,770	196,269	210,925	0.55	0.93	0.99
Southeast	1,518	2,350	2,655	68.4	64.7	69.4	103,861	152,040	184,338	0.81	1.26	1.51
Delta	568	579	588	96.3	97.2	80.4	54,711	56,287	47,243	0.30	0.33	0.28
Southern Plains	964	1,061	1,033	123.2	115.2	109.0	118,854	122,163	112,586	0.26	0.30	0.27
Mountain	816	1,113	1,092	126.2	106.8	106.8	102,961	118,900	116,564	0.24	0.29	0.28
Pacific	2,554	3,712	3,814	70.3	77.2	75.9	179,648	286,411	289,439	0.80	1.31	1.33
US48 total	**26,955**	**40,308**	**44,830**	**68.3**	**63.6**	**64.2**	**1,841,274**	**2,563,760**	**2,876,387**	**0.45**	**0.65**	**0.72**

US48 = contiguous 48 U.S. States.

Source: USDA, Economic Research Service estimates using data from CoreLogic's real estate transaction database, land use classification data from the USDA, National Agricultural Statistics Service (NASS) Crop Data Layer (2020), and USDA, NASS Census of Agriculture (1997–2017).

Table 3.2

Regional statistics on pastureland transactions, 2000–20

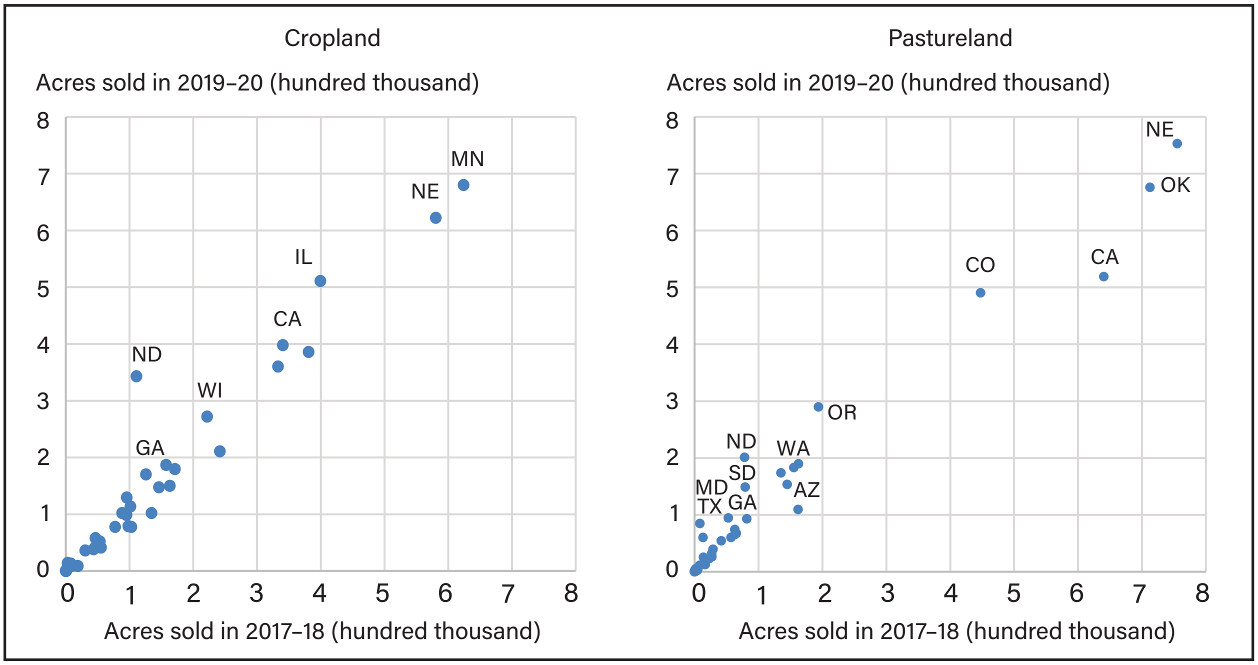
	Annualized number of transactions			Mean acreage transacted			Annualized acreage transacted			Annualized transaction rate (percent)		
Region	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20	2000–18	2017–18	2019–20
Northeast	418.74	594	613	47.8	37.0	95.6	20,017	21,964	58,574	1.09	1.26	3.66
Lake States	682.84	1,370	1,511	37.7	35.5	34.4	25,727	48,615	52,014	1.01	2.07	2.36
Corn Belt	1,731.79	2,972	3,360	27.5	27.9	28.8	47,686	82,857	96,820	0.45	0.76	0.91
Northern Plains	2,050.53	2,454	3,122	196.7	187.1	177.4	403,386	459,088	553,726	0.57	0.67	0.83
Appalachian	1,630.42	2,845	3,324	47.0	47.0	46.8	76,694	133,731	155,473	0.85	1.40	1.71
Southeast	1,646.32	2,493	3,060	67.5	57.1	59.5	111,124	142,381	182,123	1.51	1.87	2.43
Delta	592.42	871	938	44.3	41.5	45.5	26,266	36,122	42,655	0.45	0.56	0.67
Southern Plains	3,350.05	3,695	4,540	103.4	98.2	81.0	346,236	363,018	367,758	0.33	0.34	0.35
Mountain	1,772.26	2,410	2,619	202.5	158.2	145.6	358,925	381,263	381,188	0.22	0.24	0.24
Pacific	3,524.95	5,324	5,504	97.5	91.1	89.2	343,707	484,720	490,856	1.28	1.92	1.99
US48 total	**17,400.32**	**25,027**	**28,589**	**101.1**	**86.1**	**83.3**	**1,759,767**	**2,153,759**	**2,381,187**	**0.44**	**0.54**	**0.61**

US48 = contiguous 48 U.S. States.

Source: USDA, Economic Research Service estimates using data from CoreLogic's real estate transaction database, land use classification data from the USDA, National Agricultural Statistics Service (NASS) Crop Data Layer (2020), and USDA, NASS Census of Agriculture (1997–2017).

These national changes can mask changes in regional or State-level trends. The State with the biggest increase in acreage transacted was North Dakota, where roughly 544,000 acres of agricultural land was bought and sold in 2019–20, as compared with 189,000 in 2017–18 (figure 3.13). After North Dakota (232,000 acres) and Illinois (112,000 acres), California saw the third largest gains in cropland sales (58,000 acres) but saw the largest decrease in pastureland sales (122,000 acres). Pastureland sales increases were largest in North Dakota (122,000 acres), Maryland (76,000 acres), and South Dakota (69,000 acres). The three States with the largest amount of cropland sold in 2017–18 (Minnesota, Nebraska, and Illinois) saw increases in the amount of cropland sold in 2019–20, while the three States with the largest amount of pastureland sold in 2017–18 (Nebraska, Oklahoma, and California) saw decreases in the amount of pastureland sold in 2019–20.

Figure 3.13
Comparison of State-level cropland and pastureland transactions, 2017–18 versus 2019–20



Note: Labeled States denote those with a difference greater than 1 standard deviation from the mean.

Source: USDA, Economic Research Service estimates using data from CoreLogic's real estate transaction database and land use classification data from the USDA, National Agricultural Statistics Service Crop Data Layer (2020).

