United States Department of Agriculture

Economic Research Service

Economic Research Report Number 245

February 2018

Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016

Christopher Burns, Nigel Key, Sarah Tulman, Allison Borchers, and Jeremy Weber

United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

Recommended citation format for this publication:

Burns, Christopher, Nigel Key, Sarah Tulman, Allison Borchers, and Jeremy Weber. *Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016,* ERR-245, U.S. Department of Agriculture, Economic Research Service, February 2018.

United States Department of Agriculture

Economic Research Service

Economic Research Report Number 245

February 2018

Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016

Christopher Burns, Nigel Key, Sarah Tulman, Allison Borchers, and Jeremy Weber

Abstract

Farmland plays a unique and important role in agriculture. Farm real estate (which includes land and the structures on it) accounts for over 80 percent of farm-sector assets. Farm real estate values reached record highs in 2015, driven by high net cash farm income and low interest rates. However, farmland appreciation has slowed considerably over the last 2 years due to lower commodity prices and lower net cash farm income, raising questions about the potential impact on farm financial stress. This study finds that farmland appreciation lowered the share of farms that were considered financially stressed in 2000-2012, particularly those that owned less than one-quarter of their acres operated. It also finds that farms that owned at least 50 percent of their acres purchased more farmland during periods of high appreciation and land equity gains. Finally, using an economic model, it finds that current farmland values are not supported by returns to farming, suggesting that a decline in values is possible.

Keywords: farmland values, net cash farm income, farmland appreciation, tenure, farm financial stress

Acknowledgments

The authors thank Jeff Hopkins of USDA, Economic Research Service (ERS), and Ron Durst, formerly of USDA, ERS, for their guidance throughout the process. They also thank the following individuals for technical peer reviews: Tony Dorn, USDA, National Agricultural Statistics Service; Damona Doye, Oklahoma State University; Lori Lynch, USDA, ERS; Edward Rall, USDA, Farm Service Agency; and Gary Schnitkey, University of Illinois.

Thanks also to Margaret Carter and Curtia Taylor, USDA, ERS, for editorial and design services.

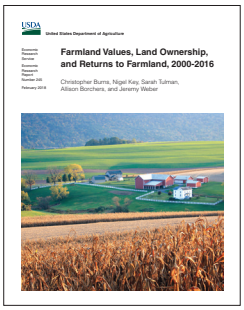
About the Authors

Christopher Burns, Nigel Key, and Sarah Tulman are economists with USDA, ERS; Allison Borchers, formerly with USDA, ERS, is an economist with the USDA Forest Service; and Jeremy Weber, also formerly with USDA, ERS, is an associate professor at the University of Pittsburgh.

Contents

United States Department of Agriculture

A report summary from the Economic Research Service *February 2018*



Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016

Christopher Burns, Nigel Key, Sarah Tulman, Allison Borchers, and Jeremy Weber

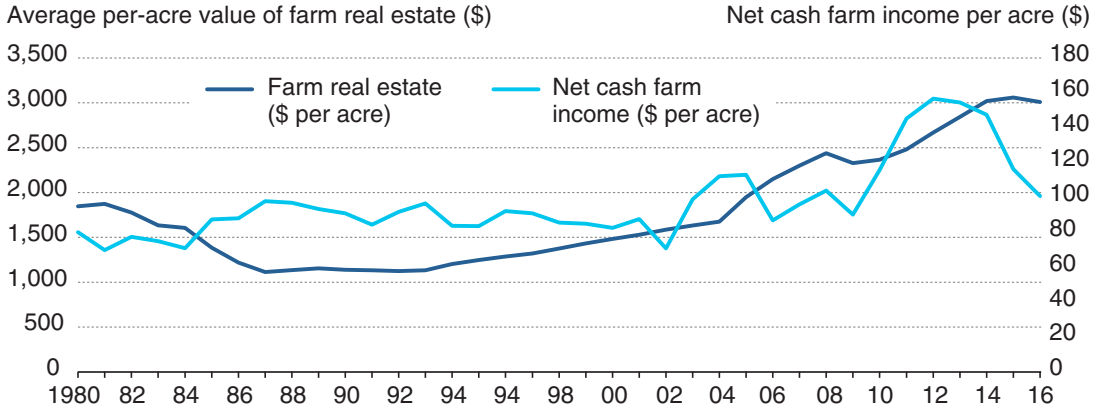
What Is the Issue?

Farmland plays a unique and important role in agriculture. Farm real estate (including land and the structures on it) accounts for over 80 percent of farm-sector assets. Farm real estate values reached record highs in 2015, driven by high net cash farm income and low interest rates. However, farmland appreciation slowed considerably from 2015 to 2016, with some regions experiencing small declines, caused largely by falling commodity prices and farm income. For farmers, the effects of changing farmland values differ depending on the amounts of land they rent versus own. This study examines factors that influenced farmland appreciation in 2000-2016 and how this appreciation affected farms through changes in their equity.

What Did the Study Find?

U.S. farmland values appreciated quickly from 2000 to 2015. Average per-acre farm real estate values (including the value of land and buildings) more than doubled, going from $1,483 per acre in 2000 to $3,060 per acre in 2015. Cropland appreciated faster than pastureland. In 2003-14, cropland values increased most in the Corn Belt, Northern Plains, Lake States, and Delta States. In 2015-16, these same regions saw lower land appreciation than other regions, even depreciation, reflecting the drop in commodity prices.

Average per-acre U.S. farm real estate values and U.S. net cash farm income, 1980-2016, in 2016 dollars



Note: Net cash farm income is calculated as the sum of total cash receipts from crops and livestock sales, Government payments, and other cash-related farm income, minus cash expenses. All values are inflation adjusted to 2016 dollars using the Gross Domestic Product deflator.
Source: USDA, Economic Research Service (ERS) net cash farm income forecast and ERS calculations using data from USDA, National Agricultural Statistics Service.

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.

Farmland returns generally did not support farm real estate values in 2000-2016. With the exception of two brief periods of high net cash farm income in 2003-05 and 2011-14, national-level farm real estate values in 2000-2016 were higher than economic theory would predict. However, when broken down by region and land use, farmland values varied significantly. Interest rates declined substantially over this period and played a major role in supporting farmland values by keeping borrowing costs low.

Farmland appreciation led to fewer financially stressed farms. Because of increasing farmland values, fewer farm businesses in 2000-2012 fit our definition of financially vulnerable (i.e., having both a debt-to-asset ratio greater than 40 percent and negative net farm income). However, land value appreciation benefitted major owners (those who own more than 50 percent of their operated land) more than minor owners (those who own less than 50 percent of their operated land). Going forward, cash rental rates will play an important role in financial stress for operations that rent large amounts of land because rental rates tend to lag in adjusting downward as farmland returns decline.

Farmland appreciation allowed crop farmers who owned land to borrow more and purchase additional land. Crop farmers in the Heartland who owned a larger share of their land responded differently to appreciating land prices than did similar farmers who owned a smaller share of their land. During periods of land price appreciation, owning a larger share of land led to greater growth in real-estate-secured debt and land purchases. However, owning a larger share did not lead to an increase in harvested acres—that is, an expansion of the operation.

Those who owned more of their land generally were older and more experienced farmers. The fact that older, experienced farmers acquired land more quickly during this period of rapid appreciation implies that the gradual transfer of land between generations from more experienced to less experienced operators may slow during periods of rapid appreciation. On the other hand, young and beginning farmers may find it easier to purchase land when land prices level out or decline.

Changes in farmland returns, interest rates, and U.S. agricultural policy will affect future farmland values. Our analysis demonstrates that future farmland values will be strongly influenced by net returns (net revenue per acre) and interest rates. As interest rates rise, farmland values fall because the cost of borrowing increases and the relative advantage that farmland investments provide diminishes compared to alternative investments. The Agricultural Act of 2014 eliminated fixed Direct Payments and expanded crop and pastureland insurance programs. Recent studies find evidence that insurance payments will be capitalized into future land values by reducing volatility in net returns.

How Was the Study Conducted?

The authors used data from the Census of Agriculture, which is administered every 5 years by USDA's National Agricultural Statistics Service (NASS); national and regional data on cash rents and land values from the NASS Quick Stats web tool; and data from the annual Agricultural Resource Management Survey (ARMS) and the 2014 Tenure, Ownership, and Transfer of Agricultural Land (TOTAL) survey, which are jointly administered by NASS and USDA's Economic Research Service (ERS). The report also updates and expands upon a 2012 ERS report (Nickerson et al.) that examined trends in land values through 2010, including macroeconomic and parcel-level factors that affected land values, and whether farm earnings supported land values. The current report examines more recent trends in farm earnings and land values through 2016. It also examines the effects of changing land values and equity on financial stress and decisions to purchase or rent additional land.

Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016

Introduction

Farm real estate values rose rapidly in the decade beginning in 2004, reaching record highs in 2015. But recent trends show slower growth and even declines in some regions caused largely by falling commodity prices and lower net cash farm income. Farmland represents the primary input and source of equity for most farms. Farm real estate, including land and the structures on the land, accounted for over 82 percent of farm-sector assets in 2016 (USDA, ERS, 2018). As a result, farmland values are an important indicator of the financial well-being of the farm sector. The rapid rise in farmland values in 2004-14 and subsequent slowing in 2015-16 raise questions: Which regions saw the highest levels of appreciation and why? Were the higher values supported by underlying economic factors such as farmland returns and interest rates? What role did Government policies play in the rapid appreciation? How did farmland appreciation affect the farm finances of land renters versus land owners? What influence did farmland appreciation have on decisions to purchase or rent additional land?

This report details the trends and factors that contributed to the rise in farmland values in 2000-2016. It describes how price appreciation of farm real estate, cropland, and pastureland varied by region over this period. It examines whether returns to farmland supported land values and what could happen to land values in the future under different interest rate scenarios. It shows how the financial positions of landowners and land renters were affected differently by increasing land values. Finally, using regression analysis, it investigates whether farmers who owned a larger share of their land acquired additional land during periods of high land appreciation. One hypothesis it explores is that farmers who own the majority of their land benefit most from farmland appreciation as their equity rises and their cost of borrowing falls.

Understanding what drives farm real estate values is important for a number of reasons. Accounting for more than 80 percent of farm-sector assets, farm real estate represents the majority of assets for most farms and is a source of collateral for lenders. Total U.S. farm real estate debt (debt secured by farmland and buildings) was estimated to be $226 billion in 2016, representing more than 60 percent of total farm debt (USDA, ERS, 2018). The total value of farm real estate was estimated at $2.44 trillion (USDA, ERS, 2018). As farmland appreciates, landowners' equity increases.[1] When land assets increase in value, landowners may also benefit from lower borrowing costs if banks perceive them as less risky. Many farm households also rely on farmland holdings as a retirement fund (Nickerson et al., 2012). If farmland increases in value more quickly than alternative investments, landowners may be able to retire earlier or live more comfortably.

Changing land values influence the structure of U.S. agriculture. The fundamental factors that drive up land values also drive up land rental rates, increasing costs for farmers who want to buy

[1] Farm equity = total farm assets – total farm debt.

or rent additional land. Young and beginning farmers[2] often state that their most significant challenge is access to farmland (Katchova and Ahearn, 2016). These farmers are more likely to own a smaller portion of the land they operate and rent a larger portion. Resource-constrained farmers, such as beginning farmers, who want to expand their operations are disproportionately affected as purchasing or renting additional land becomes more expensive.

Changes in land values may also alter the supply of farmland for sale. Historically, farmland markets have tended to be very thin, with only a small portion of land for sale at any given time. Between 2015 and 2019, it is estimated that about 10 percent (93 million acres) of all land in farms will change hands through gifts, trusts, or wills. Only a quarter of that land (21 million acres or 2 percent of land in farms) is expected to be sold to nonrelatives (Bigelow et al., 2016). A change in land values in response to changing economic conditions may affect landowners' decisions about holding, transferring, or selling farmland.

[2] Beginning farmers are defined as those who have 10 or fewer years of experience in farming.

Farmland Values: Trends by Land Use and Region, 2000-2016

This report builds on a 2012 report by USDA's Economic Research Service (ERS), *Trends in U.S. Farmland Values and Ownership* by Nickerson and colleagues. In that report, the authors used data from the 1980s through 2010 to examine trends in farmland values and the macroeconomic and parcel-specific factors that affect farmland values. They examined whether farm earnings supported farmland values by analyzing trends in farm income, interest rates, and cash rents. The authors also used the USDA, National Agricultural Statistics Service (NASS) June Area Survey, an annual survey of farmland, to understand parcel-specific impacts on land values. Additionally, they examined the relationship between Government payments and cropland values. This report updates much of the land values data used in Nickerson et al. and extends this research to examine how changes in land values and cash rents affect farm financial stress and farm expansion decisions.

