Farmland Tenancy and Conservation Practice Adoption: Are Owners and Renters any Different?

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Abstract

Conventional wisdom suggests owner-operators and renters (i.e. tenants) will make different agricultural production and management decisions. The argument is that due to rental insecurity, or uncertainty over whether their lease will be renewed or modified, tenant farmers are more motivated by short-term economic returns and are less likely to invest in potentially costly conservation practices with only medium or long-term yield benefits. This conventional wisdom suggests that landowners, on the other hand, care about the long-term return on their land asset across multiple generations and are more likely to engage in behaviors to promote the quality of their land and water resources.

We examine data from the Agricultural Resource Management Survey (including the Tenure, Ownership, and Transition of Agricultural Land survey) from 2010 to 2019, which cover different types of field crops planted including corn, soybeans, wheat, and cotton, among others. We find that average tillage disturbance rates for both share and cash renters are lower than average rates for owners for several crops, including corn, oats, and spring wheat. The adoption rates for cover cropping and structural practices are mixed. For some survey years, owners have higher adoption rates, whereas renters have higher rates in other years. To further analyze the differences between owner and tenant behavior, we pool the data across survey years and control for important co-determinants of adoption, which can be interpreted as conditional rates of adoption. Our findings suggest that a farmland tenant's propensity to adopt, on average, is not statistically different from that of an owner operator for cover crops nor structural practices. In addition, tillage disturbance rates are not statistically different across tenants and owner-operators.

Keywords: land tenure; conservation behavior and practice adoption; farmland tenancy; rental agreement, ARMS survey; TOTAL survey.

JEL codes: Q15, Q12, Q24

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Disclaimer

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Introduction

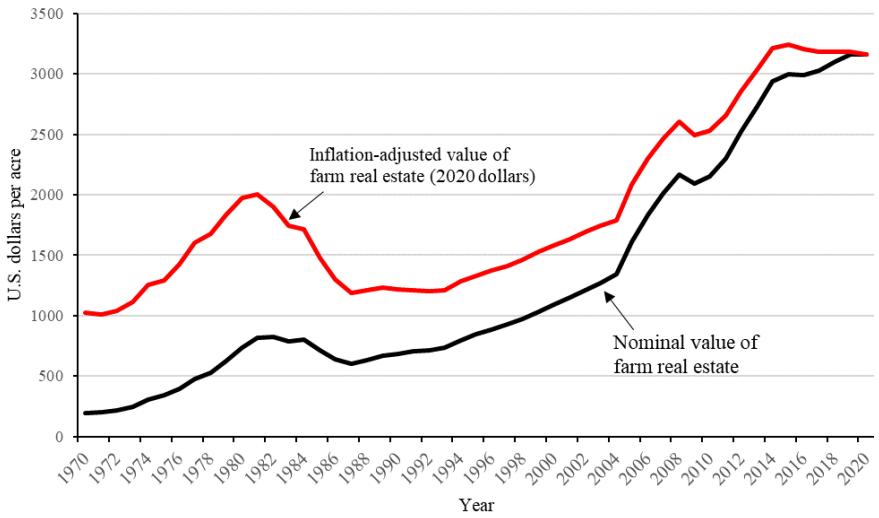
Conservation practices in agriculture, such as conservation tillage systems, cover crops, or filter strips, can produce notable on-farm and off-farm environmental benefits including erosion control, nutrient management, and carbon sequestration. Why and when farmers adopt conservation is of interest to domestic agricultural policy. The U.S. Department of Agriculture spends over five billion dollars per year on farm conservation programs to encourage practice adoption on working lands.

Land being a primary asset in crop production, the tenure status of the plots on which crops are cultivated is arguably a major component of an operator's decision to adopt conservation practices. Agricultural land is either owned or rented under a variety of contract types and levels of complexity. Different land tenure arrangements can impact the incentives for conservation adoption. This report explores trends in how agricultural contract choice and ownership type affect the adoption of conservation practices using the Agricultural and Resource Management survey, which is the U.S. Department of Agriculture's (USDA) primary source of information on the farm production practices, resource use, and the economic well-being of farms and ranches in the U.S. (USDA-ERS, 2021).

An examination of how land tenure affects conservation practice adoption has implications for the USDA's Climate-Smart Agriculture and Forestry (CSAF) initiative, which is a broad set of climate-change strategies to help improve soil health, sequester carbon, reduce greenhouse gas emissions, enhance productivity, and mitigate the impacts of climate change (USDA, 2022). CSAF seeks to leverage existing USDA programs, including the Conservation Stewardship Program, the Conservation Reserve Program, and the Environmental Quality Incentives Program, to support the initiative's climate change strategies.

There are additional policy implications associated with access to land. Approximately forty percent, or 355 million acres, of farmland in the lower 48 states is rented (Bigelow et al., 2016; USDA-NASS, 2021). As displayed in in Figure 1, U.S. farm real estate prices (per acre) have more than doubled over in the four past decades (Callahan, November 2, 2020). The national average price per acre (inflation adjusted) in 1970 was approximately $1,025, whereas the average price in 2020 was about $3,150. As a result, it can be challenging for younger and beginning farmers to purchase farmland, which arguably necessitates tenancy farming as an alternative.

Figure 1. Average U.S. farm real estate values, 1970-2020



Notes: Farm real estate prices include land and buildings. Data reflect values as of June 1 of each year as reported U.S. Department of Agriculture's annual June Area Survey. The annual gross domestic product implicit price deflator was used to convert nominal values to 2020 U.S. dollars. The estimates exclude the states of Alaska and Hawaii.
Source: USDA, Economic Research Service (Callahan, November 2, 2020).

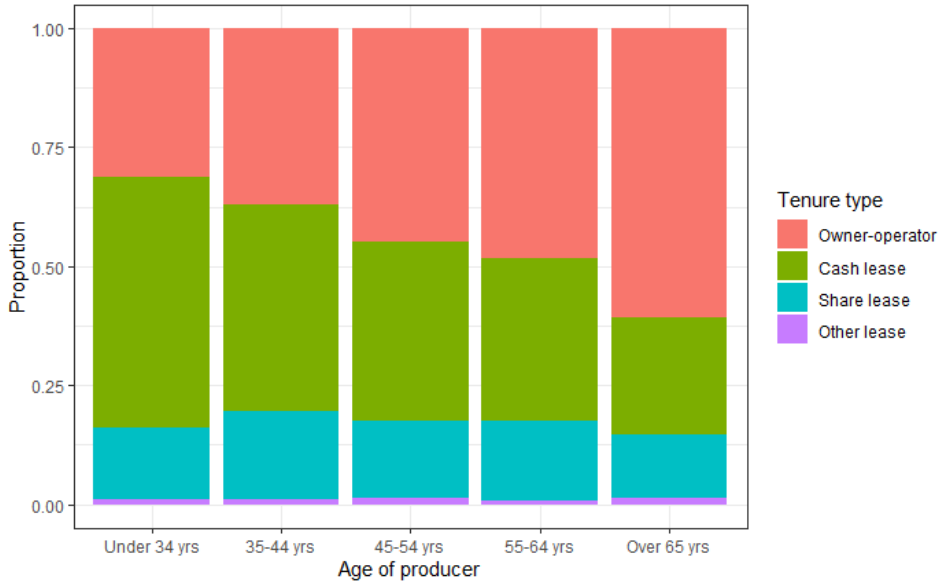
The challenge of access to land is reflected in the two bar charts offered in Figure 2, which displays ARMS data pooled for survey years 2010 through 2019. The top figure, Figure 2(a), displays the proportion of field owners versus field renters across different operator age classifications. Figure 2(a) demonstrates that the number of field operators who are tenants exceed the number of field operators who are owners for all age groups except the 65+ years group. Rates of ownership monotonically increase as age increases, a trend which reflects capital accumulation over a producer's career. The bottom figure, Figure 2(b), shows the proportion of field owners versus field renters across tenure length categories (number of years that a farmer has been operating the surveyed field). Figure 2(b) reveal that the number of tenants – cash, share, and other - exceed the owners for all tenure groups if the farmer has less than 25 years of experience operating within the surveyed field. This suggests that empirically, renters are often on a particular plot for more than a short-term duration and can be impacted by the long-term consequences of their own past production and management decisions.

Issues of landownership and agricultural land tenancy have been disputed for over three centuries among philosophers, economists, and lawyers. The dispute is based on differing incentives faced by tenants and

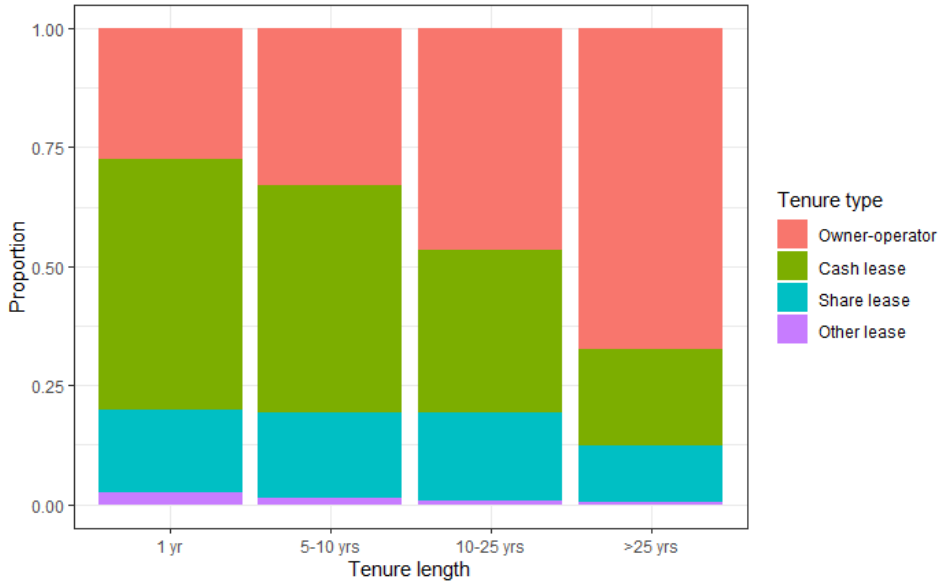
landowners over land use. Early contributors to this debate included Adam Smith and John Stuart Mill, among several other historic figures. The original debates surrounded the various merits of lease contract design based on the underlying economics returns and risks faced by the landowners and tenants.

The conventional wisdom, reflected in the three-hundred-year-old debate, implies that tenant farmers are primarily motivated by short-run economic returns and therefore their consequent production practices may come at the expense of the landowner's welfare. Whereas landowners are often interested in inter-generational transfer (e.g., keeping the land in farming), so the owners consider the future value of the land as an asset (Dubois, 2002).

Figure 2. Farmland ownership versus tenancy based on age group and tenure



(a) Own/rent by age classification



(b) Own/rent by tenure length classification

Notes: The relative frequencies, listed on the vertical axes, denote the subgroup population group sizes relative to the entire population of observations.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Johnson (1950, p. 121) captured the notion of the differing incentives faced by owner and tenant in the following quote.

> When a man sells a bushel of wheat, he has no interest in the use to which the wheat is put and is consequently willing to sell to the highest bidder. However, when a [woman] sells the use of land, [she] has a real interest in how the land will be used. Consequently, the choice of tenant is never made without considering what the impact of tenancy will be upon the value of the asset. ...[The] tenant is presumably chosen in terms of explicit or implicit notions concerning the level of output that [she] will produce on the farm. Any agreement that is reached is enforced by the short-term condition of the tenure rather than by a detailed lease contract.

