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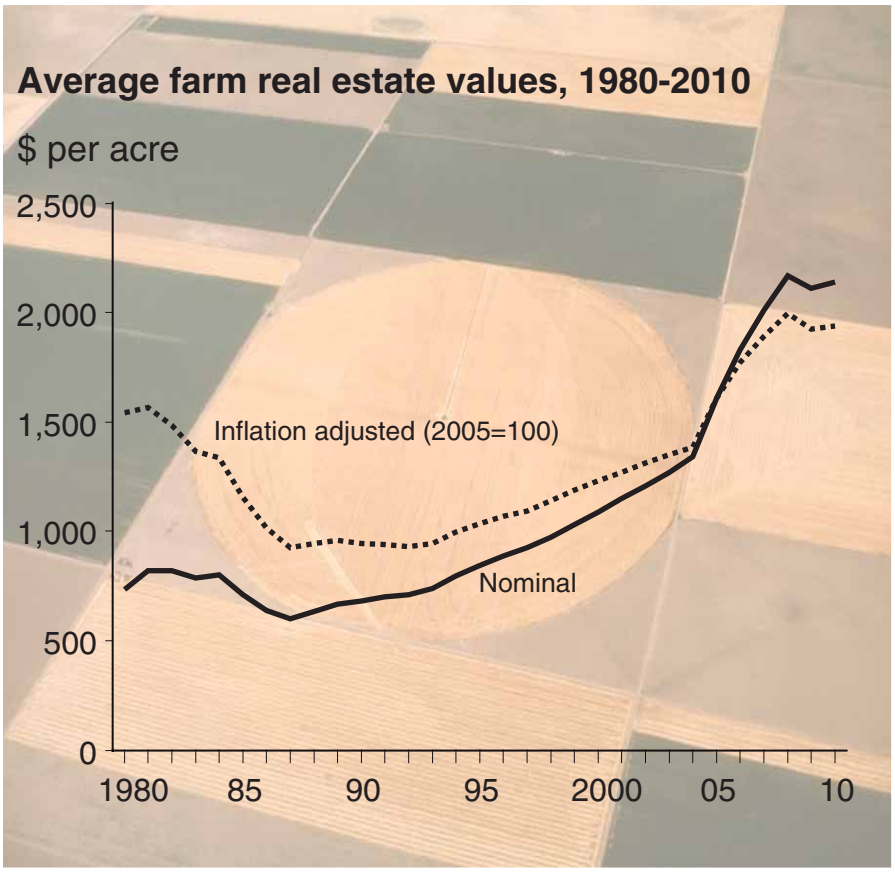
Trends in U.S. Farmland Values and Ownership

Cynthia Nickerson, Mitchell Morehart,
Todd Kuethe, Jayson Beckman,
Jennifer Ifft, and Ryan Williams



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Trends in U.S. Farmland Values and Ownership

Cynthia Nickerson, cnickerson@ers.usda.gov,
Mitchell Morehart, Todd Kuethe, Jayson Beckman, Jennifer Ifft, and Ryan Williams

Abstract

Because farm real estate represents much of the value of U.S. farm sector assets, large swings in farmland values can affect the financial well-being of agricultural producers. This report examines both macroeconomic (interest rates, prices of alternative investments) and parcel-specific (soil quality, government payments, proximity to urban areas) factors that affect farmland values. In the last few years, U.S. farmland values have been supported by strong farm earnings, which have helped the farm sector in many regions to withstand the residential housing downturn. Historically low interest rates are likely a significant contributor to farming's current ability to support higher land values. About 40 percent of U.S. farmland has been rented over the last 25 years. Non-operators (landowners who do not themselves farm) owned 29 percent of land in farms in 2007, though that proportion has declined since 1992.

Keywords: Farmland values, farmland prices, farmland ownership, tenure

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Summary

Farm real estate (land and structures) is the major asset on the farm sector balance sheet, accounting for 84 percent of the total value of U.S. farm assets in 2009. Because of this, changes in agricultural land values are a critical barometer of farm sector performance and the financial well-being of agricultural producers. These changes also have implications for a wide range of policy issues, including agricultural competitiveness, industry structure, commodity programs, conservation payments, farmland protection, and local property taxes. In addition to being the largest single investment in a typical farmer's portfolio, farm real estate is the principal source of collateral for farm loans, enabling farm operators to purchase additional farmland and equipment or to finance current operating expenses and meet household needs.

What Is the Issue?

Interest in farmland values has grown in recent years due to dramatic increases in these values—more than 10 percent in 2005 and 2006—and the boom-and-bust cycle evident in the residential land market. Questions abound about the extent to which farmland values are affected by macroeconomic factors such as alternative investments, interest rates, and debt servicing capability. In addition to these farm finance considerations, interest also centers around the extent to which parcel-specific factors—such as soil productivity, proximity to delivery points like grain elevators and highways, and the land's development potential—affect farmland values. Changes in farmland markets have also raised questions about tenure patterns, and the extent to which the benefits of farmland ownership are accruing to owners actively engaged in farming or to non-operating farmland owners.

What Did the Study Find?

Many factors that can affect farmland values and ownership, both macroeconomic and parcel-specific, change simultaneously and they interact in complex ways. Though multivariate analysis is needed to provide definitive answers, examining individual factors one at a time through trend and correlation analyses provides a first step in understanding potential relationships.

Trends in farm incomes, cash rents, and interest rates suggest that farmland values were supported by farm earnings in 2009 and 2010, but there have been periods of imbalances in the recent past. Since 2009, though farmland values have been high, the discounted returns from renting farmland have been higher. Also, in the last 2 years, average income from farming has been more than sufficient to service the debt on farm real estate purchases at current mortgage rates. A "speculative bubble" forming in farmland markets cannot be ruled out, but at a national level, farmland values have been supported of late by fundamental farm factors such as farm earnings. However, over 2005-08 and during 1978-85, farming income was insufficient to service debt on farm real estate purchases. Historically low interest rates are likely a significant contributor to farming's current ability to support higher land values. Increases in interest rates would likely put downward pressure on farmland values.

Strong farm earnings appear to have helped farmland markets withstand the significant downturn in the residential housing market in recent years, though some regions may have experienced modest impacts. In addition to its value in a farming use, farmland near urban areas derives value from its potential to be developed for residential housing and other nonfarm purposes. Significant volatility in urban real estate markets over the last decade has raised questions about the extent to which competing land markets are affecting farmland values. A comparison of rural housing and farmland values during the 2001-04 "boom" years of the housing market reveals that farmland values grew faster than rural housing values in many States. During the housing market downturn (2007-09) that affected all but the Plains and Delta regions, farmland values generally declined more moderately than rural housing values. In 19 States (notably California, Oregon, Washington, and Nevada), farmland values continued to increase even though rural housing values declined. Strong gains in agricultural returns and declining interest rates helped dampen the effects of the housing "bust" on farm real estate values.

Many of the factors that help explain the variation in farmland values across the country are parcel-specific. Farmland with higher soil quality requires fewer production inputs and management time, and land that produces more can enhance expected farming returns and thus farmland values relative to land with poorer soils. In the most rural areas where urban pressures are largely nonexistent, our analysis shows that cropland with better soils is correlated with higher land values. However, a positive correlation between soils and land values is difficult to detect near urban areas because so much of the land's value derives from potential development uses and not farm factors.

The correlation between government payments and cropland values varies regionally and by payment type. Government agricultural program payments increase income from agricultural production, and when they do so in a consistent way, the expectation of future payments may be capitalized into the value of farmland. Although farmland values generally increase with insurance premium subsidies, land values are inconsistent for land with different levels of direct and countercyclical program (DCP) payments. Also, the ratio of DCP and insurance premium payments to land values varies regionally, a consequence of what crops are—and have historically been—grown and whether they are eligible for program payments.

Non-operating landowners play a significant role in U.S. agriculture. Ownership status affects whether the benefits and risks of owning farmland accrue to active farmers or non-operating landowners. Three of the top four regions in terms of land in agriculture (Northern and Southern Plains and the Corn Belt) have non-operating owners owning more than 30 percent of the land. Non-operators owned 29 percent of all land in farms in 2007, and they owned 77 percent of farmland that is rented. Non-operators tend to be older, less likely to live on the farm, and less likely to participate in conservation programs. Despite recent increases in foreign ownership of forest land, as of February 2009, only 1.7 percent of privately owned land in farms or forest, or 22.8 million acres, was owned by foreigners.

How Was the Study Conducted?

This report uses trend and correlation analyses to identify general relationships between farmland values and both macroeconomic and parcel-specific factors. The analyses use cropland and pastureland value estimates developed by USDA's National Agricultural Statistics Service (NASS) and data from NASS' June Area Survey, in conjunction with data on a variety of factors—such as proximity to urban areas, soil quality, and irrigation status—that are likely to affect farmland values. Our analyses on farmland ownership trends largely use data from NASS' 2007 Census of Agriculture, NASS' 1999 and 1988 Agricultural Economics and Land Ownership Surveys, and ERS-NASS Agricultural and Resource Management Surveys. Because trends in farmland markets are determined by complex interactions among many potential influences, these trend analyses can help inform the design of detailed statistical analyses that would more definitively identify those factors that are significantly affecting trends in farmland values and ownership.

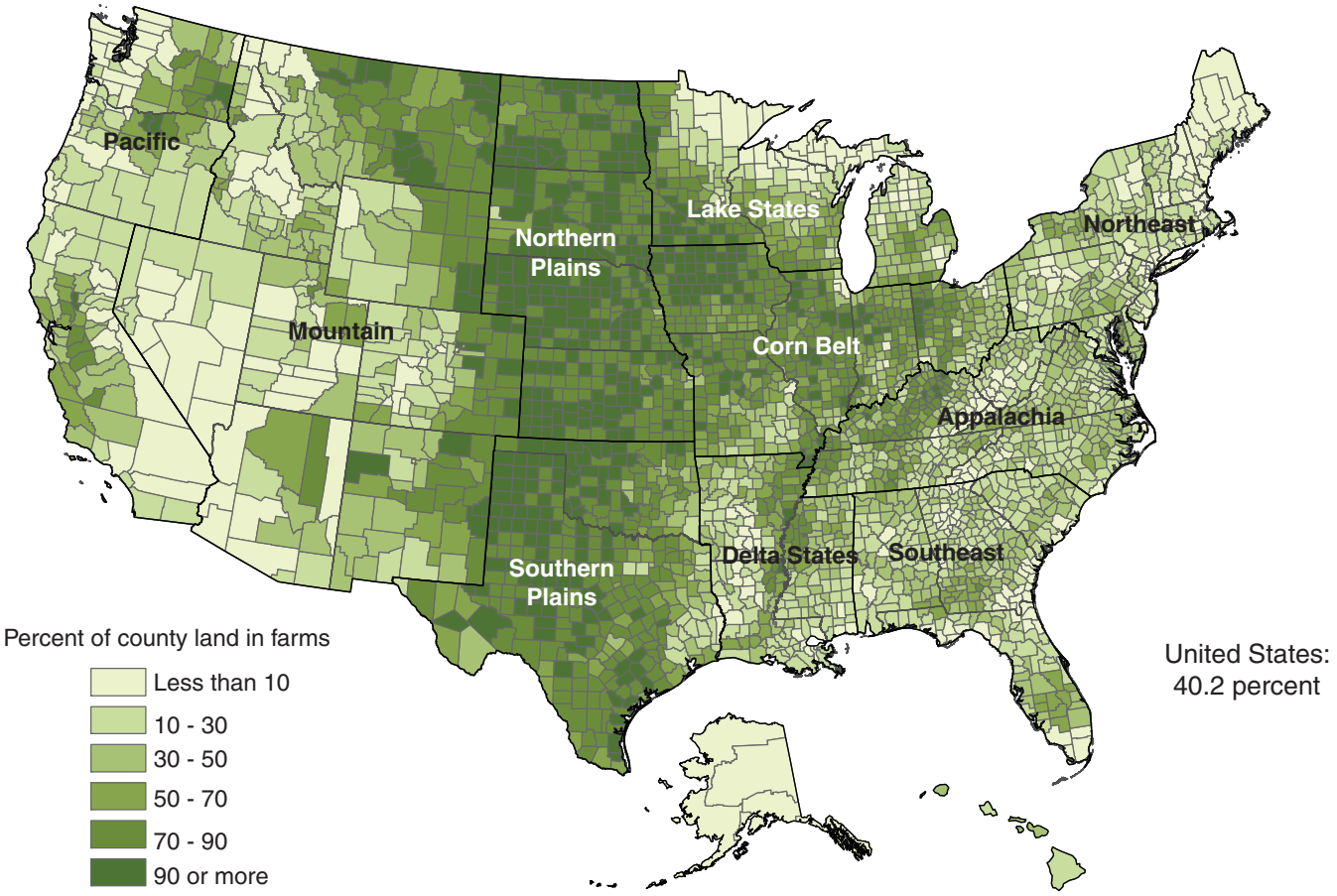
Introduction

U.S. farmland values and the factors influencing changes in those values have long been of considerable interest, and the subject of a great deal of economic research. Farm real estate (land and structures) is the major asset on the farm sector balance sheet, and accounted for 84 percent of total U.S. farm assets in 2009. Farm real estate is the principal source of collateral for farm loans, enabling farm operators to finance the purchase of additional farmland and equipment or to meet current operating expenses. Many farm households rely on landholdings as a retirement fund, so farm real estate is an investment strategy as well. Because of this, changes in agricultural land values are a critical barometer of farm sector performance and the financial well-being of agricultural producers. Changes in land values also have implications for a wide range of policy issues, including agricultural competitiveness, industry structure, commodity programs, conservation payments, and farmland protection.

About 922 million acres, or 40 percent of the Nation's land base, was in farms in 2007 (latest year for which data are available). Most farmland is in the Midwest, but it exists in all States so fluctuations in farmland markets can be both a regional and national concern (fig. 1).

Figure 1

Acres of land in farms, 2007



Source: USDA, National Agricultural Statistics Service.

Because farmland is such a significant asset in the farm sector, farmers, lenders, researchers and policymakers have long been interested in the trends in, and determinants of, farmland values. This interest has grown in recent years due to dramatic increases in farmland values; rapid changes in commodity prices arising, in part, from renewable energy policy; and volatility in other land markets. For example, residential housing prices escalated in 2005-06 and then dropped precipitously, coincident with a significant increase in commodity prices. These changes have raised questions about the extent to which farmland markets respond to changes in fundamental farm-related factors, such as commodity prices and farm income, and the extent to which they are subject to risks and changes in other land markets.

Sharply rising farmland values also evoke reminders of the trends that preceded the farm crisis of the 1980s. Farmland values rose throughout much of the post-World War II period; from 1969 to 1978, farmland prices increased 73 percent as agricultural producers responded to high returns and Federal policies that increased incentives for investing in agriculture (Barnett, 2010). In 1980, farmland prices began to decline in response to Federal monetary policy that raised interest rates to combat inflation. The rapid escalation in interest rates and energy prices precipitated a farm financial crisis that led to farm bankruptcies and bank failures throughout the 1980s (Duncan, 2008).

Farmland values are determined by factors that affect the land market as a whole, as well as factors that affect the value of individual parcels relative to each other. Examining factors at both of these scales is important in understanding how and why farmland values are changing. Macroeconomic factors behind farmland values—such as expected returns from agricultural uses, alternative investment opportunities, interest rates, and use of debt financing—and other sector-level factors—help inform whether farmland continues to be attractive as an investment and whether farmland values appear to be supported by fundamental farm factors. A micro-level perspective reveals how farmland values vary spatially due to variation in parcel-level characteristics like soil productivity, the land's proximity to markets, eligibility for farm program payments, and opportunities for nonfarm income. In this report, we examine both macro and micro aspects of farmland markets.

Farmland Values: Trends Over Time, by Region, and Land Use

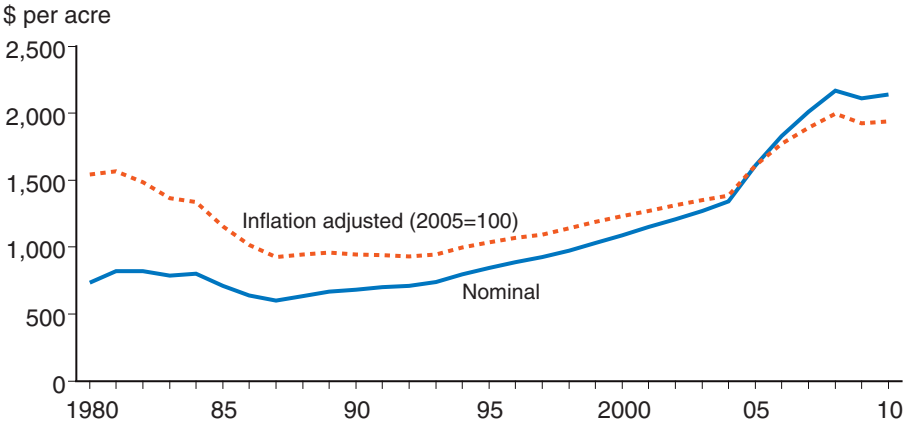
Since the farm crisis of the mid-1980s, farm real estate values (including land and buildings) have been rising in both nominal and real (i.e., inflation-adjusted) terms (fig. 2). Between 1994 and 2004, real values increased between 2 and 4 percent annually. In 2005 and 2006, values jumped 16 percent and 11 percent, before slowing to 6-7 percent in 2007 and 2008.

