The Impact of Pasture Insurance on Farmland Values

Jennifer Ifft, Shang Wu, and Todd Kuethe

This study examines the impact of publicly supported insurance on agricultural land values. The analysis employs confidential, nationally representative panel data on field-level pastureland values and exploits a natural experiment provided by gradual introduction of the Pasture, Rangeland, and Forage Insurance Pilot Program. We use a field-level fixed-effects model that controls for several time-variant factors. We find that insurance availability is associated with an increase of at least 4 percent in pastureland values. This increase is comparable with increases generated by other government programs but is much smaller than total farmland value increases experienced in recent years.

Key Words: farmland values, insurance, June Area Survey

Publicly supported insurance programs are an increasingly important component of U.S. agricultural policy. Acres insured under federal crop insurance, for example, increased from 197 million in 1999 to 265 million in 2011, and total premium subsidies increased from $950 million to $7.4 billion over the same period (Risk Management Agency 2012b). The number of publicly supported insurance programs has also increased in recent years, most notably with introduction of the Average Crop Revenue Election (ACRE) Program in 2008. New farm programs included in the Agricultural Act of 2014 suggest that insurance programs are expected to play a larger role in the agricultural sector in the future.

Previous studies have examined factors that influence farmers' decisions to purchase crop insurance (Sherrick et al. 2004), the decision to exit crop insurance (Cabas, Levia, and Weersink 2008), and the price elasticity of crop insurance (Coble et al. 1996). Others have considered issues related to adverse selection and moral hazard (Just, Calvin, and Quiggin 1999). It is also known that the availability of crop insurance can impact land-use and production decisions. O'Donoghue, Roberts, and Key (2009) found that insurance subsidies implemented as part of the 1994 Federal Crop Insurance Reform Act resulted in a moderate increase in specialization and production efficiency but the value of the efficiency gains was far smaller than the value of the subsidies. Claassen

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The authors gratefully acknowledge valuable input provided by two anonymous reviewers and by editors Arnab Basu and Sean Cash. The authors thank Tom Worth and Amy Roeder of the U.S. Department of Agriculture Risk Management Agency for their feedback and information on pasture, rangeland, and forage insurance. The authors also thank Vince Breneman, Robert Dubman, Ryan Williams, and Chengxia You of the Economic Research Service for their invaluable assistance with data and construction of key variables used in this study. The views expressed are the authors' and do not necessarily represent the policies or views of the sponsoring agencies.

et al. (2011) suggested that benefits of crop insurance stimulated conversion of land from grassland to cropland in the Northern Plains by 2.9 percent between 1998 and 2007. Goodwin, Vandeveer, and Deal (2004) found that increases in participation in insurance programs led to small increases in acreage planted, and a 30 percent decrease in premium could lead to a 0.2–1.1 percent increase in acres planted. Miao, Feng, and Hennessy (2011) concluded that a 5 percent decrease in the subsidy rate would result in 0.60 percent of insured cropland converting away from crop production.

The earlier studies establish a link between publicly supported insurance programs and land use changes. This study examines a related issue—the degree to which publicly supported insurance programs affect the value of farmland. The assertion that agricultural policies can increase the value of farmland has been well explored for various farm acts, including the Agricultural and Consumer Protection Act of 1973 (Harris 1977), the Food and Agricultural Act of 1977 (Boehlje and Griffin 1979), the Food Security Act of 1985 (Featherstone and Baker 1987), and the Federal Agricultural Improvement and Reform Act of 1996 (Goodwin, Mishra, and Ortalo-Magné 2003). In each instance, the analysis indicated that farm program payments increased farmland prices. A comprehensive literature review by Latruffe and LeMouël (2009) showed that between 12 percent and 40 percent of U.S. farmland values at the time reflected benefits provided by farm policies other than insurance. Similar analyses of publicly supported insurance programs have not been done.

As with other types of farm policies, insurance programs can increase land values through income effects and risk-reduction effects. Premium subsidies may have played a key role in increasing participation in such insurance (Young et al. 2001). Because premium subsidies have been provided, the expected value of participating in federal crop insurance programs can be positive (expected indemnities may be larger than the premium the farmer pays). And as with direct payment programs, which represent direct income transfers, increases in income expected as a result of insurance may be reflected in the value of the land. If farmers are risk-averse, the reduction in income variability provided by insurance programs may also be capitalized in eligible farmland acreage.