This idea suggests that owners have an interested in attempting to dictate or monitor tenant production decisions. The agricultural industry has evolved considerably since the publication of Johnson's (1950) quotation. However, the transaction costs associated with farming, including issues of monitoring, timeliness, and the uncertainty of weather, have contributed to the perpetuation of certain features, including informal land contracting. To this day, many agricultural land tenants have leases that are automatically renewed yearly without an explicit written contract (Allen and Lueck, 1992a). As an example, Knutson (11 December 1989) stated: "It is a common scene in U.S. agriculture: A landowner and tenant talk for a few minutes over a cup of coffee, then shake hands to clinch a one-year deal to rent a farm or piece of land. No fuss, no bother, no paperwork."[1] If the lease is written, the contract may only pertain to one attribute of the land – the surface area. Land is comprised of many different attributes including soil nutrients and moisture, all which landowners' value. While landlords could attempt to contract over these attributes or be involved in certain cultivation of conservation decisions (as we will explore in the next section), monitoring and measuring certain soil and water quality attributes can prove exceedingly difficult (Allen and Lueck, 2002). This is especially so if the owner is a non-operator (absentee) landlord or does not live in the same location of the owned farm.

Even if rental contracts do not explicitly state requirements over soil quality, or landlords are unable to successfully monitor tenant activity, renters still may have an incentive to engage in good stewardship or adopt conservation practices. As indicated by the TOTAL survey, in 2014 about 28 percent of farmland

[1] Allen and Lueck (1992a) asked a somewhat related question: "Why do simple ... contracts arise [in the agricultural industry] when real-world contracting is costly?" We discuss the nature of agricultural lease agreements in the next section.

acres had been rented to tenants for greater than ten years (Bigelow et al., 2016). Thus, rental agreements can resemble land ownership, such that renters may occupy a plot long enough and have enough certainty in their future tenure on the plot to consider long-term soil quality. Allen and Lueck (1992a) contend that the tenant "owns" many of the land's attributes for the contract period. In addition, prior studies have shown how the power of enforcement through reputation in rural communities plays a role in shaping farmer behavior. These observations beg the question: Do today's farmland tenants care more about soil quality and other environmental effects if they are effectively operating as landowners?

This report examines conservation behaviors across several years and land planted to different types of field crops. The trend analyses suggest that the adoption of conservation tillage practices of farmland tenants is not systematically different from that of a landowner or owner-operator. The trends for cover cropping and structural practices (long-term conservation management practices) adoption are highly similar between landowners and renters. Compared to owner-operators, farmland tenants seem just as apt, on average, to adopt cover cropping and structural practices.[2]

Background: Past Economic Studies Related to Landownership and Farmland Tenancy

Among past economic studies, problems between landlords and tenants (sometimes referred to as the principal-agent problem) has been explored almost exclusively in the context of lease contract choice and design. These studies led to an ongoing debate pertaining to which type of agricultural lease contract offers the best economic outcomes for both the landowner and tenant producer.

Early Studies on Farmland Tenancy: Dating Back to the 18th Century

The optimal choice of agricultural contract has been debated in the economic and law literatures for at least the past three hundred years (Smith, 1937 [1776]; Mill, 1857; Goldney et al., 1882; Marshall, 1890 [1956]; Heady, 1947; Johnson, 1950; Cheung, 1969; Newberry and Stiglitz, 1979; Allen and Lueck, 2002; Fukunaga and Huffman, 2009; Sawadgo et al., 2021). For example, Adam Smith (1937 [1776]) critiqued share contracts in *The Wealth of Nations*, and John Stuart Mill (1857) and Alfred Marshall (1890 [1956]) noted the moral hazard (lack of incentive to guard against risk where one is protected from consequences) inherent in share contracts. A 19th century English attorney George Cooke dedicated an

[2] For clarification, the ARMS survey does not identify a respondent as a landowner or farmland tenant. Rather, the survey identifies a plot of land as either owned or rented. Throughout the remainder of this report, we will refer to an observed plot that is owned as a "landowner" observation, whereas as plot that is rented as a "tenant" observation.

entire treatise to the subject of agricultural tenancy contracts, in which he advocated for one-year, cash-rent contracts.

The exploration of agricultural contracts has culminated into three categories of studies. The first is a theoretical exploration of contract choice in agricultural tenancy. The second applies observational evidence to the study of contract choice based on the behavioral and socioeconomic characteristics of tenants and landlords. The third and most recent category relates the effect of contract choice on specific production practices, including conservation agriculture. This report mostly pertains to the latter but offers a brief outline of the other two categories as all three literatures are interrelated.

Contemporary Studies on Farmland Tenancy and Contract Design

Many economic studies within the mid to late twentieth century offered theoretical examinations based on differing incentives between landowner and farmland tenant. For example, Stiglitz (1974) argued that: (i) share tenancy is akin to a labor contract that sometimes yields higher utility to the landowner over cash tenancy agreements; and, (ii) cash tenancy contracts misallocate risks, as the tenant assumes all of the market risks but is likely to be more risk-averse than the landlord. In a follow-up study, Newberry and Stiglitz (1979) offered a theoretical study in which a landowner was able to optimally set incentives for a given level of production uncertainty and risk aversion of the tenant. Roumasset (1995) contended that labor contracts (as opposed to rental contracts) can incur shirking behavior.

The early theoretical literature led to research that tested farmland contract choice based on real-world observations. For example, Cheung (1969) highlighted that landowners can create economic arrangements based on sharecropping, given suitable variation in plot size and division of the output. Other studies suggest that the type of rental contract chosen reflects the potential for tenants to inflict long-term degradation upon the plot (Allen and Lueck, 1992b, 1993, 1995, 1999). For example, Allen and Lueck (1992b) contended that share contracts are more likely when a tenant has a greater potential to over-work or exploit the land. Moreover, Allen and Lueck (1995) argued share contracts are in place to aid the landowner against any of the tenant's unobserved, risky production practices that do not promote the long-term value of the land.

Using observational data, Fukunaga and Huffman (2009) examined the role of risk and transaction costs in farmland contract choice. The authors main objective was to test contract choice (share versus cash rental) using data from the 1999 Agricultural Economics and Land Ownership Survey (AELOS), which was a special survey offered by the U.S. Department of Agriculture on farmland tenancy and

characteristics. AELOS is the predecessor to the data used within the current study – the 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey. The authors found mixed evidence for motives of contract choice; however, they identified that landlord and tenant observations seemed consistent with risk averse behavior.

Studies on Farmland Tenancy, Contract Choice, and Conservation Adoption

A more recent stream of the land tenure studies involves an empirical examination of contract choice and conservation behavior (Ervin and Ervin, 1982; Young and Shortle, 1984; Norris and Batie, 1987; Lynne et al., 1988; Nielsen et al., 1989; D'Souza et al., 1993; Featherstone and Goodwin, 1993; Soule et al., 2000; Knowler and Bradshaw, 2007; Sklenicka et al., 2015; Varble et al., 2016). For example, Soule et al. (2000) used data from the U.S. Department of Agriculture's Agricultural Resource Management Survey to determine if contract choice influenced the adoption of conservation practices by comparing a tenant's behavior to that of owner-operators. Intuitively, they found that cash- and share-renters are less likely to adopt practices that provide only long-run benefits, such as strip-cropping and contour farming. They also find that both cash- and share-renters are more likely (over owner-operators) to adopt short-term practices, such as conservation tillage, on highly erodible land. They argue the latter effect may be due to conservation compliance requirements to receive U.S. Department of Agriculture conservation program funding.

Sklenicka et al. (2015) found that erosion-control conservation practices were adopted more frequency by owner-operators than tenant farmers in the Czech Republic. Using a survey of farmers in a particular watershed of Iowa, Varble et al. (2016) found that tenant farmers were more likely to utilize conservation tillage practices. Two very recent studies examined farmland conservation adoption in the states of Illinois and Iowa (Schnitkey et al., 2021; Sawadgo et al., 2021). Both found evidence that tenant farmers were less likely adopt cover crops and other medium to long-term conservation practices.

The Agricultural Resource Management Survey: 2010-2019

To analyze conservation practices by agricultural landowners and renters, we use data from the Agricultural Resource Management Survey (ARMS), which is sponsored jointly by the U.S. Department of Agriculture's Economic Research Service (ERS) and the National Agricultural Statistics Service (NASS). ARMS is the U.S. Department of Agriculture's primary source of information on the production practices, resource use, and economic well-being of America's farms and ranches.

The ARMS survey collects data based on interviews with farm operators about their farm management practices, farm business structure and finances, and household characteristics. This survey is conducted annually and is based on a multiphase, multi-frame, and stratified sampling design. ARMS Phase 2 focuses on the practices and characteristics of one individual field within a surveyed operation. ARMS Phase 3 focuses on operator and operation-level characteristics, and are only submitted to a subset of the Phase 2 responders. We use both Phase 2 and Phase 3 data in this analysis.

To avoid overburdening the data collection on American farmers, who also respond to the Census of Agricultural survey every five years, ARMS data is split up each year according to major crops planted. For example, producers growing corn were interviewed in the 2010 survey, and producers growing barley and sorghum were interviewed in the 2011 survey. Therefore, ARMS is not a longitudinal panel, but rather a separate cross-sectional survey of farmers across years. For this report, we utilized data from the 2010 to 2019 survey years.

The ARMS survey collects information about agriculture from the lower 48 U.S. states. The states surveyed vary by year according to the top states by cash receipts for the major crop examined in that year. For example, in the 2016 survey year for corn, ARMS collected data from Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Texas, and Wisconsin. The collections of states are chosen each year to represent over 85 percent of all farm cash receipts in the U.S.[3]

The major crops planted by survey year for ARMS are provided in Table 1. Major commodity types are repeated approximately every five-to-six years. The survey year 2014 did not contain a commodity but rather the Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey. The TOTAL survey was also conducted jointly by NASS and the ERS in place of the ARMS survey. The TOTAL survey was a comprehensive study of all land rented for agricultural purposes, including both land rented out by those who are themselves active farmers and ranchers (operator landlords) and land rented out by those who do not operate a farmer themselves (non-operator landlords). The TOTAL survey was a special follow-on component to the Census of Agriculture program.[4]

[3] Additional details about the ARMS survey and methodology are available at https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/documentation.

[4] Additional details about the TOTAL survey and methodology are available at https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/TOTAL.

Table 1. Agricultural Resource Management Survey: Major crops examined by year (2010-2019)

Survey year	Major commodity type
2010	Corn
2011	Barley and sorghum
2012	Soybeans
2013	Peanuts and rice
2014	TOTAL survey
2015	Oats and cotton
2016	Corn
2017	Wheat
2018	Soybeans
2019	Barley, sorghum, and cotton

Notes: TOTAL denotes the Tenure, Ownership, and Transition of Agricultural Land Survey.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Definitions: Conservation Practices and Farmland Tenancy

For clarification, in this section we operationalize the terminology used within the remainder of the report.

Conservation Practices

Farming practices, under certain scenarios, can degrade the natural environment over time. For example, sediment, nutrient, or pesticide runoff can impair water quality. Tillage can result in soil erosion and loss of soil nutrients. Therefore, the U.S. Department of Agriculture provides conservation funding and education to improve the environmental performance of domestic agriculture with respect to soil health, water quality, air quality, wildlife habitat, and greenhouse gas emissions.

Conservation practices can be adopted by farm operators voluntarily without government assistance, adopted voluntarily with government assistance, or mandated by the federal government in certain cases (conservation compliance). The U.S. Department of Agriculture (USDA) provides a portfolio of voluntary incentive programs to promote conservation. The programs include the Conservation Reserve Program (CRP), Agricultural Conservation Easement Program (ACEP), the Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), Regional Conservation Partnership Program (RCPP), and Conservation Technical Assistance (CTA), among others. In particular,

the EQIP, CSP, RCPP, and CTA programs provide financial assistance to farmers who adopt, install, or maintain conservation practices on land in production (working lands).

In certain cases, conservation programs may be required for plots under cultivation. For certain plots, conservation compliance requirements tie practice adoption to eligibility to Federal farm program benefits (Claassen et al, 2017). These plots include highly erodible land (HEL) and wetlands. Under the HEL provision, farmers who crop on highly erodible land must apply an approved soil conservation system, or the farmers run the risk of becoming ineligible for some federal programs, including farm income support, crop disaster payments, conservation payments, crop insurance premium subsidies, and USDA farm loans and loan guarantees. Under the wetlands provision, producers must refrain from draining wetlands.