Farmland Values Vary by Region and by Land Use Type

Average land values for the Nation mask wide regional variation. Cropland values (the land value excluding buildings) exceeded $5,000 per acre in 2007 in the Northeast and Pacific regions, where high-value crops—fruits, vegetables, and orchards—are grown and development pressures are high (fig. 3). Cropland values in 2007 were only about $1,000 per acre in the Northern Plains, an area dominated by wheat and other row crop farms.

Figure 2

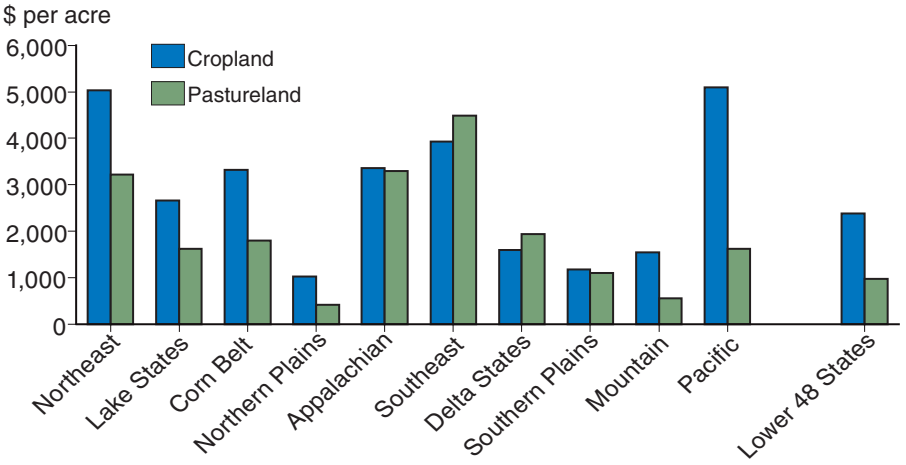
Average farm real estate values, 1980-2010



Source: USDA, National Agricultural Statistics Service.

Figure 3

Average farmland value by land use and region, as of 2007 (in 2005 $)



Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data.

Also, though national average cropland values changed little between 1999 and 2004, cropland values in some regions were more variable. For example, in the Pacific region, cropland values increased between 2 and 4 percent over 1999-2003, but decreased 16 percent between 2003 and 2004.

Average farmland values also obscure differences by type of land use. Historically, crop and pasture land prices did not diverge significantly because pasture was essential for feeding farm animals, which were an important part of the farming enterprise (Raup, 2003). More recently, when measured, nationally cropland values have exceeded pasture values due primarily to higher returns associated with cropland. Cropland enjoys a substantial premium over pastureland values in most regions (fig. 3), especially in the Pacific States where vineyards command higher land prices (Reynolds and Johnston, 2003).

However, cropland value premiums have declined over the past 10 years in every region except the Northeast. Though premiums exceeded 20 percent at some point within the last 10 years, by 2008, cropland values in the Appalachian and Southern Plains regions exceeded average pastureland values by only 3-4 percent. In the Southern Plains, nonfarm factors such as recreational income from hunting leases are contributing to increasing farmland values (Guiling et al., 2008; Henderson and Moore, 2006; Pope, 1985). (Nonfarm income streams that accrue to pastureland would contribute to declining cropland premiums.) In the Southeast and Delta regions, average pasture values rose more quickly in the last 10 years and have exceeded average cropland values since 2005 (table 1). In Georgia, Flanders et al. (2004) observe that more pastureland than cropland is near urban areas, drawing stronger demand for housing or recreational development.

Table 1
Percentage of premium cropland over pastureland values (in 2005 $)

Region	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
					Percent					
Northeast	31	35	37	37	37	52	56	62	56	61
Lake States	133	128	116	113	104	97	80	69	65	67
Corn Belt	136	122	114	105	104	102	98	90	85	93
Northern Plains	196	189	183	186	184	176	167	153	148	148
Appalachian	14	16	20	19	18	21	5	2	2	3
Southeast	15	16	10	4	2	14	-14	-12	-12	-13
Delta States	4	3	7	4	0	-2	-10	-11	-18	-17
Southern Plains	28	30	28	32	37	44	21	13	7	4
Mountain	315	310	318	319	318	254	231	191	178	171
Pacific	360	396	404	399	390	218	262	247	215	193
Lower 48 States	180	184	183	181	178	178	178	140	146	153

Source: USDA, ERS analysis of National Agricultural Statistics Service Agricultural Land Values and Rents Final Estimates.

Performance of Farmland As An Investment

Recent sharp increases in farmland values raise questions about whether farmland prices have reached levels that cannot be sustainably supported by expected agricultural returns. Examining how farmland values change relative to farmland rents, whether farm income is sufficient to service real estate debt, and how farmland compares to alternative investments indicate how farmland has been performing as an investment. These comparisons also reveal that the recent high farmland prices are not occurring under the same conditions that contributed to the farm crisis of the 1980s, at least for the farm sector as a whole.

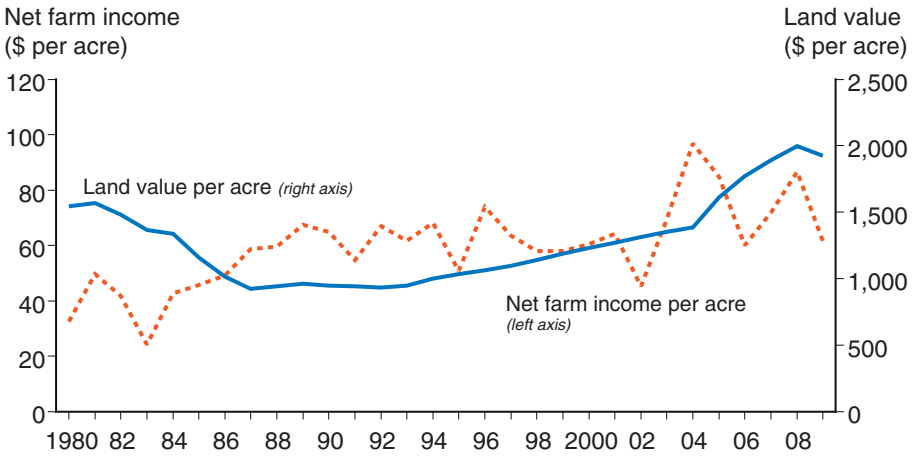
At the most basic level, capital asset pricing theory posits that farmland values are derived from the expected stream of returns that can be earned into the future by having the land in an agricultural use.[1] Farm incomes and land values were closely linked in the first half of the 20th century, but have become less so since (Shalit and Schmidt, 1982), with little correlation at the national level in recent decades (fig. 4).[2,3]

Rent-to-Value Ratios Declined Over the Last 50 Years

The farmland rent-to-value (RTV) ratio, calculated as the cash rent per acre divided by the land value per acre, is a proxy for how quickly an asset will pay for itself.[4] The roughly 45-year trend reveals a decreasing RTV ratio (fig. 5); if agricultural rents were the sole source of returns from farmland, the farmland would have paid for itself in about 14 years in 1951, but would take more than 33 years in 2007. However, in many places, nonagricultural returns can be earned from the land, such as returns from developing the land (Livanis et al., 2006). Decreasing RTV ratios are consistent with the growing importance of nonagricultural factors in determining land values. Indeed, Flanders et al. (2004) find that in Georgia, nonagricultural factors have a stronger influence on land values than cash rents.

Figure 4

Land values and farm sector net income, 1980-2009 (in 2005 $)



Source: USDA, ERS Farm Income Accounts data, available at http://www.ers.usda.gov/data/FarmIncome/Finfidmu.htm

[1]Numerous studies have examined the applicability of the present value model to farmland prices (e.g., Falk, 1991; Clark et al., 1993) and considered other factors that can affect farmland values, such as inflation and risk relative to nonfarm investments (Chavas and Thomas, 1999; Irwin et al., 1988) and local (parcel-specific) factors discussed later in this report, such as amenities and the value of land in a developed use (e.g., Libby and Irwin, 2003; Livanis et al., 2006).

[2]Net farm income in figure 4 is that for the farm sector as a whole. It is computed by determining the gross value of goods and services generated by farm assets and subtracting the expenses incurred during the year. All cash and noncash items are included in gross farm income and in expenses, regardless of whether they were earned or incurred by farm operators, contractors, or farmland owners.

[3]The farm sector includes about 800,000 farms where the operator identifies farming as the primary occupation and 1.2 million farms where the operator is not engaged in farming as a primary occupation. As a result, the latter group does not generate as much income from farming. For this group there is a substantial gap between farm income and the value of land and buildings on their operations. In contrast, the remaining 800,000 farm businesses that do generate substantial income from farming have more consistency between land/building values and farm earnings.

[4]The relationship between land rents and values was a popular research topic during the run-up and later collapse of land prices during the 1970s and 1980s. A central question of this research was whether a simple capitalization formula (value=[annual rent / capitalization rate]) could predict land prices in the current year based on current rental rates, or whether a more sophisticated model is needed (e.g., Melichar 1979, Barry 1980, Alston 1986, Burt 1986). Rents were found to help explain land price variation in some parts of the country, while in other areas the increasing influence of non-agricultural factors required more sophisticated modeling approaches (e.g., Featherstone and Baker 1987).

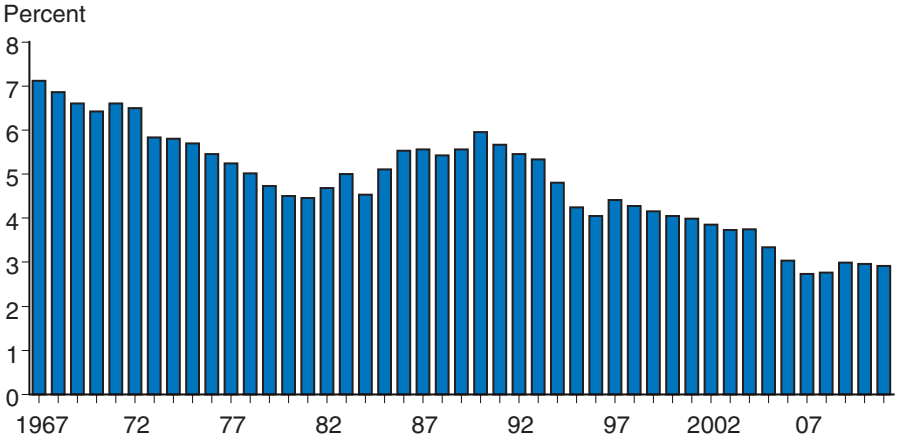
Survey data collected by USDA's National Agricultural Statistics Service (see box, "June Area Survey Data") show that since 1999, almost every USDA region has seen a decrease in RTV ratios (fig. 6). The Lake States and Southern Plains experienced the largest percentage decreases in RTV ratios, at 48.3 percent and 51.2 percent. The Delta and Mountain regions had the lowest percentage decreases in RTV ratios between 1999 and 2008, at 4.2 percent and 8.8 percent. The Delta, Mountain, and Pacific regions experienced the most volatility in RTV ratios.[5] The regions with the highest RTV ratios are the Northern Plains, Delta, Mountain, and Pacific regions.

Declining rent-to-value ratios in many regions may be due to the influence of nonfarm factors on land values, as RTV ratios are generally lower near urban

[5]More farmers in these three regions use irrigation, and some of the volatility could be due to our averaging of irrigated and non-irrigated rents and land values.

Figure 5

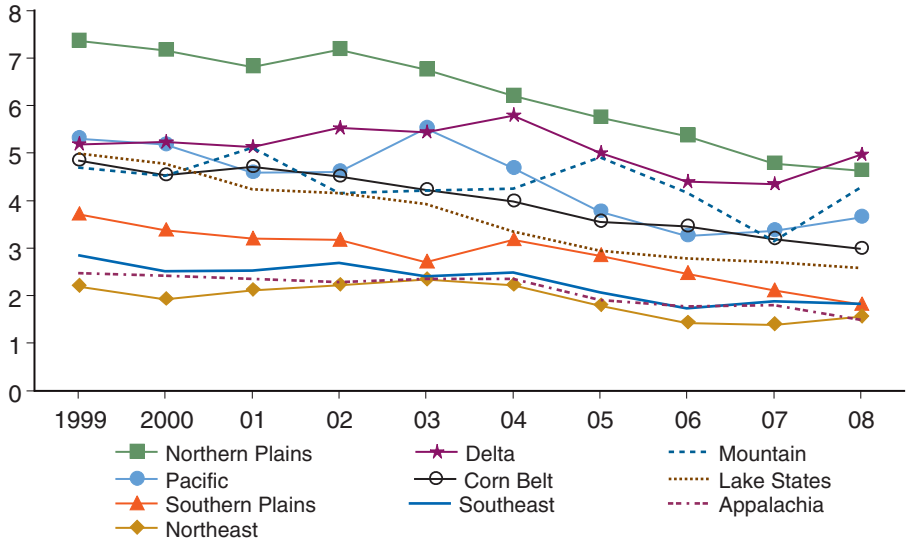
Cropland rent-to-value, 1967-2011



Sources: For 1997-2011, USDA-NASS Quickstats (http://quickstats.nass.usda.gov/). For earlier data, see USDA-ERS cash rent and Agricultural Land Values Survey data.

Figure 6

Cropland rent-to-value by region, 1999-2008[1]



[1]Ratio of per-acre cash rent for cropland to per-acre value of cropland in the June Area Survey, including both irrigated and non-irrigated cropland.

Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data.

June Area Survey (JAS) Data

USDA's NASS survey each June asks farmers to report their estimates of per acre cropland, pastureland and total real estate value (including building value), as well as cropland rents. The JAS is based on a probability area frame with an annual sample of about 10,800 segments of approximately 1 square mile. Land values and cash rents are collected from all farmers having operations within the sampled segments (NASS, 2009a). The Sample tool in the Spatial Analyst extension of ArcGIS 9.3 was used to extract the values of other data in GRID format to the JAS segment points, so that associations can be made between the JAS data and characteristics of other data, listed in Appendix A: Data Inputs. A key objective of the JAS spatial data development process is to capture the time-series lineage of the survey at unique spatial locations to generate a single set of points in a spatial dataset that represent survey locations over time.

JAS segments are surveyed longitudinally over several consecutive years, so by design, each point represents at least one survey year. We developed the spatial dataset for the years 1999 through 2008. MS Access was used to develop a table of unique sample points, defined by latitude and longitude fields. Each of these 31,242 unique spatial locations was assigned an identifier. A separate lookup table is used to join the year, State, and segment identifier to the unique location identifier, creating a one-to-many type join. Any extractions of the gridded data to the JAS segment points yielded a table including the spatial location identifier tabbed with any values intersected in the sample process. The lookup table provides the full linkage between the extracted grid data and the JAS tabular data.

areas (fig. 7). In regions such as the Corn Belt, that are heavily dominated by agriculture,[6] other factors may be playing a role in declining RTV ratios, such as increased recreational (hunting) values and long-term rental arrangements with rental prices that adjust slowly to rapidly appreciating farmland values (fig. 8). Indeed, studies have found that farmland prices are more volatile than rents (Falk, 1991; Featherstone and Baker, 1987). Rising incomes in the nonfarm rural economy in recent years may also have contributed to increases in farmland values (e.g., Henderson and Novack, 2005), with a more limited impact on rents.

Affordability of Farm Real Estate Has Varied Over Time

As farmland values surge and rent-to-value ratios decline, questions arise about the affordability of farmland. Figure 9 shows U.S. total farm real estate values from 1970, and the maximum farm real estate value that current farming income can "cash flow" (service debt on) in each year.[7] Although affordability will fluctuate above and below real estate values due to price and yield variation, during two periods in particular—1978-85 and 2005-08—income from farming alone was insufficient to service the debt on farm real estate purchases. The low levels of affordability indicate that nonfarm factors likely had a large role in determining farmland values during these periods.[8] In other periods, such as before 1974 and between 1986 and 2004, farming incomes were more aligned with the value of land.

When farmland values are high and affordability is low, some farmers might sell land to capture the capital gains benefits arising from appreciated land values.