U.S. farm real estate values have been rising since the mid-1980s, following the farm financial crisis of the early 1980s when farmland prices declined in response to rapidly rising interest rates and higher energy prices (Nickerson et al., 2012). Beginning around 2004, high net cash farm income and low interest rates led to rapid appreciation of farmland values. The average value of U.S. farm real estate[3] nearly doubled between 2004 and 2014, from $1,675 per acre to $3,019 per acre, measured in inflation-adjusted dollars.

Economic theory suggests that farmland values will change in response to changes in the underlying factors that support them, namely, returns to farmland. One measure of returns to farmland is net cash farm income per acre, or the net return that an acre of farmland generates. While this measure has considerably more variability than farm real estate values, it is often a leading indicator of changes in farmland values. The past few years have seen these two measures drop or flatten (fig. 1). Net cash farm income has dropped 36 percent since its peak in 2012. Farm real estate values have not similarly fallen, but they flattened out in 2015-16 at the national level and have begun to fall in some regions, particularly the Corn Belt and Northern Plains. (This variation in regional farmland appreciation is discussed in more detail later in the report.)

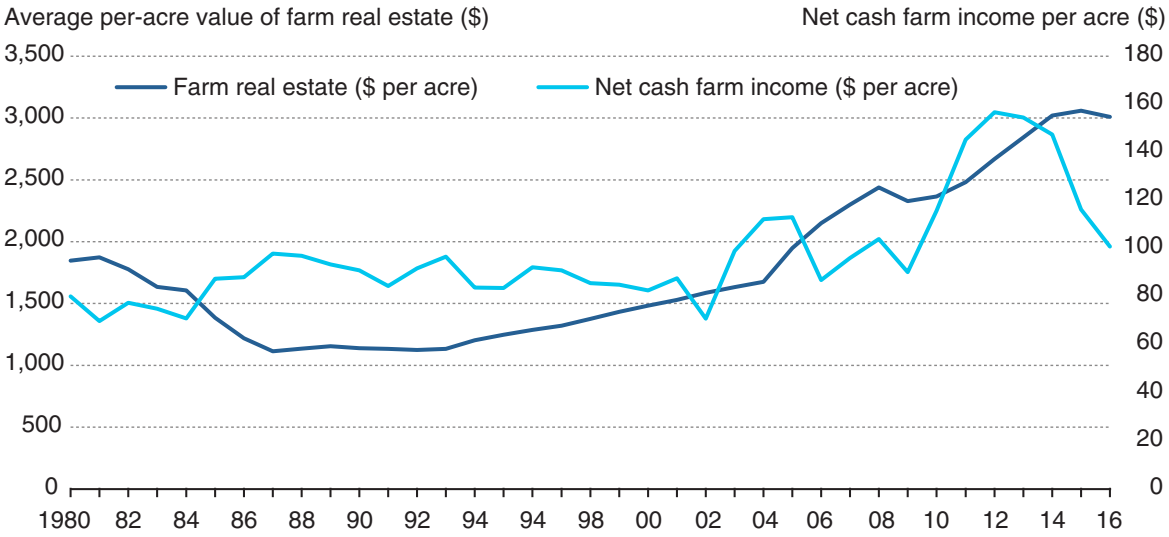
Values for both cropland and pastureland, two major uses for farmland, increased substantially in 2004-14, nearly doubling in real, or inflation-adjusted, terms (fig. 2). Note that values of cropland and farm real estate (which includes cropland, pastureland, and agricultural buildings on the land) dipped slightly in 2008-09, reflecting the impact of the Great Recession and the downturn in the U.S. housing market. In contrast, average U.S. pastureland values were not affected by the downturn.

But national trends in U.S. cropland and pastureland values can disguise regional variation in land values, which can result from differences in soil quality, annual rainfall, and proximity of urban areas, among other factors. USDA's 10 farm production regions are used to explore regional variability in land values. On average, cropland tends to be more valuable than pastureland, though the difference is small in the Delta States, Appalachian, Southeast, and Southern Plains regions (fig. 3). In 2016, the most valuable land was cropland in the Corn Belt, at an average of $6,710 per acre.

[3] Farm real estate includes the value of agricultural land (including cropland and pasture) and the buildings on that land.

Figure 1

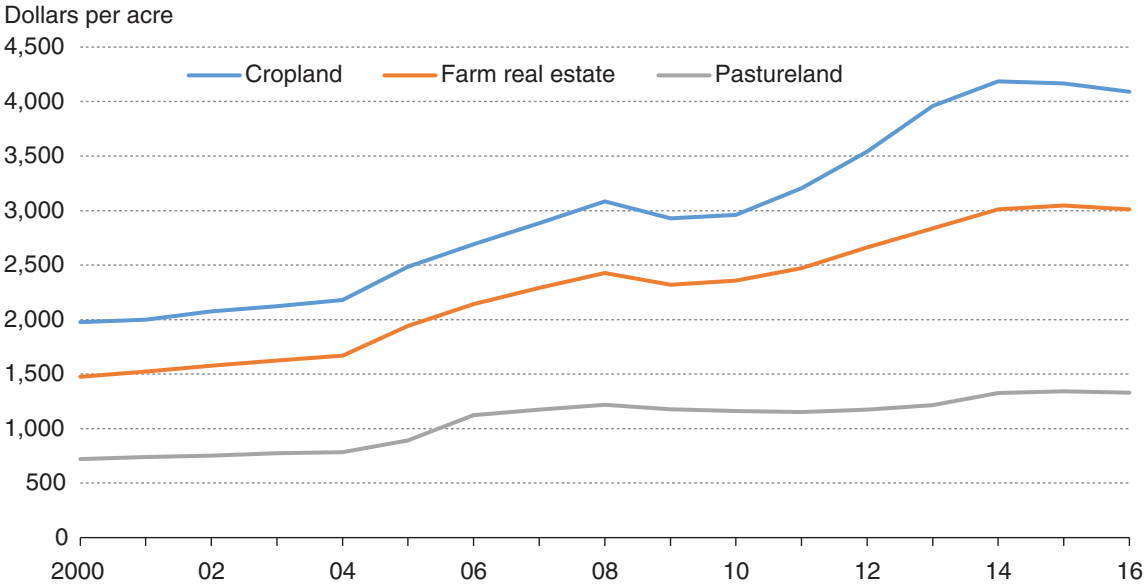
Average per-acre U.S. farm real estate values and U.S. net cash farm income, 1980-2016, in 2016 dollars



Note: Net cash farm income is calculated as the sum of total cash receipts from crops and livestock sales, Government payments, and other cash-related farm income, minus cash expenses. All values are inflation adjusted to 2016 dollars using the Gross Domestic Product deflator.
Source: USDA, Economic Research Service (ERS) net cash farm income forecast and ERS calculations using data from USDA, National Agricultural Statistics Service.

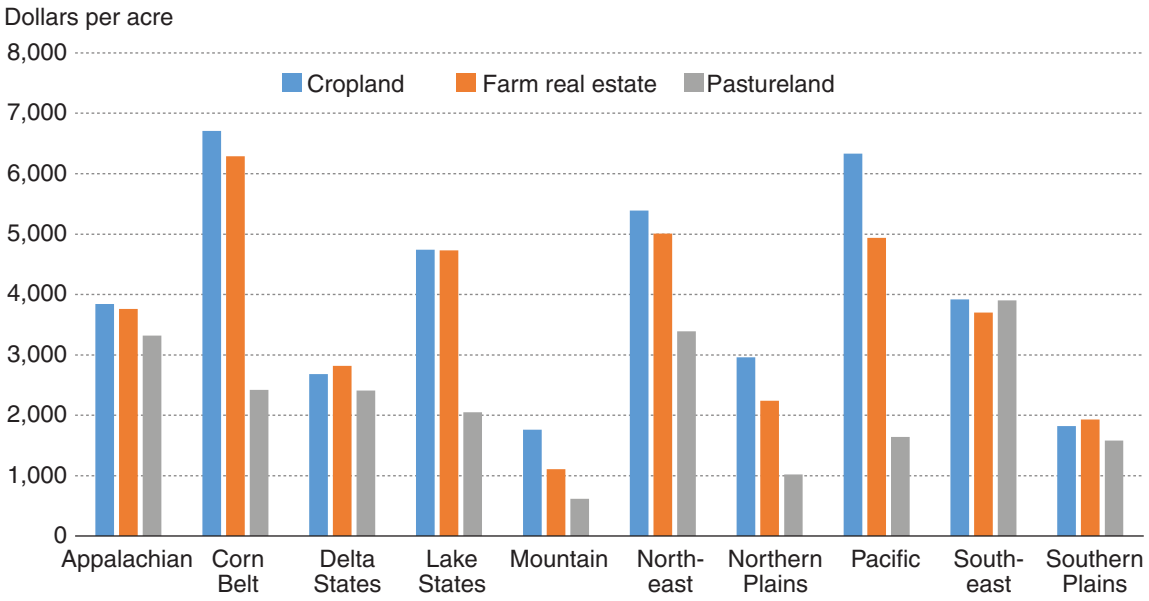
Figure 2

Average U.S. cropland, pastureland, and farm real estate values, 2000-16, in 2016 dollars



Notes: Cropland includes cropland used for crops (harvested, crop failure, and cultivated summer fallow), cropland used only for pasture, and idle cropland. Pastureland encompasses all open land used primarily for pasture and grazing. Farm real estate includes both cropland and pastureland, and the value of agricultural buildings on the land.
Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service. Gross Domestic Product deflator was used to put values into 2016 dollars.

Figure 3
National averages mask regional variation in farmland values, 2016



Notes: Cropland includes cropland used for crops (harvested, crop failure, and cultivated summer fallow), cropland used only for pasture, and idle cropland. Pastureland encompasses all open land used primarily for pasture and grazing. Farm real estate includes both cropland and pastureland, and the value of agricultural buildings on the land.
Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service.

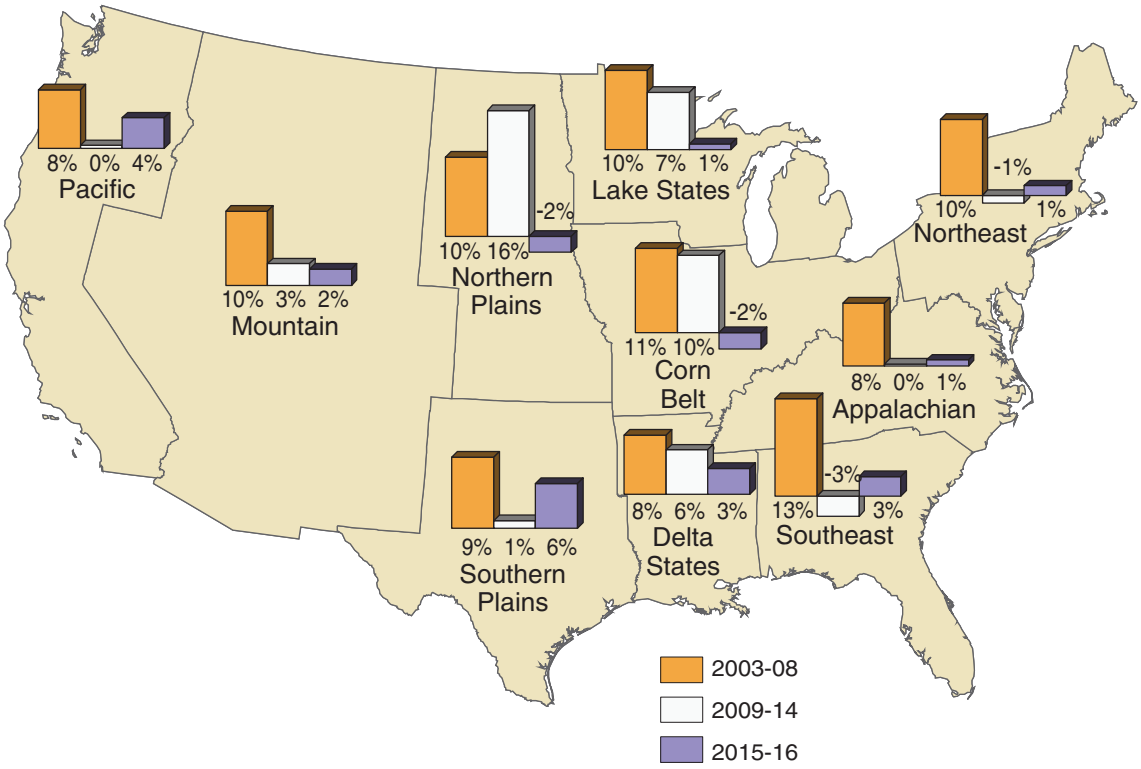
In 2003-08, cropland appreciated almost uniformly across the regions (fig. 4). However, in 2009-14, cropland appreciation was mostly concentrated in four regions: the Northern Plains, Corn Belt, Lake States, and Delta States. This was largely due to increases in commodity prices for grain and oilseed crops. Regional differences in land values may also be due to varying demands for farmland for nonagricultural purposes, such as demand for oil and gas development in shale areas.[4] The Great Recession influenced the value of cropland in close proximity to urban areas and was likely responsible for leveling or declining values in the Northeast, Southeast, and Pacific regions.