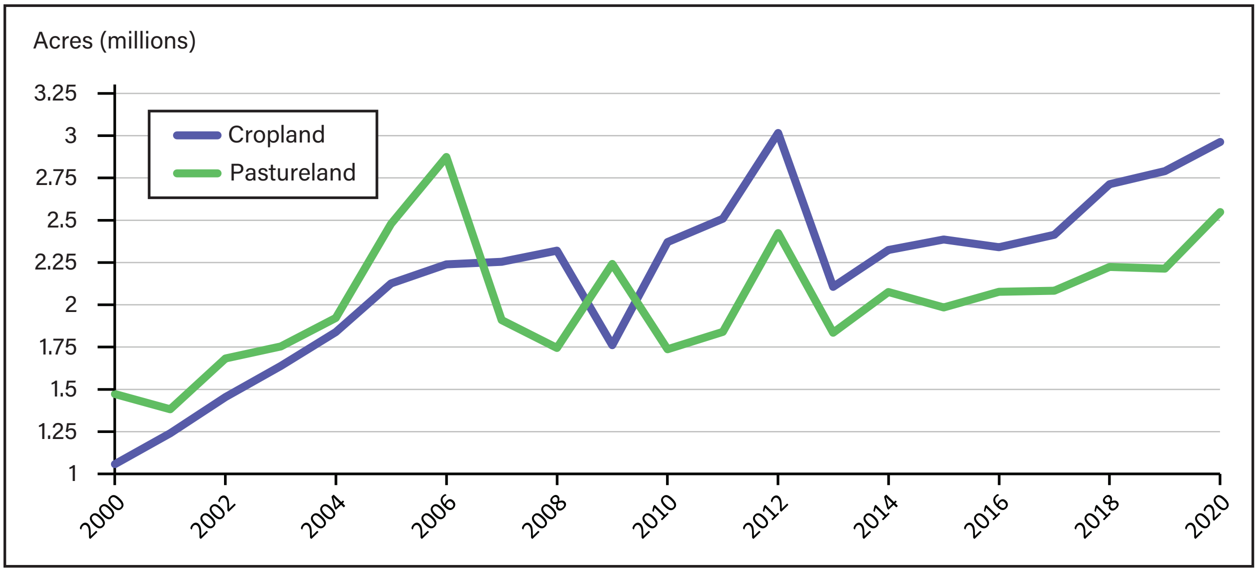
Comparing the average parcel size bought and sold annually within each timespan can reveal whether there are changes in the composition and concentration of agricultural land in the United States. In 2000–20, the average cropland acreage transacted remained relatively stable, with a 2000–18 average of 68.3 acres, a 2017–18 average of 63.6 acres, and a 2019–20 average of 64.2 acres. However, the average pastureland acreage transacted steadily decreased, with a 2000–18 average of 101.1 acres, a 2017–18 average of 86.1, and a 2019–20 average of 83.3 acres. For both land types, the typical (median) transaction was for 40 acres, except for recent pastureland transactions (2017–20) that were closer to 37 acres. This shows that the 2019–20 increase in annual average acreage transacted is not the result of larger parcels being sold but is almost exclusively the result of an increase in the overall number of transactions (table 3.1).

Beyond comparing timespans, year-to-year trends for cropland and pastureland can be compared. Market transactions of cropland and pastureland sold each year in 2000–20 indicate a large drop in pastureland sales in 2007, and that cropland has been outselling pastureland every year since 2010 (figure 3.14). The mean and median cropland and pastureland parcel acreage in 2000–20 can also be compared. The median acreage is relatively stable across both time and land uses, generally tending toward 40 acres (figure 3.15). However, the mean acreage is much higher for pastureland, which is more susceptible to large spikes in the mean value, with the largest one of these spikes occurring in 2009. This suggests that while the typical size of cropland and pastureland parcels are of similar size, large pastureland parcels tend to be larger than large cropland parcels.

As a final visualization, the annual transaction rate for cropland and pastureland was overlayed with USDA, Economic Research Service's annual net farm cash income estimates. A comparison of these trendlines suggests a strong relationship between increases in net farm income (NFI) and the amount of agricultural land sold in each year (figure 3.16). One explanation for this relationship might be that when NFIs are high, there are more farmers with the financial means to expand their operations by purchasing additional land. It might also be that higher NFIs allow landowners to charge higher rents, making investment in agricultural land more desirable.

Figure 3.14

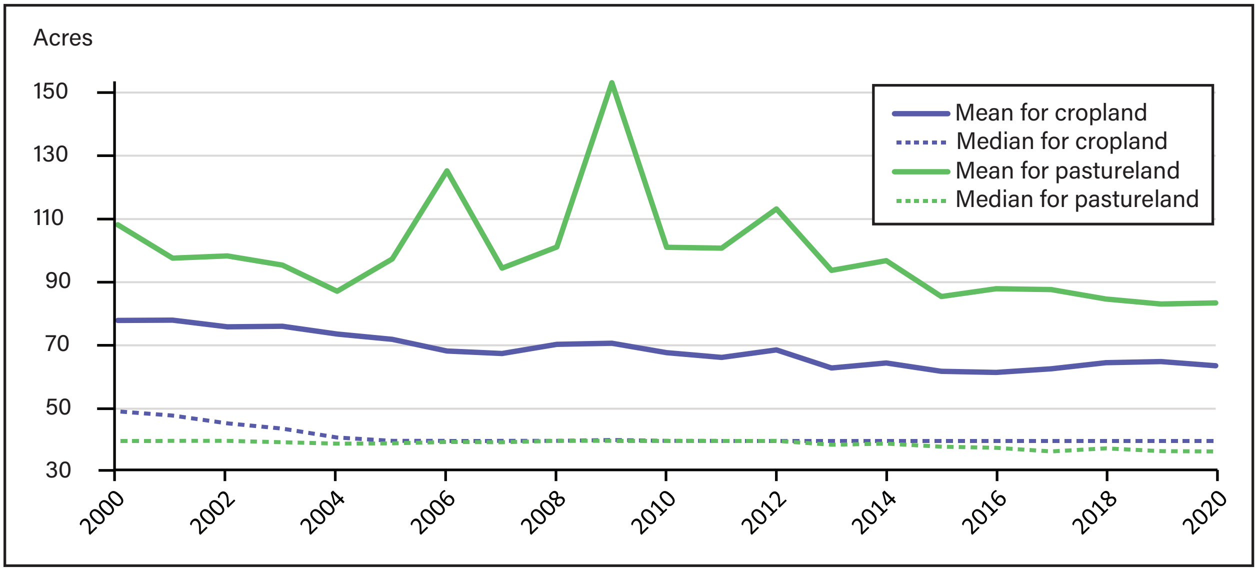
Total acres of cropland and pastureland sold in the United States, 2000–20



Source: USDA, Economic Research Service estimates using data from CoreLogic's real estate transaction database and land use classification data from the USDA, National Agricultural Statistics Service Crop Data Layer (2020).