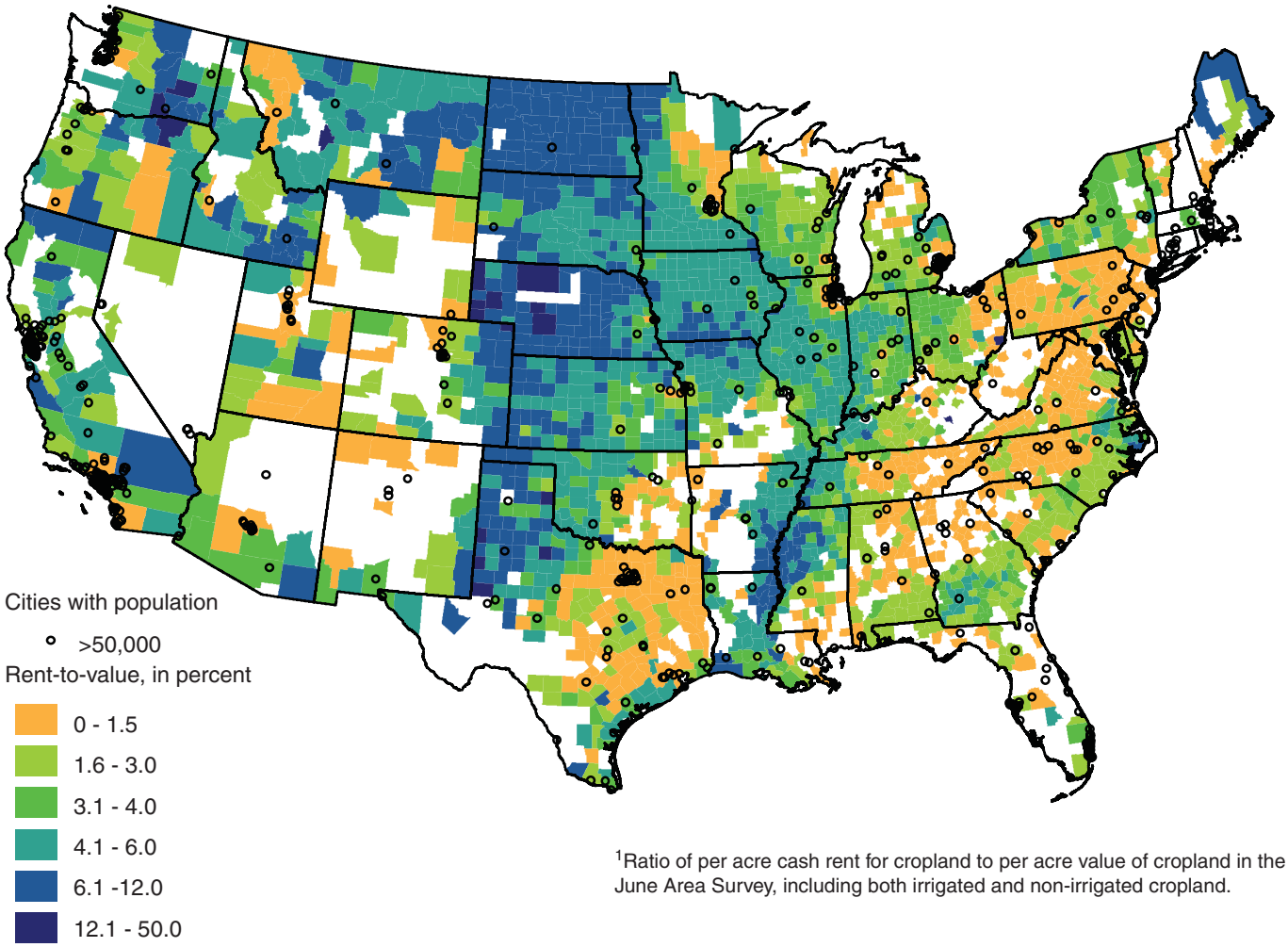
[6]Although some Corn Belt States like Ohio have extensive areas of low-density urban influence, ERS estimates that nearly three-quarters of farmland in the Corn Belt is not subject to urban influence.

[7]The amount of cash available to service debt on the purchase of all land and buildings is calculated as revenues from all crops and livestock produced, government payments, insurance payments, and cooperative dividends less operating and ownership expenses (i.e., adjusted net returns). To determine the maximum value of real estate that can be purchased from the adjusted net returns, we assume a loan term of 30 years and use average annual mortgage rates for this type of loan. This is then used to calculate the maximum real estate value that could be mortgaged based on agricultural production only. Trends over time in farm real estate affordability can be examined using data from the farm sector accounts (http://www.ers.usda.gov/Briefing/FarmIncome/).

[8]Nonfarm factors include purchases for recreation uses or for residential or other types of development.

Figure 7

County average rent-to-value ratios[1], 1999-2008



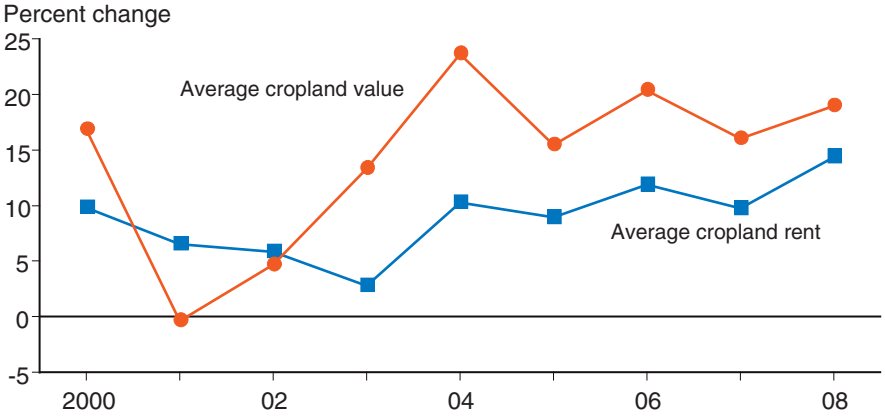
[1]Ratio of per acre cash rent for cropland to per acre value of cropland in the June Area Survey, including both irrigated and non-irrigated cropland.

Note: The nonshaded areas either did not have any farms included in the JAS or had insufficient observations due to low levels of agricultural production.

Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data.

Figure 8

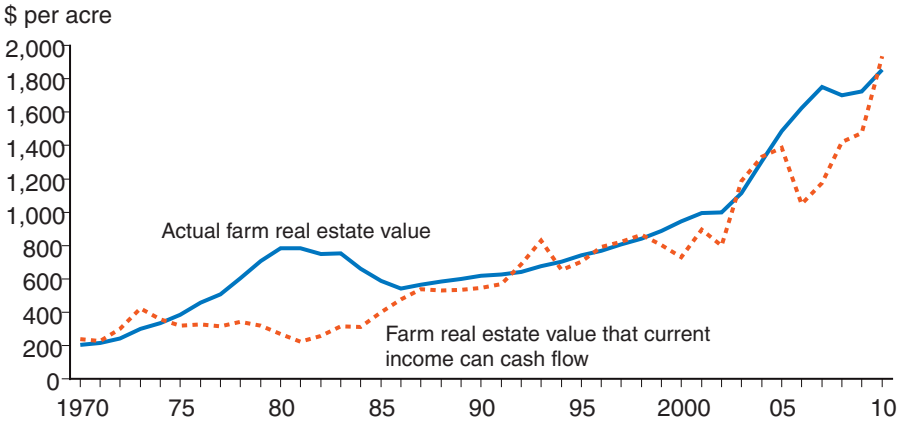
Annual changes in per-acre average cropland value and rent in the Corn Belt, 2000-08



Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data.

Figure 9

Current value of farm real estate versus maximum affordable value



Sources: USDA, ERS Farm Balance Sheet data, http://www.ers.usda.gov/Briefing/FarmIncome/Data/Constant-dollar-table.xls.

Yet, other farmland owners will not necessarily react by immediately selling their land. Farmland markets have historically been very thin, with some estimates indicating about 0.5 percent of U.S. farmland is sold annually.[9] Farmland owners may hold onto land if the family has held it for a long time or because they derive other nonfinancial (lifestyle) benefits from owning the land. Indeed, studies of farmland market activity reveal that sales of farmland are often forced due to death or retirement rather than a result of affordability levels (Raup, 2003). Nonetheless, for farm operators who owned the land they operated in 2007, about 53 percent of land was acquired at arm's length from an unrelated seller, about 25 percent of acres owned were inherited, and 19 percent were purchased from relatives.[10] For purchases from relatives at least, evidence suggests the buyers negotiate terms that are more favorable, which can help in periods of high farmland prices or low levels of affordability. Robison et al. (2002) find that farmland was sold to relatives at a discount when compared to land sold to nonrelatives. Debt-servicing difficulties and high real-estate transaction costs have led to increased demand for leasing rather than owning land (Sherrick and Barry, 2003).

The current environment of low interest rates has two positive effects on agricultural real estate values (Schnitkey, 2010). First, for those who have to purchase land with debt capital, it lowers the total cost of purchasing land. The effect of the recent declines in interest rates is evident in figure 9 by the sharply upward trend in the amount of land value that can be cash-flowed with falling farm mortgage rates. Indeed, farm mortgage interest rates have been at record lows in very recent years, and farmland purchasers are increasingly using debt financing. Agricultural and Resource Management Survey (ARMS) data reveal that land purchases by farm operators in 2008 and 2009 were financed predominantly by credit (74 and 65 percent, respectively) and, in 2009, over half of farm real estate transactions involved debt financed for 75 percent or more of the purchase price. Second, interest rates represent returns on competing fixed investments, and when they are low, farmland looks more attractive as an investment alternative. Coupled with increases in crop prices and improved agricultural credit conditions, some regions experienced double-digit increases in farmland values in 2010 (Oppendahl, 2010; Briggeman and Akers, 2010). Low interest rates also aid those who are buying farmland for other uses of the land (see box, "Trends in Farmland Purchases").

[9]Estimated using USDA-NASS data from the 1999 Agricultural and Land Economics Survey (Sherrick and Barry 2003).

[10]These estimates are based on USDA-NASS/ERS' Agricultural Resource Management Survey of farm operators, and account for about 71 percent of land in farms. Estimates are not available on how land was acquired by non-operating landlords, who owned 29 percent of farmland in 2007. Non-operating landlords own farmland and rent it to farmers rather than operate it themselves.

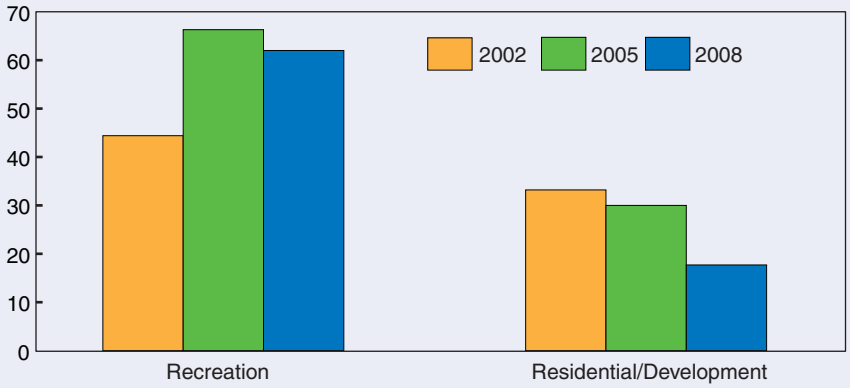
Trends in Farmland Purchases

The sharp increases in farmland values in recent years have sparked an interest in the characteristics and intent of farmland buyers. In the 10th District of the Federal Reserve[1], farmland appears to have been purchased by nonfarmers much more for recreation than for development or residential purposes. Purchases of farmland for development in this region have been decreasing since 2002, while purchase of farmland for recreation weakened in 2008. Henderson and Akers (2009) report that this decline in demand has led to a stabilization of land prices after several years of increasing prices. Based on the Iowa 2009 Farmland Value Survey, about 23 percent of land sales were to investors, a decrease from previous years. Likewise, more farmers were reported to buy land (Duffy, 2009).

[1]Includes Colorado, Kansas, Nebraska, Oklahoma, Wyoming, and portions of western Missouri and northern New Mexico.

Reason for farmland purchases by nonfarmers (10th Federal Reserve District)[1]

Percent of respondents[2]



[1]Includes Colorado, Kansas, Nebraska, Oklahoma, Wyoming and portions of western Missouri and northern New Mexico.
[2]Respondents were asked the most common reasons for farmland purchases by individuals other than farmers. Respondents could choose more than one response, and therefore percentages will not sum to 100.
Source: Henderson and Akers (2009).

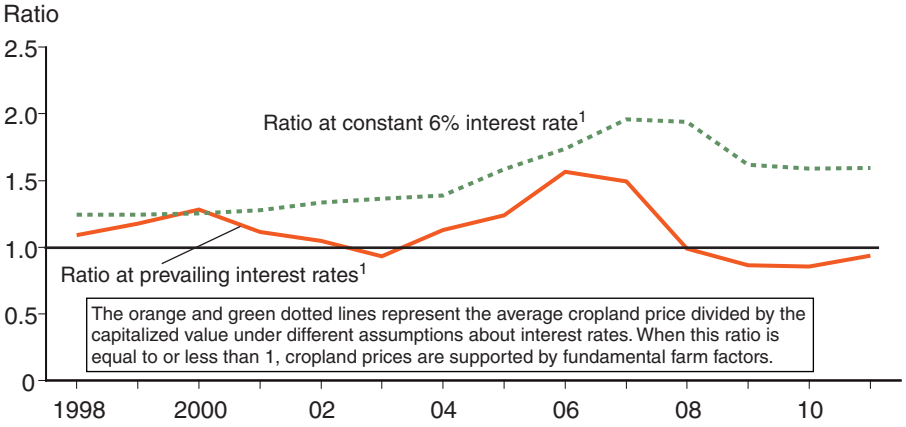
Farmland Values Were Supported by Farm Earnings in 2009-10

From an investment perspective, capitalized values are used to quantify impacts of both cash rent and interest rate changes on land values. A capitalized value represents the estimated discounted value of all future cash flows to farmland. The capitalized value is calculated by dividing cash rent (a measure of cash flow generated from agricultural production) by a discount factor, typically an appropriate interest rate. When farm real estate values divided by the capitalized value (price-to-value ratio) exceed 1, farmland values are not supported by the stream of cash flows the farmland could earn. During 2004-08, farmland values were not justified based on farm earnings alone (fig. 10).[11] Subsequently, market signals indicate that farmland was somewhat undervalued at current interest rates, so it is not surprising that farmland values increased in 2009-10.

[11]This is consistent with the low affordability findings noted in figure 9.

Figure 10

Cropland price-to-value ratios, 1998-2011



2011 forecast.

[1]Ratios are calculated as the average cropland value per acre divided by the capitalized values. Capitalized value = per-acre cropland cash rent / interest rate on 10-year note. The dotted line represents the same ratio, with capitalized value calculated using a constant 6% interest rate.

Sources: USDA, ERS analysis of National Agricultural Statistics Service farmland value and rent data.

The separate effects of changes in the interest rate are also evident in figure 10. In 2000, current rates were equal to the long-term average Treasury note rate of 6 percent. The dotted green line shows changes in the cropland price-to-value ratio when the interest rate is held constant at this 6-percent average. Since 2000, this price-to-value ratio has declined below what it would have been had interest rates remained at the long-term average. In 2010, the price-to-value ratio was about 0.9 based on current rates. If interest rates were to jump to the long-term average, the price-to-value ratio would sharply increase to over 1.5, signaling that land values would not be supported by the stream of rents the land could earn at historical interest rates. Farmland markets could subsequently react with sharp reductions in farmland values. Although in the 1980s interest rates did increase abruptly (and farmland values declined dramatically), such abrupt changes are not common. Gradual changes in interest rates have a more muted effect on farmland markets because expectations change and market participants have more time to adjust.

Some predict that stable farm incomes and interest rates will keep farmland values stable, although increasing volatility in the agricultural markets could lead to reductions in farmland values (Henderson and Akers, 2009; Schnitkey, 2010). In addition to limited changes in interest rates, recent trends in several other macroeconomic factors differ from patterns during the farm crisis of the 1980s. In the early 1980s, increasing crop supplies, a strong dollar, and weakened export demand contributed to rapid declines in farmland values. At present, the demand for crops for food and as an energy source is keeping commodity stocks tight and export demand for corn and other commodities strong. Also, some predict that the dollar is likely to remain weak for some time (Henderson, 2010). However, some caution that the size of the U.S. trade deficit increases the risk of investing in farmland. If other countries become less willing to cover the U.S. deficit, interest rates could climb and debt-financed real estate values could fall (Raup, 2003).

Farmland has historically been a stable investment and has become more attractive relative to other investments in recent years

Farmland serves both as a productive asset and capital investment. Like any capital investment, an appreciation in farmland price carries important (unrealized) capital gains. To examine the returns to investing in farmland relative to other investments, we estimate returns to farmland versus the S&P 500 and gold. Returns are measured as the percentage change in value from year to year. The percentage change is a simple measure that reflects the value of holding an asset for one additional period, which should reflect the expected income generated from the asset.

The expected return of an asset is a function of the investment horizon. Assets that are held for many decades can yield returns that are quite different than assets held for shorter time periods. To account for this, we present the return of a $1,000 investment in (1) farmland, (2) a stock fund tied to the S&P 500, and (3) gold over three time horizons: a return in 2008 to purchases in 1970, 1980, and 1990.

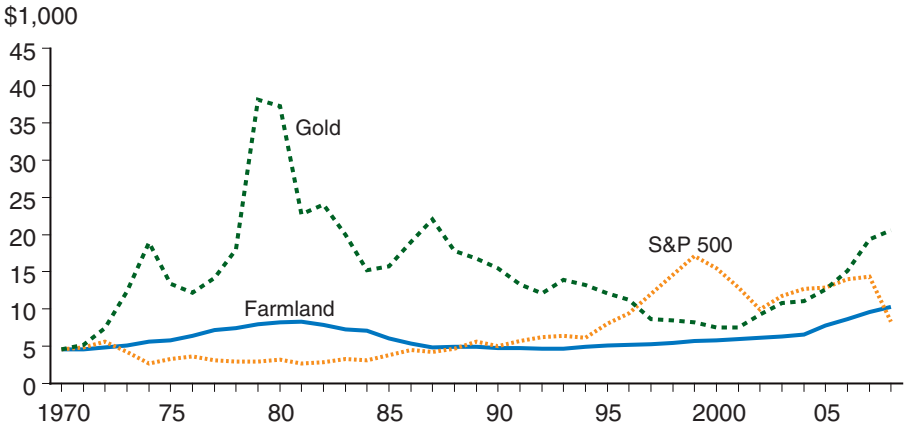
Our comparisons are based on real returns using the GDP price deflator (with a base year of 2007), so that the annual returns represent an appreciation in asset value without the influence of inflation. In addition, the initial investment of $1,000 is expressed in real terms in 2007 dollars. For example, in real terms, a $1,000 initial investment in farmland is equivalent to $4,630 in 1970; $2,183 in 1980; and $1,376 in 1990.

Given an initial investment in farm real estate made in 1970, both gold and the S&P 500 composite index outperform farmland returns (fig. 11a). Although gold exhibits the highest degree of variability, the average annual rate of return is 7 percent, followed by the S&P at 3.2 percent and farmland at 2.3 percent.