In 2015 and 2016, net cash farm income fell from its 2013 peak. The primary factors driving lower net cash farm income are lower commodity prices and lower cash receipts (USDA, ERS, 2018). As expectations for future net cash farm income have been adjusted downward, land value appreciation has moderated and even declined. The Northern Plains and Corn Belt, which had high levels of cropland value appreciation in 2009-14, had low to negative growth from 2015 to 2016, reflecting the drop in cash grain and oilseed prices.

[4] ERS research shows that oil and gas development in shale areas in Pennsylvania and Texas may have had negligible or positive effects on average farm real estate values (Weber and Hitaj, 2015). A factor contributing to regional differences may be the extent to which land owners also own the oil and gas rights to the land.

Figure 4

Average annual percentage change in cropland values for selected periods, 2003-16



Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service.

What Factors Determine Farmland Values?

Farmland values are determined by individual factors that are unique to each land parcel and by macroeconomic factors such as interest rates and inflation that affect all land. This report focuses on macroeconomic factors by examining the role the farm economy, interest rates, and agricultural policy have played in land values in 2000-2016.

Returns and Interest Rates

As stated earlier, economic theory predicts that farmland values will change as the expected net returns to farmland change because the value of an asset should equal the present discounted[5] value of the stream of income from the asset. The most important factor influencing farmland values is the income that can be generated from the land, or cash returns per acre. Land that is more productive and produces higher crop yields for a given level of inputs will have higher cash returns per acre. Rental rates for productive farmland are usually higher than those for less productive farmland because farmers are willing to pay more for the use of the land. Thus, cash returns per acre drive both farmland values and cash rental rates.

Capitalized land values can be used to estimate what land values current farm returns can support. A commonly used measure of capitalized value is cash rent per acre (a proxy for cash returns per acre) divided by the interest rate on the 10-year Treasury note. Comparing actual land prices to the capitalized value indicates whether land values are supported by current farmland returns and interest rates. If farmland prices are supported by current farmland returns and interest rates, the capitalized value—or price-to-value (PTV) ratio—should be around 1.0. A PTV ratio higher than 1.0 suggests that current income does not support land values.

Generally, *cropland* prices in 2000-2016, as reflected in PTV ratios, were supported by farm earnings (cash returns per acre), although capitalized values for cropland were above 1.0 in 2000-2002 and 2005-08 (fig. 5). Values in 2005-09 reflect the influence of the collapse of the nonfarm U.S. housing bubble. The PTV ratio hit an all-time low of about 0.5 in 2012, driven by large cash returns to farmland caused by high commodity prices. However, with the drop in net cash farm income between 2014 and 2016, the ratio has climbed back toward 1.0.

The importance of interest rates to cropland values can also be seen using this measure. If 10-year Treasury note rates[6] are fixed at the 2000 level (6 percent), the cropland PTV ratios stay above 1.0 in 2000-2016 (fig. 5). This indicates that current returns would not have supported farmland values during this period without falling interest rates. As a result, future increases in interest rates could lead to a decline in farmland values.

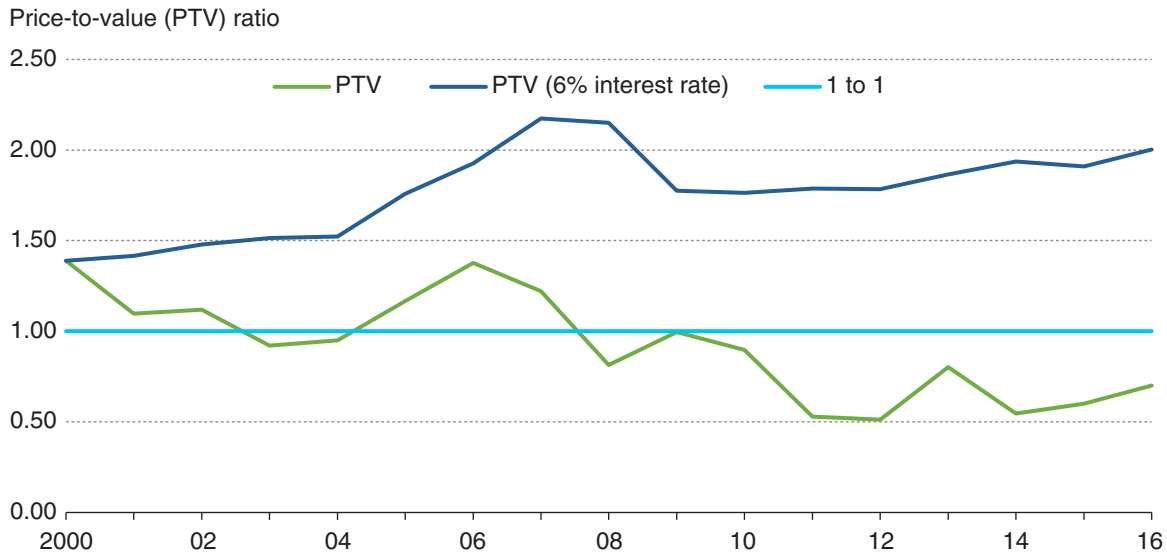
Interest rates can affect farmland values in two ways. First, they can raise or lower the cost of borrowing. For example, higher interest rates will raise the cost of real estate borrowing and lower demand for farmland. Second, higher interest rates make equally safe financial investments (10-year Treasury notes, for example) potentially more valuable, leading to a decline in farmland investment. Lower interest rates will have the opposite effect, decreasing the cost of borrowing and making farmland a more attractive investment.

[5] The discounted (present) value of an asset refers to the sum of the future income stream deflated by the cost of capital or discount rate.

[6] The interest rate on the 10-year Treasury note.

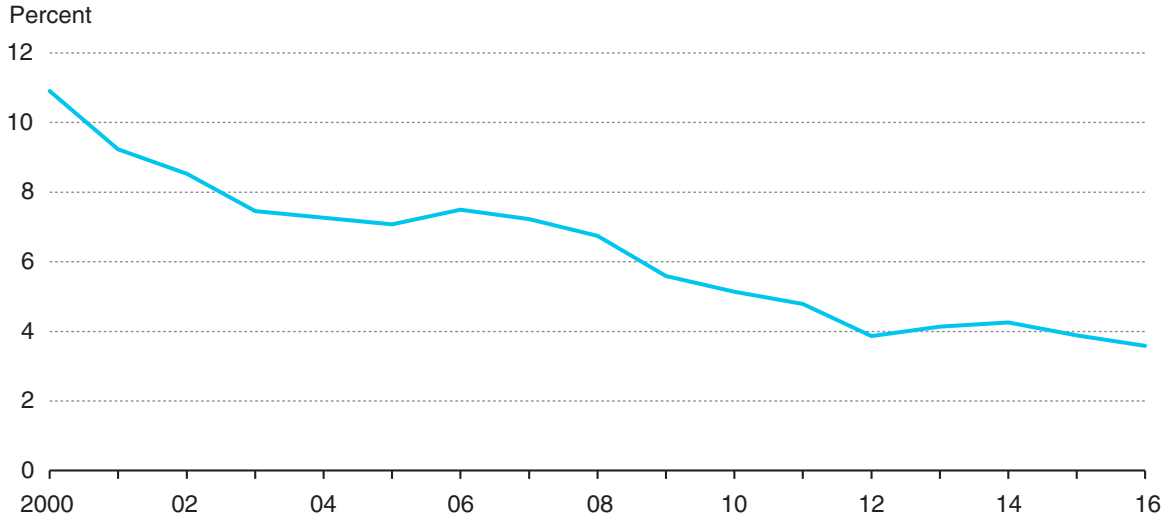
Mortgage rates have been low over the past decade (fig. 6), making it less expensive for farms to borrow to purchase farmland. The interest rate for a 30-year mortgage dropped from over 10 percent in 2000 to under 4 percent in 2016. Continued low mortgage rates likely help explain why land values have remained high despite the recent downturn in cash returns per acre.

Figure 5
Cropland capitalization values (price-to-value ratios), 2000-16



Source: USDA, Economic Research Service (ERS) calculations using data from USDA, National Statistical Service and ERS farm income data. Gross Domestic Product deflator was used to put all values in 2016 dollars.

Figure 6
Thirty-year mortgage interest rates, 2000-16, in inflation-adjusted terms



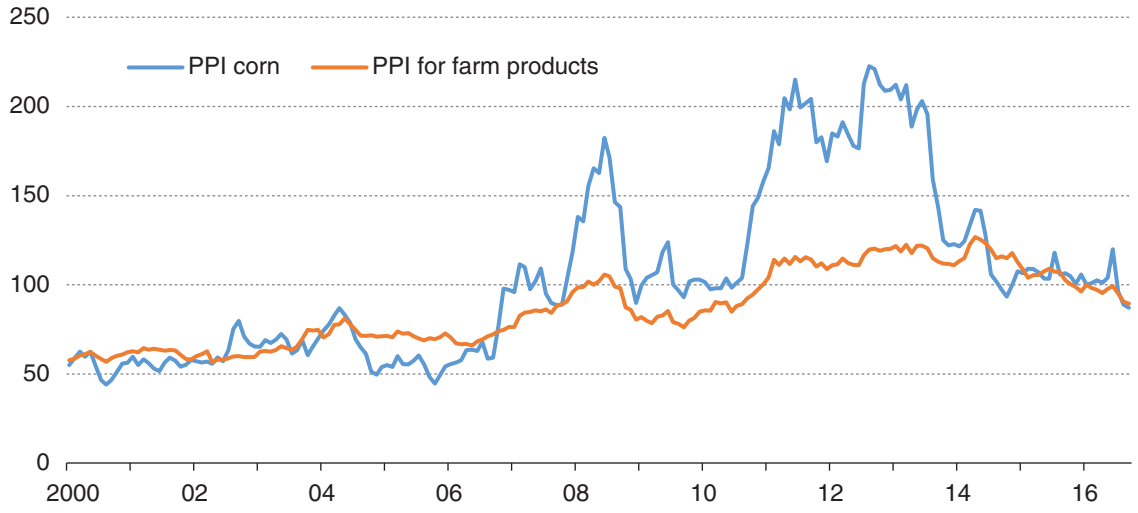
Source: USDA, Economic Research Service calculations using data from the Federal Home Loan Mortgage Corporation. Nominal interest rates were adjusted for inflation using the Gross Domestic Product deflator with base year 2016.

Government Policy and Commodity Prices

Federal renewable energy policy (the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007) contributed to the rise in prices for corn, soybeans, and wheat as well as other biomass crops used in renewable energy fuels (Trostle, 2008). By establishing mandates for production of biofuels (e.g., corn-based and cellulosic ethanol), these policies prompted rising commodity prices for corn (fig. 7), oilseeds, and other cash grains in 2007-08 and 2011-13. These crops are predominantly raised in the Corn Belt, Lake States, and Northern Plains regions, which saw the greatest cropland value appreciation in 2004-14.

Farmland values are also affected by agricultural policy and programs, including commodity programs, conservation programs, and crop insurance. Farm program payments aim to provide a safety net for U.S. farms by reducing income volatility and providing income support. Past studies have found that program payments are capitalized into the price of land. That is, the payments increase the value of land by increasing the expected returns from farming. A 2009 study found that between 15 and 30 percent of the value of farmland may be explained by farm program payments (Latruffe and LeMouël, 2009). More recent studies have also found positive capitalization effects for fixed Direct Payments[7] for cropland (Ifft et al., 2015) and pasture insurance for pastureland (Ifft et al., 2014). The former program provided income support to farmers who produced on land that had historically grown eligible commodities, while the latter reduces the income volatility and increases expected revenues for farms with eligible pastureland.

Figure 7
Producer Price Index (PPI) for all farm products and PPI for corn, 2000-16



Note: Base year = 2016.
Source: USDA, Economic Research Service calculations using data from U.S. Bureau of Labor Statistics, retrieved from Federal Reserve Bank of St. Louis, Federal Reserve Economic Data (FRED).

[7] Fixed Direct Payments were based on enrolled acreage and historical production of specific commodities—mostly field crops such as barley, wheat, corn, and soybeans. This program was eliminated in the Agricultural Act of 2014.