Figure 3.15

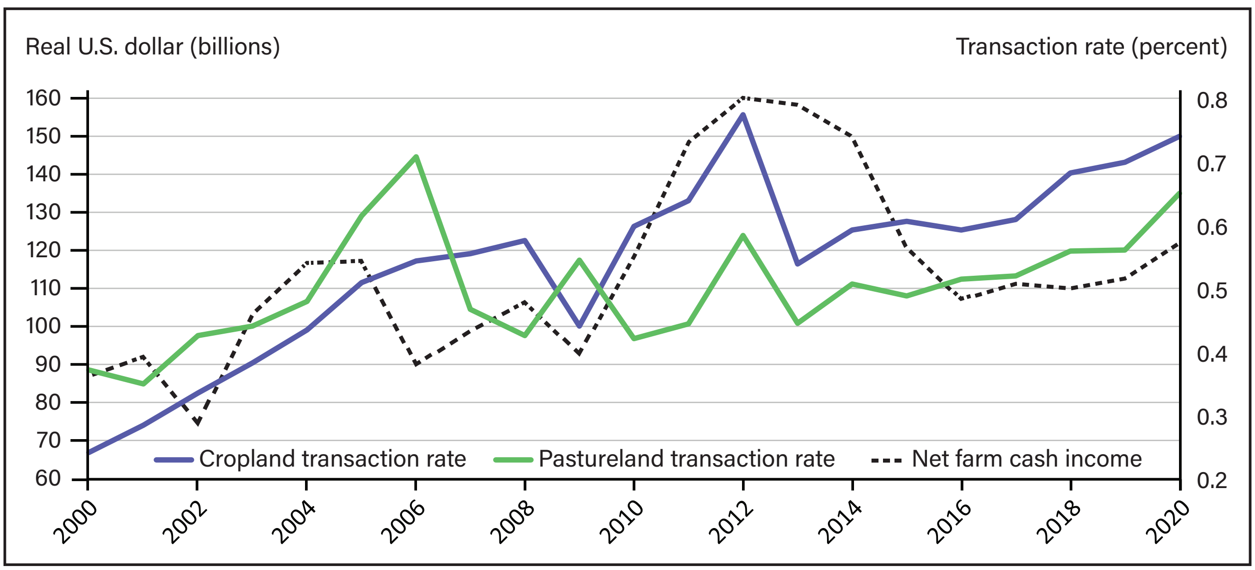
Mean and median parcel size of U.S. cropland sold, 2000–20



Source: USDA, Economic Research Service estimates using data from CoreLogic's real estate transaction database and land use classification data from the USDA, National Agricultural Statistics Service Crop Data Layer (2020).

Figure 3.16

Net farm cash income and transaction rate of cropland and pastureland, 2000–20.



Note: The transaction rate refers to the amount of agricultural land (cropland or pastureland) that was sold in a given year. Net farm cash income values are adjusted for inflation (i.e., real U.S. dollars) using the U.S. Department of Commerce, Bureau of Economic Analysis gross domestic product price index rebased to 2021 (2021 = 100) by USDA, Economic Research Service (ERS).

Source: USDA, Economic Research Service (ERS) Farm Sector Income and Wealth Statistics data as of May 6, 2022; USDA, ERS estimates based on data from CoreLogic's real estate transaction database and land use classification data from the USDA, National Agricultural Statistics Service (NASS) Crop Data Layer (2020); and USDA, NASS' Census of Agriculture (1997–2017).

Conclusion

It will take some time until the effect of the COVID-19 pandemic on the farm economy and land markets is fully known. However, the analysis in this report reveals that several farmland indicators in the past 2 years differed substantially from the less recent prepandemic levels. Real cropland and pastureland values increased for the first time in the past 5 years as positive capital gains were reported, albeit not to the same degree as in 2000–14. The amount of agricultural land being bought and sold, and the transaction rate for cropland and pastureland, also increased considerably. Taken together, these trends indicate a period of increased demand for farmland. The analysis also showed a continued decrease in PTV and RTV ratios during the pandemic, which would support increased demand as farmland improves its position as an investment. One area in which appreciation was not seen was in rents (for both cropland and pastureland); however, given that rents lag values, such a change may not be visible in the near term. Finally, a caveat should be noted that the analysis does not provide any arguments or evidence regarding causality. The degree that these farmland trends were caused by the COVID-19 pandemic rather than other underlying economic conditions, such as low interest rates or high global demand for agricultural products, remains unknown and could be a focus of future research.

References

Bigelow, D., Ifft, J., & Kuethe, T. (2020). Following the market? Hedonic farmland valuation using sales prices versus self-reported values. *Land Economics,* 96(3): 418–440.

Borchers, A., Ifft, J., & Kuethe, T. (2014). Linking the price of agricultural land to use values and amenities. *American Journal of Agricultural Economics*, 96(5), 1307–1320.

Burns, C., Key, N., Tulman, S., Borchers, A., & Weber, J. (2018). *Farmland values, land ownership, and returns to farmland, 2000-2016* (Report No. ERR-245). U.S. Department of Agriculture, Economic Research Service.

Burt, O. R. (1986). Econometric modeling of the capitalization formula for farmland prices. *American Journal of Agricultural Economics*, 68(1), 10–26.

Doye, D., & Brorsen, B. W. (2011). Pasture land values: A "Green Acres" effect?" *Choices*, Quarter 2.

Dubman, R., Key, N., Law, J., Litkowski, C., Mandalay, O., Subedi, D., Todd, J. E., & Whitt, C. (2021). *Agricultural income and finance situation and outlook: 2021 Edition* (Report No. EIB-228). U.S. Department of Agriculture, Economic Research Service.

Featherstone, A., Taylor, M. R., & Gibson, H. (2017). Forecasting Kansas land values using net farm income. *Agricultural Finance Review,* 77(1), 137–152.

Featherstone, A., & Baker, T. G. (1988). The effects of reduced price and income supports on farmland rent and value. *Applied Economics Perspectives and Policy*, 10(2), 177–189.

Floyd, J. E. (1965). The effects of farm price supports on the returns to land and labor in agriculture. *Journal of Political Economy*, 73(2), 148–158.

Hardie, I. W., Narayan, T. A., & Gardner, B. L. (2001). The joint influence of agricultural and nonfarm factors on real estate values: An application to the mid-Atlantic region. *American Journal of Agricultural Economics*, 83(1), 120–132.

Kirwan, B. E., & Roberts, M. J. (2016). Who really benefits from agricultural subsidies? Evidence from field-level data. *American Journal of Agricultural Economics*, 98(4), 1095–1113.

Sherrick, B. J. (2018). Understanding farmland values in a changing interest rate environment. *Choices*, Quarter 1.

Sherrick, B. J., & Barry, P. J. (2003). Farmland markets: Historical perspectives and contemporary issues. *Government policy and farmland markets: The maintenance of farmer wealth*, 27–49.

U.S. Department of Agriculture, National Agricultural Statistics Service. (2021). *Cropland data layer.*

U.S. Department of Agriculture, Economic Research Service. (1989). *Rural land transfers in the United States* (Report No. AIB-574).

U.S. Department of Agriculture, Economic Research Service. (2012). *Major land uses.* Retrieved July 22, 2024.

U.S. Department of Agriculture, Economic Research Service. (2020). *ARMS farm financial and crop production practices.* Retrieved February 7, 2022.