Over a shorter investment horizon—when farm real estate is purchased in 1980 rather than 1970—the S&P 500 is the favorable investment, with an

Figure 11a

Returns to farm real estate versus stocks and gold, 1970-2008



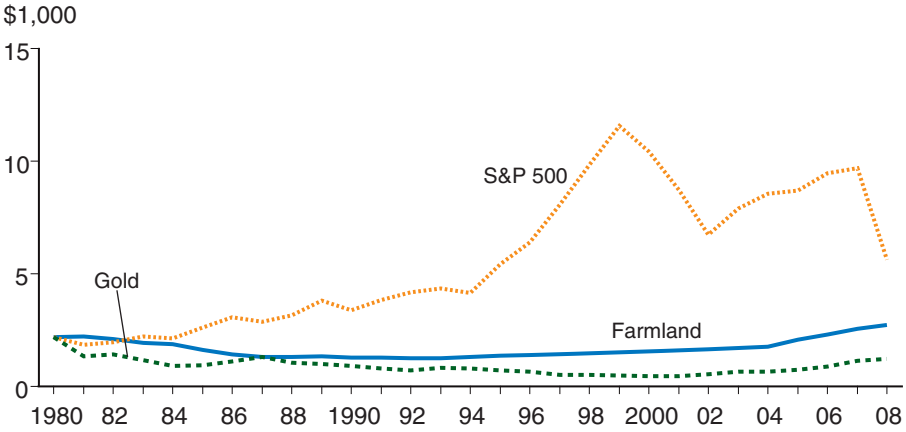
Sources: Farmland returns are derived from the USDA, National Agricultural Statistics Service June Area Survey estimates of average value per acre of all farms and buildings in the continental United States.The S&P 500 and gold prices are based on end-of-year settlement prices.

average annual appreciation rate of 4.9 percent (fig. 11b). Farmland returns appreciate 1 percent per year while gold exhibits a net loss of less than 1 percent per year, on average. The low returns to farmland are not surprising given the farm crisis of the early 1980s, during which farmland values were greatly diminished. Between 1984 and 1985, farmland values declined by a record 14 percent.

Over an even shorter investment horizon, the same investment in 1990 nets similar returns for farmland (4.4 percent) and the S&P 500 (4.6 percent per year) (fig. 11c). Although gold declined in value throughout the 1990s, returns rebounded in 2002, yielding an average annual return of 2.5 percent. Farmland values exhibited a relatively stable increase compared to the other investment alternatives, across all three investment horizons.

Figure 11b

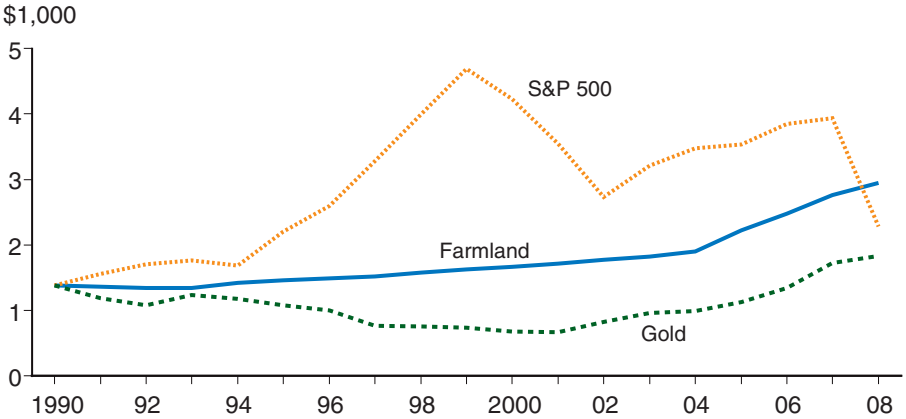
Returns to farm real estate versus stocks and gold, 1980-2008



Sources: Farmland returns are derived from the USDA, National Agricultural Statistics Service June Area Survey estimates of average value per acre of all farms and buildings in the continental United States. The S&P 500 and gold prices are based on end-of-year settlement prices.

Figure 11c

Returns to farm real estate versus stocks and bonds, 1990-2008



Sources: Farmland returns are derived from the USDA, National Agricultural Statistics Service June Area Survey estimates of average value per acre of all farms and buildings in the continental United States. The S&P 500 and gold prices are based on end-of-year settlement prices.

Parcel-Specific Factors Affecting Farmland Values

The previous section demonstrates how macroeconomic factors can affect farmland values. Yet, factors that are unique to each farm parcel also affect the parcel's ability to generate returns, and these differences give rise to spatial variation in farmland values. Indeed, an indirect approach to measuring the impacts of net returns or rents on farmland value—one that is often employed in the economic literature—is to examine the relative importance of parcel-specific characteristics in explaining variation in farmland values across the country.[12]

Farmland is capable of generating several types of returns, depending on its use. In some areas, farmland value may be derived solely from its ability to support agricultural production, so parcel-specific factors such as soil quality, access to market terminals, and government payments are important determinants of land values. However, farmland close to urban areas may also generate nonfarm returns from the option to develop land for residential, commercial, or industrial uses. Parcel-specific factors related to development potential include distance from population concentrations and access to roads. Another nonfarm factor affecting farmland values is the amenity value of land. Amenity values arise from the scenic views, varied topography, mild temperatures, and other factors that attract people to rural areas and make certain locations particularly desirable. Surveys of real estate brokers (Duffy, 2009) reveal—and economic studies confirm—that both farm-related and nonfarm-related factors are likely to be important in explaining variation in farmland prices. Regardless of the type of returns land generates, the relative importance of such spatially explicit factors is likely to vary across location and time.

The June Area Survey conducted by USDA's National Agricultural Statistics Service (NASS) provides a unique opportunity to examine relationships between farmland values and some of the most commonly considered, spatially explicit determinants of farmland values (see box, "June Area Survey Data" on p. 7). National analysis using spatially explicit data is a complex task: it requires data sources that use consistent definitions for the entire country and significant computational resources. Our analyses using these data demonstrate the importance of using spatially explicit data to understand local influences on farmland values. We construct estimates of land values as the weighted average of the values reported for the tracts within each segment (the sampling unit). Each segment contains a geocode, allowing segment-level values to be linked with a variety of spatially explicit data that may affect farmland values.

Farm-Related Factors Affecting Farmland Values

More Productive Soils Are Correlated with Higher Cropland Values

Farmland with better soil quality can improve yields and reduce production inputs and management time, which can enhance farming returns and thus farmland values. However, the contribution of better quality soils to farm-

[12]The hedonic technique—a statistical modeling approach economists often use when modeling the determinants of farmland values—assumes a parcel can be identified by a unique set of attributes and that the value of a land parcel is an aggregation of the values of its individual attributes. It is an indirect approach that allows researchers to substitute proxies for actual measures of net returns which are typically not available (Freeman, 1993).

land values can vary depending on the proximity of the land to urban areas (Palmquist and Danielson, 1989). Some studies have found that demand for land in urban uses is a significant component of land values in areas near large towns and cities (Chicoine 1981; Shi et al., 1997; Livanis et al., 2006; Hardie et al., 2001). In such cases, the effect of urban influence can be so strong that it masks the relationships between farmland values and characteristics that contribute to the agricultural earnings potential of the land.

In demonstrating the soil quality/land value relationship, we control for the effects of urban-related demand by limiting the JAS data to observations that were at least 25 miles from the borders of cities of at least 50,000 people. Our measure of soil quality is based on a "land capability class" measure that represents the soils with the fewest limitations for agricultural uses (see Appendix A). For this subset of more "rural" data points, cropland values were significantly and positively correlated with better soil quality in some regions.[13] These findings are consistent with empirical studies that found a positive (and statistically significant) relationship between soil quality measures and farmland values (Huang et al., 2006; Xu et al., 1993; Palmquist and Danielson, 1989; Chavas and Shumway, 1982).

[13]Results were similar when the population size of cities was set at 25,000.

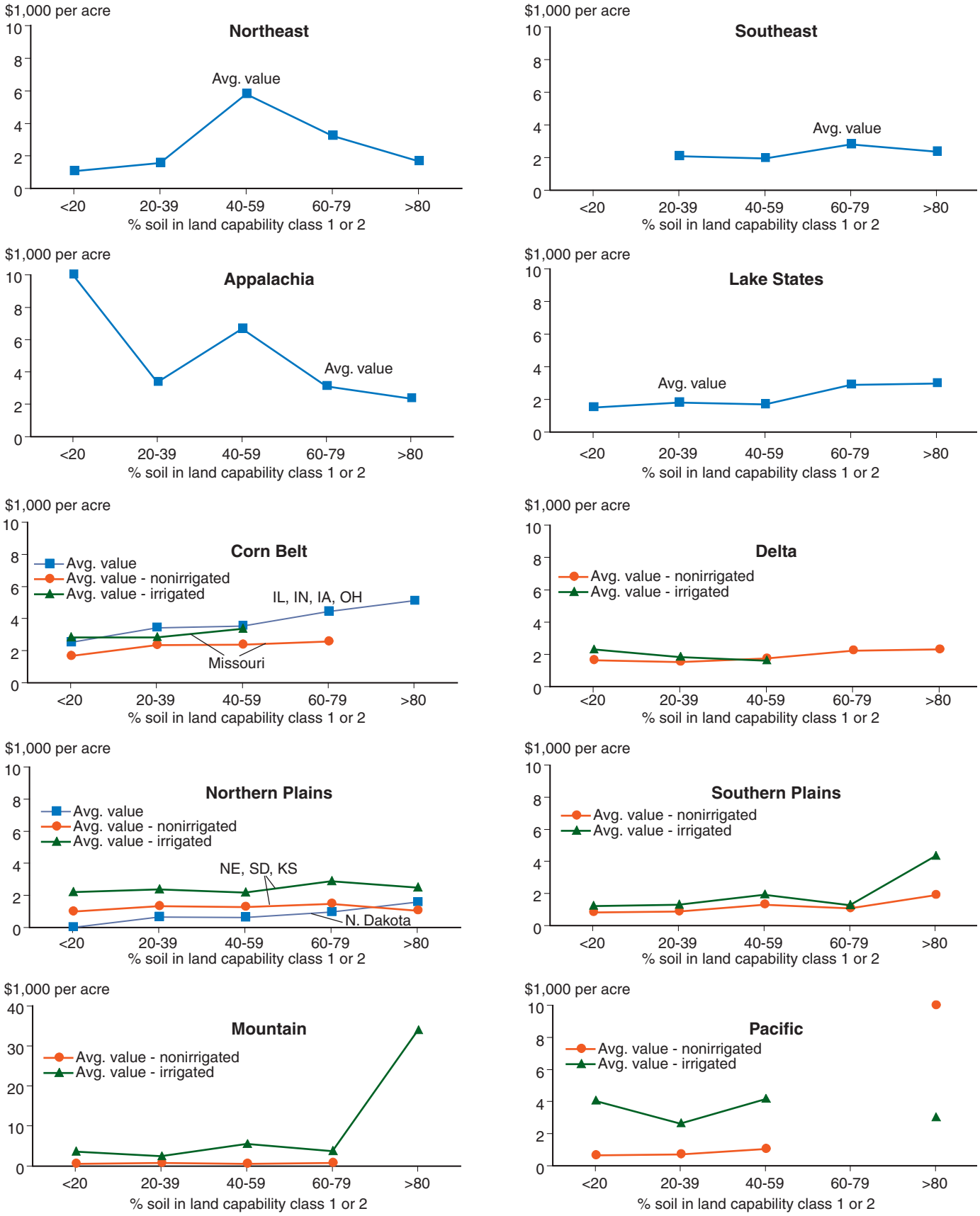
The effect of soil quality on cropland strengthened as we limited the data to even more rural parcels (those at least 40 miles from population concentrations of at least 50,000). However, patterns vary substantially across regions (fig. 12). In 2008, there was a positive correlation between our soil quality measure and cropland values in the Corn Belt, Lake States, and North Dakota (in the Northern Plains region), but a negative or insignificant correlation in the Appalachian region. Also, we found that relationships between soil quality and land values varied by irrigation status. In the JAS data, respondents in eastern States were not asked to provide separate estimates of cropland values for irrigated and non-irrigated land, whereas respondents in the western States—where irrigation is more prevalent—were asked to do so. In most regions where cropland value data were available by irrigation status, irrigated land values exceeded average non-irrigated land values, as expected (fig. 12). Also, the correlation between soil quality and irrigated land values was stronger (the slope of the irrigated land value line is steeper) than between soil quality and non-irrigated land values.

Our analysis of the correlation between soil productivity and farmland values demonstrates the importance of examining parcel-specific factor/land value relationships at a very disaggregated level. For example, when analyzing the relationship at a national level, a positive correlation between better soils and cropland values was not evident over 2005-08.[14] The analysis also demonstrates that controlling for parcel-specific factors other than urban influence is particularly important in some regions. A study by Palmquist and Danielson (1989) in North Carolina that did so found strong and significant negative relationships between farmland values and erosion potential or wetness of the land (two characteristics that determine the Land Capability Class), contrary to the finding above for the Appalachian region. The more intuitive findings in that study—that better soils increase farmland values— may also be attributable to the more detailed measures of erosivity and wetness that the authors were able to construct for their limited study area.

[14]We examined the correlations using different years to test the sensitivity of the findings, but the patterns did not vary across years.

Figure 12

Average per-acre cropland values and share of county soils in land capability class 1 or 2 by region, 2008



Source: USDA, ERS analysis of National Agricultural Statistics Service, June Area Survey data.

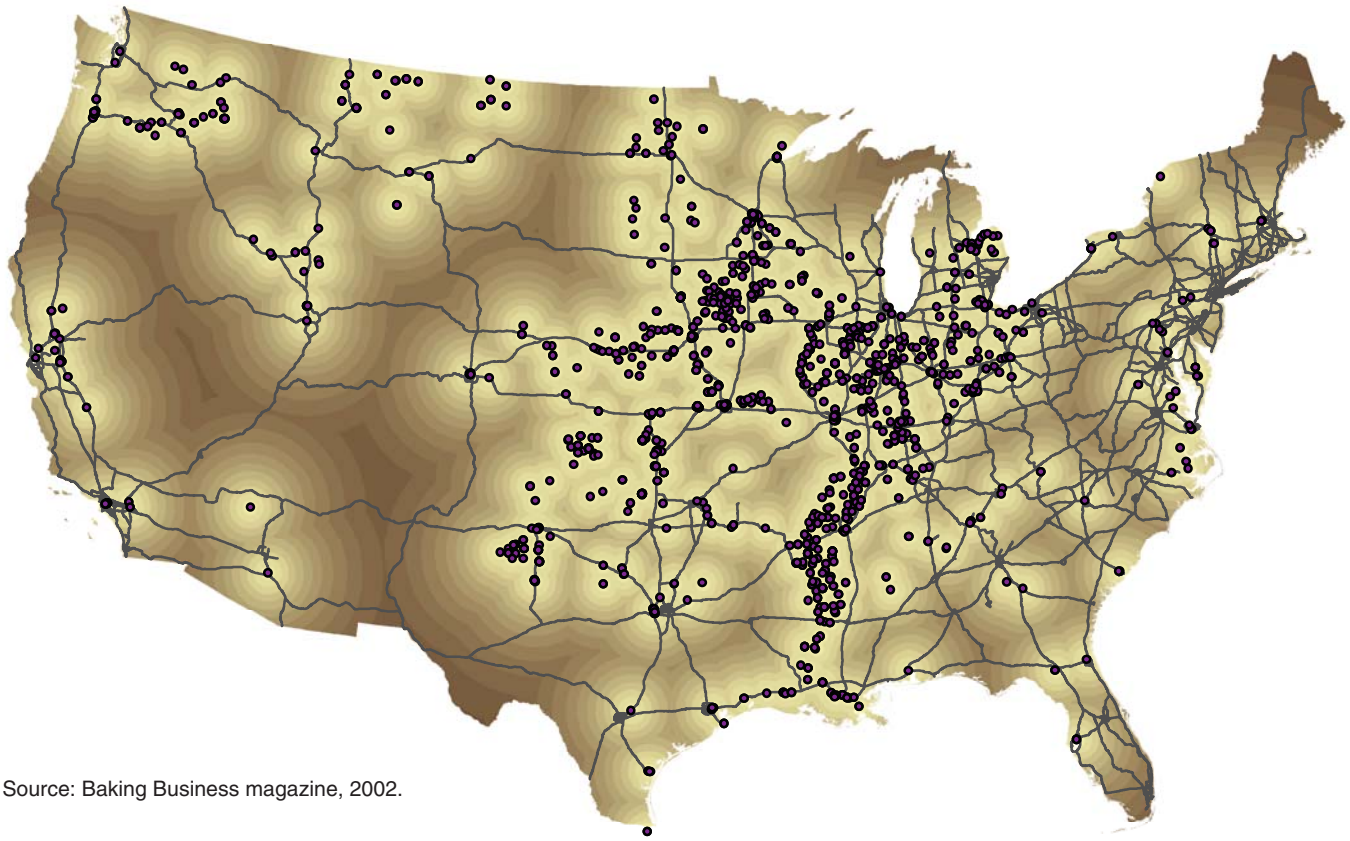
Land Value Effects of Proximity to Market Channels Vary by Location

Because transportation costs increase with distance, the proximity of land to important points of delivery for crops can affect net returns and land values. Again, using spatially explicit data is important when examining these relationships, at least when points of delivery are unevenly distributed. For example, grain elevators are heavily concentrated in several Corn Belt States and along the Mississippi River. For farms in these regions, there is little variation in the distances between cropland parcels and a grain elevator, making it difficult to ascertain a relationship (fig. 13). In the Northern Plains where there is more variation in farm distances to elevators, the expected relationship between proximity and cropland values is more evident. The cropland value-proximity relationship is even more pronounced when the data are limited to a single State (North Dakota) (fig. 14).