The Agricultural Act of 2014 (2014 Farm Bill) eliminated fixed Direct Payments and created new programs designed to help farmers mitigate price and revenue risk, including Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC). These two programs aim to reduce the variability of farm income by providing payments to eligible producers when prices or revenues fall below respective reference levels. The 2014 Farm Bill also introduced two new insurance products, the Supplemental Coverage Option (SCO) for all crops and the Stacked Income Protection Plan (STAX) for upland cotton. Currently, there are no studies that have examined whether these new programs have impacted farmland values.

Past studies have also analyzed whether land renters or land owners benefit from agricultural payments (subsidies). Roberts et al. (2003) found that between 34 and 41 cents of every dollar of Government payments were capitalized into land rents. Kirwan (2009) found that 75 percent of agricultural subsidies were captured by land renters, compared to only 25 percent by landowners. Further work by Kirwan and Roberts (2016) found evidence that when land markets are less competitive (i.e., land rental markets are thin), more of the benefits of agricultural payments accrue to land renters, while the opposite is true when they are more competitive.

Changes in Farmland as an Investment

The farmland capitalization rate can be viewed as a proxy measure for how quickly an asset will pay for itself. The capitalization rate, or rent-to-value (RTV) ratio, is the cash rent per acre divided by the land value per acre. For example, a capitalization rate of 7 percent indicates that farmland pays for itself, assuming it is financed solely through rent, in about 14 years. This financing formula generally does not include property or other taxes paid on the land.

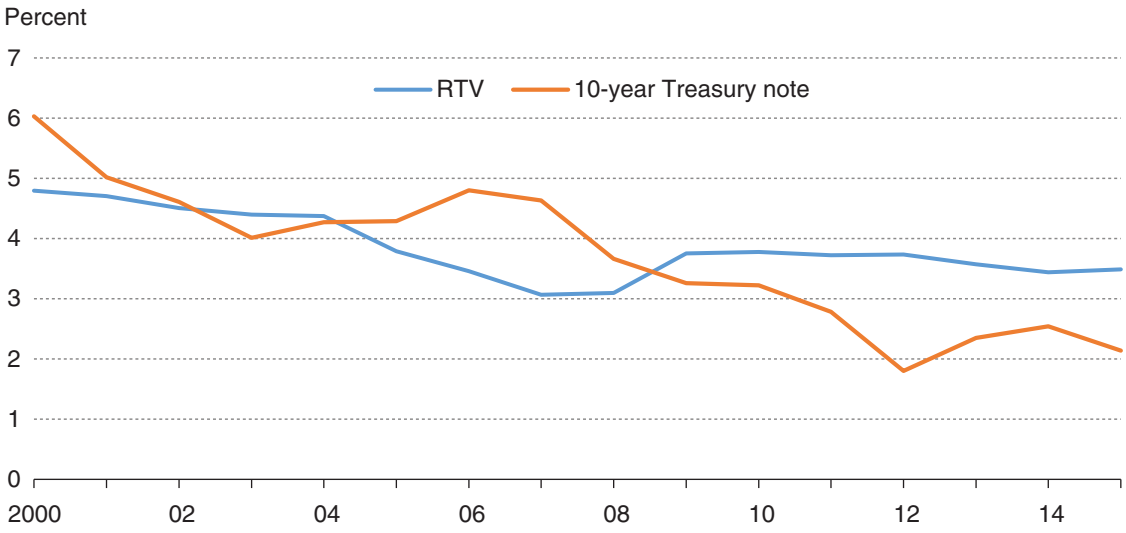
The cropland capitalization rate declined in 2000-2016, corresponding closely to yields on the 10-year Treasury note. Both are considered safe investments, so comparing them is a useful way to understand where land prices are headed. Since 2000, the yield on the 10-year Treasury note has gone down at a slightly faster rate than the cropland capitalization rate (fig. 8). Since about 2009, the cropland capitalization rate has been slightly higher than the Treasury note yield, suggesting that farmland is a better investment. Both can be viewed as expectations of future returns—a lower value indicates lower expected future returns. Until interest rate increases or other factors begin to push cropland values down, farmland will remain a more attractive investment than its low-risk alternative, the 10-year Treasury note.

Cropland capitalization rates have declined in almost every region since 2000 (fig. 9), converging on values of between 2 and 4 percent and becoming more homogenous across regions. The Northern Plains and Delta States regions saw the largest relative declines in 2000-2016.

The decline in capitalization rates reflects the increasing influence of such nonfarm factors as interest rates, developmental uses, and recreation uses on land values (Nickerson et al., 2012). As nonagricultural factors become more important in the valuation of farmland, particularly near urban areas, economic models that predict future farmland values must take them into account. A simple capital asset pricing model using only agricultural returns will likely not be accurate.

Figure 8

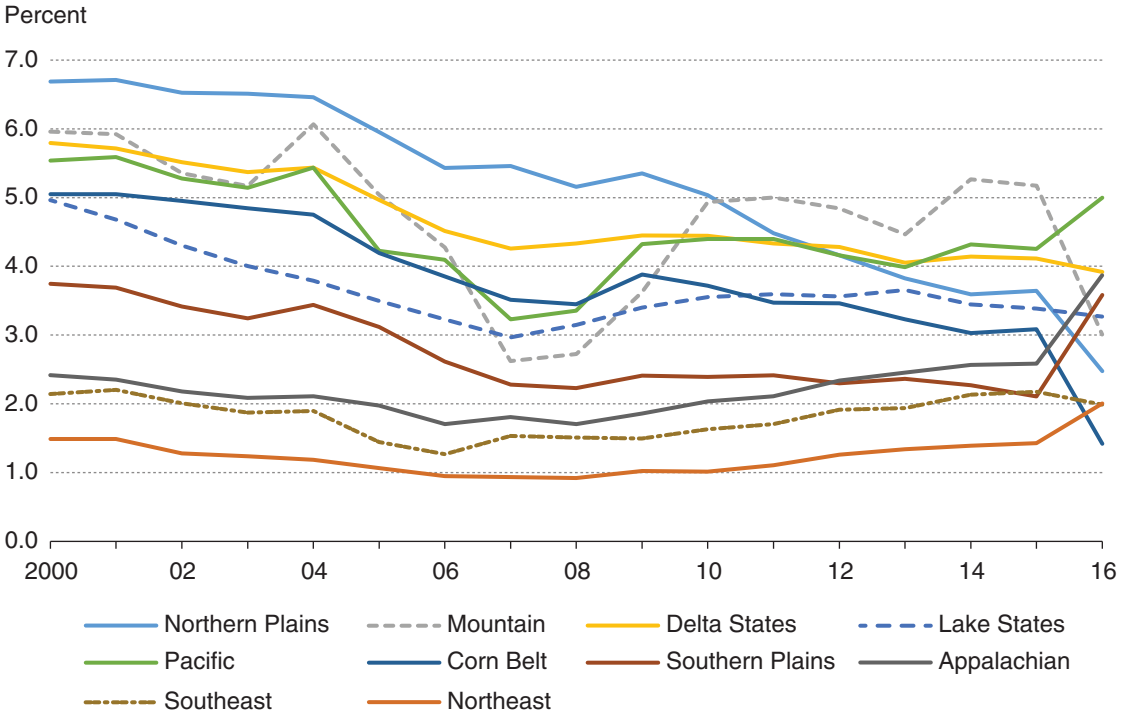
Cropland capitalization rates (rent-to-value ratios) and 10-year constant maturity U.S. Treasury note yields



RTV = rent-to-value ratio.
Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service and Federal Reserve Bank of St. Louis Federal Reserve Economic Data (FRED).

Figure 9

Cropland capitalization rates in the 10 U.S. Department of Agriculture farm production regions, 2000-16



Note: The cropland capitalization rate is calculated as cash rent per acre ÷ cropland value per acre.
Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service.

Parcel-Level Factors That Affect Land Values

While macroeconomic conditions and government policies can affect farmland values throughout the United States, parcel-level factors also strongly influence farmland values. If land values are driven by expected cash returns, the primary source of expected returns for farmland is production of agricultural goods and services. However, farmland can produce income from other (nonagricultural) sources, including residential or commercial uses, recreational uses, energy production, and mineral extraction (Nickerson et al., 2012).

Farmland that has potential for hunting, fishing, or other recreational use will potentially have higher values (Guiling et al., 2009; Zhang and Nickerson, 2015). Land with more productive soil or located close to grain elevators or highways will also be more highly valued. Real estate markets and development values play a more significant role in the value of farmland located closer to metropolitan areas. A study by Nickerson et al. (2012) showed that most farmland was not negatively affected by the U.S. housing downturn between 2006 and 2009. In only three States did declines in the residential housing market coincide with declines in farmland values. Thus, farmland values are generally independent of the residential housing market except in areas in close proximity to urban areas.

Farmland Appreciation, Cash Rental Rates, and Farm Financial Stress

Higher farmland values, driven by higher returns to farming, increase land equity and, consequently, the wealth of farmers who own their land. Higher returns also increase land rental rates because farmers who rent out land expect their renters can earn more. Many farms, particularly those that grow row crops (e.g., corn, wheat, and soybeans), rent substantial portions of their land. Rental rate increases, in response to higher farmland returns, increase farmers' land expenses. As many as one-third of commercial farm businesses incur net farm income losses in a given year. In consecutive years, farm income can swing widely from negative to positive and vice versa (Key et al., 2017). So even during high-income years for the sector as a whole, some farms will lose money. This compounds the problem of higher rental expenses and increases farmers' financial stress.

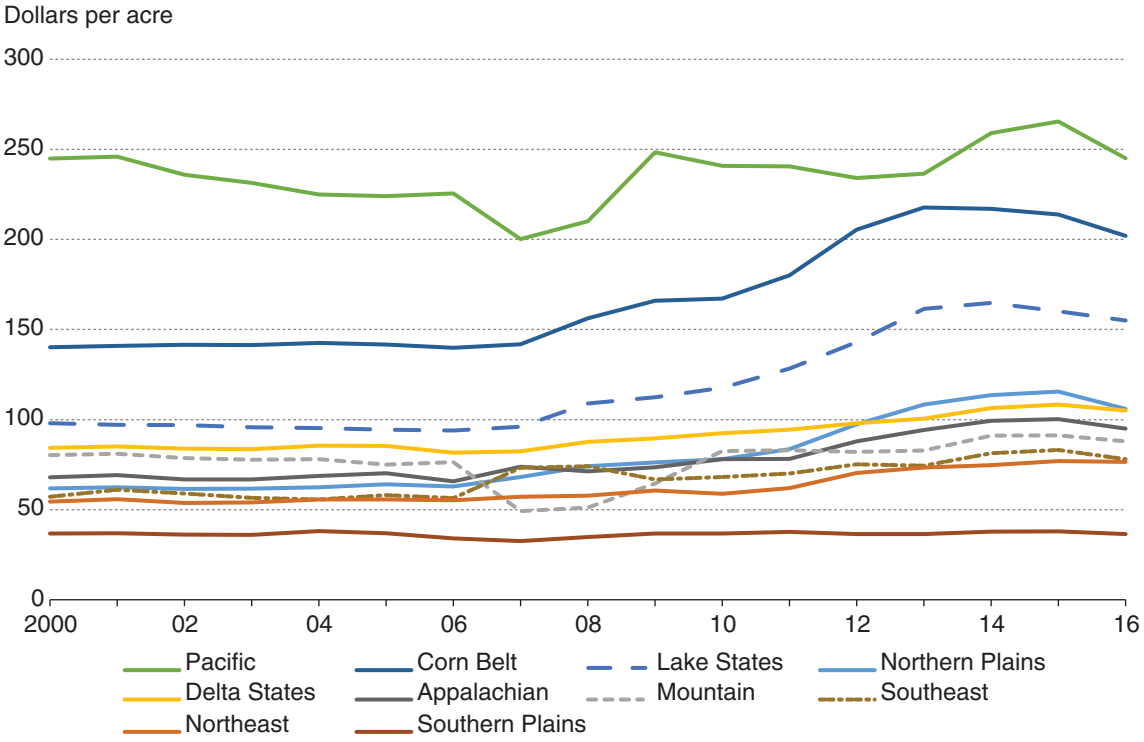
Farmers rent land under four basic types of rental arrangements: fixed cash rent, share rent, flexible or hybrid cash rent (a combination of share and cash rent), and free rent. Under a fixed cash rental agreement, the tenant agrees to pay a fixed amount for rented land. Under a share rental arrangement, the renter agrees to pay the landlord a portion of the total revenue generated, which can vary based on yields and prices. Some share rental agreements allow for sharing operating costs and management expertise. A small proportion of land renters—if the renter is a relative of the landlord, for example—do not pay anything, in a free-rent arrangement. In 2014, fixed cash rental agreements represented over 70 percent of agreements for operator landlords and just under 70 percent of all agreements for nonoperator landlords (landowners who are not currently farming) (Bigelow et al., 2016).