U.S. Department of Agriculture, Economic Research Service. (2022). *Farm income and wealth statistics.* Retrieved February 7, 2022.

Winikoff, J.B. & Maguire, K. (2024). The role of commercial energy payments in agricultural producer income (Report No. EIB-271). U.S. Department of Agriculture, Economic Research Service.

Conclusion

The Coronavirus (COVID-19) pandemic presented farm operations with many unexpected challenges. Nonetheless, farm sector profitability improved in the first year of the COVID-19 pandemic. In 2020, farm sector profitability, as measured by net cash farm income (gross cash income less cash expenses), increased relative to 2019 (appendix A). Growth in direct Government payments, including Coronavirus Food Assistance Program (CFAP) and Paycheck Protection Program (PPP) payments (discussed in chapter 1), were enough to offset lower cash receipts for farm commodities and higher production expenses. In 2021, net cash farm income (NCFI) continued to increase due in part to higher commodity prices and continued COVID-19-related Government payments. Although sector-level profits increased due to the heterogeneity within the sector, not all farms saw profits increase across 2020–21.

Despite the growth in farm income for the sector, median total household income for farm households fell in 2020 relative to 2019. In 2021, median total household income increased to above prepandemic levels. Household characteristics (discussed in chapter 2) likely affected how some households recovered in 2021.

NCFI reached a record high in 2022 following record cash receipts from farm commodity sales. As commodity prices have fallen, net income is forecast to decline through 2024 based on data released on September 5, 2024 (appendix A). The 2024 forecast for NCFI would keep it above its 10- and 20-year average when prior values are adjusted for inflation. (Appendix B provides information on the reliability of these forecasts.) On the farm sector balance sheet, the value of real estate assets (land and buildings) is forecast to grow through 2024, continuing the trend of increased demand for the purchase of cropland and pastureland observed during the first years of pandemic (discussed in chapter 3). Median total income received by farm households remained relatively stable in 2022 and then declined in 2023. Yet it is projected to remain above prepandemic levels through 2024.

Although officially the COVID-19 pandemic is no longer a national emergency, it is likely to continue to affect farm operations, farm households, and farmland values. There will be some effects of the pandemic that won't be fully known or understood until later.

Appendix A: Farm Sector Income Statement and Balance Sheet Forecasts for 2024

The USDA, Economic Research Service (ERS) releases Farm Income and Wealth Statistics three times a year, usually in February, late August/early September, and late November/early December. The tables A.1 and A.2 below provide data as of this report's publication, including 2024 calendar year forecasts for the farm income statement and balance sheet as published on September 5, 2024.

Tables and files with the most recent income and wealth estimates and forecasts, along with a discussion of the most recent forecast, can be found on the USDA, ERS website by searching the website for the following terms: data products, farm income and wealth, farm economy, farm sector, farm income, and farm finances.

Table A.1

U.S. farm sector cash income statement, 2019–24F

	2019	2020	2021	2022	2023	2024F	2014–2023	Change 2022–2023	Change 2023–2024F
	Billion dollars (2024)						Average	Percent	
Gross cash income	514.2	532.2	569.6	648.3	607.4	577.1	556.5	-6.3	-5.0
All commodity receipts	445.3	437.2	503.4	576.7	539.7	516.5	491.9	-6.4	-4.3
Crop receipts	233.6	240.9	279.9	300.5	283.8	249.0	259.1	-5.6	-12.2
Animals and products receipts	211.7	196.3	223.4	276.2	256.0	267.4	232.8	-7.3	4.5
Cash farm-related income	41.9	40.8	36.7	55.0	55.1	50.2	43.2	0.0	-8.8
Forest products sold	0.7	0.7	0.8	0.8	0.7	0.8	0.8	-5.5	2.3
Machine hire and custom work	5.0	4.6	5.2	5.6	5.9	6.0	5.3	4.9	3.1
Other farm income	36.2	35.5	30.7	48.7	48.5	43.4	37.0	-0.4	-10.4
Direct government payments	27.1	54.2	29.5	16.5	12.6	10.4	21.4	-23.9	-17.2
Cash expenses 1/	382.6	388.4	393.0	425.0	437.0	423.0	403.5	2.8	-3.2
Interest 1/	23.9	22.4	21.6	25.2	28.3	29.7	22.7	12.5	5.0
Non-real estate	9.2	8.1	7.1	8.5	10.7	11.3	8.7	26.5	5.3
Real estate 1/	14.7	14.3	14.4	16.7	17.6	18.4	14.1	5.4	4.8
Labor expenses	41.9	43.5	41.7	44.2	49.6	51.7	43.5	12.1	4.2
Property taxes and fees 1/	16.0	16.7	16.7	16.6	16.4	17.9	16.3	-0.9	9.1
Farm origin	131.6	129.5	134.5	152.6	154.2	145.6	138.3	1.1	-5.6
Feed purchased	71.7	67.6	74.2	88.9	82.1	70.2	74.8	-7.7	-14.4
Livestock and poultry	34.4	34.5	34.9	37.1	44.1	48.1	36.3	18.9	9.2
Seed	25.6	27.4	25.4	26.6	28.0	27.2	27.2	5.4	-2.8
Manufactured inputs	68.5	70.1	77.0	88.2	84.2	74.9	76.6	-4.5	-11.0
Electricity	6.9	7.1	7.3	6.8	7.3	7.3	7.2	6.4	0.5
Fertilizer and lime	26.9	29.1	33.6	38.9	36.7	32.4	32.1	-5.6	-12.0
Fuel and oil	15.9	14.3	15.8	19.6	18.1	15.9	17.1	-8.1	-11.8
Pesticides	18.7	19.7	20.3	22.8	22.2	19.4	20.1	-2.6	-12.7
Other intermediate expenses 1/	79.0	83.3	79.2	83.0	87.1	86.8	83.1	5.0	-0.4
Net rent to landlords 2/	21.7	22.9	22.3	15.3	17.1	16.3	23.0	12.1	-4.5
Net cash income	131.6	143.8	176.6	223.3	170.3	154.1	153.0	-23.7	-9.6

Note: Values are adjusted for inflation using U.S. Department of Commerce, Bureau of Economic Analysis gross domestic product price index rebased to 2024 (2024 = 100) by USDA, Economic Research Service. F = forecast. Components may not sum to totals due to rounding.

1/ Excluding expenses associated with operator dwellings.

2/ Excluding landlord capital consumption.

Source: USDA, Economic Research Service Farm Income and Wealth Statistics data from September 5, 2024.