Proximity to ethanol plants also illustrates location effects. In recent years, Federal energy policies supporting the production of biofuels through renewable fuel standards and tax credits have increased the demand for corn, which has elevated corn and other commodity prices. In addition to spurring general crop price increases, ethanol production reduces local transportation costs to terminal markets and provides a competing source of demand for grain. Research has found evidence of higher corn prices up to 68 miles from ethanol plants (McNew and Griffith, 2005). Other research—based on a survey of agricultural lenders in the seven States covered by the Federal

Figure 13

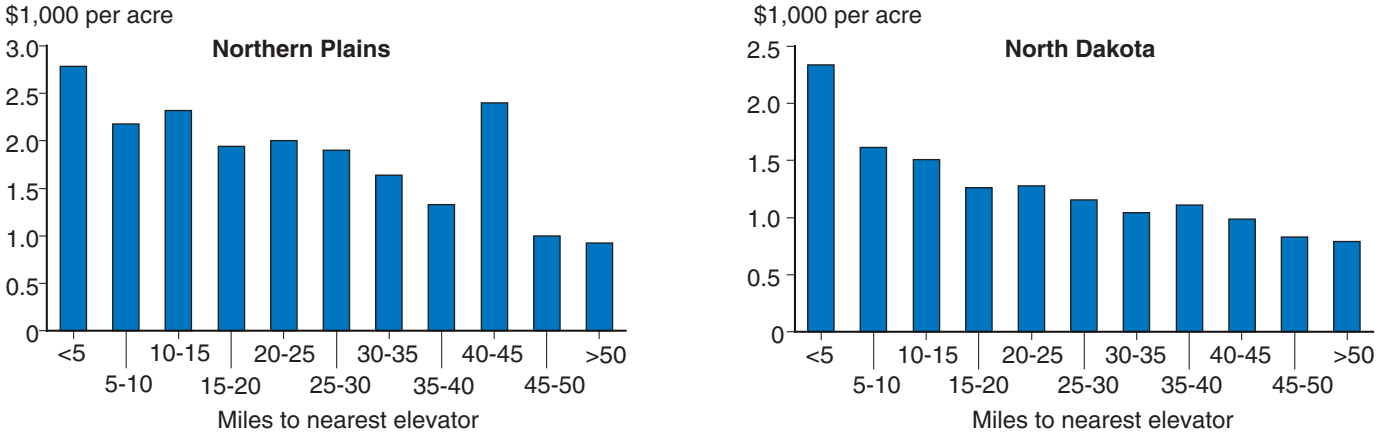
Spatial distrbution of grain elevators, 2002



Source: Baking Business magazine, 2002.

Figure 14

Cropland value per acre by distance to nearest elevator, Northern Plains and North Dakota, 2008



Sources: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data and grain elevator location data.

Reserve Bank of Kansas City—found that cropland adjacent to an ethanol plant can be valued more than $150 per acre higher than cropland more than 50 miles away, with proximity to multiple ethanol plants producing a higher premium than proximity to a single plant (Henderson and Gloy, 2009).

Correlation Between Government Payments and Cropland Values Varies Regionally and by Payment Type

Government agricultural program payments may increase income from agricultural production. When they do so in a consistent way, the value of farmland is likely to increase due to expectations of a future income stream from government payments or reduced volatility in farm revenues (Gardner, 2003).[15] Although expectations of future government payments are difficult to observe, numerous studies have considered the degree to which payments under commodity programs are reflected in land values (see Moss and Schmitz, 2003, and references therein). Farmers have received commodity program payments for many decades, though the programs are subject to change and most must be reauthorized as part of the Farm Bill every 5 years. Over 2004-07, commodity payments averaged less than $25 per acre, but in some regions exceeded $100 per acre (USDA-ERS, 2011a).

The type of government payment or program can affect how they are reflected in farmland values. Payments that are certain might be accounted for differently than payments that are realized only under low prices, yields, or revenue. Production flexibility contract payments— direct payments to producers with "base acreage" (i.e., historical rights to program benefits) until the program was replaced in 2002—have been shown to increase cropland values (Goodwin et al., 2003; Roe et al., 2003). For programs that support market prices, a relationship between the payments and cropland values is more tenuous because payments fall when market prices are higher than pre-established target prices—i.e., at the time when land values increase the most (Gardner, 2003). However, Goodwin et al. (2011) found that price support payments such as loan deficiency payments—which pay the difference when market prices fall below support prices—can add significantly to the value of land, due to reduced variability of farm earnings and more certain cash-

[15]Other non-land inputs would also likely capture some of the benefits of government payments when farmers respond by increasing production.

flow. Studies on the impact of government programs on cropland rents have commonly found that direct payments are more likely to be reflected in rental rates than price support (Latruffe and LeMouel, 2009).

Two of the largest commodity programs enacted under the 2002 and 2008 Farm Acts (in terms of dollars spent) provide fixed direct payments and countercyclical payments. These programs make payments to farmers based on historical production (base acreage) of specific commodities such as corn, oilseeds, wheat, rice, and cotton, and payments are independent of farmers' cropping decisions in the current year.[16] Direct payments are fixed during the 5-year periods of the Farm Acts, while countercyclical payments are price-dependent and less predictable—payment is triggered by market prices falling below a pre-defined price, with the payment not known until after harvest. The impacts of different government payments on cropland values are difficult to predict based only on theoretical models, so empirical studies provide important insight. However, empirical evidence of the size of the impact has not been conclusive. For example, estimates of the impact of direct payments on land values range from negligible in some studies to 10-50 percent, depending on the region (Goodwin et al., 2003; Barnard et al., 1997).

[16]Payments are made to landowners if they operate the land. If the land is rented, the payments accrue to cash renters. Under a share-rent agreement, payments are split between the landowner and share renters. Landowners who rent out the land and don't receive the payment directly may capture the benefits of the income stream through bidding up the lease payments.

Farms can also receive subsidized crop insurance premiums. Several Federal crop insurance plans—both for yield and revenue—are available to farmers. Almost all major commodities are covered by Federal crop insurance, which is administered by USDA's Risk Management Agency and delivered to farmers through private agents. Farmers pay 50 to 60 percent of the total crop insurance premium, and the areas for which crop insurance is available and the number of crops insured have been increasing over the past decade. Currently, over 270 million acres are insured, with subsidies of over $5 billion per year (USDA-ERS 2011a; 2011b).

Figure 15 shows average cropland values for land with different levels of direct and counter-cyclical program (DCP) payments[17] and crop insurance premium subsidies. Counties in the bottom 20th percentile of cropland acres are excluded to focus the analysis on more farm-dependent counties and to improve comparability of different payment levels. In 2007, crop insurance premium subsidies totaled $3.7 billion and DCP payments $6.2 billion. Although cropland values generally increase with insurance premium subsidies, the pattern is less consistent for DCP payments. Crop insurance premium subsidies may have a more consistent impact in recent years, because farmers have been receiving about $2 in indemnity payments for every $1 of premiums paid by farmers (Goodwin et al., 2011). This suggests that crop insurance premium subsidies and DCP payments might have different impacts on land values, but controlling for other factors affecting land values will be important.

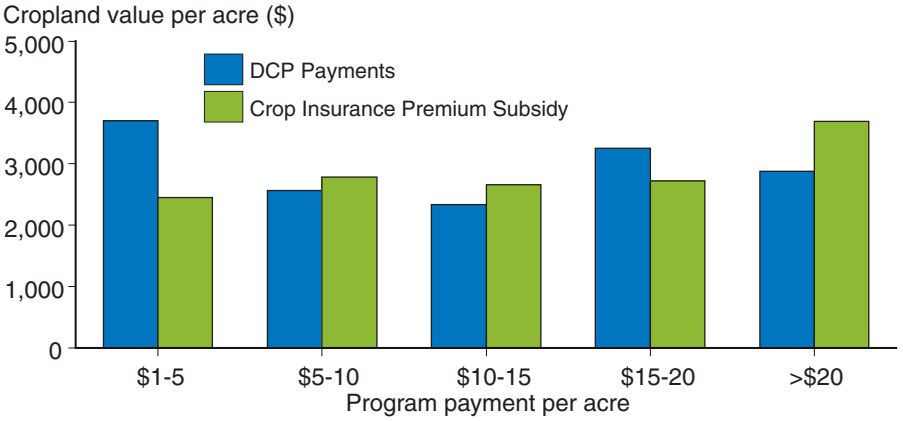
[17]Administrative data reported for tax purposes (1099 tax information) were used to calculate direct payments. These data did not disaggregate direct and countercyclical payments, but in 2007 the total expenditure through the DCP for direct payments was approximately $5.1 billion versus $1.1 billion in countercyclical payments. DCP payments from the 1099 tax information, and RMA indemnity payments by county, were converted to 1-mile resolution grids and combined with the JAS sample points. See Appendix A.

There are considerable regional differences in the ratio of payments to cropland values (fig. 16).[18] Much of this regional diversity is likely based on differences in what crops are, and have historically been, grown. Cropland in the Delta and Southeast regions appears to have the largest level of DCP payments relative to cropland values. Cotton and rice production are high in these regions, especially the Delta (USDA-ERS, 2011c); DCP payments for these crops are the highest per acre, and the cotton base has most consistently received countercyclical payments. Some regions (the Northern and Southern

[18]Counties with ratios of both direct payments and premium subsidies to land values below 0.01, as well as counties with no JAS observations, appear as white on the map. In addition to excluding counties that are in the bottom 20 percent of cropland acres, counties without at least nine tract-level observations from 2006 to 2008 are excluded; these also appear as white. This ensures at least three farms were in the county sample from 2006 to 2008, as farms remain in the JAS for 5 years.

Figure 15

Cropland values by amount of selected government payments, 2007

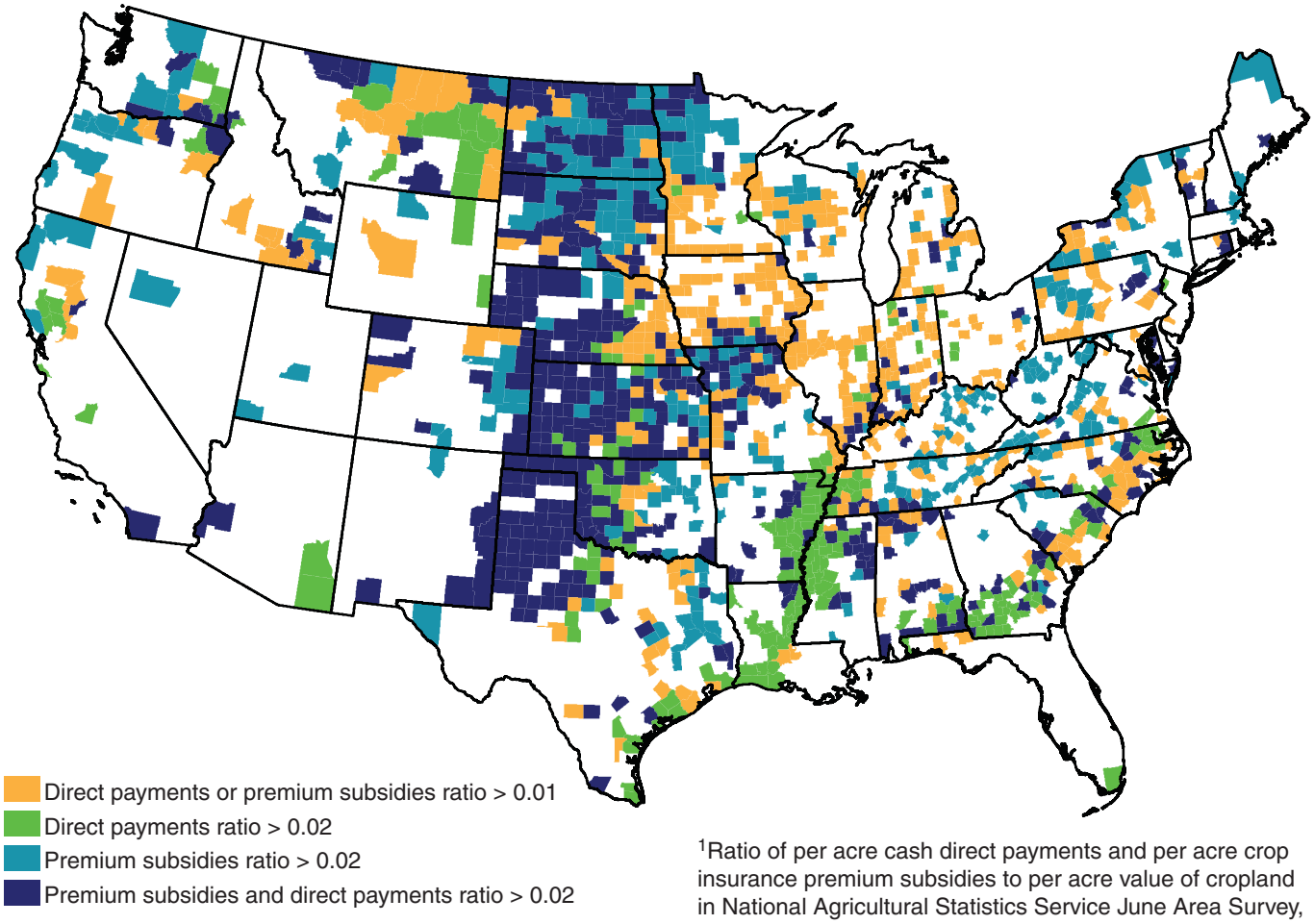


DCP = Direct and countercyclical program payments.

Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data, Risk Management Agency and Farm Service Agency data, and Census of Agriculture data.

Figure 16

Ratio of selected government payments to cropland value[1], 2006-08



[1]Ratio of per acre cash direct payments and per acre crop insurance premium subsidies to per acre value of cropland in National Agricultural Statistics Service June Area Survey, including both irrigated and non-irrigated cropland.

Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data, Risk Management Agency and Farm Service Agency data, and Census of Agriculture data.

Plains) have high levels of both premium subsidies and DCP payments relative to cropland values. The Corn Belt and Lake States have the lowest level of subsidies and DCP payments relative to land values. Areas without DCP payments but higher premium subsidies tend to be areas where fruits, vegetables, and other crops (sugar beets, other specialty crops) not part of the DCP historical program base are grown.

The need for additional empirical study of the impacts of government payments on farmland values—and how the impacts vary by payment type and by region—is particularly important given the current trend of high commodity prices, large government deficits, and debate over the future of agricultural payment programs. It is especially challenging to predict potential impacts on farmland values should programs be abruptly eliminated. Many studies have determined that agricultural payments raise farmland values. However, these studies use hedonic or other statistical regression approaches that capture only marginal changes (i.e., the change in per-acre values for a $1 change in payment) and do not take into account changes in commodity market prices, the emergence of replacement programs, and other significant consequences of eliminating agricultural programs. Nonetheless, our analyses suggest that abrupt changes in agricultural payment programs are likely to affect farmland values, with varying regional effects.

Nonfarm-Related Factors Affecting Farmland Values

Empirical studies of farmland values have found that in some areas of the country, returns from agricultural production are not the most significant contributor to farmland prices. Indeed, studies have estimated that well over half the variation in farmland prices is due to nonfarm factors in some States (Peterson, 1986; Plantinga et al., 2002).

Farm Real Estate Values Are Positively Correlated with Proximity to Urban Areas

The demand for land that can be developed for urban use is the most significant nonfarm factor affecting farmland values in areas that are more urbanized or are experiencing faster population growth (Livanis et al., 2006; Hardie et al., 2001). According to the classical model of urban form, land is allocated based on the needs of various economic agents who bid according to their desire to be close to markets or urban centers. The value of land, or location rent, declines as one moves away from urban centers.

While proximity to population centers and increased access to markets and customers could influence farmland values by increasing expected agricultural returns, development demand for residential, commercial, and industrial uses tends to increase farmland values even more. The U.S. population continues to grow and disperse, and all States are experiencing urban-related influences on farmland values to some degree. To acquire land for nonagricultural purposes, developers typically must bid higher than the agricultural production value of the land. As a result, even a limited number of conversions of farmland to urban uses can lead to generally higher farmland values in areas influenced by urban demand for land.

A typical approach to identify the amount of land subject to urban influence is to examine the location of land relative to the size and number of population concentrations. The Population-Interaction Zones for Agriculture (PIZA) measure developed by ERS is based on the concept of a gravity model (Shi et al.,1997) that accounts for both size of populations within a 50-mile radius, as well as distance between a land parcel and the populations (see Appendices A and B). Using the PIZA index, more than three-quarters of farm real estate (farm land and buildings) were estimated to be rural in 2008 (fig. 17). These are lands in tracts without any part of a town of 2,500 or more residents, and with the primary commuting pattern to sites within the tract. About one-fourth of farm real estate was estimated to be subject to some degree of urban influence.