As with farmland values, cash rents for cropland vary considerably depending on the region. Much of this variation is driven by the earning potential of the land. In 2016, the most expensive region was the Pacific, at $245 per acre per year; the least expensive was the Southern Plains, at $37 per acre (fig. 10). Cash rents changed dramatically in certain regions in 2000-2016. Cash rents in the Lake States, Northern Plains, and Corn Belt increased the most during this period. In fact, cash rents in the Corn Belt increased 52 percent (in inflation-adjusted dollars) from 2004 to 2014.

Historically, cash rents have lagged behind farmland values when large changes occur in the farm economy. For example, cash rents for cropland in the Corn Belt generally did not appreciate as quickly as cropland values in 2000-2016 (fig. 11). They also lag behind when the farm economy turns down. In 2009, net cash farm income dropped about 13 percent from the previous year (measured in inflation-adjusted dollars), but cropland cash rents in the Corn Belt adjusted downward more slowly. Evidence of cash rental value declines lagging behind declines in operator returns also has been documented in Illinois (Schnitkey, 2015) and elsewhere, suggesting that if farmland values decline, cash rents will adjust downward more slowly, potentially adding more financial stress to farms that cash rent large portions of their operated acres. Similarly, upward adjustments in cash rents will lag behind land value increases.

Figure 10

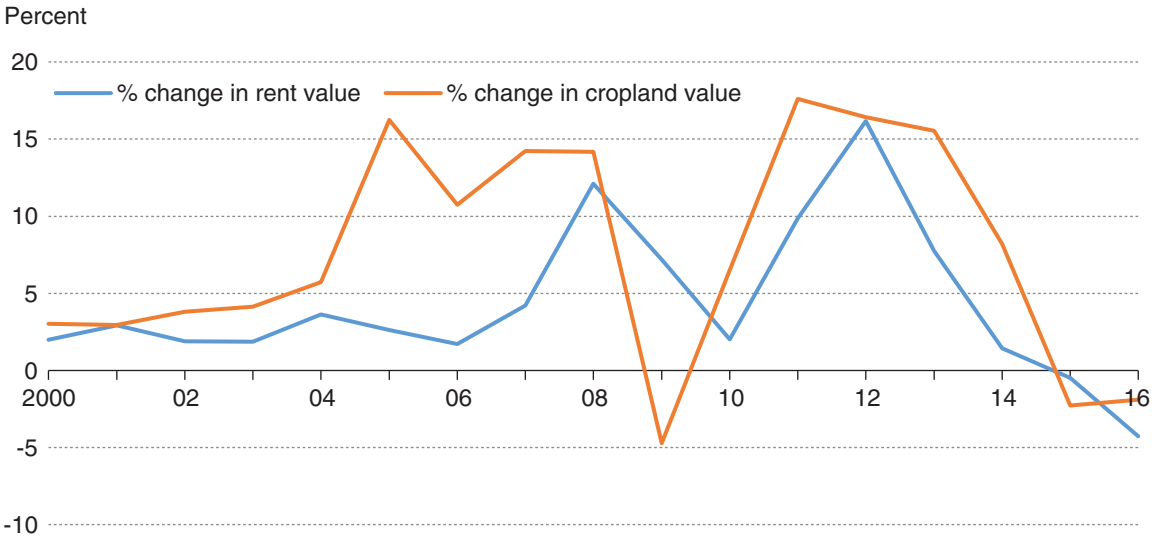
Cash rents (annual) for cropland by region, 2000-2016, in 2016 dollars



Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service. All rental rates are reported in 2016 dollars using the Gross Domestic Product deflator.

Figure 11

Changes in cropland value and cropland rent in the Corn Belt, 2000-2016



Source: USDA Economic Research Service calculations using data from USDA, National Agricultural Statistics Service.

Changes in Cash Rental Rates by Land Tenure (2014-15)

For many large cash grain farms, land rental expenses make up a large portion of the total costs of the operation. It is important to understand the dynamics of cash rental rate changes because many farms will renegotiate their rental rates downward if farmland returns continue to decline.

About 13.6 percent of U.S. farms that cash rented land in 2015 reported a change in their cash rent for the same land rented in 2014, according to USDA's annual Agricultural Resource Management Survey (ARMS). This also means that 86 percent did not see a change, reflecting the fact that cash rents typically do not change from year to year.

Many renters and landlords have longstanding lease arrangements. Although 70 percent of these leases are renewed annually, their terms do not often change. One reason may be that 80 percent of rented land is owned by nonoperator landlords, who may view changes in rental agreements as a transaction cost (Bigelow et al., 2016). As a result, land rental rates may be "sticky" or less responsive to changes in underlying economic conditions. An environment of sticky rents can create profitability issues when commodity prices fall below a certain level.

To examine how farm size affects the rate at which cash rents change and how much they change, we look at large farms in the Northern Plains, Corn Belt, and Lake States because they were more likely to see their cash rents change in 2014-15. Most cash grain and oilseed production occurs in these regions. Farms that produce these commodities require big machinery that is expensive and only economically feasible and efficient for larger farms, many of which cash rent a large number of acres. Most farms in the Northern Plains, Lake States, and Corn Belt did not experience a change in cash rental rates in 2015. Only about 6.5 percent reported a change up or down. Overall, a greater percentage of these farms saw an increase (8 percent) than a decrease (2 percent), despite the drop in net cash farm income, reflecting the idea that rents are sticky and do not respond immediately to a drop in net returns per acre.

However, larger farms (measured in acres operated) were more likely to see their cash rents change. Larger farms were also more likely to see their cash rents decline from 2014 to 2015 (table 1). Among farms that experienced a drop in cash rents, those that operated more than 1,000 acres were 7 times as likely to see their cash rental rates decline as those that operated less than 500 acres. The mean decline in cash rents for large farms was $26 per acre. For a farm cash renting 1,321 acres (the mean for farms with a drop in cash rents operating 1,000 acres or more), a $26 decline in the cash rental rate per acre represents a reduction of $34,346 in rental expenses.

Table 1
Characteristics of farms in the Corn Belt, Lake States, and Northern Great Plains that experienced a decline in cash rents from 2014 to 2015 for some acres rented

Acres operated	Percentage with change in cash rent	Percentage with cash rent decline	Mean decline in per-acre cash rent	Mean per-acre cash rent	Mean acres cash rented
<500	3.4%	0.7%	-$30	$212	145
500-1,000	13.4%	3.7%	-$24	$251	330
1,000+	23.9%	5.2%	-$26	$260	1,321

Source: USDA, Economic Research Service (ERS) calculations using data from ERS's 2015 Agricultural Resource Management Survey (ARMS).

Cash Rental Rates and Profitability

To further understand the impact on profitability of high cash rents during periods of low farm income and prices, we look at the typical corn and/or soybean farm businesses within the Corn Belt, Lake States, and Northern Plains. In 2015, these regions together accounted for 78 percent of U.S. corn production and 65 percent of U.S. soy production by value (or 80 percent and 63 percent, respectively, of harvested acres).

We use farm businesses because they represented 94 percent of total U.S. agricultural production and accounted for 857,000 farms out of a total of 2.1 million.[8] They also tend to be larger farms that operate more acreage than residential farms. Data from the 2015 ARMS provide a snapshot of farms' margins in an environment of relatively low commodity prices and declining farm income. Commodity prices were derived using weighted averages of State-level data from the NASS Quick Stats database. (At the time this report was written, data from 2015 were the latest available.) The net return, excluding cash rent, can be interpreted as the break-even cash rent for an additional acre of cash rented land. This calculation excludes the farmer's opportunity costs (the potential benefit of using the money in the next-best alternative).

For all farm businesses specializing in corn or soybeans in these regions, the net return per acre was above the break-even level (table 2, panel 1). However, for intermediate farms ($350,000 or less in gross cash farm income, where farming is the principal operator's primary occupation), to reach the break-even level, their average cash rents would have to fall by 24.8 percent for predominantly corn farms (where corn accounted for at least 50 percent of the total value of production) and 26.3 percent for predominantly soybean farms (where soybeans accounted for at least 50 percent of the total value of production) (table 2, panel 2).

It is important to note that, because of data constraints, this is a farm-level analysis, rather than for corn-specific or soybean-specific acres. Therefore, both gross cash farm income and expenses (including rent per acre) also reflect the other commodities produced on the farm. Predominantly corn farms received an average of 64 percent of their total production value from corn (58 percent of harvested acres), and soybean farms received 69 percent of their total production value from soybeans (67 percent of harvested acres). In the three regions, 48 percent of predominantly corn farm businesses (39,194 out of 82,198) and 71 percent of predominantly soybean farm businesses (21,512 out of 30,430) were intermediate farms.

When looking at farms of all sizes, all corn or soybean farms would have earned a profit, on average, on an additional rented acre—or on a first rented acre for farms that did not rent any land in 2015 but might have been considering expanding by renting land. However, for small farms, an additional (or first) rented acre would have generated a loss, on average.

Most operations would not experience the full impact of changes in cash rental rates across all operated acres. Only 13 percent of corn and/or soybean farm businesses in these regions rented all of their land in 2015. Therefore, although average cash rental rates would have had to fall by 24.8 and 26.3 percent for corn or soybean farms, respectively, to break even in 2015, that may or may not correspond to an average acre within an operation, depending on the mix of owned versus rented land. This effect will be discussed in greater detail later in the report.

[8] A farm business is defined as a farm where the primary occupation of the principal operator is farming or a farm with at least $350,000 in gross cash farm income.

Table 2

Effect of cash rent on net return per acre for corn and/or soybean farms in the Corn Belt, Lake States, and Northern Plains in 2015, by size: all farm businesses and intermediate farms

Panel 1

All farm businesses	Corn	Soybean
Gross cash farm income per acre	$668.15	$552.42
Expenses excluding cash rent per acre	$378.17	$336.16
Net return excluding cash rent per acre	$289.98	$216.26
Cash rent per acre	$202.02	$152.37
Net return per acre	**$87.96**	**$63.89**
Percentage above break-even rent	**43.5%**	**41.9%**
Yield per acre (bushels)	175	49
Price per bushel	$3.57	$8.89

Panel 2

Intermediate farms	Corn	Soybean
Gross cash farm income per acre	$503.33	$400.99
Expenses excluding cash rent per acre	$389.22	$304.97
Net return excluding cash rent per acre	$114.11	$96.02
Cash rent per acre	$151.72	$130.33
Net return per acre	**-$37.61**	**-$34.31**
Percentage above break-even rent	**-24.8%**	**-26.3%**
Yield per acre (bushels)	162	46
Price per bushel	$3.57	$8.89

Notes: The top table shows results for all farm businesses, which encompass both intermediate farms ($350,000 or less in gross cash farm income, where farming is the principal operator's primary occupation) and commercial farms (gross cash farm income greater than or equal to $350,000). The bottom table focuses solely on intermediate farms to highlight the difference in the financial pressure that smaller and larger farms face, even when limiting the analysis to farm businesses. Some data limitations affect the interpretation of these results. These calculations were done at the operation level, rather than at the commodity level—for example, using gross cash farm income rather than commodity revenues—to be consistent with expenses, cash rent, and rented acres, which are only available at the operation level. We use these measures as proxies for commodity-specific measures, given the large percentages of total value of production and of harvested acres accounted for by these commodities on these operations. On average and on a per-acre basis, fixed expenses—property and real estate taxes, noncash rent and leases, interest payments, and insurance expenses—accounted for approximately 17 percent of all expenses (excluding cash rent) per acre, compared to 83 percent for variable expenses such as seed, fertilizer, labor expense, fuel cost, and others. Most of the table was calculated using the 2015 ARMS, with the exception of the commodity prices. These were derived using weighted averages of State-level data from NASS Quick Stats. The commodity yields and prices, although not directly used in the calculations, are shown to provide context for market conditions and relative productivity. The net return excluding cash rent, as presented in table 2, can be interpreted as the break-even cash rents for an additional acre of cash rented land. This calculation excludes the farmer's opportunity costs (potential benefit of using the money in the next-best alternative).

Source: USDA, Economic Research Service (ERS) calculations based on ERS's 2015 Agricultural Resource Management Survey (ARMS) and data from USDA, National Agricultural Statistics Service.

Financial Stress and Land Appreciation in 2000-2015

Changes in land values can influence the financial stress experienced by a farm in several ways. As farmland appreciates and land assets become more valuable, the solvency ratio (debt-to-asset) of the farm decreases. Farms with lower solvency ratios are generally considered to be less financially stressed, all else equal. However, it is important to note that a farm can have a high debt-to-asset ratio and not be financially stressed if the farm generates enough revenue to service its debt.

To determine how land appreciation affected farm financial stress, we calculate the percentage of farms classified as financially vulnerable for 2000 through 2015.[9] A farm is classified by ERS as financially vulnerable if it has a high debt-to-asset ratio and negative net farm income. (For more details, see the box "How ERS Classifies a Farm's Financial Position.")