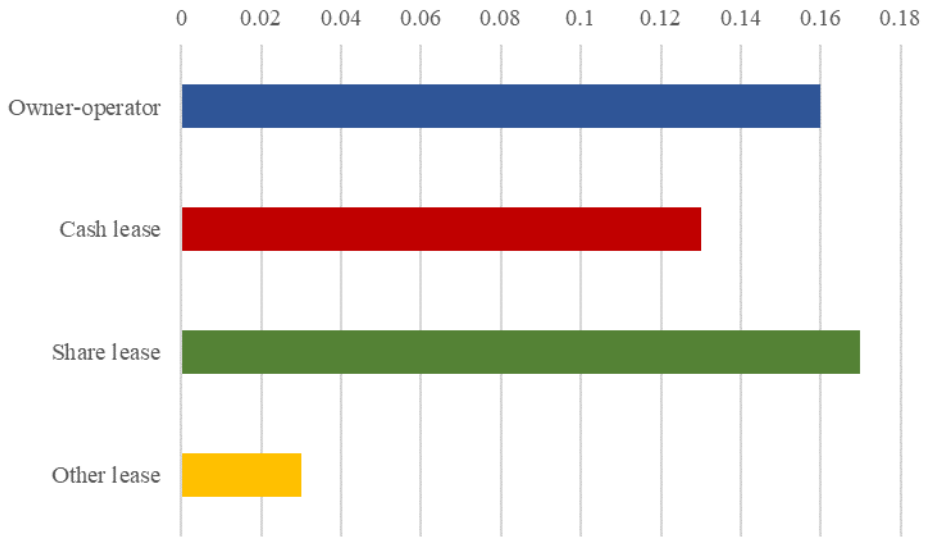
As conversation compliance mandates practice adoption, it is useful to see if owners and renters face similar rates of HEL or wetland designation, as differential designation rates may be a driver of differential rates in practice adoption. However, differential designation rates should not be interpreted as an indicator of how each tenancy group engages soil stewardship, as plots can be highly erodible regardless of contemporaneous or past cultivation decisions, and any action that was taken that may have contributed to a plot's HEL status may have occurred under a different tenancy status as what was recorded in the survey year. It also may be relatively more difficult to find willing tenants for HEL-designated or wetland plots.

Figure 3 provides conservation compliance rates for highly erodible lands and wetlands designations by each tenancy group (own vs cash vs share) for all ARMS data pooled for 2010-2019. Figure 3(a) provides trends for the highly erodible lands (HEL) designation, whereas Figure 3(b) offers trends on the wetlands designation. Designation rates of highly erodible lands and wetlands are generally low for all plots, regardless of tenancy status. Aggregating across all survey years, highly erodible land designations were observed in about 16 percent of the sample of owner-operators, 13 percent of cash leasers, 17 percent of share leasers, and about three percent hybrid or other leasers. The relatively smaller proportion of cash-rented fields under HEL may reflect the difficulty in renting out land that comes with additional regulatory requirements on the operator. Landowners had slightly more wetland designations at about four percent of the overall sample versus only four percent on operations with fixed-cash renters, three percent with share renters, and six percent of renters with hybrid or free leases.

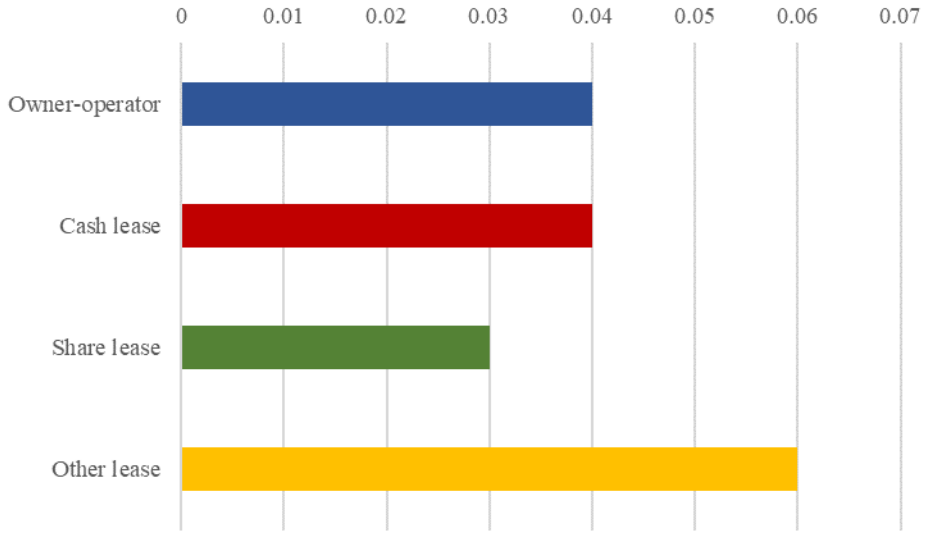
The conservation programs explored within this report can be broadly divided into three categories: short-run, medium-run, and long-run practices.

Short-run practices: Less upfront costs and the farm (or ranchland) benefits are generally realized within two years or less. We classify **conservation tillage** as a short-run practice. Conservation tillage (CT) is a generic term used to describe tillage systems that have the potential to conserve soil and water by reducing soil losses relative to conventional forms of tillage. An operational definition of conservation tillage is a system that retains 30 percent or more of crop residue on the soil surface; the main types of conservation tillage include mulch-till, ridge-till, zone-till, and no-till (Carter, 2005). Conservation tillage practices offer benefits to production and the environment by reducing the likelihood of soil erosion, increasing the amount of soil organic matter, improving water infiltration, and lowering soil carbon losses (USDA-NRCS, 2017). Conservation tillage is classified as a short-run practice as upfront capital costs (a no-till planter) are often followed by immediate costs savings upon adoption (e.g., reduced fuel and labor costs).

Figure 31. Conservation compliance rates: Highly erodible lands and Wetlands (2010-2019)



(a) Highly erodible lands



(b) Wetlands

Notes: Figure (a) illustrates the compliance rates of owners and renters with fields designated as highly erodible land. Figure (b) illustrates the compliance rates of owners and renters with fields designated as wetlands.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Medium-run practices: Generally, higher upfront costs and the benefits may not be experienced within the first two years of adoption. We classify **cover cropping** as a medium-run practice. Cover crops occur in a crop rotation during the period in between two commodity or forage crops plantings (Wallander et al., 2021). Unlike primary commodities, cover crops (CC) generally support secondary farmers' needs rather than grown for trade or human consumption. Cover crops consist of unharvested cereal rye, oats, winter wheat, and clover, among others. Cover crops have been demonstrated to improve soil health, prevent soil and wind erosion, improve the availability of soil water, suppress weeds, and feed cattle, among other benefits (USDA-NRCS, 2021). Despite the benefits, CC practice require upfront seed costs, planting labor costs, and possibly termination costs after the growing season. No land is taken out of production. The conventional wisdom that farmland tenants are more interested in short-run economic gains, may suggest that renters are less inclined to adopt CC practices due to the upfront costs.

Long-run practices: Highest upfront costs and the benefits may not be experienced within the first two years of adoption. We consider **structural practices** such as **riparian buffers, filters strips,** or **grass waterways** as long-run practices. Structural practices can filter runoff and remove contaminants before they reach water bodies, reduce soil erosion, provide wildlife habitat, and protect against flood. They are generally expensive to implement – they often involve planning and heavy equipment. Additional costs may include seed, labor, as well as the opportunity cost of cultivation (taking land out of production). It is generally difficult to reverse the land use back to crop cultivation.

Overall Trends in Conservation Practice Adoption

Figure 4 displays overall adoption rates for conservation tillage, cover cropping, and structural practices for all data across the ARMS survey years from 2010 to 2019 (except for 2014 in which the TOTAL survey was conducted).

Conservation tillage

The overall rates of conservation tillage adoption are provided in 4(a) – this figure is based on the pooled dataset across survey years.[5] The adoption rates are similar among landowners (69 percent), share leasers (65 percent), cash leasers (68 percent), and other leasers (66 percent).

Cover cropping

The rates of cover crop adoption are provided in Figure 4(b). Both landowners and cash renters had adoption rates at seven percent, whereas share renters had a rate of four percent and other renters had an adoption rate of eight percent. The other renters had a much smaller sample size than landowners, cash, or share renters. As a result, a few large operators, that we identified as having an "other lease" (hybrid or free lease) and utilizing conservation tillage, are skewing the adoption rate upward for that group.

Structural practices

The adoption rates of conservation structural practices are offered in Figure 4(c). About 24 percent and 22 percent of landowners and cash renters adopted, respectively whereas twenty percent of share renters and eighteen percent of other renters adopted the practices.

Land Tenure

Land tenure is broadly defined as the laws, rules, and customs regarding the use, control, and transfer of land (Bigelow et al., 2016). Rules of tenure define how property rights to land are to be allocated within societies and the associated responsibilities and restraints (Food and Agriculture Organization of the United Nations, 2002). Put simply, tenure determines who can use the resource, for how long, and under what conditions. A landowner is defined as a person or entity that owns agricultural land, and a landlord is a type of landowner who rents the land to one or more agricultural operators. There are two major types of landowners: operator landlords and non-operator landlords. Operator landlords are a subset of owner-operators who operate a portion of their land and rent out the remainder. Non-operators rent their land but are not actively involved in farming operations.

[5] To define conservation tillage adoption, as per NRCS standards we consider any observation with a Soil Tillage Intensity Rating (STIR) of 80 or less as engaged in conservation tillage. More information on STIR is included in the later section on practice adoption by crop.

Typology of Lease Agreements

A rental or lease agreement refers to a legally binding contract that specifies the right of the tenant to use the land, which is the sole property of a landowner, in exchange for a defined rental amount and time period. When referencing a specific contractual agreement, we will use the terms lease and rental agreement interchangeably throughout the rest of the report.

There are four broad categories of farmland lease agreements.

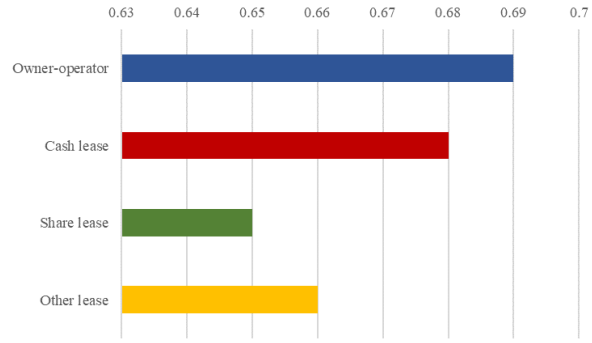
Share contracts: Landlord and tenant generally split input costs and the tenant provides all the labor and remaining costs of operation. The harvests or revenues are then generally divided according to the contractual agreement (e.g., a fifty/fifty or twenty-five/seventy-five split) (Schnitkey et al., 2021). Input costs and harvest/revenues are usually split along the same ratio. In such agreements, the landlord reduces the tenant's production risks by covering some of the costs, and the landlord is compensated by part of the economic returns.

Cash-rental contracts: Tenant pays a fixed dollar amount in rent, and the landlord is generally not involved in production, giving the tenant more autonomy. The tenant assumes all market risks and is generally entitled to all returns. Cash rental arrangements are the most common lease type, covering approximately seventy percent of all rented farmland in the Midwest, as measured in 2014 (Bigelow et al., 2016).

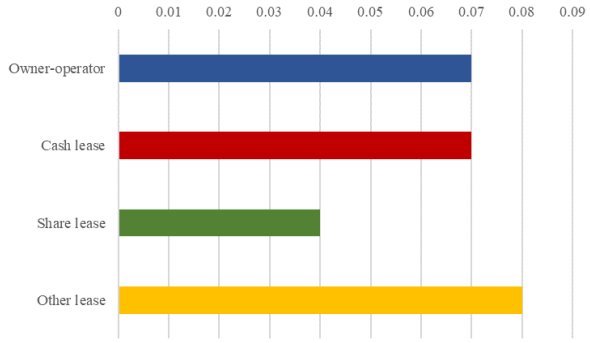
Flexible or hybrid contracts: Generally, a combination of cash and share payments. Alternatively, the rental payment is based off commodity prices after the crop is harvested.