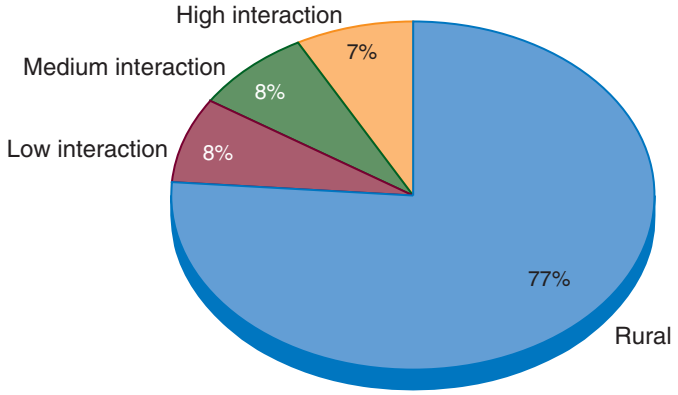
Farm real estate values tend to decline the farther the land is situated from urban areas or population centers. Figure 18 shows the mean value of farm real estate, including all buildings and structures, at increasing distance from the borders of population centers. As one moves farther from a population center, the average farm real estate value per acre declines regardless of the size of the population center (50,000, 25,000, 10,000, or 5,000 residents). The gradient steeply declines at a distance less than 10 miles and then declines more gradually with increasing distance.

Further, the mean values are higher for larger cities. For example, the average value for agricultural parcels within 5 miles of a city of at least 50,000 residents is approximately $16,801 per acre, whereas the average value the same distance from a town of at least 5,000 residents is $10,705.

A major limitation of this definition of urban influence is that it provides little control for the relative size of population centers. For example, the definition of a city with at least 50,000 residents includes population centers such as Scranton, PA, with a population of just over 70,000 residents, and New York City, with a population of over 8 million residents. To mitigate this shortcoming and examine the robustness of the land value gradient, we evaluated two alternative measures of urban influence (see Appendix B). The additional analyses revealed very similar results.

Figure 17

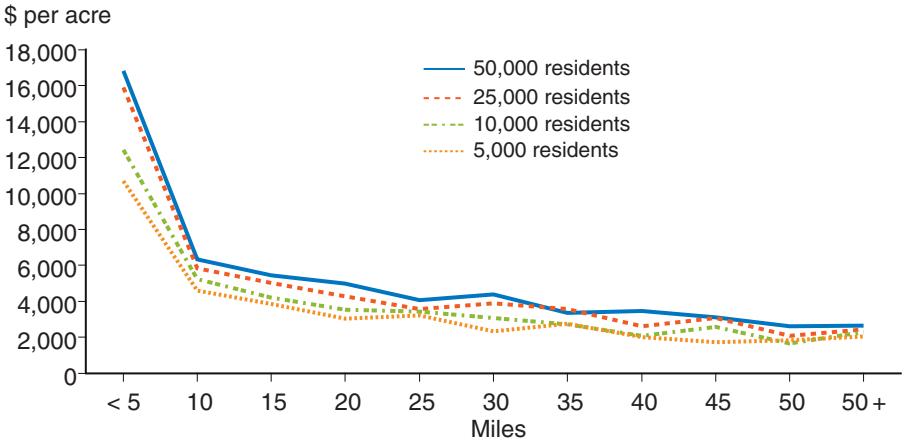
Agricultural real estate subject to urban influence, 2008



Note: Low, medium, and high interaction categories reflect the extent of interaction with population concentrations.
Source: USDA, ERS analysis of NASS June Area Survey data and PIZA data (see Appendix A). Agricultural real estate includes land and buildings.

Figure 18

Farm real estate values by distance to population centers, 2008



Sources: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data and Census of Population data. Agricultural real estate includes land and buildings.

Farm Real Estate Values Fall as Access to Road Transportation Declines

Economic theory suggests that access to transportation may play an important role in determining land values. Transportation infrastructure provides farmers with access to markets (urban centers, elevators, or other delivery points) and reduces input costs related to transportation. Figure 19 shows the average farm real estate value per acre relative to distance to major highways (interstates). Transportation effects may vary depending on urban influence, and the figure therefore divides the sample by PIZA classification (see Appendix B).

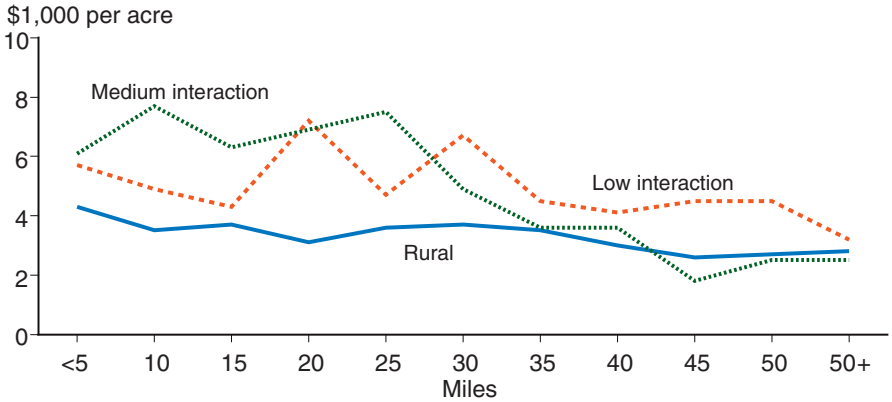
The average value per acre exhibits a similar pattern across all PIZA classifications, declining as distance to interstate highways grows. The price decline is more pronounced at higher levels of population interaction.

Farmland Values May Not Be Strongly Linked with Rural Housing Markets

Farmland values are highly correlated with distance to urban areas. As a result, farmland values near urban areas are tied to the value of competing land use activities. Yet, because farmland provides a source of revenue through the production of agricultural goods and services, the pattern of aggregate farmland values and the values in developed uses (mainly residential uses) may differ by location according to agricultural production characteristics. One national analysis (Plantinga et al., 2002) using 1997 data found that the influence of development potential was highest in places with urban areas and little agricultural land. On average, the development value contributed about 10 percent to the total value of agricultural land, ranging from more than 30 percent in many Northeastern States and Florida (the contribution was more than 80 percent in New Jersey) to less than 5 percent in most of the Northern and Southern Plains States.

Figure 19

Farm real estate values by distance to nearest interstate highway by PIZA code, 2008



See appendix B for PIZA definitions.
Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data, PIZA data and interstate highway data (see Appendix A).

The contribution of development value to farmland values raises questions about the extent to which farmland markets are susceptible to changes in residential markets. Over the last decade, the residential real estate market has undergone dramatic changes, with a housing boom that peaked in 2005 followed by a contraction. The contribution of residential investment to GDP dropped more than 20 percent from 2005 to 2007, with the contraction greatest in States where growth in residential home building was strong during the boom period (Siniavskaia, 2008). During 2001-04, California, Arizona, Oregon, Florida, Maryland, Connecticut, and Rhode Island all experienced increases of 20 percent or more in the Rural Housing Price Index (RHPI); in 2007-09, the RHPI in these States declined by at least 10 percent (fig. 20).[19] In the Northern and Southern Plains and Delta regions, the housing downturn dampened growth in the RHPI rather than reversing the gains over the 2001-04 period.

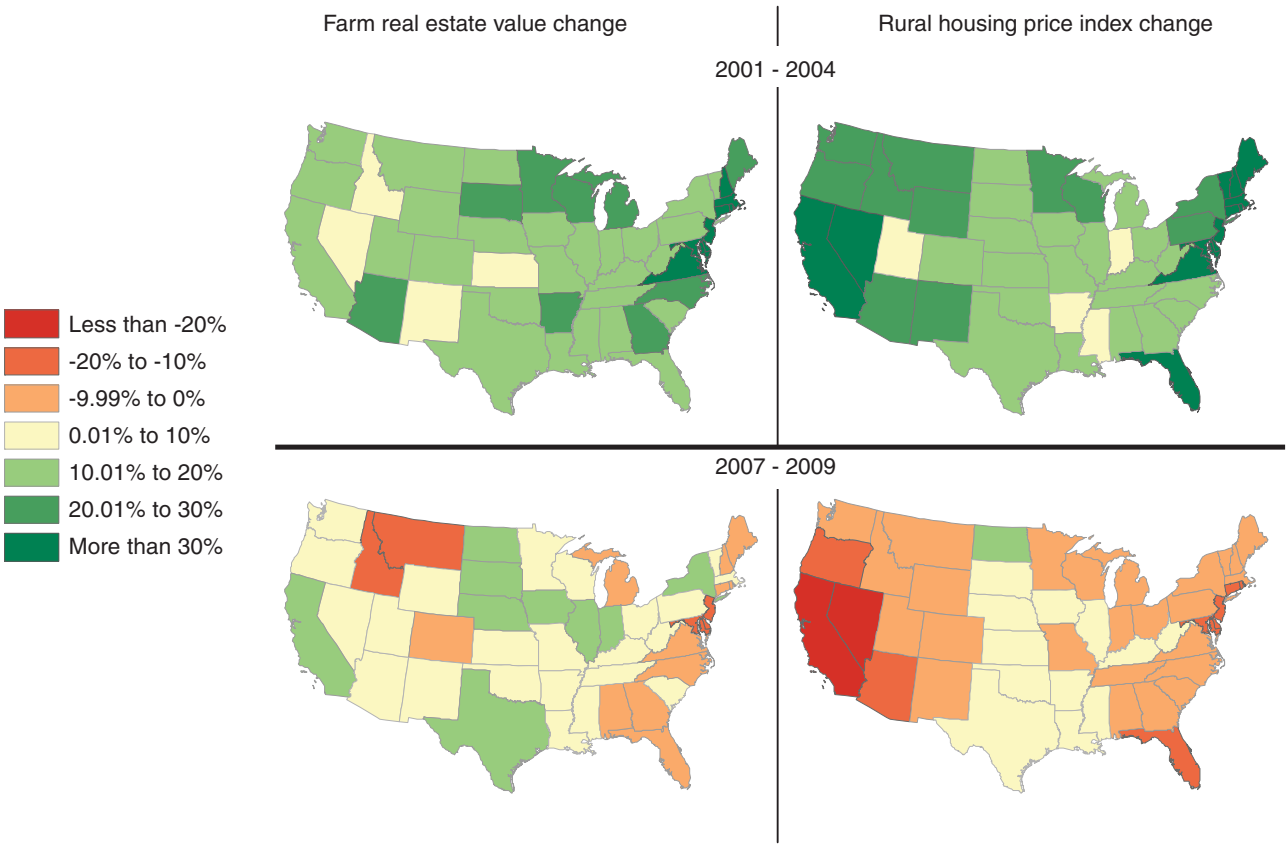
A comparison of farm real estate values between the boom-and-bust periods reveals that farm real estate values increased in all States during 2001-04, and the gains were often as great or greater than gains in the rural housing market (fig. 20). From 2007 to 2009, farm real estate values declined in many States, but the reversals were generally more moderate than in the rural housing sector. In 19 States, notably California, Oregon, Washington, and Nevada, farm real estate values actually increased in 2007-09 while the RHPI declined. These trends suggest that strong gains in farm earnings and declining interest rates during 2007-09 helped the farmland market withstand the significant downturn in housing markets.

The relationship between farmland and rural housing markets is more evident when examining trends for particular States. The selected States (California, Iowa, and Massachusetts) represent three distinct areas in terms of agricultural production and residential housing. Average farm real estate value per acre and were obtained from the National Agricultural Statistics Service (USDA/NASS 2009a). Rural housing price index values were obtained from the Federal Housing Finance Agency (see footnote 19).

[19]The Housing Price Index (HPI) is published quarterly by the Federal Housing Finance Agency (FHFA, previously the Office of Federal Housing Enterprise Oversight) (Calhoun, 1996). HPI is a broad measure of single-family house prices. The measure is a weighted, repeat-sales index drawing from repeated sales or refinancing of the same property whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac. The HPI includes house price figures at a number of spatial intervals, including Census division, State, and metropolitan statistical area (MSA). The nonmetropolitan HPI measure (which we call RHPI) has been published at the State level by FHFA quarterly since 1995. The measure includes all repeat sales mortgages in nonmetro areas as defined by the Office of Management and Budget (OMB).

Figure 20

Changes in farm real estate values and rural housing values by State, 2001-04 and 2007-09



Sources: USDA, National Agricultural Statistics Service (2009a) and housing price index data (see footnote 19).

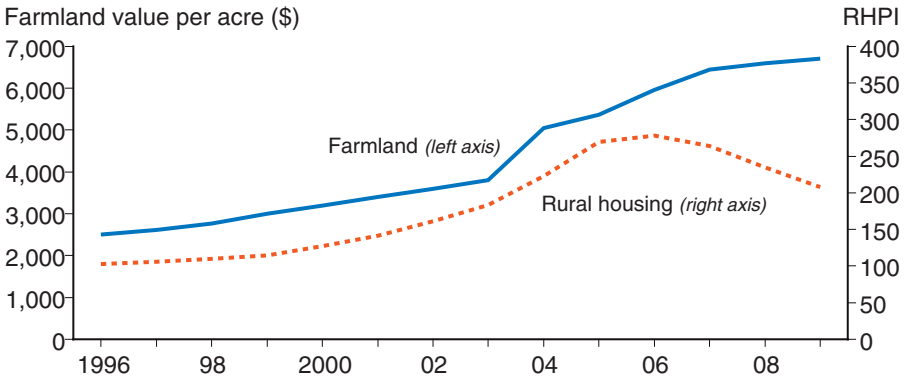
California's real estate sector in 1996-2009 was characterized by rapid price appreciation followed by a downturn during the housing price bubble (fig. 21). The period of rapid price appreciation can also be observed in farm real estate values. From 1996 to -2007, both price series exhibited a similar average annual appreciation rate: 6 percent for rural housing and 8 percent for farm real estate. Farm real estate values continue to increase, albeit more slowly after the housing bubble burst in the late 2000s.

The price trends are more tempered in Iowa, where rural housing prices exhibited a moderate increase throughout 1996-2007, with an average annual increase of 4 percent (fig. 22). At the same time, farm real estate prices increased 7 percent per year, with gains particularly strong in 2004-07. Between 2007 and 2009, both price series leveled off.

As in California, rural housing prices in Massachusetts exhibited a boom-and-bust pattern in 1996-2009 (fig. 23). However, changes in farm real estate prices were less pronounced, increasing through 2006 and declining through 2009. Although the downturn is similar in magnitude for both housing and farm real estate values, the price appreciation was much greater for residential real estate. Rural housing prices appreciated 9 percent per year in 1996-2009, versus 4 percent for farm real estate.

Figure 21

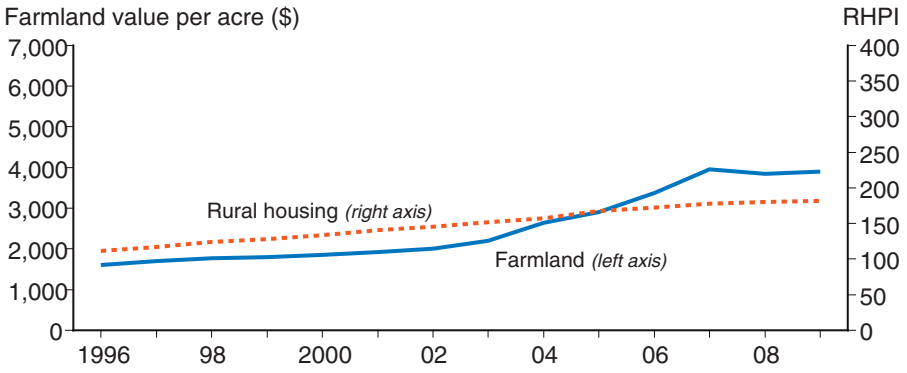
Farm real estate values and rural housing price index (RHPI) in California, 1996-2009



Source: USDA, ERS analysis of National Agricultural Statistics Service 2009a and housing price index data (see footnote 19).

Figure 22

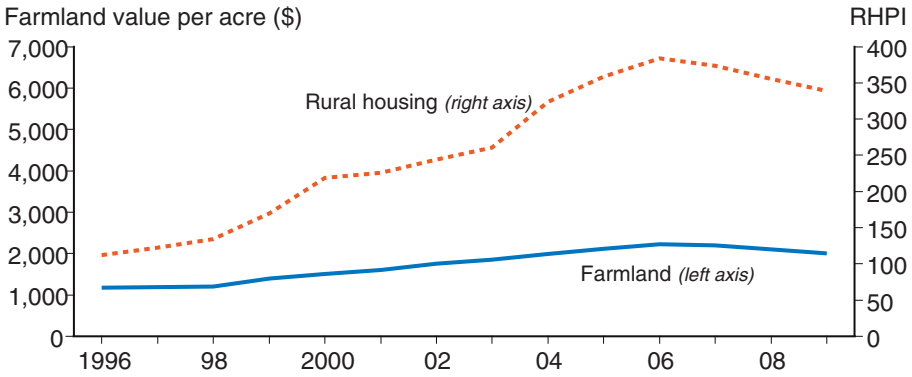
Farm real estate values and rural housing price index (RHPI) in Iowa, 1996-2009



Source: USDA, ERS analysis of National Agricultural Statistics Service 2009a and housing price index data (see footnote 19).

Figure 23

Farm real estate values and rural housing price index (RHPI) in Massachusetts, 1996-2009



Source: USDA, ERS analysis of National Agricultural Statistics Service 2009a and housing price index data (see footnote 19).

Natural Amenities Are Positively Related to Farm Real Estate Values

A number of studies suggest that like other land values, farmland values are influenced by the amount and nature of natural amenities, such as scenic views and varied terrain that attract people to an area (Pope, 1985). ERS' analysis of population changes suggests that high-amenity counties next to metropolitan areas are the most desirable places to live (USDA-ERS, 2009), so high-amenity areas could increase the development value of the land.