How ERS Classifies a Farm's Financial Position

USDA's Economic Research Service (ERS) classifies a farm's financial position using two financial measures: the debt-to-asset ratio and net farm income. The debt-to-asset ratio measures the proportion of assets (e.g., value of land and buildings) owed to creditors to cover the farm's outstanding debt obligations. A higher debt-to-asset ratio indicates that more of the assets are financed through debt, and the farm has a higher leveraged position. Net farm income is the income available to the farm operation after subtracting production expenses, noncash benefits to labor, and inventory changes from gross farm income. Gross farm income is the sum of gross cash farm income, nonmoney income, the value of commodities consumed on the farm, and the imputed rental value of the principal operator's farm dwelling.

Farms classified as "favorable" are considered to be in good financial health, with a low leveraged position and positive net farm income. Farms classified as "vulnerable" are considered financially stressed because they have both a high debt-to-asset ratio and negative net farm income. In all, there are four classifications:

Favorable: Debt/assets <40 percent and net farm income >0,

Marginal income: Debt/assets <40 percent and net farm income <0,

Marginal solvency: Debt/assets >40 percent and net farm income >0,

Vulnerable: Debt/assets >40 percent and net farm income <0.

We also broke farm businesses into land tenure quartiles, based on the ratio of land owned by the farm business to land operated (see the box "Defining Land Tenure").

[9] The 2015 ARMS provides the most recent farm-level data available on the financial well-being of the U.S. agricultural sector.

Defining Land Tenure

Land tenure is defined as the ratio of acres owned to total acres operated (land tenure = acres owned divided by acres operated). Based on their tenure, farms fall into one of four quartiles:

Q1 - Land tenure is less than 25 percent,

Q2 - Land tenure is between 25 and 50 percent,

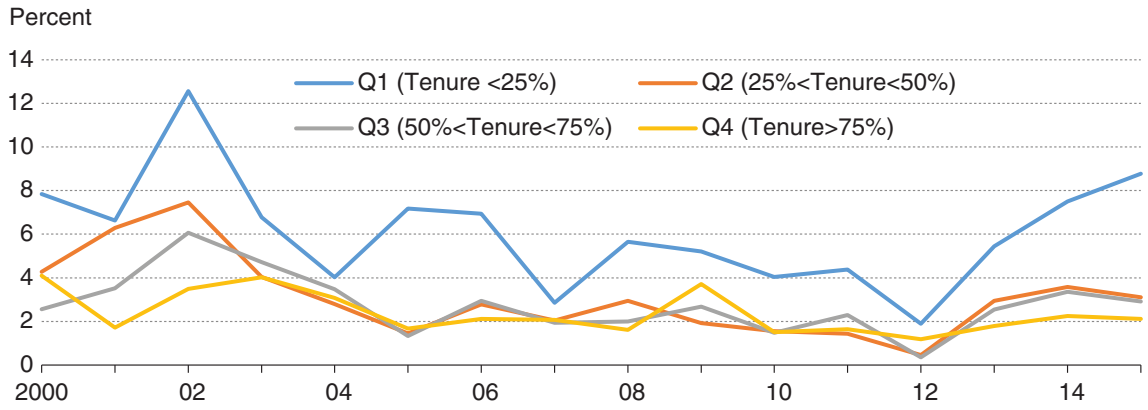
Q3 - Land tenure is between 50 and 75 percent,

Q4 -Land tenure is greater than or equal to 75 percent.[10]

For example, a farm that owned all of its land would be assigned to land tenure quartile Q4, while a farm that rented all of its land would be assigned to land tenure quartile Q1.

The study finds that the percentage of farm businesses classified as financially vulnerable dropped between 2000 and 2012 across all four land tenure quartiles, coinciding with rapid land value appreciation and increasing net farm income (fig. 12). This holds true even when the determination is based only on whether the debt-to-asset ratio is greater than or equal to 40 percent. This trend was most pronounced for farm businesses in tenure quartile Q1 (owns less than 25 percent of acres operated), where the percentage considered financial vulnerable dropped from 13 percent in 2002 to 2 percent in 2012. However, this downward trend reversed in 2013-15, coinciding with lower rates of land appreciation and lower farm income in 2014-15. Financial stress can also be caused by swings in net farm income, when a farm has positive income in some years and negative income in others. Previous studies have shown that individual farms have very volatile farm household and total household income, driven primarily by swings in farm income (Key et al., 2017).

Figure 12
Percentage of farm businesses classified as financially vulnerable by land tenure quartile, 2000-2015



Note: Financially vulnerable farms have a debt-to-asset ratio greater than or equal to 40 percent and negative net farm income. Land tenure measures the percentage of operated land that is owned by the farm.
Source: USDA, Economic Research Service (ERS) calculations using data from ERS's 2000-2015 Agricultural Resource Management Surveys.

[10] A farm that rents out land could potentially have a land tenure ratio greater than 1. These farms would fall into land tenure quantile Q4.

In 2013-15, the share of farm businesses in tenure quartile Q1 that were classified as financially vulnerable increased substantially, far surpassing the top three land tenure quartiles. This suggests that farm businesses with lower levels of land tenure are more financially vulnerable in periods of lower net farm income. Farms without sufficient equity or cash reserves may need to take on more debt to finance the operation in lean years. This liability, combined with the lower levels of collateral these farms can offer relative to similar farms that own a larger percentage of their land, may lead to increased borrowing costs if lenders view them as more risky, making the farms more vulnerable to a downturn in the farm economy.

The Effect of Changing Land Values on Farm Household Wealth, Borrowing, Land Ownership, and Farm Size

Land value appreciation and depreciation have different implications for farmers depending on the amount of land owned versus rented. Rising land values can help landowners borrow, purchase land, expand production, or make other onfarm investments. Particularly for larger scale crop farmers, farm real estate represents a substantial share of total household wealth and is the most important source of equity used to secure loans. Because land is an important source of collateral, land value appreciation or depreciation can influence landowners' access to credit (Plaxico and Kletke, 1979; Lowenberg-DeBoer and Boehlje, 1986; Weber and Key, 2014 and 2015). When values rise, the wealth gains from land price appreciation provide additional collateral for loans, allowing landowners to increase borrowing. When land prices fall, farmers lose equity, their borrowing costs may increase, and their access to credit may shrink or even disappear.

For farmers who rent much of the land they operate, higher land prices can make it more difficult to expand production or purchase more land. Unlike landowners, renters do not enjoy wealth gains from land price appreciation. Instead, rents usually rise along with land values, so renters see higher operating costs in periods of land appreciation. For many crop farmers, rent represents a sizable share of total costs. For example, for the average commercial-scale corn farmer in 2014, land rent was the second largest input expense (after fertilizer and pesticides), averaging $161,000 per year and representing 22 percent of total input costs (ARMS, 2014).

To better understand how changing farmland values influence borrowing, cropland expansion, and land ownership decisions, we use data from the 1997, 2002, and 2007 Censuses of Agriculture to compare farmers who have similar characteristics but differ in the share of farmland they own. The same farms are observed over two 5-year periods, each with different land appreciation rates. As prices increased, farmers who owned a greater share of their farmland had a larger wealth gain than farmers with similar size farms who rented more of their land. To identify the effect of land appreciation, we test whether farmers who own a greater share of their land expanded their operations faster, bought more land, or borrowed more from 2002-07 compared to 1997-2002.

The comparison sample includes crop farmers who harvest at least 25 acres, are located in the Heartland, and who responded to the 1997, 2002, and 2007 censuses (see Appendix for a description of how the sample was created). In 1997, the average farm in the sample owned 35 percent of the land it operated and produced roughly $470,000 in output on 1,360 acres of farmland. The average farmer paid almost $30,000 to service debt. At the time, the average fixed interest rate on farm real estate loans was 8.8 percent, implying the average farmer had about $340,000 in debt (Agricultural Finance Databook, 2010).[11]

To estimate the change in land wealth from land appreciation in the two periods, we calculate the farm real estate appreciation rate by NASS Crop Reporting District (a group of agriculturally similar and geographically contiguous counties in the same State). All crop farms in each census year were used to calculate each district's average value per acre of farm real estate. For the sample, the average farm's real estate appreciated by 6 percent from 1997 to 2002 and by 28 percent from

[11] The implied debt is roughly consistent with estimates from the Agricultural Resource Management Survey, which shows that in 1997, the average farm in the Heartland with $500,000-$999,999 in sales had $367,000 in liabilities (ARMS, 2016).

2002 to 2007. The appreciation rates imply that a dollar more in initial land wealth would have caused wealth to increase by 6 cents in the first period (= 1.06 x $1 – $1) and by about 30 cents in the second period (= 1.28x $1.06 – $1.06). For the average farm, owning rather than renting 1 percentage point more of the land in the farm corresponds to roughly 15 acres worth about $32,250. This land would have appreciated to $34,185 in the first period (= $32,250 x 1.06) and then to $43,757 in the second period (= $34,185 x 1.28). Therefore, increasing the share of land owned by 1 percentage point would have increased wealth by $7,637 more in the second period than in the first period (= ($43,757 – $34,185) – ($34,185 – $32,250)).

First, for the two groups of farmers—those who own at least 50 percent of the land operated (major owners) and those who own less than 50 percent (minor owners)—the percent change in wealth was calculated from 1997 to 2002 (the low-appreciation period) and from 2002 to 2007 (the high-appreciation period). Major owners owned, on average, 40 percentage points more of the land on the farm, causing an increase in wealth that was $309,600 greater in the second period than in the first ($309,600 = $7,740 x 40), compared to minor owners. Then, to see if this increase in wealth affected farm business decisions, the difference between the two periods and between major and minor owners was calculated for four outcomes: interest payments on any debt, interest payments on real-estate-secured debt, acres owned, and acres harvested (table 3).

Table 3
Comparisons of growth rates in four outcome variables for major and minor owners

Outcome	Ownership category	Percent change		Difference
		1997-2002 Low appreciation	2002-07 High appreciation	
Interest payments on debt secured by real estate	Minor owners	25.9	-13.4	-39.3
	Major owners	7.9	-14.0	-21.9
	Difference			17.4
Interest payments on all debt	Minor owners	20.6	-6.2	-26.8
	Major owners	8.5	-10.7	-19.2
	Difference			7.5
Acres owned	Minor owners	31.5	3.3	-28.3
	Major owners	3.3	2.2	-1.0
	Difference			27.2
Acres harvested	Minor owners	10.0	-3.2	-13.2
	Major owners	8.7	-6.9	-15.5
	Difference			-2.3

Notes: Major owners are defined as owning 50 percent or more of the land in the farm; minor owners own less than 50 percent. The sample contains 2,784 major owners and 808 minor owners.

Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service 1997, 2002, and 2007 Censuses of Agriculture.

In the low-appreciation period (1997-2002), major owners increased their real-estate-secured debt at a substantially slower rate than minor owners. However, in the rapid-appreciation period (2002-07), major and minor owners both decreased their expenditures on debt at about the same rate. Both major and minor owners probably experienced declining borrowing costs because of lower interest rates or because high farm income allowed them to pay down debt, rather than because they borrowed less (only interest payments are observed, not borrowing levels).

Comparing how interest payments changed between periods for major and minor owners provides insight into the effects of land appreciation. The growth rate in interest payments declined by 21.9 percentage points for major owners compared to 39.3 percentage points for minor owners. That is, the growth rate in interest payments was 17.4 percentage points higher for major owners than for minor owners. This is consistent with the theory that during periods of rapid land appreciation, those who own most of their land can increase borrowing more than those who rent most of their land.

If land wealth permits greater borrowing by increasing farmers' collateral, the largest likely effect is on borrowing that is secured with real estate. Descriptive comparisons across the two periods and across major and minor owners are consistent with this relationship. For interest payments on any debt, the difference in growth across the two groups and periods was 7.5 percentage points, which is less than half of the difference in growth for payments on debt secured by real estate.

The rate of growth in acres owned for major and minor owners both slowed in the second period. For minor owners, however, the slowdown was much faster. Compared to the prior period, land owned grew 27.2 percentage points faster for major owners than for minor owners, which translates into 132 acres for the average farm. Therefore, the rapid land appreciation was associated with a relatively greater increase in the rate of land purchases for the major owners. In contrast, there was little difference between major and minor owners in acres harvested.[12]

Econometric Model Results

While the differences between major and minor owners shown in table 3 are suggestive, they may reflect differences in the characteristics of farms in each category. For example, if minor owners are younger, on average, than major owners, we might expect minor owners to grow more in the early period compared to the later period. To control for differences in farm and operator characteristics that might be correlated with the share of land owned and changes in the outcome variables, we estimate a multivariable regression (see Appendix for details). The model controls for farm size, value of production per acre, operator age, operator experience, and whether the farm is individually owned. It also includes a time-varying Crop Reporting District effect to control for the interaction between changing commodity prices and a district's suitability for growing the crops favored by the changes.