Free land contracts: As the name suggests, the land is rented without any stated financial remuneration.

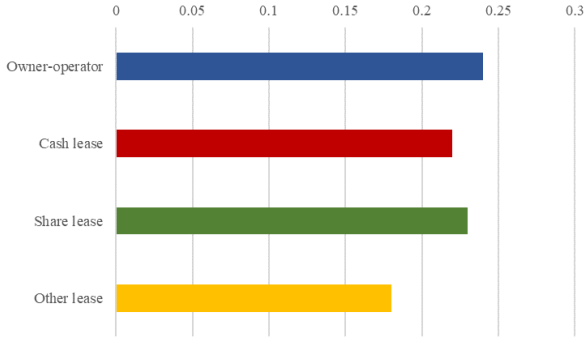
Figure 4. Trends in adoption rates of conservation practices (2010-2019)



(a) Conservation tillage



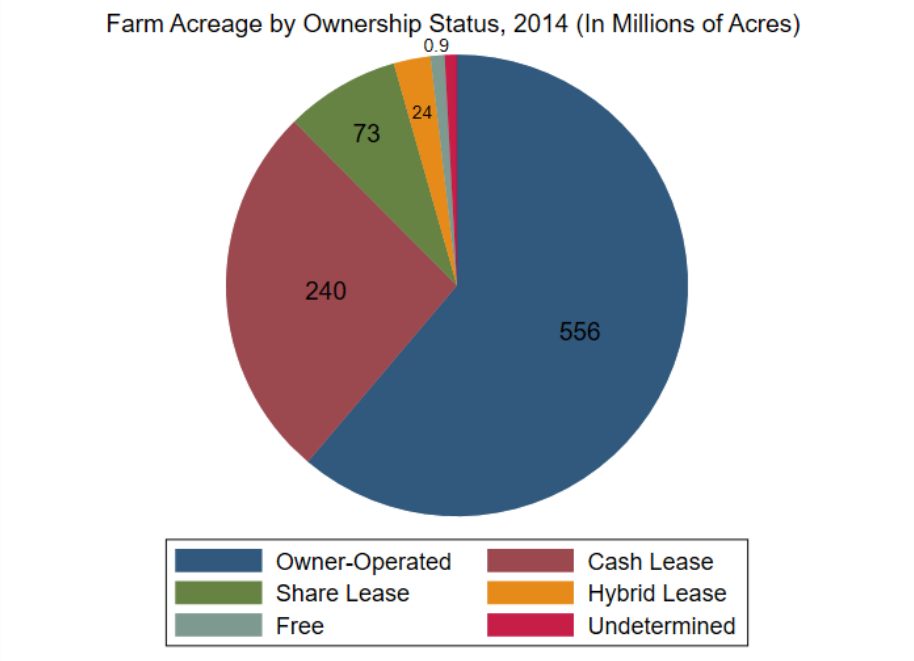
(b) Cover cropping



(c) Structural Practices

Notes: This figure represents the percentages of adoption rates across pooled survey years from 2010 to 2019. Figure (a) represents the adoptions rates of conservation tillage; figure (b) represents the adoption rates of cover cropping; and, figure (c) represents the adoption rates of structural practices. Rates are defined as subgroup adopters relative to the subgroup population. For example, the ratio of cash renters adopting conservation tillage relative to the entire population of survey respondents who were cash renters.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Figure 5. Farm acreage by ownership (owned versus rented) status, 2014

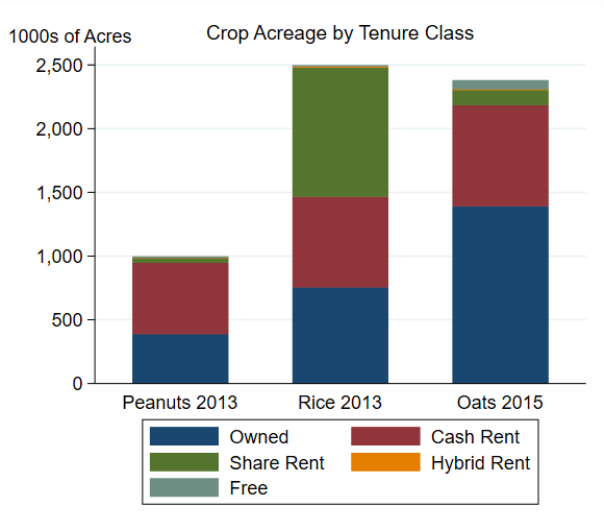


Notes: This figure represents the percentages of farmland by owned or leased fields.
Source: USDA, Economic Research Service using annual data from USDA's TOTAL survey, 24.

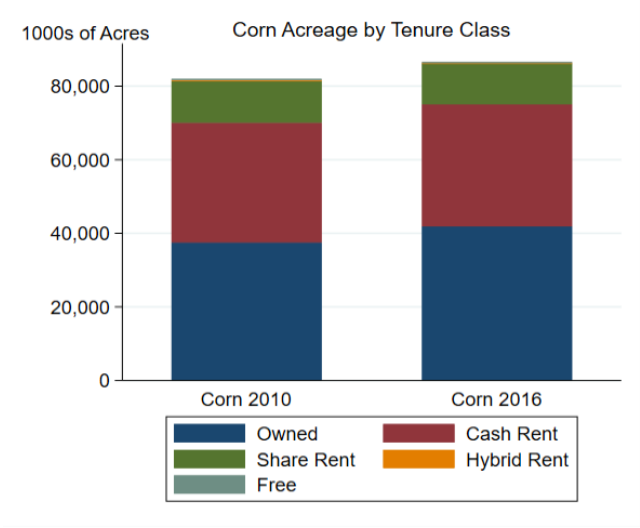
The total amount of acreage of farm and pastureland by owner status (owned versus leased) is offered in Figure 5. Owner-operated land is the most common land tenure classification, making up approximately 5.6 billion acres, or 61% of farmland in the lower 48 states. Cash rental contracts are the second most common form of land tenure classification, making up approximately 2.4 billion acres, or 26% of farmland. Share rental contracts are the second most common rental contract, making up approximately 8% of farmland.

Proportions of land ownership versus tenancy can also be explored for individual crops.
For each crop surveyed by ARMS from 2010-2019, we plot the total acreage under each tenure classification as a stacked bar graph in Figure 6. When a crop is surveyed more than once in the decade, we include both years to examine trends.

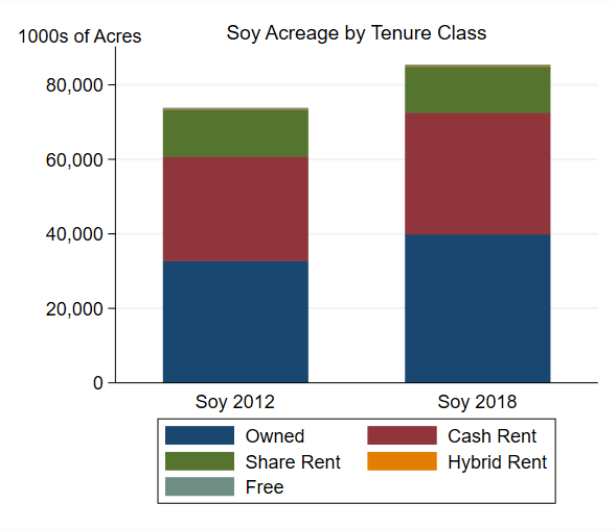
Figure 6. Farm and pastureland acreage by ownership status (owned versus leased) by principal field crop



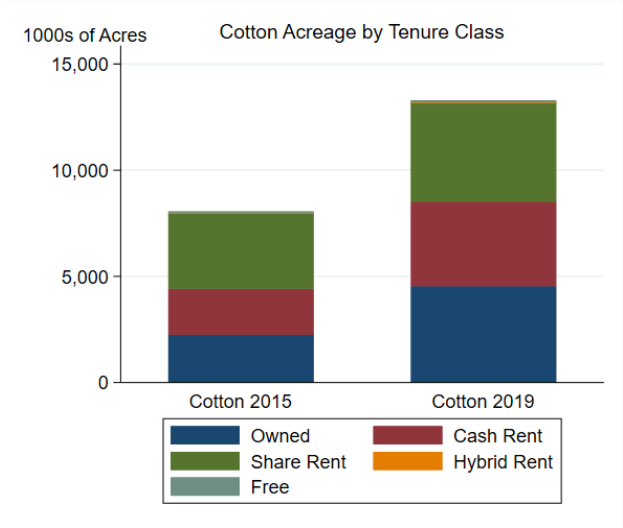
(a) Crop Acreage



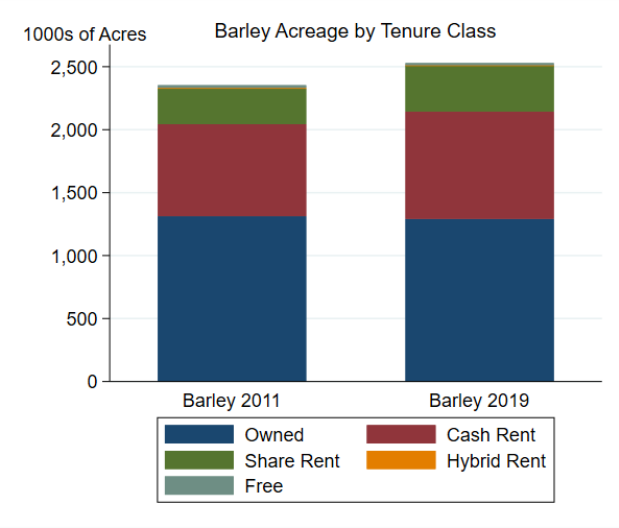
(b) Corn Acreage



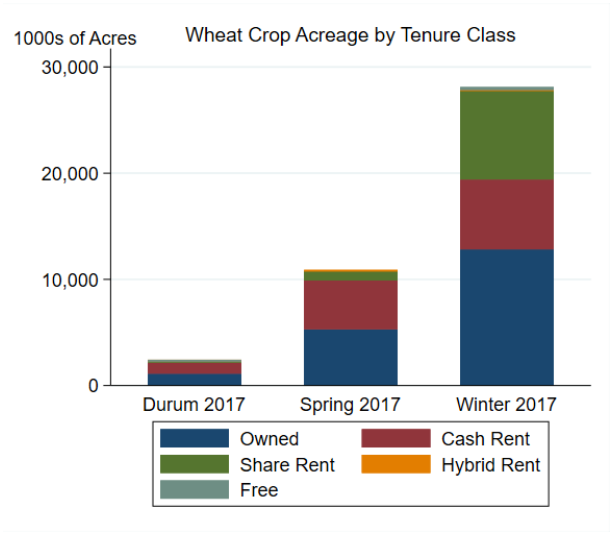
(c) Soy Acreage



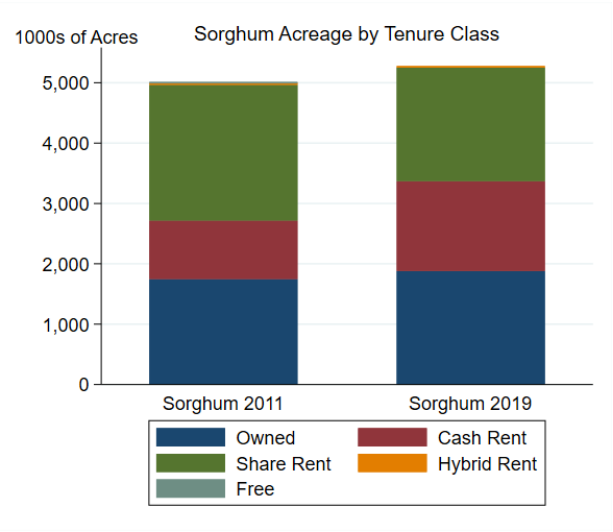
(d) Cotton Acreage



(e) Barley Acreage



(f) Wheat Acreage



(g) Sorghum Acreage

Notes: This figure represents the percentages of farmland by owned or leased fields.
Source: USDA, Economic Research Service using annual data from USDA's TOTAL survey, 2014.