Table A.2

U.S. farm sector balance sheet, 2019–24F

	2019	2020	2021	2022	2023	2024F	Change 2022–2023	Change 2023–2024F
	Billion dollars (2024)						Percent	
Farm sector assets	3,676.4	3,724.5	3,896.0	4,026.4	4,116.9	4,222.3	2.2	2.6
Investments and other financial assets	105.5	109.5	128.2	125.3	125.0	120.2	-0.2	-3.8
Investment in cooperatives	7.5	6.1	7.8	6.0	5.8	6.8	-3.9	17.4
Financial assets and net accounts receivable	98.0	103.4	120.4	119.3	119.2	113.4	-0.1	-4.9
Inventories	196.2	193.8	205.5	214.8	219.7	223.7	2.3	1.8
Crops	59.8	60.2	66.2	76.7	68.2	63.1	-11.2	-7.5
Animals and animal products	119.6	116.9	118.5	115.5	130.8	139.9	13.3	6.9
Breeding animals	76.1	78.4	77.2	75.7	82.0	90.5	8.3	10.4
Nonbreeding animals	43.5	38.5	41.3	39.8	48.8	49.4	22.6	1.1
Purchased inputs	16.8	16.7	20.8	22.6	20.7	20.8	-8.1	0.3
Cash invested in growing crops	4.8	4.2	5.6	5.3	4.0	NA	-23.3	NA
Prepaid production expenses	9.3	9.7	12.3	14.2	13.5	NA	-5.0	NA
Prepaid insurance	2.7	2.8	3.0	3.1	3.2	NA	3.1	NA
Real estate	3,038.4	3,089.6	3,211.4	3,354.6	3,424.2	3,523.6	2.1	2.9
Machinery and vehicles	336.4	331.7	350.8	331.7	348.0	354.7	4.9	1.9
Farm sector debt	507.0	525.0	539.7	527.3	532.2	540.8	0.9	1.6
Real estate	323.1	343.4	369.2	355.4	353.4	359.6	-0.6	1.8
Commercial banks	118.0	115.2	114.7	113.7	111.6	NA	-1.8	NA
Farm Credit System	150.9	167.2	179.9	174.9	172.3	NA	-1.5	NA
Farm Service Agency	9.6	11.1	12.1	12.2	12.8	NA	5.0	NA
Farmer Mac	9.2	10.3	10.9	10.6	10.4	NA	-2.3	NA
Individuals and others	12.7	15.7	26.2	18.7	21.8	NA	16.2	NA
Storage facility loans	1.0	1.1	1.2	1.3	1.4	NA	5.4	NA
Life insurance companies	21.5	22.8	24.2	24.0	23.1	NA	-3.4	NA
Non-real estate	183.9	181.6	170.5	171.9	178.9	181.1	4.0	1.3
Commercial banks	85.8	75.1	74.1	72.8	74.3	NA	2.0	NA
Farm Credit System	63.8	65.8	64.4	65.8	71.6	NA	8.8	NA
Farm Service Agency	4.6	4.4	3.8	2.9	2.6	NA	-9.7	NA
Individuals and others	29.7	36.3	28.2	30.4	30.4	NA	0.0	NA
Farm sector equity	3,169.4	3,199.5	3,356.3	3,499.1	3,584.7	3,681.5	2.4	2.7
Ratios	Percent						Percent	
Debt/asset ratio	13.79	14.10	13.85	13.10	12.93	12.81	NA	NA
Debt/equity ratio	16.00	16.41	16.08	15.07	14.85	14.69	NA	NA
Equity/asset ratio	86.21	85.90	86.15	86.90	87.07	87.19	NA	NA

Notes: Values are adjusted for inflation using U.S. Department of Commerce, Bureau of Economic Analysis gross domestic product price index rebased to 2024 by USDA, ERS, 2024 = 100. F = forecast. NA = not applicable. Components may not sum to totals due to rounding.

Source: USDA, Economic Research Service Farm Income and Wealth Statistics data from September 5, 2024

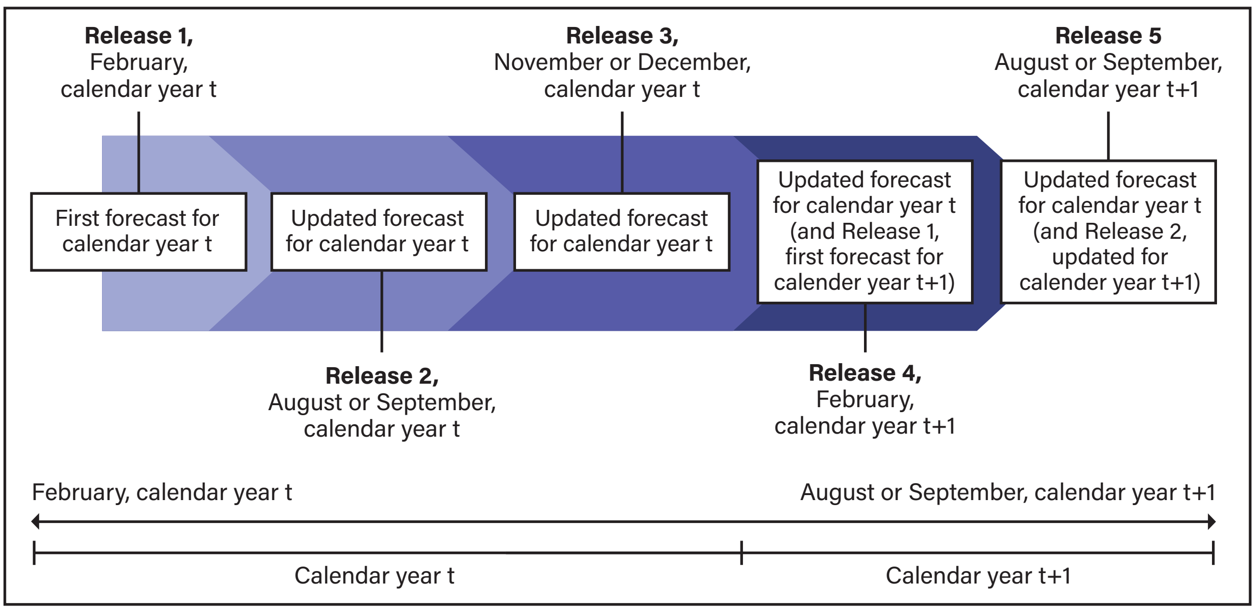
Appendix B: Reliability of the Farm Income Forecasts

Wilson Collins, Tatiana Borisova, Jonathan Law, and Carrie Litkowski

USDA, Economic Research Service's (ERS) net farm income (NFI) and net cash farm income (NCFI) estimates serve as indicators of the health and well-being of the farm economy. USDA, ERS releases forecasts of each measure that are referenced by a variety of stakeholder audiences, including input suppliers, farm organizations, policymakers, and researchers. In April 2022, USDA, ERS released an archive of historic farm income and wealth statistics that contained estimates and forecasts from releases dating to 1977, though the first full yearly observations began in 1981 (USDA, 2022). Using data from 1981 onward from this archive, the authors evaluated the reliability of the forecasts relative to the most recent estimates and produced confidence intervals that can be presented with future forecast releases to provide additional information to the stakeholders. To evaluate the reliability of the forecasts, percentage forecast error was used to account for nonstationary data, such as values that fluctuate due to changing levels of inflation.

USDA, ERS releases estimates and forecasts of farm income and wealth three times a year. Values for a given year are forecast four times, starting in February of that year (Release 1). The first estimate is released in August or September of the following year (Release 5) (figure B.1).

Figure B.1
USDA, ERS's Farm Income and Wealth Statistics forecast release schedule



Note: Due to the data collection lag, complete data for the past calendar year are not generally available in February, and therefore, Release 4 is still referred to as a "forecast." Release 5 is the first release referred to as an "estimate" because of its reliance on more complete data, for example, from USDA's National Agricultural Statistics Service surveys and USDA's Agricultural Resource Management Survey.