The more rigorous econometric results confirm the conclusions suggested by the descriptive comparison of major and minor owners, providing further evidence that farmers used their equity in land as collateral for loans (table 4). The study finds a statistically weak link between the share of land owned and total interest expenses, but a strong link to interest expenses for real-estate-secured debt held by younger farmers. Owning 1 percentage point more of the land in the farm was associated with 1.44 percentage points in greater growth in interest expenses on real-estate-secured debt for producers under age 50. For an average farm that had $19,354 in real-estate-secured debt expenses, this implies an increase in expenses of $281. With an interest rate of 8.1 percent (the average between 2002 and 2007), this result implies an additional debt of $3,465. The same effect is not seen for older farmers; for them, greater wealth had a weak negative effect on interest expenses for real-estate-secured debt.

[12] Because the panel spans 10 years, the decline in harvested acres in the second period (2002-07) reflects the aging of the farm operators—operators tend to reduce the number of acres of harvested later in their farming careers.

Table 4

The effect of a 1-percentage-point increase in share of land owned on the growth rate of four outcome variables, regression results

Outcome variable	All	Operator age	
		Under 50	50 and over
Interest payments on real estate-secured debt	0.51*	1.44***	-0.54
Interest payments on all debt	0.21	0.72*	-0.32
Acres owned	0.70***	1.01***	0.34**
Acres harvested	-0.01	0.11	-0.02

*** Significant at the 1-percent level; ** significant at the 5-percent level; * significant at the 10-percent level. Note: The estimated effects are based on relating the initial share of the land owned by the farm to growth in the outcome variable during a period of high farmland appreciation relative to a period of low appreciation. The effects are estimated for the entire sample and separately for farmers who, in 1997, were younger than age 50 and those who were 50 or older. Splitting the sample by age permits estimating different effects for farmers who are more likely to have a demand for credit (because they are in a growth phase of the business) and more likely to be constrained by their wealth (because they have had less time to accumulate it). See Weber and Key (2015) for details.

Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service 1997, 2002, and 2007 Censuses of Agriculture.

Turning to land purchases, younger farmers with larger wealth gains bought more land. For them, a 1-percentage-point increase in share owned caused growth in the amount of land owned to increase by 1.01 percentage points. The effect corresponds to a purchase of about 4.9 acres, which would have cost about $12,250. (For the sample, the average value of farm real estate in 2002 was approximately $2,500 per acre.) The result implies that the average young farmer in the sample financed roughly 30 percent of land acquisitions through debt (0.30 = $3,465 / $12,250).

The results for acres harvested support the conclusion that land-induced increases in wealth had no clear effect on acres harvested. With no change in crop acreage, the estimates imply that farmers who gained more from land appreciation replaced cropland rented from others with cropland they purchased.

Implications for Land Ownership and Land Price Volatility

The findings suggest that farmers owning relatively more land will respond to land price appreciation by increasing borrowing and expanding the share of cropland owned. The 2015 ARMS data illustrate how farm size, operator age, and operator experience are correlated with land ownership for farms with at least $10,000 in crop sales (table 5). The data show a strong inverse relationship between share of operated land that is owned and farm size (value of production). Farmers owning less than 25 percent of their land produce, on average, over twice as much output as farmers owning more than 75 percent of their land. These results imply that rapid land value appreciation would increase the growth rate of land purchases more for smaller farms. Conversely, a period of declining land prices would be accompanied by greater consolidation of ownership among large farms.

The ARMS data also show that farmers who rent most of the land they operate are younger and have less farming experience, on average, than those who own most of their land. Only 13 percent of farmers who owned at least 75 percent of their land were beginning farmers (defined as having 10 or fewer years of experience), compared to 26 percent of farmers who owned less than 25 percent of their land. Beginning farmers who are less than 50 years old are concentrated in the group that owns little of the land they operate. Specifically, only 5 percent of those owning at least 75 percent of their

land were young, beginning farmers, compared to 21.5 percent of those owning less than 25 percent of their land. Young, beginning farmers who also produce more than $100,000 worth of crops are even less likely to own most of their land. These farmers represented only 2 percent of farms owning more than 75 percent of their land, compared to 12 percent of farms owning less than 25 percent of their land.

Table 5

Farmers who rent most of their land are more likely to be young and beginning farmers with larger operations

	Percent of operated land that is owned, 2015			
	<25	25-50	50-75	>75
Value of production ($1,000)	634	647	475	279
Acres operated	1,142	1,211	833	527
Operator age (years)	50.9	55.5	60.3	61.4
Operator experience (years)	23.7	30.5	32.4	30.1
Beginning farmer (% of category)	25.7	9.8	4.8	13.1
Young and beginning (% of category)	21.5	7.7	2.4	5.3
Young and beginning, and value of crop production > $100,000 (% of category)	12.0	4.6	1.9	1.9
Number of farms	138,643	69,726	72,749	280,470

Note: Sample includes all farms with at least $10,000 in crop sales. Percent of farmland owned is defined as the ratio of the acres owned to acres operated. All values in 2015 dollars. Beginning farmers are those with 10 or fewer years of experience. Young farmers are those less than 50 years old.

Source: USDA, Economic Research Service (ERS) using data from ERS's 2015 Agricultural Resource Management Survey.

Over time, farmland gradually passes from older to younger farmers through land sales and inheritance. The findings that wealth gains from land appreciation permit farmers to purchase additional land and that older and more experienced operators generally own more of their land suggest that a rapid increase in land values could slow the transfer of land from older to younger farmers. On the other hand, young, beginning farmers may be better able to purchase land when land prices level out or decline.

Finally, the results also provide indirect evidence of a mechanism for land price volatility. If land price appreciation raises wealth, which leads to more borrowing to buy land, this would likely further increase land prices and wealth. The findings indicate that farmers who had larger wealth gains from land appreciation borrowed more to purchase land than they would have otherwise. By leveraging their newly acquired equity to buy land, farmers, especially younger farmers, contribute to further increases in land values. Conversely, the link between land prices and borrowing implies that a sustained decline in land values could reduce borrowing and thereby further suppress land prices.

Future Farmland Value Scenarios and Potential Impacts of Government Policy

Future farm real estate value projections are sensitive to both farmland returns and interest rates. We simulate four possible scenarios for farmland values over the next 3 years (2017-19) by changing cash returns per acre and interest rates from the 2016 baseline. Farmland returns are measured by net cash return per acre, a net measure of the income generated from the land (calculated as the sum of net cash farm income, rent paid to landlords, and interest paid on real estate) divided by number of acres. Land values that could be supported by specified net cash returns and interest rates, known as capitalized values, are calculated as 80 percent of the net cash returns per acre divided by the 30-year mortgage interest rate.

The four scenarios consist of different combinations of low/high cash returns and low/high interest rates. Low (high) cash returns represent a 15-percent decrease (15-percent increase) in farmland returns from 2016 levels. Low (high) interest rates represent a 0.5-percent decrease (1.5-percent increase) in interest rates from 2016 levels. All changes in interest rates and cash returns are done incrementally, with the full change occurring in 2019. These scenarios are not meant to represent actual land value forecasts, but to illustrate what might happen to land values under a range of different scenarios for these two major drivers (net cash returns and interest rates).

Scenarios for Farm Real Estate Values Depend on Returns to Farmland and Interest Rates

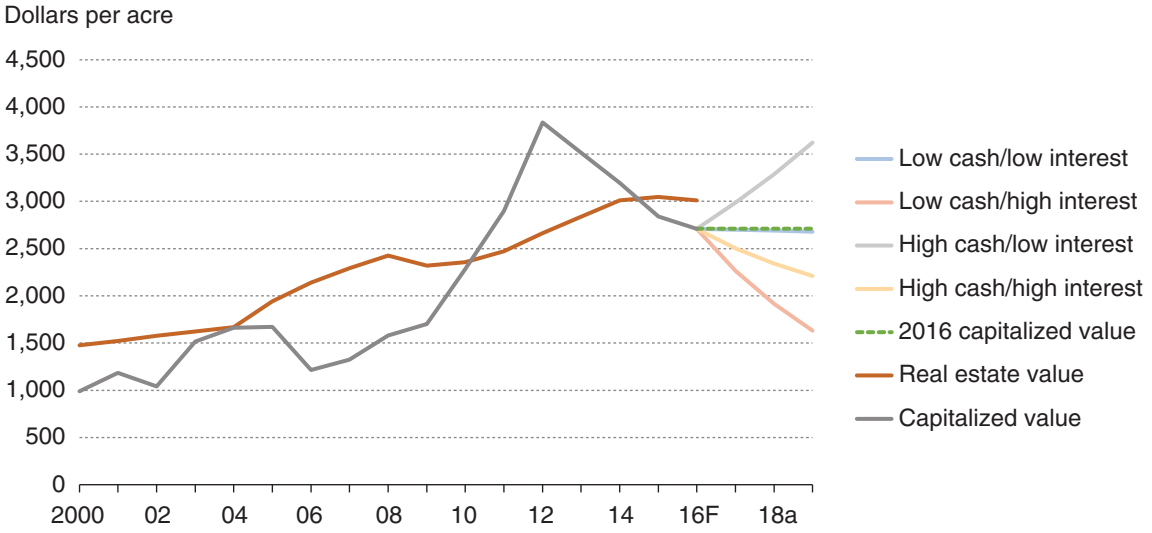
Small interest rate changes can have a substantial effect on farmland values (fig. 13). Under a higher net cash return/lower interest rate scenario, farmland capitalized values are higher than the current 2016 baseline. In contrast, capitalized values in both higher interest rate scenarios (low and high cash returns) fall below the 2016 baseline. Finally, if net cash returns decline by 15 percent from 2016 levels by 2019, and interest rates fall another 0.5 percent, farmland values will be marginally affected.

The scenarios also show that farm real estate values have generally not been supported by current income, except during periods of high net cash farm income (2011-14). In 2015, for example, we estimate that net cash farm income would not have supported current farm real estate values at the national level, given current interest rates. However, the difference between supported and actual values varies regionally and by land use.

If net cash farm income continues to decline, farmers will be less able to service debt on real estate, and farmland will become less affordable—until land prices adjust downward. The decline in affordability of farmland since 2012 (suggested by the gap between actual land values and capitalized values) indicates that nonfarm factors (e.g., low interest rates) are helping support land values. A rise in interest rates in the future will increase borrowing costs for farmers and put downward pressure on farmland values.

Figure 13

Comparison of farmland real estate values and capitalized values (which cash flows would support) under different cash return and interest rate scenarios



Notes: Low (high) cash returns represent a 15-percent decrease (15-percent increase) in farmland returns from 2016 levels. Low (high) interest rates represent a 0.5-percent decrease (1.5-percent increase) in interest rates from 2016 levels. 2016F represents the current forecast for net cash farm income. 2017a-2019a represent hypothetical land values based on different interest rate and net cash farm income scenarios. "Capitalized value" denotes historic capitalized land values over the 2000-2015 period; "2016 Capitalized value" denotes the capitalized farmland value projected out to 2019. All values are reported in 2016 dollars using the Gross Domestic Product deflator.
Source: USDA, Economic Research Service calculations using data from USDA, National Agricultural Statistics Service.

Changes in U.S. Agricultural Policy and Land Values: The Agricultural Act of 2014

The Agricultural Act of 2014 made several substantial changes in U.S. agriculture policy. Broadly speaking, the Act eliminated fixed Direct Payments; expanded the Federal crop insurance program, including the Supplemental Coverage Option (SCO) and the Stacked Income Protection Plan (STAX) for upland cotton; and created new risk-mitigating programs, including Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC). The fixed Direct Payments program was designed to be decoupled from production decisions, making these payments a guaranteed form of income support for qualifying farms. In contrast, crop insurance and risk-mitigating programs provide higher payments when crop prices or yields are low, which reduces the volatility of cash flows and raises expected revenues. Because Federal agricultural programs generally raise the expected net returns to farming and reduce farm income volatility, they raise demand for farmland—both rented and owned. Facing a greater demand for land, landowners can charge more for land they sell or rent. A key question, therefore, is how much of the benefits of agricultural programs go to farmers in the form of higher income versus to landowners in the form of higher rents.

Crop insurance is now the primary tool of the U.S. farm safety net, but questions remain about the extent to which crop insurance will affect farmland values in the future. Evidence from the economic literature has shown crop insurance programs and other risk-mitigating policies (ARC and PLC) in the 2014 Farm Bill reduced farm income variability for eligible farms (Key et al., 2017). Economic theory suggests that crop insurance reduces the variability of future returns to farmland, and that this benefit will be capitalized into the value of land.