As displayed in Figure 6, proportions of land ownership verses different types of tenancy vary across crop type. Corn, soy, oats, peanuts, barley, spring wheat, and durum wheat are very owner and cash-rent dominant, with the sum of owner and cash-rent acreage making up over 80% of each crop's survey year

acreage. Cotton, rice, sorghum, and winter wheat have greater proportions of acreage in share contracts – share contracts make up at least 30 percent of each crop's survey year acreage.

Paulson and Schnitkey (2013) note that the overall trend in the market is in favor of cash-rent over share-based contracts. Examining Figure 6, this looks to be case for the most commodities in which we observe two survey years. For barley (2011 and 2019), sorghum (2011 and 2019), soy (2012 and 2018), and cotton (2015 and 2019) , we observe an increase in both the gross acreage planted on cash rented land but also an increase in the proportion of acreage planted on cash rented land. Corn (2010 and 2016) experienced an increase in gross acreage planted on cash rented land but a slight decrease in proportion.

Contract Characteristics

The nature of land contracting in the American agricultural sector can inform how tenants may behave in the context of soil stewardship and conservation practice adoption. As displayed in the previous section, cash, share, hybrid and free contracts are all present at different acreage proportions for major commodity crops. Although how renumeration takes place is the main difference between the forms of agreements, and contracts can differ across other dimensions in ways that may impact conservation. The level of formality, and the level at which landlords get involved in decision-making on the piece of rented land, are both explored in the TOTAL survey.

Informal Contracts

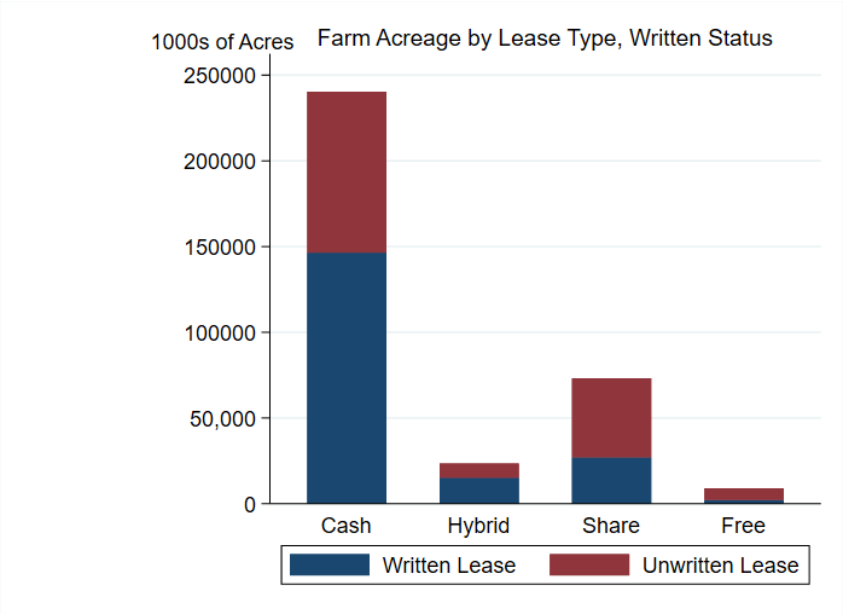
The 2014 TOTAL survey questioned landlords about the written formality of their rental contracts with tenants. Displayed in Figure 7 is the amount of acreage under each of the four rental contract types (cash, share, hybrid, and free) that is under a written or unwritten contract. [6]

As of 2014, 39 percent of all farmland acreage in the lower 48 states in cash contracts was under unwritten rental agreements. Of acreage in share contracts, 63 percent were under unwritten rental agreements. The category with the highest proportion of acreage under written rental agreements, hybrid, had 35 percent of acreage under unwritten rental agreements, which fits with the more complicated nature of hybrid contracts. Free contracts, which require no renumeration from the tenant, had the largest share

[6] The TOTAL survey asked landlords detailed questions about the rental agreements with their three largest (in terms of acres rented) tenants. Only 1 percent of all landlords had more than three tenants. Therefore, information collected on rental agreements through the TOTAL survey represents 98 percent of rented land. A note has been provided under each figure affected by this truncation

of acreage under unwritten agreements with 75 percent. Across total acreage, 45% was under unwritten contracts.

Figure 7. Farm acreage by lease type (written versus unwritten leases), 2014



Notes: This figure represents the percentages of farmland by lease type (written versus unwritten leases). See footnote 3 for information regarding the representative sample.
Source: USDA, Economic Research Service using annual data from USDA's TOTAL survey, 2014.

These findings are in line with estimates from previous studies. In a survey of farms in Nebraska and South Dakota, Allen and Lueck (1992a) found that fifty-seven percent of all contracts were oral in nature. and the non-verbal (or written) contracts were short (generally one-to-three pages) and stipulated little details about land use. Of the survey responses, many of the lease agreements had been renewed on an annual basis up to thirty years. Farmland lease agreements tend to be simple contracts - the lease agreements generally do not contain transaction-specific assets, other than the land itself, and there were numerous potential lessors or profitable use of the land. Thus, the transaction costs appear to be too high for more complicated agreements, and these types of arrangements can perpetuate through time provided that both parties are satisfied with the contractual agreement.

Monitoring and Social Norms

We define monitoring as the behavioral economics of a firm or individual's compliance with law (Langevoort, 2002). Monitoring is the formal (or informal) process by which the principal (landlord) or

agent (farmland tenant) ensures that the other party is fulfilling the tenancy contract. When leasing land, to prevent a tenant from overworking the soil a landlord may attempt to contract over certain production decisions – the types of crops grown, the types of fertilizer or pesticide used, cultivation decisions, conservation practices adopted, or participation in government programs (regardless of if the contract is written or not, although it is probably easier to enforce provisions if the contract is written). Whether or not a landlord includes such clauses will depend on 1) how easy it is to monitor tenant behavior and 2) the payoff from monitoring.

The 2014 TOTAL survey questioned landlords on how involved they are in certain aspects of decision making on leased plots. Four of those questions dealt with decisions related to conservation practices – cultivation decisions, adoption of one-season conservation practices, adoption of permanent cultivation practices, and participation in government programs. Available answers included – decisions made by tenant only, landlord only, tenant and landlord together, and tenant and landlord separately. Figure 8 shows acreage proportions for which rental contract type under each of the four decision-making splits.

Cultivation decisions are primarily made by the tenant only for the majority of acreage across the four rental contract types. Intuitively, the landlord is involved in some capacity for hybrid and share contracts more often than cash contracts, as input costs are often shared in hybrid or share arrangements. If the landlord is involved in the decision-making, it is most often done together with the tenant. The low proportion of acreage in which the landlord is involved in cultivation decisions may be an indicator of the difficulty in monitoring and enforcing cultivation-related clauses in rental contracts.

Decisions regarding one-season conservation practices, such as the adoption conservation tillage, are primarily made by the tenant only. Like decision-making regarding cultivation, the landlord is involved in some capacity for hybrid and share contracts more often than cash contracts. If the landlord is involved in the decision-making, it is most often done together with the tenant. There is however a non-trivial amount of acreage in cash-leases (6.7 percent) in which the adoption of one-time conservation practices is determined by the landlord only, which suggests that for some landlords the monitoring or enforcement of the adoption of temporary practices is possible.

Permanent conservation practices often take cropland or pastureland out of production and are hard to reverse. Not surprisingly, the landlord is often involved in any decision regarding their adoption across all contract types. For most of the acreage in cash rental agreements however the tenant still has full control over the decision. One explanation for why landlords allow renters to make permanent decisions on their

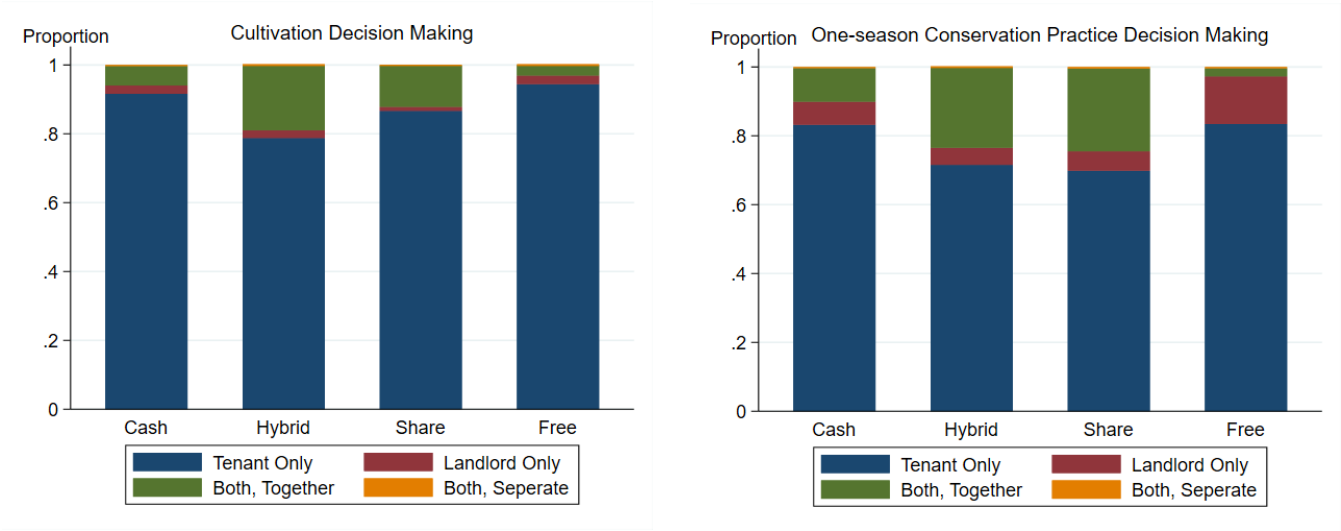
land is that if a renter chooses to implement a permanent conservation practice, any benefits can be capitalized into the cash rental rate, ultimately rewarding the landlord.

While tenant has full control over any decision to participate in government programs for most cash and hybrid contract acreage, the landlord is involved in some capacity for most of the share acreage.

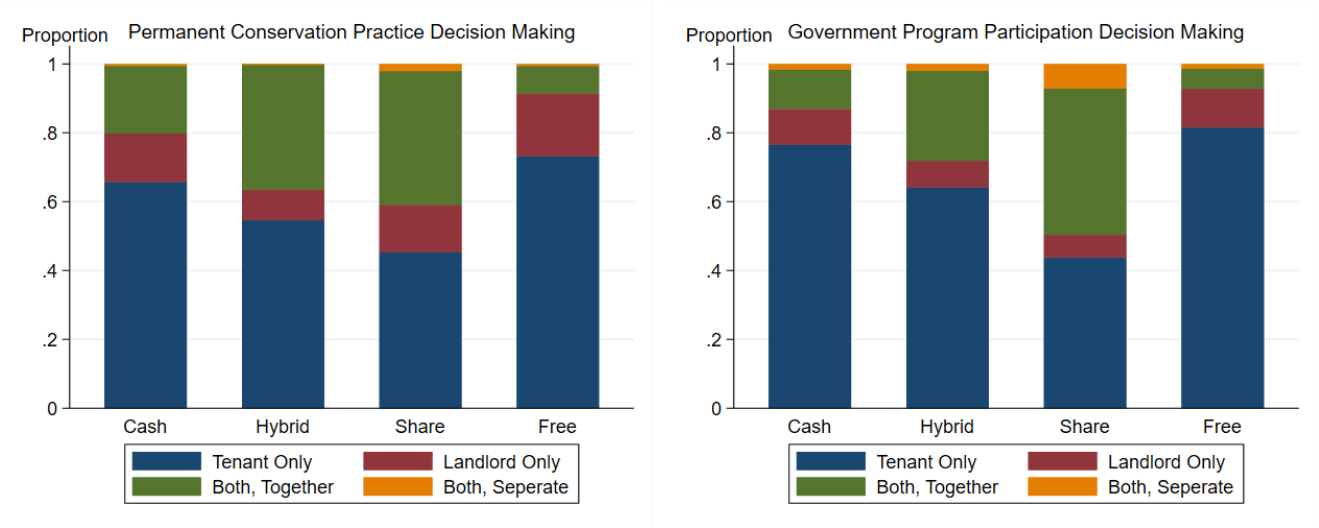
Although, the monitoring of behavior of a farmer does come from local peer groups as well (Saak, 2012). Social norms, on the other hand, are defined as the customary or ideal forms of behavior by which individuals within a group attempt to conform (Burke and Young, 2011). According to Burke and Young (2011), social norms induce positive feedback loops between individual members and a group such that the more widely a norm is practiced by the group, the more strongly the motivations for each individual member.