Farmers' risk aversion is difficult to measure (Cao, Carpentier, and Gohin 2011), but some evidence suggests that farmers typically are risk-averse (i.e., Lins, Gabriel, and Sonka 1981, Chavas and Holt 1996). Chavas and Thomas (1999) found evidence that a dynamic capital asset pricing model (CAPM) that incorporates both risk aversion and transaction costs is well suited to farmland markets. While that type of model is difficult to implement at a micro level, their work suggests that programs that reduce risk should be included in models that estimate farmland values. Indeed, most models of crop insurance participation and farmland values suggest that, even without the premium subsidy, the availability of effective insurance would be reflected by the market as higher farmland values. Risk-averse producers are willing to purchase insurance because their expected utility is greater when the variance of their future incomes is smaller. The most basic model of farmland values stipulates that those values reflect the present value of future farm income, and it follows that risk-averse producers would be willing to pay a premium for farmland with insurance availability because the variance of future farm income would be lower.

The relationship between insurance and land values has been overlooked in part because most insurance programs are introduced nationally, and most acres in production of covered crops are eligible for program benefits. The effects of the programs are therefore difficult to distinguish from effects of other changes occurring at the time. This study exploits a natural experiment provided by introduction of the Pasture, Rangeland, and Forage Insurance Pilot Program (PRF insurance) in 2007 to measure the impact of insurance programs on farmland values. PRF insurance was introduced gradually at a county level and is not yet available everywhere. The gradual introduction process allows us to compare land values for pasture in areas with and without the program. With this unique advantage, our study fills a gap in the literature regarding whether and how publicly supported insurance programs influence farmland values.

The Pasture, Rangeland, and Forage Insurance Pilot Program

Currently, there are about 588 million acres of pasture and range land and 61.5 million acres of hay land in the United States (RMA 2012a). Forage and livestock producers frequently suffer financial losses associated with various natural hazards, especially drought, and those losses vary greatly from year to year as a result of different weather conditions. In 2011, for example, agricultural losses in Texas due to drought reached a record $7.62 billion, including $3.23 billion for livestock losses (Fannin 2012). The U.S. Department of Agriculture's (USDA's) Risk Management Agency (RMA) introduced the PRF insurance program in 2007 to mitigate losses by farmers and ranchers caused by weather.

PRF insurance is a group risk plan that provides coverage for forage crop losses on pasture and range land due to adverse weather conditions. The program uses two sets of indexes to evaluate conditions that can affect forage production over periods of time. Some states use a rainfall index in which losses are calculated based on deviations from normal precipitation for the grid (approximately twelve miles by twelve miles in size) and index interval(s) during particular time periods. Other states use a vegetation index that is based on Normalized Difference Vegetation Index (NDVI) data from the U.S. Geological Survey's Earth Resources Observation and Science (EROS) system of satellites observing long-term changes in the "greenness" of vegetation. Grids for the PRF vegetative index are approximately 4.8 miles by 4.8 miles in size. Losses are calculated based on deviations from normal vegetation levels. Both methods are dependent on historic levels within each grid rather than on individual farms or ranches or specific weather stations (RMA 2012a, Sharp, Hewlett, and Tranel 2011).

In 2007, PRF insurance was rolled out at the county level as a pilot program, a standard approach for new insurance products that allows for expansion as the program demonstrates its viability. Eligible counties in nine states (Oregon, Idaho, North Dakota, South Dakota, Colorado, Oklahoma, Texas, Pennsylvania, and South Carolina) were enrolled in 2007 with three states added in 2008 (Alabama, New York, and Wyoming), six in 2009 (Kansas, Montana, Nebraska, Missouri, North Carolina, and Virginia), and six in 2011 (California, Utah, Arizona, New Mexico, Georgia, and Florida). Pilot counties were initially selected on the basis of proposals submitted by insurance providers since all federal crop insurance products are administered by private insurance companies. In 2011, there were 24 states in which every county was eligible (RMA 2012c). PRF premium subsidies nationwide increased from $41.5 million in 2007 to $60.1 million in 2011 and acres insured increased from 28.5 million to 34.4 million in the same period. Total indemnities paid out have ranged from $43.9