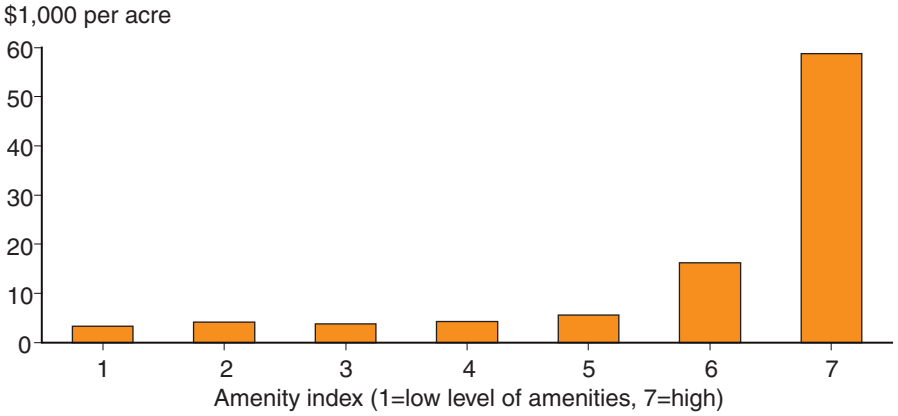
The Natural Amenities Scale published by the Economic Research Service offers a quantitative measure of landscape amenities at the county level for the contiguous United States (see Appendix A). The scale is constructed based on the notion that positive natural amenities include mild climate, varied topography, and proximity to surface water, including ponds, lakes, and shoreline. The scale is constructed using information on land surface topography, winter temperatures and sunlight, summer temperatures and humidity, and water cover. The Natural Amenities Scale is categorized by deviations from mean amenity levels, ranging from 1 (low amenity) to 7 (high amenity). The scale has been used in previous research, including a study of the effects of natural amenities on rural population change (McGranahan, 1999).

High levels of natural amenities have a large positive effect on farm real estate values, with a mean value per acre of $58,732 at the highest level of the index value (fig. 24). At the lowest levels of natural amenities, mean values are $3,351 per acre. The impact of natural amenities falls greatly from the highest classification (7) but remains relatively constant at lower levels (1-5).

While natural amenities arising from topography and climate conditions are correlated with land values, other amenities arise from the farmland itself and tend not to be reflected in the land's value. These "rural" amenities include the habitat provision, groundwater recharge, and open-space benefits provided by having land in an agricultural use as opposed to a more intensive use (Hellerstein et al., 2002; Irwin et al., 2003). Though the landowner cannot

Figure 24

Average farm real estate values and natural amenities, 2008



Source: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data and ERS Natural Amenity Scale data.

typically capture the value associated with rural amenities through selling land on the market, evidence suggests that people do value these public goods and they are a primary reason for public support for farmland protection policies (e.g., Kline and Wichelns, 1996). Demand for protecting rural amenities is highest in suburban and urban fringe areas where the loss of agricultural lands to urban uses is highest (Nickerson and Hellerstein, 2003; Kline and Wichelns, 1994).

While the rural amenity value of land is not reflected in farmland values, some policies to protect rural amenities can affect farmland values. State and local governments in every State have enacted measures to help retain farmland in an agricultural use and to prevent the loss of rural amenities (Hellerstein et al., 2002). Preferential assessment programs, in which landowners get property tax relief for keeping the land in agriculture, generally have little effect on farmland values—likely because many such programs contain penalties wherein a portion of the property tax savings must be paid upon conversion to a developed use (e.g., Parks and Quimio, 1996; Wunderlich, 1997). Regulatory policies such as zoning often specify minimum lot sizes, and many zoning laws restrict the ability of landowners to convert farmland to urban uses. However, studies show that such policies reduce land values for the restricted farm parcels when development pressure is present (Gottlieb and Adelaja, 2009; Beaton, 1991).

In some cases, impacts of farmland protection vary by location. Wisconsin's exclusive agricultural zoning policy, which helps contain urban development, was found to decrease per-acre farmland prices for smaller agriculturally zoned parcels located closer to cities but increase prices for larger parcels far from cities (Henneberry and Barrows, 1990). Purchase of development rights programs, in which landowners voluntarily sell the rights to develop the land in exchange for a payment, result in permanent (or very long term, 25-30 year) restrictions on nonfarm development. In theory, once the development rights have been sold, the market value of the preserved land will reflect only its value in a farming use, which in urbanizing areas can be significantly lower than its residential market value. However, several studies have found little evidence that such development restrictions significantly lowered preserved farmland prices (Nickerson and Lynch, 2001; Lynch et al., 2007; Anderson and Weinhold, 2008). The authors speculated that landowners who farm as a recreational pursuit are outbidding "traditional" farmers for the preserved land.[20]

[20]Easements are also used to protect land from conversion to cropping uses. For example, Shultz and Taff (2004) found that easements to protect wetlands significantly lowered land values in North Dakota.

Farmland Ownership Trends

The ownership of agricultural land can have far-reaching implications on the food and fiber system. The most recent estimate of the number of farmland owners was in 1999, when USDA-NASS estimated that there were more than 2.2 million agricultural landlords.[21] Ownership arrangements can affect farmland values through their impacts on the decisionmaking behavior of farm operators, including production decisions, adoption of technologies, and conservation practices that can enhance the productivity of the land. For example, operators who are full tenants and own none of the land they operate are more likely to specialize in crops (versus livestock) than operators who own the land they operate (Hoppe et al., 2007). While there has been longstanding interest in the characteristics of farmland owners and the extent to which they are actively engaged in farming, this interest has increased in recent years with the increase in farmland prices and uncertainty over whether farmers or nonfarmers are reaping the benefits of farm program payments.[22]

[21]Also, in 1999, over 80 percent of landlords leased to only one tenant (USDA-NASS, 1999).

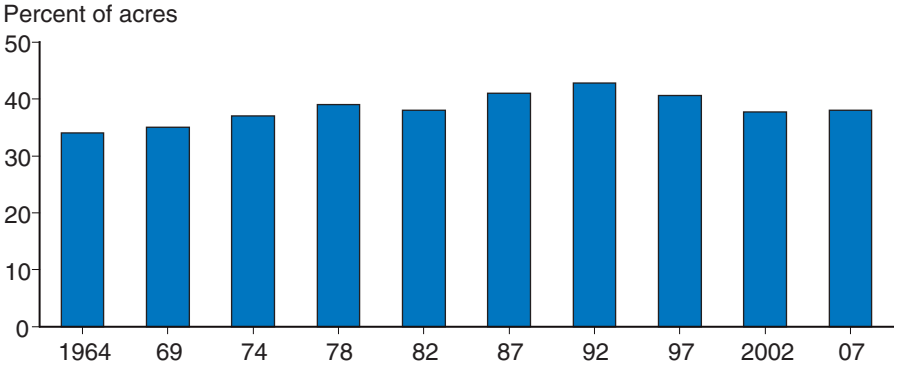
[22]One study estimated that of the $40 billion in total land value attributable to farm program payments in the Heartland, $25 billion is related to land owned by non-operators (Barnard et al., 2001).

The amount of land in farms that is rented by farm operators has fluctuated over time, ranging between 34 percent and 43 percent of farmland over 1964-2007 (fig. 25). The rising share of rented land from 1982 (38 percent) to 1992 (43 percent) was partly due to the farm crisis in the early 1980s that forced some farms out of business and the owners to rent their land. However, since 1997 the amount of acreage rented has remained below 40 percent. The distribution of rented farmland varies across regions, with the highest proportions in Illinois, Iowa, Kansas, and the Mississippi Delta. Except for increases in a few areas (the Mississippi Delta region, southern Illinois, eastern North Dakota, and the Central Valley in California), the geographic concentration of counties with at least half of farmland rented or leased in 2007 was similar to 1950 (fig. 26). With such a large amount of farmland rented, landlords clearly play a significant role in U.S. agriculture, particularly in some regions.

Farmland owners can be grouped into two categories: owner-operators (those owning all the land they operate; this includes farmers who operate some land and rent out additional land to other farmers) and non-operating land owners (NOLs). The proportion of land in farms owned by NOLs declined from 37 percent in 1992 to 29 percent in 2007 (USDA-NASS, 2009). The amount of acres held by NOLs differs across regions (fig. 27). In 2007, in three of the top

Figure 25

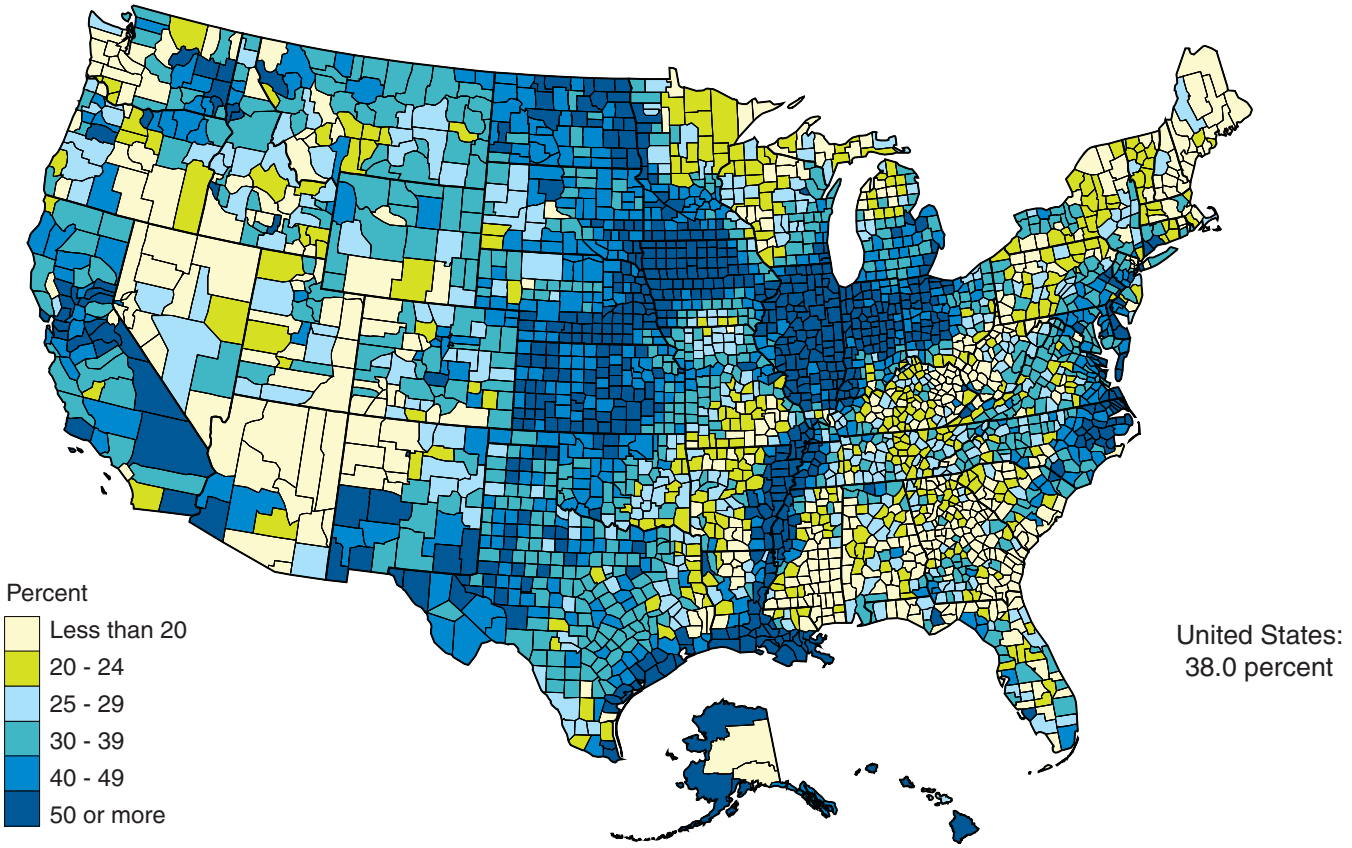
Share of farmland acres rented or leased, 1964-2007



Source: Census of Agriculture, multiple years.

Figure 26

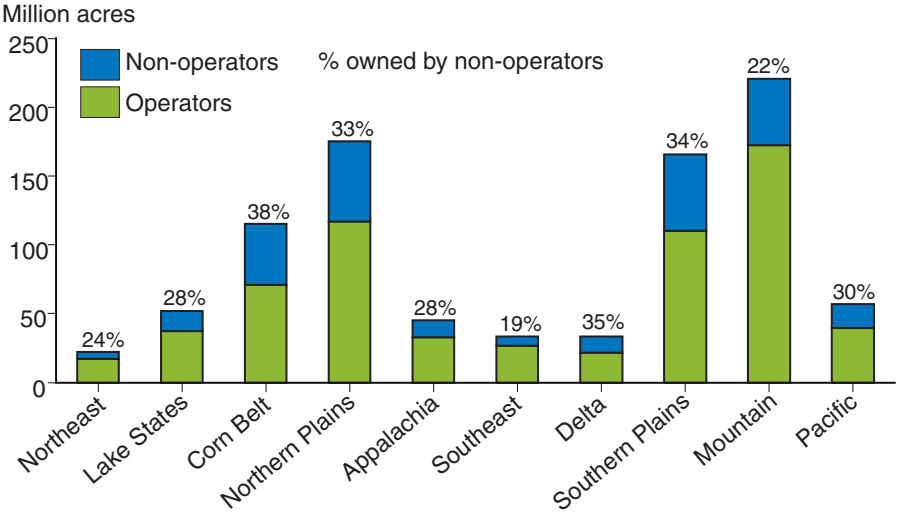
Percent of land in farms rented or leased, 2007



Source: USDA, National Agricultural Statistics Service.

Figure 27

Farmland owned by operators and non-operator landlords by region, 2007



Source: Census of Agriculture (2007).

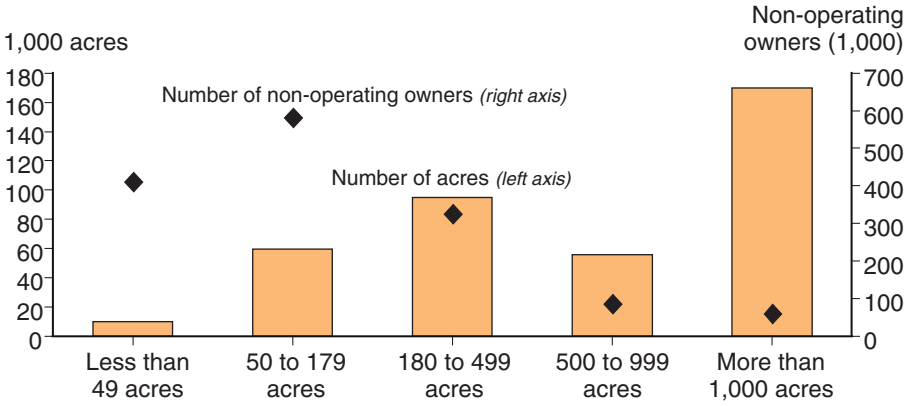
four regions in terms of land in agriculture—the Corn Belt, Northern Plains, and Southern Plains—NOLs owned more than 30 percent of the land. NOLs also owned 30 percent or more of farmland in the Delta and Pacific regions. Many reasons contribute to this pattern, including laws in some States that limit farmland ownership by nonfarmers or by foreign owners.

The characteristics of farm operators have been well documented (Hoppe et al., 2007), but much less is known about non-operator landlords. Data from a survey of private farmland owners in 1999 (the most recent available) revealed that most land owned by NOLs was concentrated in the hands of relatively few people who owned large amounts of land. In 1999, 4 percent of NOLs owned at least 1,000 acres of farmland, and collectively they controlled 44 percent of all acreage owned by NOLs (fig. 28). However, about 68 percent of NOLs owned less than 180 acres each; these landlords owned 18 percent of the land owned by NOLs.

Using a combination of the two most recent surveys of private farmland owners (1988 and 1999) and 2007 Census of Agriculture data indicates whether characteristics of farmland owners are changing over time. Age of farmland owners is of particular interest because land turnover is higher among older owners. A greater proportion of non-operators (than operators) are older than 70: 47 and 42 percent of NOLs were older than 70 in 1988 and 1999, respectively, while only about 20 percent of owner-operators were older than 70 over the past three decades. Far fewer NOLs live on the farm, compared with owner-operators (29 versus 82 percent in 1999), though another 29 percent of NOLs live within 5 minutes of the farm they own (Barnard et al., 2001). It also appears NOLs were less likely to be enrolled in the Conservation Reserve Program (CRP) or the Wetlands Reserve Program (WRP), at least in the 1980s and 1990s.[23] The proportion of owner-operators participating in the CRP or WRP increased in 1999-2007 from 10 percent to 16 percent; national data are not available to determine whether enrollment patterns among non-operators changed after 1999. This is consistent with research that found that tenants were less likely than owner-operators to adopt conservation practices that provide benefits over the longer term (Soule et al., 2000). In 1999, non-operators also tended to own farm real estate that was about $100 per acre less valuable, on average, than land owned by owner-operators.

Figure 28

Number of non-operating owners and the acres they own, 1999



Source: USDA, National Agricultural Statistics Service Agriculture Economics and Land Ownership Survey (AELOS), 1999.

[23]USDA's Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP) are two conservation programs that retire cropland from production. While non-operators might be more reluctant to participate due to contract lengths (at least 10 years in CRP, and 30 years in WRP), the benefits of enrolling land include reduced farm labor requirements and payments to the landowner. However, it is not always clear whether landlords are classified as NOL or operators when they have land, particularly whole farms, enrolled in these long-term land retirement programs.

Table 2
Characteristics of the average farmer and non-operating landowner

	1988		1999		2007
Characteristic	Non-Operator	Owner-Operator	Non-Operator	Owner-Operator	Owner-Operator
			Percent		
70 years or older	47.7	21.7	42.1	17.6	19.1
Live on farm	36.3	78.6	29.0	82.2	76.8
Enrolled in the Conservation or Wetlands Reserve Program	8.1	11.1	8.0	10.4	15.7

Sources: USDA, National Agriculture Statistics Service Agricultural Economics and Land Ownership Survey (1988 and 1999) and Census of Agriculture (2007).