Saak's (2012) findings suggest that monitoring and social norms influence the reputation of regional products and production. Also, Allen and Lueck (1992a) found that monitoring and social norms act as an enforcement mechanism for farmland contracts, in which cheaters are punished through lost future trades and a farmer's collective reputation encourages cooperation between contract parties.

Figure 8. Land tenure: government participation, management decisions, and conservation practice, 2014



(a) Cultivation decisions (b) One-season conservation decisions



(c) Permanent conservation practices (d) One-season conservation practices

Notes: This figure represents the proportion of farmland by lease type on which decision-making regarding conservation-related activities is conducted by the tenant or the landlord. See footnote 3 for information regarding the representative sample.
Source: USDA, Economic Research Service using annual data from USDA's TOTAL survey, 2014.

Conservation Practices: Current Patterns of Practice Adoption by Land Tenure

Conservation Tillage Trends

Historically, conservation tillage has been measured on the farm by using the soil tillage intensity rating or STIR index. The STIR index is defined by the USDA's Natural Resource Conservation Service (NRCS) to evaluate the kind, severity, and number of ground disturbing passes on soil quality (Claassen et al., 2018). STIR ratings are determined by the operational speed of tillage equipment, number of passes, tillage type, depth of the tillage operation, and percent of the soil surface are disturbed.

Values of the STIR index range from zero to 200, with lower values indicating less soil disturbance. Conservation tillage systems are defined as any operation that achieves a STIR of 80 or less, while conventional tillage is any operation that achieves a STIR higher than 80. Within the conservation tillage category, no-till is defined as a system that refrains from any tillage operation, while mulch or reduced tillage is any system where the soil is tilled but soil disturbance is low (with a maximum STIR value of 80 (USDA-NRCS, 2016)).

Figure 9 offers the average STIR values by crop and year, separated by owner, cash renter, and share renter. For crops that are surveyed more than once between 2010-2019, the values are displayed together for visual comparison of trends over time in Figure 9(a). For crops that are surveyed only once between 2010-2019, values are displayed in Figure 9(b). Across both plots, STIR values vary widely by crop, which reflect the different agronomic requirements, regions, and cultures associated with each crop.

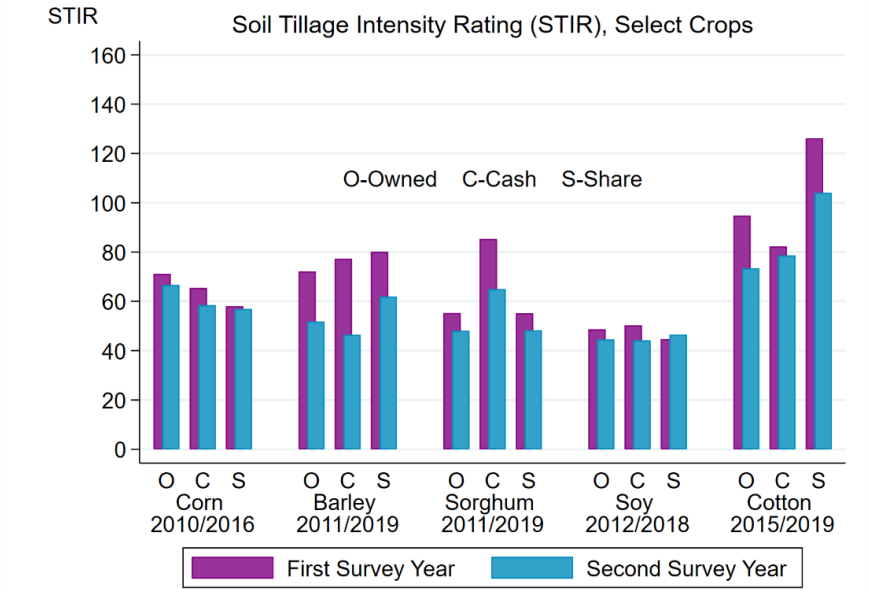
For crops in 9(a), it appears that average STIR values fall from the first survey year to the second for most crop/tenancy categories, apart from sharecroppers planting soy in from 2012 to 2018. This reflects the greater proliferation of reduced-till systems over time in the 2010s (Claassen et al., 2018).

Across both 9(a) and 9(b), no clear pattern emerges across crops regarding STIR values on owner-operated fields compared to cash or share rent fields. For corn in both years, cash and share tenants appear to disturb the soil less than owners by 5-10 index points, perhaps reflecting the cost-sensitive, fully utilized nature of large Midwestern corn operations supplemented with rented parcels. For soy and winter wheat, owners and renters appear to possess fairly even average STIR values. Sharecroppers appear to have higher STIR values on average than cash renters or owners for cotton, barley, and peanuts by 10-20 index points, but comparatively low STIR values for sorghum, rice, oats, durum wheat and spring wheat.

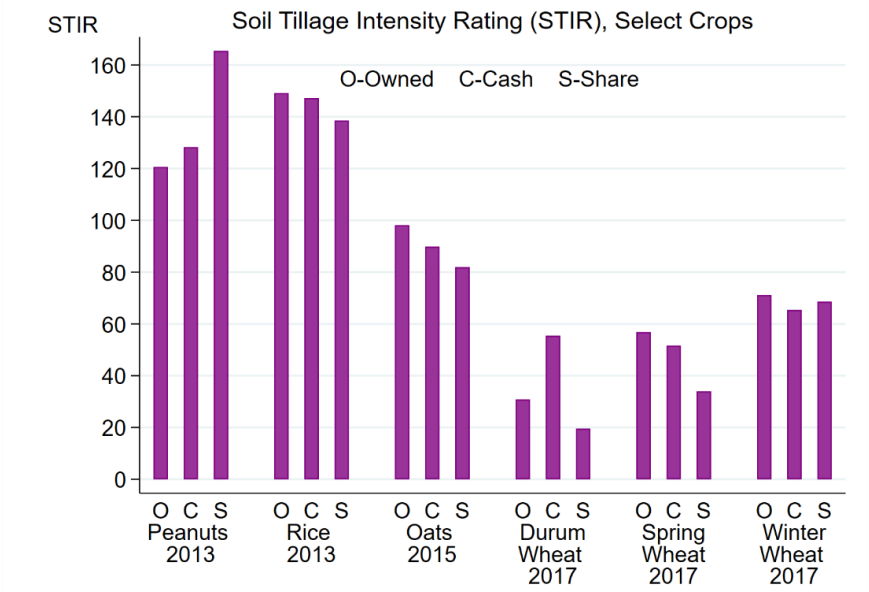
Figure 9 is informative by offering general trends in observed soil tillage intensity ratings within sample and across time. However, the underlying data for the trends are not adjusted for other factors, that may affect an operator's observed STIR value.

Therefore, we estimated a regression of the field-level STIR value on land tenancy type, including other variables that may affect a plot's STIR value. To estimate the regression, we pooled the ARMS data across all survey years – that is, the dataset for the regression includes all the different crop types across the years 2010 through 2019. Other covariates include tenure length, farm class (gross revenues), total number of farm-level acres, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, crop, and county fixed effects. The regression estimates allow us to hold the other factors fixed and assess whether average STIR values are affected by land tenure type.

Figure 9. Average Soil Tillage Intensity Rating value by year (2010-2019)



(a) Crops with multiple survey years : corn, barley, sorghum, soy, and cotton.



(b) Crops with one survey year : peanuts, rice, oats, and durum, spring and winter wheat

Notes: This figure represents the average soil tillage intensity rating values by year between landowners and renters across all the ARMS survey years from 2010 to 2019.

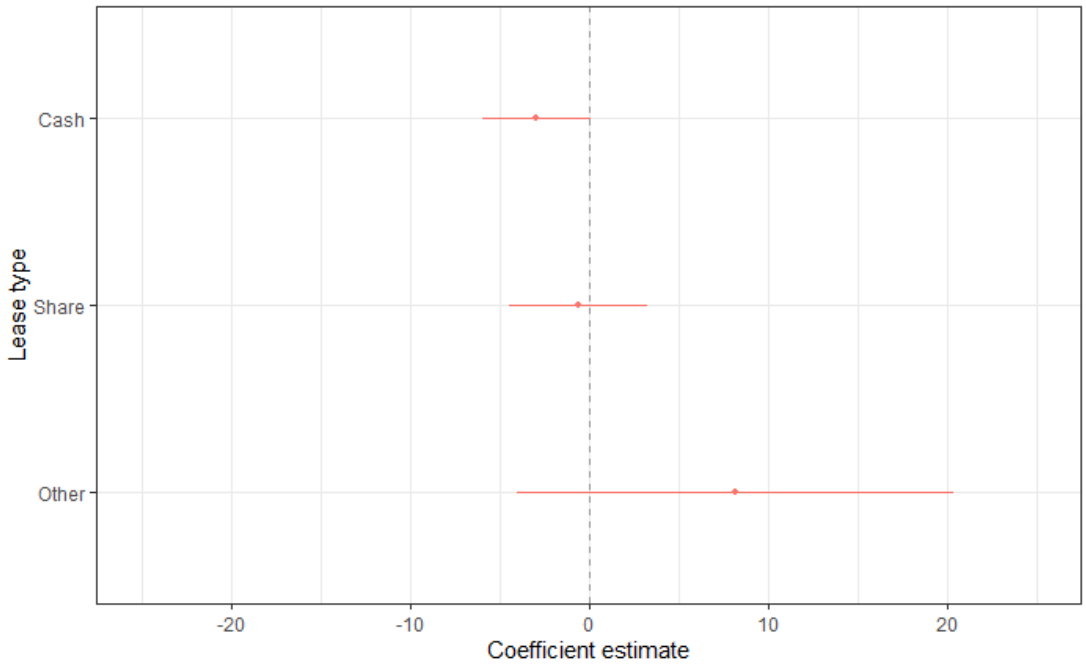
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

The points in Figure 10 represent the regression estimate for the difference between the STIR value associated with each lease type (cash, share, and other) and the STIR value of owner operators, conditional on the stated covariates. If there is no difference, on average, between owners and tenants, then the point in the diagram would fall precisely at zero on the horizontal axis (the vertical broken line). For example, the point estimate for the difference in the observed STIR value of cash renters (relative to owner operators) was approximately -2.7. In other words, cash renters, on average, had an estimated STIR value (conditional on all the other co-determinants) that was approximately 2.7 index points lower than owner operators. The smaller estimated STIR values suggest that cash renters were marginally more likely to utilize conservation tillage systems over owner operators.

However, the lines to the left and right of the point estimate, in Figure 10, represent the whiskers, which denote the 95 percent confidence interval.[7] If the difference between in STIR values between owner operators and renters are significant, then the broken line at zero should not be contained within the whisker lines. As offered in the diagram though, all three types of rental group estimates have 95-confidence interval that fall on or across the zero value, implying that we do not have strong statistical evidence to suggest that average STIR values are significantly different between owner operators and renters. Thus, the STIR values of farmland tenants, on average, appear to be no different from that of owner-operators after controlling, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, crop, and county fixed effects.

[7] The confidence interval indicates where the population parameter is likely to reside. Put differently, we are 95 percent confident that the mean value is somewhere along the whisker lines, for each estimate, within Figure 10.