Source: USDA, Economic Research Service (ERS).

Percentage forecast error is calculated as follows:

$$PFE_{i,t} = \frac{Estimate_t - Forecast_{i,t}}{Estimate_t}$$

where $PFE_{i,t}$ is the percentage forecast error for year t and forecast i, $Forecast_{i,t}$ is the i^{th} forecast for year t, and $Estimate_t$ is the estimate for year t as of February release in 2022. We use "percentage forecast error" and "percentage difference" interchangeably in this publication.

Forecast revisions from release to release are expected to lower the percentage forecast error, on average. While this improvement is largely the case, note that both average absolute percentage forecast error and forecast error variance increase from Release 1 to Release 2 and Release 3 to Release 4 for NFI, albeit only the increase in variance from Release 1 to Release 2 is significantly different from zero (tables B.1, B.2).

The authors compared the forecast errors for the USDA, ERS forecasts with the error for a naïve forecast. Here, the naïve forecast is equal the previous year's latest published estimate. Forecasts 2, 3, and 4 outperformed the naïve forecast for both NFI and NCFI (table B.1). Forecast 1 should not be compared to the naïve forecast because the income estimate for the prior year is not available at the time forecast 1 for the current year is released. So, the naïve forecast includes information not available when forecast 1 is made.

Table B.1

Forecast error performance

	Average absolute percentage difference (AAPD), 1981–2020				
	Forecast release (1): February (percent)	Forecast release (2): August/ September (percent)	Forecast release (3): November/ December (percent)	Forecast release (4): February (percent)	Naïve forecast (percent)
Net cash farm income	11.9**	6.9	6.9	6.9	10.6
Net farm income	13.4	14.5*	12.0	12.5*	18.5

* Not significantly greater than the value for the previous forecast release, based on paired t-test and a 95-percent confidence level.

** Forecast 1 should not be directly compared to the naïve forecast because the naïve forecast based on prior year's estimate is not available when forecast 1 is released.

Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

Table B.2

Forecast error variance

	Forecast error variance, 1981-2020			
	Forecast release (1): February (percent)	Forecast release (2): Aug./Sept. (percent)	Forecast release (3): Nov./Dec. (percent)	Forecast release (4): February (percent)
Net cash farm income	10.8	8.6	8.5	8.5
Net farm income	16.8	23.3	18.1	18.3*

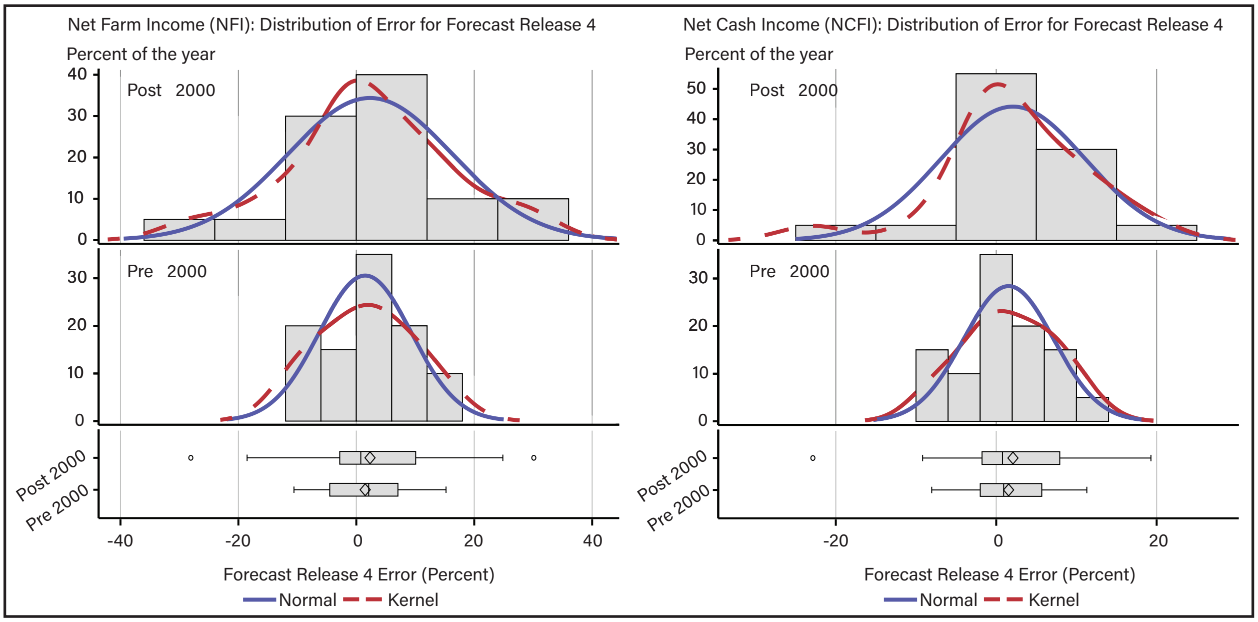
* Not significantly greater than the previous forecast value using Snedecor and Cochran F-test and a 95-percent confidence level.

Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

The authors then examined if the distribution of forecast errors was evolving over time. If the distribution was changing, then it may not be reasonable to generate confidence intervals using the entire sample of the years included into the archive. For an initial test, the sample (1981–2020) was split in half and tested to see if the mean and variance of the percentage forecast error had changed.[26] Evidence of a changing distribution was found for forecast 4, with a higher variance in the post-2000 sample, in both NFI and NCFI. The increase in the variance in post-2000 sample can be seen from figure B.2, which displays probability density function estimations and box-and-whisker plots for post-2000 period compared with pre-2000 (for NFI on the left and NCFI on the right). This increase in the variance of the forecast error can possibly be attributed to increased volatility across the agricultural economy due to an era of rapid biofuel production that introduced additional volatility into agricultural markets (Hertel & Beckman, 2011).

Figure B.2

Forecast release (4) error: Probability density function estimations and box-and-whisker plots for net farm income and net cash farm income, 2001–20 and 1981–2000



Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

The results implied that the distribution of forecast errors evolved over time. For this reason, the authors used a 15-year rolling window to generate forecast confidence intervals. For example, the authors used the 2005–19 period to generate a confidence interval for 2020, with the expectation that this process would prevent confidence intervals for recent years from being overweighted by the low volatility period of the 1980s through early 2000s. Using statistical tests explained in the next section, the authors found that this approach improved the confidence intervals even for forecasts that did not display signs of a changing error distribution.

Following Isengildina Massa et al. (2011), the authors generated confidence intervals for each forecast release using three procedures: histogram intervals, parametric estimation, and nonparametric kernel density estima-

[26] Note that for these calculations and the analysis presented below, the authors calculated the forecast error using NCFI and NFI estimates from Release 5. In contrast, values in Tables B.1 and B.2 were based on the latest estimate available as of February 2022. Release 5 included the first official estimate for a calendar year; estimate revisions past Release 5 were generally small. For example, Borisova et al. (2023) found the mean (median) absolute percent deviation between Estimate 5 and Estimate 15 of 6.1 percent (4.9 percent) for NCFI and of 7.7 percent (4.3 percent) for NFI.

tion. For the histogram-based procedure, the forecast error data were arranged in ascending order and each datapoint was numbered (n=1, …, N). Then, for each datapoint, the ratio of the datapoint's number to the total number of observations (n/N) was used to find the percentile each datapoint represents. For example, with 15 observations, the lowest percentage error in the sample would represent the 7-percent lower confidence limit.