million in 2007 to $182.3 million in 2011. The number of eligible counties grew from 329 in 2007 to 973 in 2010 and the number of counties in which acres were enrolled rose from 323 in 2007 to 624 in 2010. The average number of acres enrolled per county in 2007 was 180,314 with a standard deviation of 318,601. In 2010, the average number of acres enrolled per county was 49,087 with a standard deviation of 131,195 (RMA 2012b). The total number of acres enrolled each year is likely affected by county size because some of the counties initially enrolled (many in western states) were substantially larger than counties enrolled later.

The PRF program's premium subsidies are set in a manner similar to other federal crop insurance programs in that the subsidy is a share of the total premium rather than an absolute amount. The subsidy levels decline as the level of coverage increases and, for the entire federal crop insurance program, generally vary from 38 percent to 80 percent (General Accountability Office 2013). For PRF insurance, subsidies have averaged around 55 percent of the total premium (RMA 2012b). With the exception of a small increase in subsidies for enterprise-level coverage in the 2008 Farm Bill, the subsidies for federal crop insurance have not been changed. Hence, any increase in the annual subsidy amount is a result of increases in acres enrolled, coverage levels chosen, and/or premiums.

Data and Methodology

Farm real estate is the major asset on the farm-sector balance sheet, accounting for 84 percent of total U.S. farm assets in 2009 (Nickerson et al. 2012). This key role of land in the agricultural economy has led to a vast literature on the determinants of agricultural land values that offers a wide array of modeling approaches. The dynamic relationships between agricultural land values, production returns, and macroeconomic conditions have been modeled through time-series models (Kuethe, Hubbs, and Morehart 2013, Shaik and Miljkovic 2010, Just and Miranowski 1993, Awokuse and Duke 2006) while cross-sectional hedonic models have been used to examine locational and time-invariant land characteristics (Dillard et al. 2013, Blomendahl, Perrin, and Johnson 2011). Difference-in-differences models have been used to evaluate the impact of ethanol policies on farmland values (Towe and Tra 2013).

We examine the relationship between publicly supported insurance and agricultural land values using data from USDA's June Area Survey (JAS), a confidential survey designed to provide annual, nationally representative snapshots of agricultural land values. The JAS collects field-level (tract) farmer-reported market values for cropland, pasture, and farm real estate (including the value of buildings and structures). Farmer-reported land values have been used in studies of the impacts of government policies on the value of farmland (e.g., Goodwin, Mishra, and Ortalo-Magné 2003, Towe and Tra 2013). The farmland value data used in this study are also used to inform USDA farmland value estimates, which have been shown to be highly correlated with transaction values (Zakrzewicz, Brorsen, and Briggeman 2012). The survey uses an area frame sampling methodology in which "segments" that are approximately one square mile in size are randomly sampled. Operators of all of the parcels or tracts of land within a segment are interviewed, and if a tract includes pasture, the survey collects per-acre land values. The survey also identifies parcel sizes and whether parcels are irrigated. A weighting procedure ensures that the sample yields values that are representative of the population at a state and national level. The data set spans 2005 through 2010, which includes the two years prior to introduction of PRF insurance and its expansion. We thus model the impacts of publicly supported insurance on pastureland values using an indicator variable that takes a value of one for counties in which PRF coverage is available and zero otherwise. The gradual roll-out of the program provides a natural experiment captured by the indicator variable.

JAS offers an unbalanced panel of pastureland values and, as a result, we can construct a reduced-form fixed-effects model. Although the panel is unbalanced with one-fifth of the sample replaced with new parcels each year, movement into and out of the panel is random and therefore does not induce sample-selection bias (Wooldridge 2002). Our reduced-form model is based on the capitalization (or present value) model commonly used in studies of the incidence of government payments. In the model, we assume that the price of farmland is determined by the present value of all future expected cash flows attached to use of land. Even though some researchers have challenged the validity of this approach (and proposed new methods) (Feldstein 1980, Castle and Hoch 1982, Campbell 1987, Clark, Fulton, and Scott Jr. 1993, Clark, Klein, and Thompson 1993, Just and Miranowski 1993), the model has commonly been used to estimate the impact of government payments on land values (Barnard et al. 1997, Weersink et al. 1999, Clark, Fulton, and Scott Jr. 1993, Clark, Klein, and Thompson 1993).