Figure 10. Whisker plots of Soil Tillage Intensity Rating by land tenure, 2010-2019)

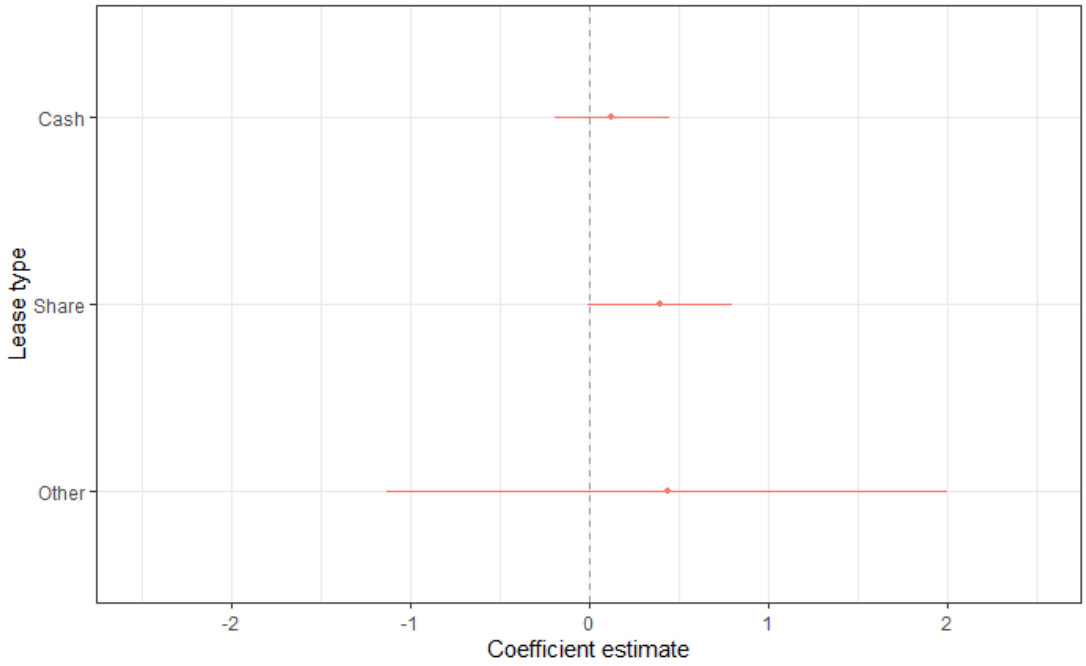


Notes: This figure represents estimates of field-level soil tillage intensity rating values for three categories of lease types. The estimated results are based on a pooled regression of the STIR value on owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, crop, and county fixed effects. The dots represent the coefficient estimates; the lines (or whiskers) to the left and right represent the 95 percent confidence interval.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

As an additional assessment of the data, we can narrow the observed STIR values to 20 and below (across all survey years), which is a measure of no till adoption. As the name implies, no till operations utilize little to no tillage of the soil. We used an identical regression approach as outlined above, and Figure 11 offers whisker plots of the differences in STIR values only for the surveyed farmers that presumably have adopted no tillage systems. As before, all farmland tenant types have estimated STIR ratings that are no difference, on average, from owner operators. Share renters, on average, have estimated STIR ratings that are slightly larger than owner operators, and in this case, the difference is weakly significant as the 95 percent confidence interval falls along the broken vertical line. Although, the point estimate is 0.4, implying that share renters only have a slightly larger average STIR value of 0.4 index points, which is arguably economically insignificant. In other words, our regression model is powerful enough to detect a small difference, but the estimate is not likely meaningful from an operational standpoint.

Conservation tillage practices are relatively inexpensive to adopt with immediate realized cost savings. Other conservation practices, such as cover cropping or structural practices generally require higher upfront investment, so renters may be less apt to adopt such practices. We explore cover cropping in the next section.

Figure 11. Whisker plots of No Tillage Adoption (Soil Tillage Intensity Rating by land tenure, 2010-2019)



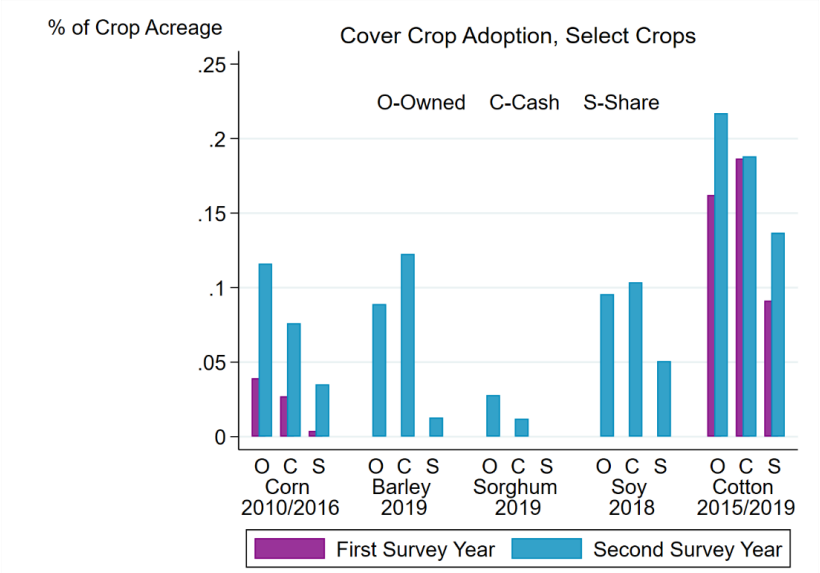
Notes: This figure represents estimates of field-level soil tillage intensity rating values for three categories of lease types. The estimated results are based on a pooled regression of the STIR value on owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, crop, and county fixed effects. The dots represent the coefficient estimates; the lines (or whiskers) to the left and right represent the 95 percent confidence interval.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Cover Crop Adoption Trends

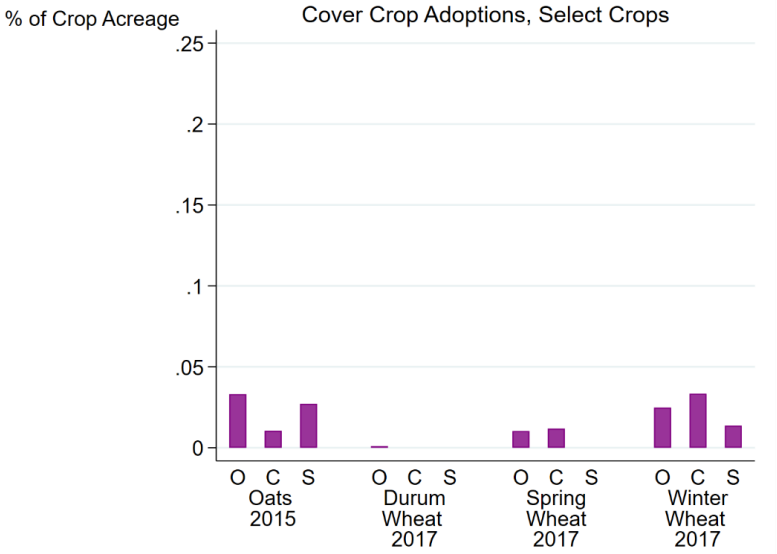
Figure 12 offers cover crop adoption rates by crop and year, separated by owner, cash renter, and share renter. For crops that are surveyed more than once between 2010-2019, the values are displayed together for visual comparison of trends over time in Figure 9(a). For crops that are surveyed only once between 2010-2019, values are displayed in Figure 9(b). An explicit question about cover crop adoption was not posed in the 2011 through 2013 survey years, so those years are omitted from Figure 12.

Adoption rates increase for all tenancy groups for corn from 2010-2016, as well as for cotton from 2015-2019 (the only two crops for which we have multiple years of cover crop questions). For corn in both years, owner operators outpace share and cash renters in adoption, while owner operators outpace share and cash contracts in cotton in only the later survey year. Cash renters adopt cover crops at higher rates than owners for barley 2019, soy 2018, spring wheat 2017, and winter wheat 2017, although the percentage point differences are quite small as overall adoption rates are low. Owners adopt cover crops at higher rates than renters for sorghum 2019, oats 2015, and durum wheat 2017, although once again the percentage point differences are quite small as overall adoption rates are fairly low.

Figure 12. Adoption rate of cover cropping among landowners and renters (2010-2019)



(a) Crops with multiple survey years : corn, barley, sorghum, soy, and cotton.



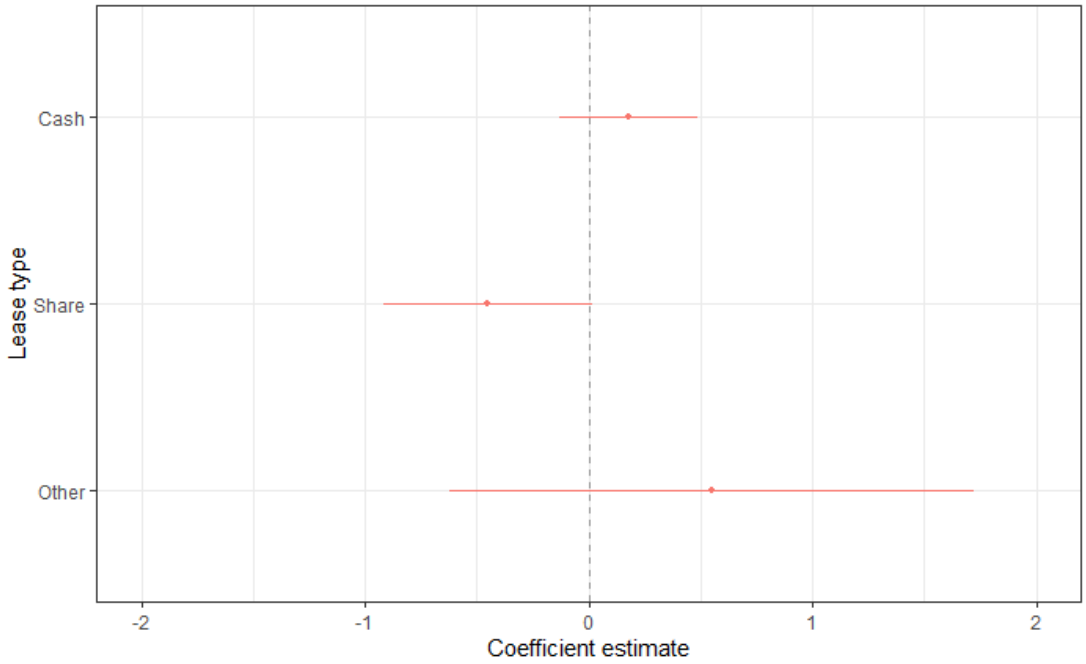
(b) Crops with one survey year : peanuts, rice, oats, and durum, spring and winter wheat

Notes: This figure represents the adoption rate of cover cropping adoption among landowners and renters in the 2010 and 2015-2019 ARMS survey years. The years 2011-2014 are omitted due to missing data.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

In general, the crop-specific adoption rates of cover cropping displayed in Figure 12 are suggestive that the conventional wisdom, that farmland tenants are not motivated by medium-term conservation practices, is not incredibly evident. Before drawing this conclusion, it would be helpful to adjust the data once again for other determining factors of on-farm cover crop adoption among landowners and renters. As before, we pool the data across available survey years and then conduct a logistic regression of the binary cover crop practice adoption on owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation conservation program participation, as well as year, crop, and county fixed effects. These estimates can be interpreted as an average tenant's inclination to adopt cover cropping after controlling for several other seemingly important co-determinants toward adoption.

The propensity estimates, of cover crop adoption, are offered in Figure 13. The results for the cover crop estimates are qualitatively similar to the previous STIR estimates. As before, the points in Figure 13 represent the probability of adoption for each type of renter (relative to owner operators). If the estimated difference (between a tenant and owner operator's propensity to adopt) is exactly zero, then the point in the diagram would fall precisely on zero on the horizontal axis (displayed as the vertical broken line). For example, the point estimate for cash renters was approximately 0.18, which implies that cash renters have an approximate 20 percent ($e^{0.18} \approx 1.2 - 1 = 0.2$) greater relative propensity to adopt cover crops compared to landowners. However, an estimated zero difference (the broken vertical line) is contained within the 95 percent confidence interval – that is, the whisker lines to the left and right of the estimated point for cash renters. Therefore, our estimates lack the statistical confidence to suggest that the propensity for adoption is systematically different between landowners and cash renters. The point estimates suggest that share leasers have about a 57 percent less relative propensity, and tenants with other leases have 73 percent greater relative propensity to adopt cover crops. Although again, the zero line is contained within both estimates 95 percent confidence intervals, implying that there is no statistical evidence to suggest that the propensity to adopt is different between landowners and the other two tenancy groups.