The parametric procedure fitted parametric distributions to the data to generate the confidence interval. Normal and Gumbel distributions were tested, applying the Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling goodness-of fit-tests. The goodness-of-fit test rejected the null hypothesis that the forecast error was distributed with Gumbel distribution. For the normal distribution, all tests failed to reject the null hypothesis that the distribution is appropriate, and therefore, only the normal distribution was used in the rest of the study.

For the nonparametric kernel density estimate procedure, the kernel density was estimated using Silverman's rule of thumb (1986).

The three procedures to generate confidence intervals were compared based on an out-of-sample performance metric: hit rates. After the confidence interval was estimated for each year using only data from prior years, the hit rate described the proportion of times the confidence interval contained the true value, y_t. Hit rates were defined by the indicator variable I_t,

$$I_t = \begin{cases} 1, if \;\; y_t \in [l_{t-1}(\alpha), u_{t-1}(\alpha)] \\ 0, if \; y_t \;\; \notin [l_{t-1}(\alpha), u_{t-1}(\alpha)] \end{cases}$$

where $[l_{t-1}(\alpha), u_{t-1}(\alpha)]$ are the lower and upper limits of the confidence interval for y_t made at time t-1 for confidence level α.

Finally, the hit rate was tested to determine if it was significantly different from 90 percent, using a likelihood ratio coverage test proposed by Christoffersen (1998),

$$LR = \; -2\ln\left(\frac{(1-\alpha)^{n_0}\;\alpha^{n_1}}{(1-\hat{p})^{n_0}\;\hat{p}^{n_1}}\right) \;\rightarrow\; \chi^2(1)$$

where n_1 is the number of "hits," n_0 is the number of "nonhits," and $\hat{p} = n_1/(n_0 + n_1)$ is the maximum likelihood estimator of p.

In terms of hit rates, the nonparametric kernel density method outperformed all other methods, given a range of time periods considered, and all kernel coverage levels were not significantly different from 90 percent (table B.3). The rolling window (last 15 years of data) hit rates were selected because they outperformed the alternative of using all prior data in all cases.

Table B.3
Hit rate performance for 15-year rolling window confidence intervals

		Histogram (percent)	Parametric (percent)	Nonparametric (percent)
Net cash farm income	Forecast 1	92.0	92.0	92.0
	Forecast 2	91.7	91.7	95.8
	Forecast 3	84.0	72.0*	84.0
	Forecast 4	76.0*	72.0*	80.0
Net farm income	Forecast 1	88.0	88.0	88.0
	Forecast 2	87.5	87.5	87.5
	Forecast 3	80.0	84.0	84.0
	Forecast 4	76.0*	76.0*	84.0

*Significantly different from the 90-percent coverage (using Christoffersen's coverage test).

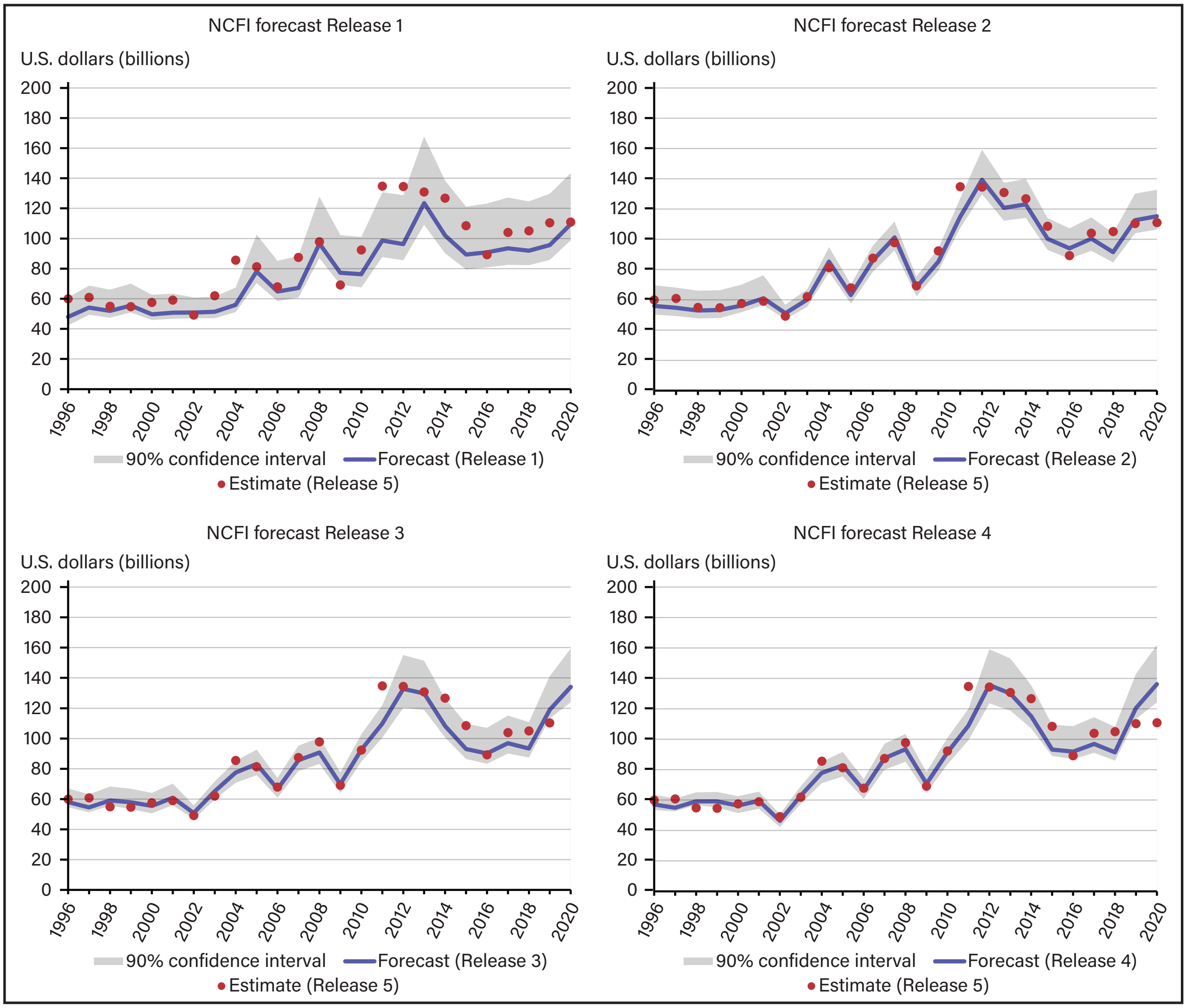
Note: Time period included in the analysis was 1981–2020, and with 15-year rolling window, the out-of-sample hit rate comparison started in 1996.

Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

Kernel density confidence intervals performed the best out of the three types of confidence intervals. There was an asymmetry in some of the confidence intervals (figures B.3 and B.4). The asymmetry was consistent with the findings of prior work, which found a bias in the forecasts, with a tendency to underpredict (Kuethe et al., 2018; Bora et al., 2020; Isengildina Massa et al., 2021; Kuethe et al., 2022).

Figure B.3

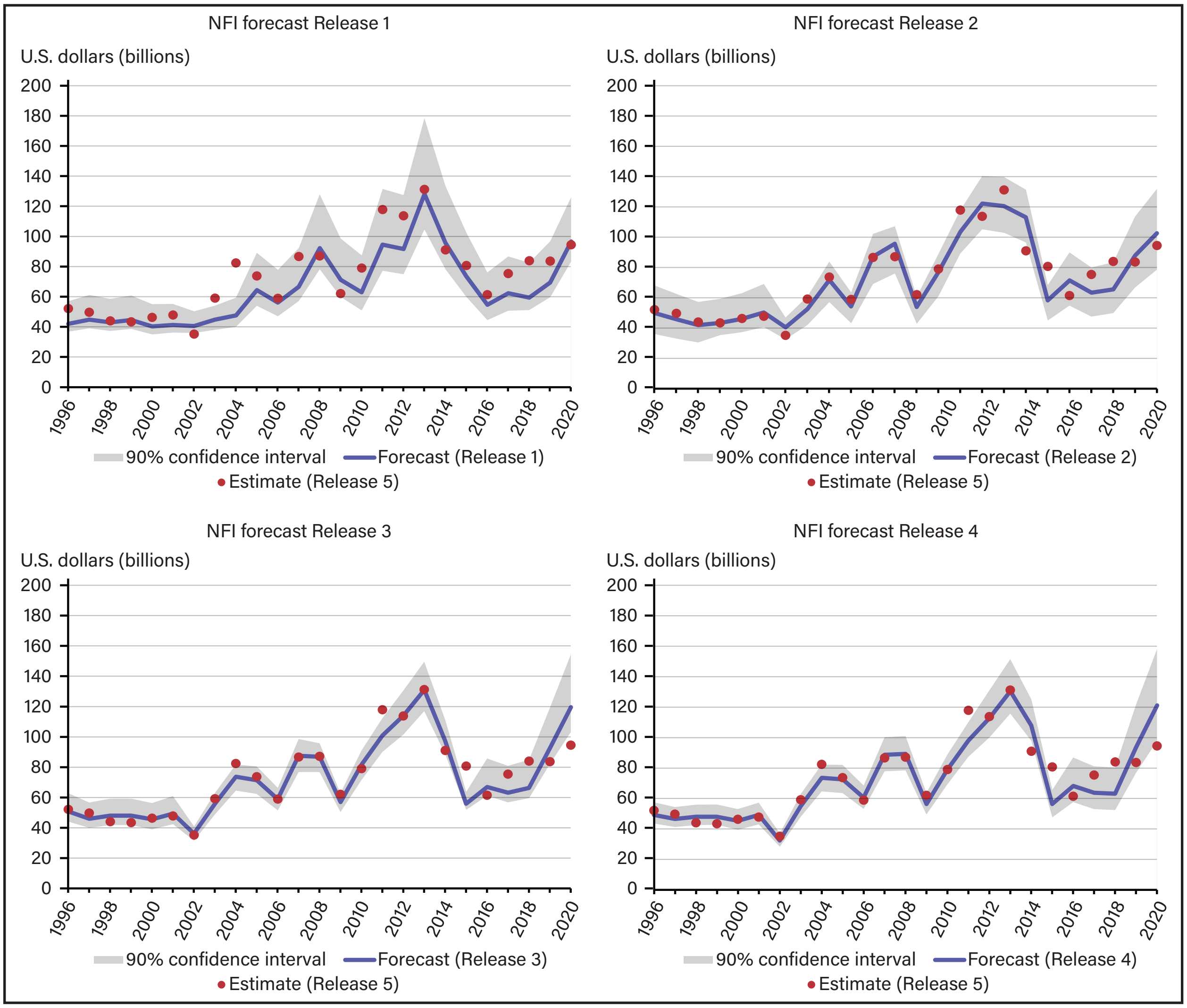
Kernel density estimate confidence intervals for net cash farm income



Note: The line represents the forecast, the shaded region represents the confidence interval, and the circles represent the estimate (from Release 5). If a circle lies outside the shaded region, the estimate is outside of the confidence interval of the forecast, and it is considered a miss for that year and forecast in the hit rate analysis above.

Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

Figure B.4
Kernel density estimate confidence intervals for net farm income



Note: The line represents the forecast, the shaded region represents the confidence interval, and the circles represent the estimate (from Release 5). If a circle lies outside the shaded region, the estimate is outside of the confidence interval of the forecast, and it is considered a miss for that year and forecast in the hit rate analysis above.

Source: USDA, Economic Research Service (ERS) calculations using USDA, ERS Historical Farm Income and Wealth Statistics data from April 22, 2022.

Overall, this analysis evaluated the reliability of the NFI and NCFI forecasts and proposed a process for producing confidence intervals around forecasts in future releases. These contributions allow for additional interpretation of the forecast releases and provide important context for stakeholders interested in understanding the typical range of sensitivity of forecasts.

References

Bora, S.S., Katchova, A. L., & T.H. Kuethe, T. H. (2020). The rationality of USDA forecasts under multivariate asymmetric loss. *American Journal of Agricultural Economics*, *103*(3), 1006–1033.

Borisova, T., Litkowski, C., Law, J., & Mandalay, O. (2023). *The evolution of U.S. farm sector profitability forecasts in 2020* (Report No. AP-118). U.S. Department of Agriculture, Economic Research Service.

Christoffersen, P. F. (1998). Evaluating interval forecasts. *International Economic Review*, *39*(4), 841–862.

Hertel, T. W., & Beckman, J. (2011). *Commodity price volatility in the biofuel era: An examination of the linkage between energy and agricultural markets*. National Bureau of Economic Research. NBER Working Paper No. 16824.

Isengildina Massa, O., Scott, I., Good, D, & Massa, L. (2011). Empirical confidence intervals for USDA commodity price forecasts. *Applied Economics*, *43*(26), 3789–3803.

Isengildina Massa, O., Karali, O., Kuethe, T., & Katchova, A. (2021). Joint evaluation of the system of USDA's farm income forecasts. *Applied Economic Perspectives and Policy*, *43*(3), 1140–1160.

Kuethe T. H., Bora, S., & Katchova, A. (2022). Improving ERS's net cash income forecasts using USDA baseline projections. *Journal of Agricultural and Resource Economics*, *47*(2), 246–261.

Kuethe, T. H., Hubbs, T., & Sanders, D. R. (2018). Evaluating the USDA's net farm income forecast. *Journal of Agricultural and Resource Economics, 43*(3), 457–468.

Silverman, B. W. (1986). *Density estimation for statistics and data analysis*. Chapman & Hall, London – New York, 175 pp.

U.S. Department of Agriculture, Economic Research Service. (2022). *Archive of Selected Historical Farm Income and Wealth Statistics Forecast and Estimate Data in CSV File Format (ZIP).* (April 22, 2022). U.S. Department of Agriculture, Economic Research Service.