Summary and Conclusions

In 2004-14, U.S. farm real estate nearly doubled in real value. In 2015, farmland values reached record levels before beginning to soften in 2015-16. The details of this appreciation, the factors that led to high farmland values, the implications for farm financial stress, and the appreciation's effect on minor and major landowners include:

- U.S. farmland values appreciated at a high rate in 2000-2014, but some regions saw declines in 2015-16. Nationally, values of farm real estate (including land and buildings) nearly doubled in inflation-adjusted dollars. Cropland appreciated faster than pastureland, particularly in the regions of the Northern Plains, Lake States, and Corn Belt. In 2003-14, cropland values increased most in the Corn Belt, Northern Plains, Lake States, and Delta States regions.
- Macroeconomic factors that contributed to high farmland values included high commodity prices (particularly for grains and oilseeds), low interest rates, and Government policies (renewable fuels mandate, Government payments, and crop insurance) that raised the expected net returns to farming. Parcel-specific factors that affected farmland values include alternative-use values such as recreational and developmental use, especially for land near urban areas.
- Nationally, returns to farmland generally did not support farm real estate values in 2000-2016, with the exception of the high net cash farm income years of 2003-05 and 2011-14. However, this finding varies by land-use type and region. In 2015-16, farm real estate values were higher than the income generated by the land. If farmland returns remain at current low levels, farmland values will likely decrease in the future.
- Farmland value appreciation led to fewer farm businesses (defined as farms where the primary occupation of the principal operator is farming or farms with at least $350,000 in gross cash farm income) being classified as financially vulnerable (debt-to-asset greater than 40 percent and negative net farm income) in 2002-12. However, land value appreciation benefitted major owners (those who own more than 50 percent of their operated land) more than minor owners (those who own less than 50 percent of their operated land). Going forward, cash rental rates will play an important role in financial stress because they tend to lag in adjusting downward as farmland returns decline. This lag may increase financial stress for all farmers, but particularly minor owners who operate large cash grain farms and rent large amounts of land.
- Based on a study of crop farms in the Heartland region, farmers who owned a larger share of their land responded differently to appreciating land prices than did similar farmers who owned a smaller share of their farmland. In particular, during periods of price appreciation, owning more of one's land led to greater growth in real-estate-secured debt and land purchases. However, owning a larger share did not lead to an increase in harvested acres. The findings suggest that land price appreciation will not significantly affect farm structure but could increase the rate at which land is purchased by those who own a larger share of their land. This dynamic implies that the gradual transfer of land between generations from older, more experienced farmers to younger, beginning operators could slow during periods of rapid appreciation. On the other hand, young and beginning farmers may find it easier to purchase land when land prices level out or decline.

Future trends in farmland values will depend on net cash returns to farmland, interest rates, and agricultural policy. A small increase in interest rates is likely to cause farmland values to decline by increasing borrowing costs and increasing the opportunity cost of alternative investments, all else equal. The Agricultural Act of 2014 eliminated fixed Direct Payments and expanded crop and pastureland insurance programs. Evidence from the academic literature suggests that insurance payments will be capitalized into land values by reducing volatility in net returns.

References

Agricultural Finance Databook. 2010. "Section C: Reserve Bank Surveys of Farm Credit Conditions and Farm Land Values," Federal Reserve Statistical Release.

Bigelow, D., A. Borchers, and T. Hubbs. 2016. *U.S. Farmland Ownership, Tenure and Transfer*, EIB-161, U.S. Department of Agriculture, Economic Research Service, Aug.

Guiling, P., P.W. Brorsen, and D. Doye. 2009. "Effect of Urban Proximity on Agricultural Land Values," *Land Economics* 85(2):252-64.

Hoppe, R.A., and D.E. Banker. 2010. *Structure and Finances of U.S. Farms*, EIB-66, U.S. Department of Agriculture, Economic Research Service, July.

Ifft, J., T. Kuethe, and M. Morehart. 2015. "The Impact of Decoupled Payments on U.S. Cropland Values," *Agricultural Economics* 46(5):643-52.

Ifft, J., C. Nickerson, T. Kuethe, and C. You. 2012. *Potential Farm-Level Effects of Eliminating Direct Payments*, EIB-103, U.S. Department of Agriculture, Economic Research Service, Nov.

Ifft, J., S. Wu, and T. Kuethe. 2014. "The Impact of Pasture Insurance on Farmland Values," *Agricultural and Resource Economics Review* 43(3):390-405.

Katchova, A., and M. Ahearn. 2016. "Dynamics of Farmland Ownership and Leasing: Implications for Young and Beginning Farmers," *Applied Economic Perspectives and Policy* 38(2):334-50.

Key, N., D. Prager, and C. Burns. 2017. *Farm Household Income Volatility: An Analysis Using Panel Data From a National Survey*, ERR-226, U.S. Department of Agriculture, Economic Research Service, Feb.

Kirwan, B. 2009. "The Incidence of U.S. Agricultural Subsidies on Farmland Rental Rates," *Journal of Political Economy* 117(1):138-64.

Kirwan, B., and M. Roberts. 2016. "Who Really Benefits from Agricultural Subsidies? Evidence from Field-level Data," *American Journal of Agricultural Economics* 98(4):1095-1113.

Latruffe, L., and C. LeMouël. 2009. "Capitalization of Government Support in Agricultural Land Values Prices: What Do We Know?" *Journal of Economic Surveys* 23(4):659-91.

Lowenberg-DeBoer, J., and M. Boehlje. 1986. "The Impact of Farmland Price Changes on Farm Size and Financial Structure," *American Journal of Agricultural Economics* 68(4):838-48.

Nickerson, C., and A. Borchers. 2011. "U.S. Farmland Tenure Patterns: Overview," presented at USDA Agricultural Outlook Forum, U.S. Department of Agriculture, Economic Research Service, Feb.

Nickerson, C., M. Morehart, T. Kuethe, J. Beckman, J. Ifft, and R. Williams. 2012. *Trends in U.S. Farmland Values and Ownership*, EIB-92, U.S. Department of Agriculture, Economic Research Service, Feb.

Plaxico, J., and D. Kletke. 1979. "The Value of Unrealized Farm Land Capital Gains," *American Journal of Agricultural Economics* 61(2):327-30.

Roberts, M., B. Kirwan, and J. Hopkins. 2003. "The Incidence of Government Program Payments on Agricultural Land Rents: The Challenge of Identification," *American Journal of Agricultural Economics* 85(3):762-69.

Schnitkey, G. 2015. "Decreasing 2016 Cash Rents on Professionally Managed Farmland and Lags in Cash Rent Changes," *farmdoc daily*(5):174, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, Sept. 22.

Trostle, R. 2008. *Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices*, WRS-0801, U.S. Department of Agriculture, Economic Research Service, May.

U.S. Department of Agriculture (USDA), Economic Research Service (ERS). 2018. U.S. Farm Sector Financial Indicators, 2011-2018F (released Feb. 7, 2018).

U.S. Department of Agriculture (USDA), Economic Research Service (ERS) and National Agricultural Statistics Service (NASS). 2014. Farm Structure and Finance and Crop Production Practices Tailored Reports, Agricultural Resource Management Survey (ARMS).

U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). 2006. *Land Values 2006 Summary*.

U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). 2012. *Land Values 2012 Summary*.

Weber, J.G., and C. Hitaj. 2015., "What Can We Learn about Shale Gas Development from Land Values? Opportunities, Challenges, and Evidence from Texas and Pennsylvania," *Agricultural and Resource Economics Review* 44(2): 40-58.

Weber, J., and N. Key. 2014. "Do Wealth Gains from Land Appreciation Cause Farmers to Expand Acreage or Buy Land?" *American Journal of Agricultural Economics*. 96(5):1334-48.

Weber, J., and N. Key. 2015. "Leveraging Wealth from Farmland Appreciation: Borrowing, Land Ownership, and Farm Expansion," *Land Economics* 91(2):344-61.

Zhang, W., and C. Nickerson. 2015. "Housing Market Bust and Farmland Values: Identifying the Changing Influence of Proximity to Urban Centers," *Land Economics* 91(4):605-26.

Appendix

Sample of Heartland Crop Farms

USDA's National Agricultural Statistics Service attempts to collect data on all farms and their operators every 5 years through the Census of Agriculture. Each farm's principal operator has a unique identification number, which this study uses to link farms responding to the 1997, 2002, and 2007 censuses.[13] The long form of the census collects information on business costs including interest expenses on debt. All farms in the 2007 census received the long form, but only about a third received it in 1997 and 2002. This study uses only continuing farms that received the long form.

U.S. agriculture covers distinct agro-climatic regions that produce different commodities and have different land tenure patterns. To reduce the risk that unobserved farm characteristics correlated with the share of land owned and farm behavior confound estimates, the study focuses on the observable characteristics of crop farms (those harvesting at least 25 acres and with less than $10,000 in livestock sales in each census year) in the U.S. Heartland. USDA's Economic Research Service (ERS) defines the Heartland by grouping counties with similar farms, soils, and agro-climatic conditions. The Heartland region accounts for more than half of the cash grains produced in the country—most notably corn and soybeans (Hoppe and Banker, 2010). The region also has active land rental markets. In the five major States of the Heartland—Illinois, Indiana, Iowa, Missouri, and Ohio—49 percent of the land in farms is rented, of which three-quarters is rented from landlords who do not operate a farm themselves (Nickerson and Borchers, 2011).

For continuing crop farms in the Heartland that do not rent out land, the share of land operated by the farm is calculated as the sum of acres owned and acres rented in. Farms that rent out land were excluded because they are likely different from farms renting in some land because they could easily expand by cultivating the land rented to others. The distribution of farms by the share owned reveals a bimodal distribution, with clustering at the end points. The study focuses on the 66 percent of farms that own 10 to 90 percent of the land operated—referred to as partial renters. Focusing on partial renters reduces the risk of confounding land-related wealth effects with unobserved characteristics associated with owning or renting all of the land in the farm.

Empirical Model

The empirical strategy compares the responses of farmers who own different shares of the land they operate in periods of small and large increases in farmland values. The base empirical model has three main independent variables: the share of land owned by the farm (*Share Owned*), a binary variable indicating the 2002-07 period of rapid land appreciation (*P2*), and their interaction:

$$(1)\quad \Delta\gamma_{i\tau}=\alpha+\delta_1 P2_{i\tau}+\delta_2 Share\ Owned_i+\delta_3(Share\ Owned_i\cdot P2_{i\tau})+\delta_4(Share\ Owned_i^2)+X_{i97}\beta_1+\gamma_{crd(i\tau)}+\varepsilon_{i\tau}$$

[13] It is not possible to use the most recent 2012 Census because the empirical methodology requires a comparison between *consecutive* periods of low (1997-2002) and high (2002-07) land price appreciation. Land prices in 2007-12 appreciated at approximately the same rate as 2002-07.

The dependent variable is the log difference $(\Delta y_{it} = ln(y_{it}) - ln(y_{it-1}))$ in one of four outcomes over one of two periods, 1997 to 2002 or 2002 to 2007. The outcomes are interest payments on any debt, interest payments on real-estate-secured debt, acres owned, and acres harvested. The control vector X includes the log of the total land in the farm (owned plus rented), the log of the value of production per acre harvested, an indicator variable for whether the farm is individually owned, and a linear and quadratic term for the age of the farm's principal operator and years of experience operating the farm. The 1997 values are used for all of the control variables. A time-varying Crop Reporting District effect $\gamma_{crd(it)}$ is included to control for time-specific local shocks such as the interaction between changing commodity prices and a district's suitability for growing the crops favored by the changes.

The setup in (1) fits a difference-in-difference framework with two periods and a continuous treatment variable (*Share Owned*). The interpretation on the coefficient of *Share Owned* is the same as if it were a binary variable: the effect of going from owning none of the land in the farm (*Share Owned* equals zero) to owning all of the land (*Share Owned* equals 1).

The share of land owned in 1997 may be correlated with unobserved characteristics of the farmer, such as wealth endowments, credit constraints, and entrepreneurial ability. In land rental markets, low-ability farmers will generally be outbid by high-ability farmers, thereby reducing their share of land owned (land owned divided by land farmed). Thus, the share owned may be correlated with ability and growth. Equation (1), however, allows farmers who rent most of their land to grow faster (or slower) than those who rent less. The key assumption for identification of the wealth effect is that the difference in growth rates between major and minor renters in the first period would persist in the second period had land values appreciated at the same rate in both periods.

We estimate (1) using two-stage least squares and calculate robust standard errors clustered by farm. The time-specific Crop Reporting District effect controls for arbitrary correlation in the behavior of farms in the same district in the same year, while clustering errors by farm captures correlation in the residuals of the same farm over time. The full results of the estimated model, additional information about the model specification, and various tests of the model are given in Weber and Key (2015).