Figure 13. Estimated propensity for cover crop adoption among owners and renters (2010-2019)



Notes: This figure represents the estimated propensity of cover crop adoption among landowners and renters. The estimated results are based on a pooled regression of cover crop adoption on owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, county, and crop fixed effects. The dots represent the coefficient estimates; the lines (or whiskers) to the left and right represent the 95 percent confidence interval
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Conservation Structural Practices Adoption Trends

The final category of conservation adoption we explore are structural practices. As indicated in the previous section, these types of practices require the most upfront costs. For a tenant facing uncertainty over how long their tenure on a plot will last and the practice's payback period (determined by any gradual yield benefits) over time may be too long for them to adopt.

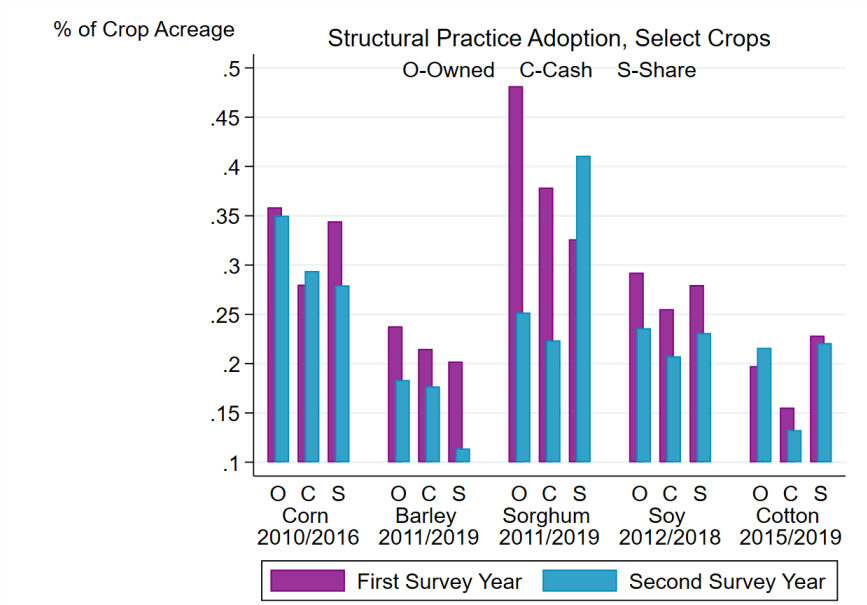
The general trends in adoption rates among owner-operators and different tenant types are outlined in Figure 14. For crops that are surveyed more than once between 2010-2019, the values are displayed together for visual comparison of trends over time in Figure 14(a). For crops that are surveyed only once

between 2010-2019, values are displayed in Figure 14(b). Unfortunately, because ARMS changed the way information regarding structural practices is elicited in the 2018, it is not recommended to make comparisons across time for barley, sorghum, soy, and cotton.

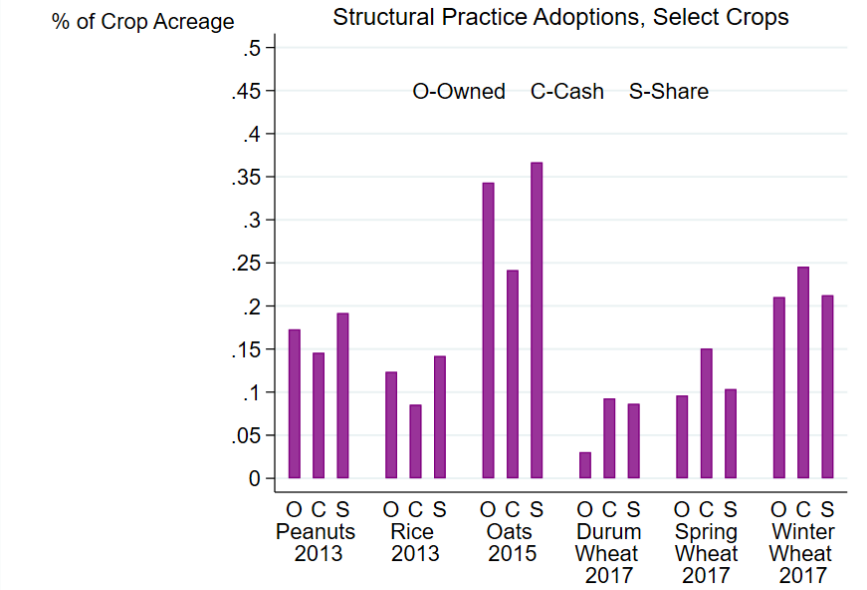
In agreement with the conventional wisdom, cash renters adopt structural practices less than owner-operators for most crops displayed (every crop beside the wheats). Interestingly, sharecroppers often display similar adoption rates to owner-operators, or at least rates closer to the owner-operator adoption rate than what cash renters display. Earlier in the report, Figure 8 displays data from the TOTAL survey showing how landlords are more involved in decision-making regarding the adoption of permanent conservation practices for share contracts compared to cash contracts. This visual correlation could represent greater landlord involvement in structural practice adoption for share contracts, to the point where the plot can be effectively considered as "owner-operated" for large decisions such as structural practices.

As before, the past trends provide general information about unconditional adoption rates, but the trends do not offer additional information about farmer and farm characteristics that may contribute toward the adoption of structural practices. Following the two previous sub-sections, we adjust the data by running a logistic regression of the binary indicator of structural practice adoption against owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, conservation program participation, as well as year, crop, and county fixed effects. As in the previous sub-section, we provide the estimated propensities for structural practices adoption in Figure 15.

Figure 14. Adoption rates of structural practices among landowners and renters (2010-2019)



(a) Crops with multiple survey years : corn, barley, sorghum, soy, and cotton.



(b) Crops with one survey year : peanuts, rice, oats, and durum, spring and winter wheat

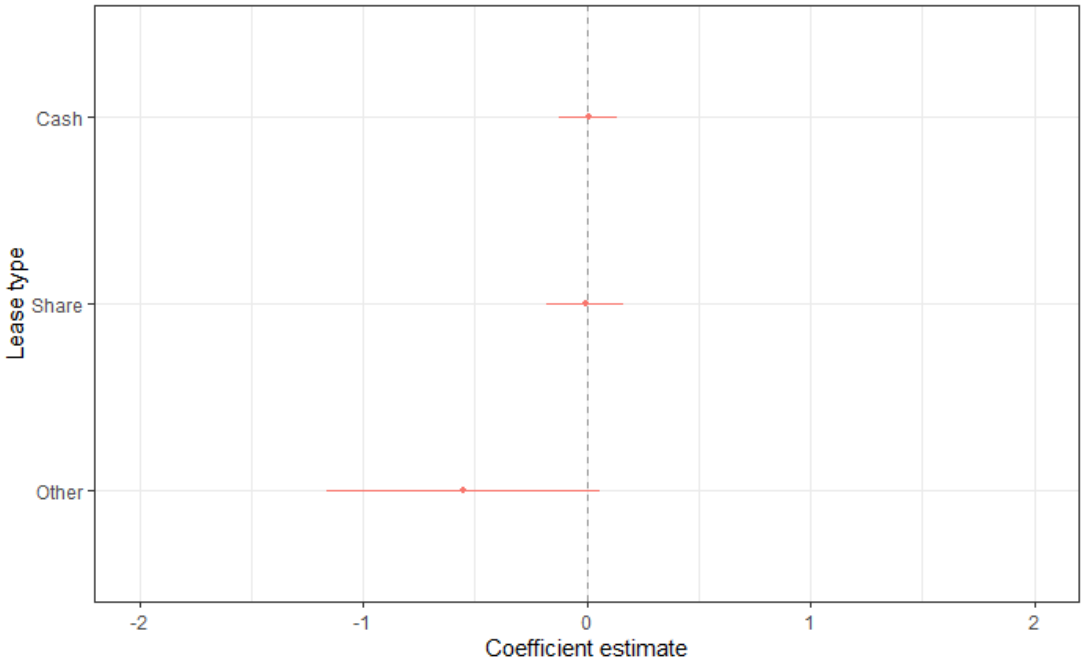
Notes: This figure represents the adoption rates of structural practices among landowners and renters across all the ARMS survey years from 2010 to 2019. The year 2014 is omitted as the TOTAL survey was conducted in that year.
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

Similar to the estimate results above, the point estimates in Figure 15 represent the renter's propensity to adopt structural practices (relative to owner operators). As before, if the estimate is zero, then the results imply there is no statistical difference in the operator's inclination to adopt (i.e., renter's propensity relative to landowner). As displayed in the figure, there is no statistical difference between cash and owner's willingness to adopt structural practices. The same applies to share renters. Tenants with hybrid or free leases (labeled as "Other") have a smaller relative propensity, but zero is contained with the 95 percent confidence interval, implying that the difference is not statistically different from zero. These findings suggest that farmland tenants are just as willing, on average, to adopt structural practices as owner operators. Again, the estimates seem contrary to the conventional wisdom that farmland tenants are not interested in implementing longer-term conservation practices.

Conclusions

There is a 300-hundred-year-old debate within economics about the best type of lease contract or arrangement (formal or informal) between landowners and farmland renters. We explored the differing incentives between the two groups and discussed the various theoretical economic arguments about farmland rental contract design. This debate is based on the premise that renters potentially care less about the land quality (than do landowners) and are more concerned with short-run economic returns due to tenure insecurity.

Figure 15. Estimated propensity of structural practices adoption among owners and renters (2010-2015)



Notes: This figure represents the estimated propensity of structural practices adoption among landowners and renters. The estimated results are based on a pooled regression of structural practice adoption on owner/renter status, land tenure length, farm characteristics, conservation compliance indicators (highly erodible land and wetland designations), average annual growing degree days, average annual precipitation, and conservation funding participation, as well as year, crop, and county fixed effects. The dots represent the coefficient estimates; the lines (or whiskers) to the left and right represent the 95 percent confidence interval
Source: USDA, Economic Research Service using annual data from USDA's ARMS data, 2010-2019.

This premise motivated the question: If conventional wisdom suggests renters are only more by short-term returns, then are they less likely to adopt environmentally beneficial agricultural conservation practices? As about forty percent (or approximately 355 million acres) of contiguous U.S. farmland is rented, an understanding of farmland tenants' motivations and behaviors offers potential policy implications for conservation, water quality, carbon sequestration, and wildlife habitat.

In this report, we examined conservation practice adoption and behavior across eight separate survey years of the USDA's Agricultural Resource Management survey from 2010 to 2019 (including the 2014 TOTAL survey). Arguably landowners have the incentive to promote the quality of their agricultural land (one of the largest assets for their farm operation), and we examined renter conservation behavior relative

to owners. The trend analyses across these survey years suggest that renters behave almost identically to owners with conservation tillage adoption, as demonstrated by similar soil tillage intensity rating values. This is further supported by similar reported adoption rates within the Agricultural Resource Management survey. As discussed, conservation tillage is a relatively inexpensive conservation practice to adopt, with relatively small upfront capital costs followed by immediate variable cost savings.

We extended the analysis to explore cover cropping and the adoption of structural practice, which are more costly to implement relative to conservation tilling. The trend analyses for cover cropping and structural practices were slightly more mixed. That is, the (unconditional) adoption rates for cover cropping were higher for owner operators in some survey years and higher for farmland tenants in other years. After controlling for other important determinants though (akin to conditional adoption rates), we estimated no statistical difference between owner and tenant propensity to adopt cover cropping. The findings are qualitatively similar for structural practice adoption; that is, we estimated no statistical difference, on average, between owner and tenant propensity to adopt. Our findings seem contrary to the conventional wisdom that farmland renters are not motivated to adopt agricultural conservation practices.

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