Many Non-Operating Landlords Live in Towns and Urban Areas

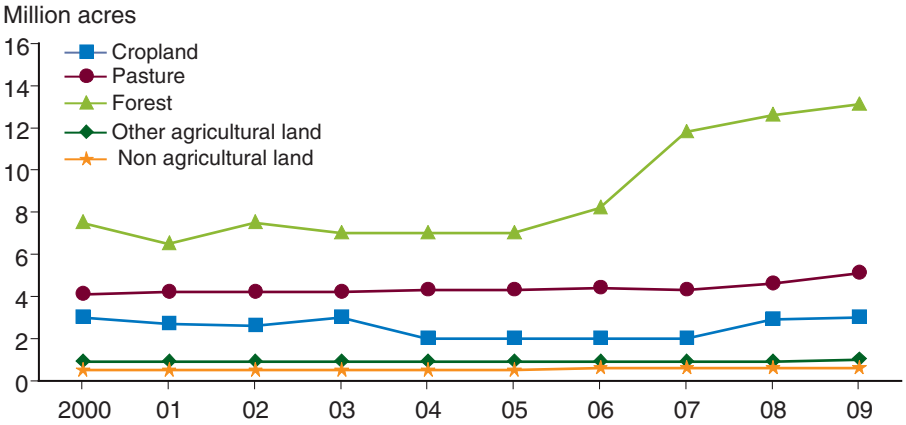
The Agricultural Economics and Land Ownership Survey (AELOS) indicates that in 1999 (the last update), 42 percent of all farm landlords lived in a city, town, or urban area.[24] Some farm program payments are paid directly to landlords (see footnote 16), and when a large percentage of farmland owners may live in urban areas, it raises questions about whether—in addition to supporting farm incomes—farm program payments benefit the rural economy as intended (Drabenstott, 2005). However, ERS analysis of 2004 data on government payments made in Federal commodity and conservation programs revealed that over 90 percent of payments in 2004 were mailed to rural addresses outside of census-defined urban areas and clusters.

[24]The AELOS does not distinguish towns and cities based on population size, so it is possible some landlords report living in towns that would be classified as "rural" according to Census Bureau definitions of urban areas and clusters.

Relatively Little U.S. Farmland Is Foreign Owned

High levels of foreign demand for farmland could put upward pressure on farmland prices. Despite recent increases in foreign ownership of forest land, annual data compiled by USDA's Foreign Agricultural Service reveals that, as of February 2009, only 1.7 percent of privately owned land in farms or forest, or 22.8 million acres, was owned by foreigners (fig. 29). The majority of foreign-owned land is owned by people or firms from two countries: Canada (34 percent) and the Netherlands (17 percent). Most foreign ownership is concentrated in Maine: 15.7 percent of Maine's privately owned farm

Figure 29
Trends in foreign holdings of U.S. farmland, 1999-2009



Source: Blevins et al., 2010.

and forest land, or 2.82 million acres, is foreign owned. Of this amount, 2.77 million acres are forest land. Other States with relatively high levels of foreign ownership of farm and forest land include Hawaii (8.8 percent), Washington (7.6 percent), Nevada (5.2 percent), and Alabama (5.1 percent). Foreign interests own 2.57 million acres in Texas. Some States prohibit foreign ownership of agricultural land (Luttrell, 1979).

Conclusions

Farmland represents a significant investment and a large portion of the wealth of many U.S. farmers. With farmland real estate values growing largely steadily since the farm financial crisis in the mid-1980s, interest in the driving forces behind farmland values has grown, especially amid the residential housing downturn. Since 2005, increases in crop prices and cash rents, coupled with low interest rates and improved agricultural credit conditions, are giving rise to double-digit increases in farmland values in some regions.

Historical relationships between cropland and pastureland values have changed in some regions. Cropland values have typically exceeded pasture values and have been at least twice as large as pasture values in the Midwest and West in the last decade. But the premium has shrunk recently, and in two regions—the Southeast and Delta—average cropland values have remained below average pasture values since 2004-05. Studies suggest that nonfarm factors could be contributing to the relative changes in crop and pasture values. Pastureland can provide a stream of recreational income from hunting leases, and in the Southeast, pastureland tends to be closer to urban areas and development demand.

How has farmland been performing as an investment? Trends in farm incomes, cash rents and interest rates suggest farmland values were supported by farm earnings in 2009 and 2010. This suggests that in very recent years (when measured at the national level), farmland values are supported by fundamental farm factors. Yet, several macroeconomic measures indicate that over a longer horizon, farmland values are becoming less correlated with farm-related factors once thought to support those values. Declining rent-to-value ratios indicate cash rents are increasingly smaller relative to farmland values, and the ratio is smallest for cropland close to urban areas. Also, the affordability of farmland has varied over time. While in 2009-2010 average income from farming has been more than sufficient to service farm real estate debt, during 2005-08 and during 1978-1985, this was not the case. A lack of correlation with net farm incomes, declining rent-to-value ratios, and low levels of affordability all suggest that nonagricultural factors are increasingly important in determining farmland values.

Farm program payments are under increased scrutiny amid a historic debate over the size of the Federal deficit. Our analyses suggest that changes to some of the largest farm programs would likely have impacts that vary across regions. Direct and countercyclical (DCP) payments are a larger percentage of cropland values in the Delta and Southeast regions than elsewhere. While the extent to which farm program payments increase farmland values is uncertain, studies indicate at least some capitalization of farm program payments. Large reductions in DCP payments might have the greatest potential to reduce land values in the Delta and Southeast. The Corn Belt and Lake States regions generally have the lowest level of subsidies (through both the DCP program and crop insurance) relative to land values. In the Appalachia and Northeast regions, some areas have high levels of insurance premium subsidies relative to land values, but some areas also have low levels of DCP payments relative to land values.

How does farmland compare to alternative investments? While farmland has historically been a stable investment, it has been outperformed by the S&P 500 (and gold, when investments have been held for nearly 40 years). Yet in very recent years, farmland has become more attractive as an investment, as reflected in surveys that indicate active investor interest in farmland, at least in some regions: nearly a quarter of farmland purchases in Iowa were made by investors in 2009. However, uncertainty about the renewal of major farm commodity programs and future interest rates could reduce the attractiveness of farmland as an investment relative to other alternatives.

While macroeconomic conditions affect farmland values, farmland values are also driven by parcel-specific factors that collectively determine the land's potential returns from being in an agricultural use. The importance of using spatially disaggregated data, though complex and time consuming, is particularly evident when examining correlations between common proxies for net returns to agricultural production. Our analyses reveal that the positive relationships between better soils and cropland values became evident only when we controlled for proximity to large population concentrations (we retained land value observations only in the most rural areas). Parcel-specific effects also vary substantially across regions, with opposite effects in some cases (e.g., soil quality was negatively correlated with cropland values in the Appalachian region but positively correlated elsewhere). Cropland values generally increase with proximity to points of delivery (grain elevators, highways) in rural areas.

Significant volatility in residential real estate markets over the last decade has raised questions about the extent to which competing land markets affect farmland values. A comparison of rural housing and farmland value trends in California, Iowa, and Massachusetts—three States that are distinct in terms of location, agricultural production and residential housing—reveals that the boom-and-bust cycle in the housing market in the last decade had no, or relatively modest, negative impacts on farmland markets. Of the three States, only farmland values in Massachusetts declined between 2006 and 2009, coincident with rapid losses in residential housing values. These comparisons suggest that farmland markets may be fairly independent of residential housing markets in some places but not in others. However, the moderating impacts of historically low interest rates and high crop prices almost certainly mitigated the downturn in value that farmland markets could have otherwise experienced.

Coupled with questions about the likely stability of farmland values are questions about whether active farmers benefited from the recent increases in those values. With about 40 percent of farmland being rented, and with more than 30 percent being rented from non-operating landowners in several regions (largely the Midwest and Pacific), it is clear that non-operating landowners play a significant role in U.S. agriculture. Not only do non-operators reap some of the benefits (and bear some of the risks) of changes in farmland values, land owned by non-operators is managed somewhat differently—for example, such lands may be less likely to be enrolled in conservation programs.

The trend analyses in this report provide an important foundation in understanding the factors driving farmland values and ownership. Nonetheless,

the correlations of values and tenure status with macroeconomic and parcel-specific factors do not necessarily identify causal relationships. Many of the factors affecting land values and ownership are changing simultaneously, and it is difficult to know from trend analysis alone which or to what extent particular factors are contributing to changes. Additional research that statistically analyzes these complex interactions can help identify which of the myriad factors have the most significant impacts on farmland values and ownership.

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Appendix A: Data Inputs

Euclidean Distance Metrics:

Distances to three types of features were calculated using a Euclidean distance (straight-line distance) tool in ArcGIS. The output cell size for these Euclidean distance grids was 1 mile.

Interstates

The source of the interstate data is the US National Transportation Atlas Interstate Highways, through ESRI, from 2002. A one-mile resolution Euclidean distance grid was calculated from interstates out to a maximum distance of 2,000 kilometers.

Grain elevators

The best available set of terminal and subterminal grain elevators are derived from Baking Business Magazine/Souza Publishing (2002). A 1-mile resolution Euclidean distance grid was calculated from grain elevators out to a maximum distance of 2,000 kilometers. This set excludes country grain elevators.

Water ports

The port data contain physical information on commercial facilities at the principal U.S. Coastal, Great Lakes, and Inland Ports (USDOT Bureau of Transportation Statistics 2004). The data consist of listings of a port area's waterfront facilities, including information on berthing, cranes, transit sheds, grain elevators, marine repair plants, fleeting areas, and docking/storage facilities. Collection of data is performed on a rotational basis to ensure onsite accuracy at each facility. A 1-mile resolution Euclidean distance grid was calculated from water ports out to a maximum distance of 2,000 kilometers.

Counties

Counties come from the Environmental Systems Research Institute counties from the year 2000. The county polygons were converted to a 30-meter resolution grid.

1099 tax information

Totals of FSA program payments by county were summarized and extracted from the FSA database for 1999-2008. These were joined to counties, and converted to a 1-mile resolution grid for each year.

Indemnity payment data

Totals of RMA indemnity payments by county were summarized for 1999-2008 and converted to 1-mile resolution grids.

Ethanol processing capacity surfaces

Using the ethanol capacity attribute of ethanol plants, ERS generated a grid using the ArcView's kernel density function tool. The output cell size is 4 kilometers, and the capacity is distributed over a 125-kilometer distance from each plant. This study considers the ethanol capacity grids from 2002 through 2008. The kernel density approach is a way to demonstrate the expected decay of influence from ethanol plants on land value as a function of distance.

Land capability class (LCC)

This is one of the attributes available in the Natural Resources Inventory (NRI). Its purpose is to classify soils into one of eight classes describing suitability for agricultural production. The county-level measure used in this study is the percent of the county cropland area composed of LCC classes 1 and 2, the two best suitability classes. Inherent soil qualities—such as wetness, erosivity, stoniness, shallowness, and drought properties—are considered in the class assignment; however, anthropogenic soil enhancements are not considered.

For the official NRCS definition of LCC, visit http://www.nrcs.usda.gov/technical/NRI/1997/summary_report/glossary.html.

For LCC class and subclass descriptions, visit http://www.nrcs.usda.gov/technical/NRI/maps/meta/m6175.html.

Crop yields

Average corn yields were derived from the NASS Crop County Estimates database. Yields were averaged from 2001 to 2006 at the county level to get an overall yield expectation.

PIZA

The ERS Population Interaction Indexes to Classify Agricultural Land (PIZA) is a measure of urban influence on agricultural lands available in a 5-kilometer resolution grid. See Appendix B and http://www.ers.usda.gov/Data/PopulationInteractionZones/accessdata.htm

Population Interaction Index (PII)

The Population Interaction Index (PII) is designed to provide a cardinal measure of the potential interaction between nearby urban-related population and agricultural production activities in each grid cell. This is a 5- kilometer resolution grid. See Appendix B and http://www.ers.usda.gov/Data/PopulationInteractionZones/accessdata.htm

Natural Amenities Scale

The ERS natural amenities scale is a measure of the physical characteristics of a county area that enhance the location as a place to live. The scale was constructed by combining six measures of climate, topography, and water area that reflect environmental qualities most people prefer. These measures

are warm winter, winter sun, temperate summer, low summer humidity, topographic variation, and water area. The data are available for counties in the lower 48 States. The file contains the original measures and standardized scores for each county, as well as the amenities scale. This county-level measure was converted to a 1-mile resolution grid. See http://www.ers.usda.gov/Data/NaturalAmenities/

Appendix B. Alternative Measures of Urban Influence

Population Interaction Index (PII)

The first alternative measure of influence is the population interaction index (fig. B1). The population interaction index ranks each location or area on a continuous scale in terms of the potential interaction between nearby urban-related population and agricultural production activities. The index is created for a series of 5-kilometer grid cells laid out across the contiguous 48 States. The index for a single location takes the form:

$$PII_i = \sum_{j=1}^{N} \frac{P_j}{D_{ij}}$$

where P_j is the population of cell j, and D_{ij} is the distance between cell i and cell j. The measure is aggregated across N grid cells within a 50-mile radius of cell i. The index increases as population increases and/or as distance to the population decreases.

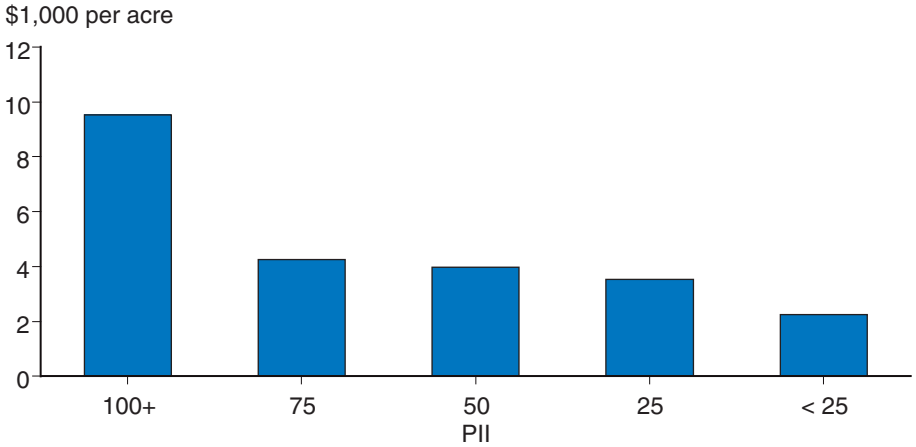
PII therefore provides a measure of urban influence that accounts for differences in population size of urban centers, as well as the potential for multiple nearby urban centers. Figure B1 demonstrates that the average value per acre for farmland declines as urban influence decreases. The decline is greatest at the highest levels of PII or the greatest amount of urban/rural interaction. At the greatest level of population interaction, the average value per acre is $9,515; at the lowest level, the value is $2,252.

Population-Interaction Zones for Agriculture (PIZA)

The population-interaction zones for agriculture (PIZA) identify agricultural land use in which urban-related residential, commercial, or industrial activities affect the economic and social environment of agriculture. Building on the PII grid cell data, PIZA classify grid cells into either rural or population interaction zones based on threshold values. The rural zone includes popula-

Figure B-1

Farmland value per acre by PII



Sources: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data and PIZA data.

tion that supports active commercial farming, including related input and output industries. The threshold values vary for each of the 20 USDA Land Resource Regions to account for differences in farmland productivity. Grid cells initially classified into the population-interaction zone were further classified into one of three categories representing increasingly higher levels of population interaction.

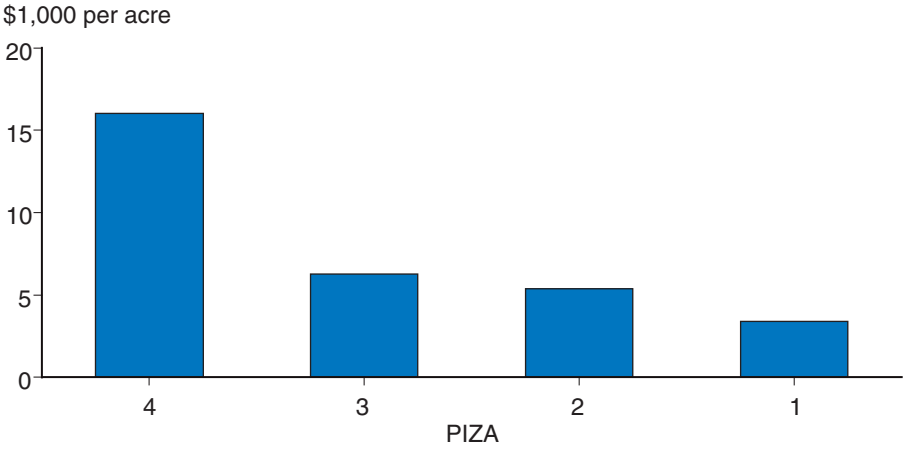
PIZA classifies each grid cell into one of four categories:

- 1 = rural
- 2 = low population interaction
- 3 = medium population interaction
- 4 = high population interaction.

The figure below depicts the average value per acre for all agricultural lands by PIZA classification. Similar to the previous measures of urban influence, the value per acre is highest in areas with the greatest degree of population interaction and declines as population interaction decreases. For areas with high population interaction, the mean farmland value per acre is $16,041, versus $3,408 in rural areas.

Figure B-2

Farmland value per acre by PIZA



Sources: USDA, ERS analysis of National Agricultural Statistics Service June Area Survey data and PIZA data.