The unbalanced JAS panel allows us to control for a number of important factors using fixed effects. Tract fixed effects control for unobservable time-invariant factors that might be correlated with selection into the PRF pilot program. This is an especially important element of our empirical strategy since selection into the program most likely was not random for several counties. We can identify the impacts of the program under the assumption that local suitability for the insurance program was incorporated into selection for the pilot in a manner that was independent of time-variant factors that we do not control for. Temporal fixed effects (year) control for macroeconomic conditions such as interest rates and inflation and for other time trends that would affect all parcels equally, such as increases in commodity prices during the study period. We also control for several time-variant factors that are key drivers of farmland values.

We use the PRF roll-out as a natural experiment in which farms receive a "treatment" when PRF insurance becomes available in the county in which they are located. Mathematically, the basic model can be expressed as

$$L_{it} = \mathbf{X}_{it}\beta + \delta_1 PRF_t + f_i + \tau + \varepsilon_{it} \quad (1)$$

where L_{it} is the farmer-reported pastureland value for tract i in year t, $\mathbf{X}_{it}$ is tract-level time-variant characteristics for tract i in year t, β represents unknown parameters to be estimated, PRF_t is an indicator variable taking a value of one if PRF insurance is available in year t with associated parameter δ (the incidence rate), f_i is the tract fixed effect for tract i, τ is the temporal fixed effect for year t, and ε_{it} is the regression residual for tract i in year t.

The spatial nature of the JAS survey data allows us to incorporate additional covariates ($\mathbf{X}_{it}$) to control for time-variant factors that may influence pastureland values. Nonagricultural factors also may play a large role in determining pasture values (Doye and Brorsen 2011). The model controls for county-level population growth through population data obtained from U.S. Bureau of Economic Analysis regional economic accounts and state-level housing values from the U.S. Federal Housing Finance Agency. We use second-quarter nonmetropolitan housing values from each year from the all-transactions index (not seasonally adjusted) because the JAS is conducted in early June. A change in housing values or populations could impact pasture valuations through potential for development and recreation opportunities.

Returns and expenses are included separately in our analysis following Vyn et al. (2012). Ideally, we would use returns for pastureland as an explanatory variable. However, such data is not available at a county level and would even be difficult to calculate at a state or national level. The next best data available is county-level livestock revenues and expenses and feed expenses, which can be obtained from the Bureau of Economic Analysis. The data for livestock revenue do not include any insurance payments. The data are available at the county level but are expressed in per-acre terms using county-level pasture acreages from the USDA Census of Agriculture. County-level pasture acreages for the years between each agricultural census were estimated using a linear spline following Goodwin, Mishra, and Ortalo-Magné (2011). The impacts of livestock revenue and expense and feed expense variables on pasture values are ambiguous. Forage grown in pastures is a substitute for feed so increases in the cost of feed could increase the value of pastureland. However, livestock producers often supplement forage with purchased feed, which implies that an increase in the cost of feed would decrease the value of pastureland. In terms of livestock expenses and revenues, cattle are produced and sold at various ages and what is accounted for in returns and expenses varies from operation to operation. Cow/calf herds are typically raised on pasture with stock often being sold before reaching market weight, but feeder cattle or calves could be considered a livestock expense for some operations in the same county. Furthermore, livestock expenses and revenues in any given county might not accrue to producers who use pasture. Despite these potential issues, inclusion of county-level returns and expenses is a feasible method for controlling for unique local conditions that affected returns from pasture and also may have influenced farmland markets. In a similar fashion, we estimate per-acre payments from government programs using county-level data obtained from the USDA Farm Service Agency Producer Payment Database that are disaggregated by program.[1]

Ideally, all observations in our sample would have the potential to benefit from PRF enrollment. Pastureland can be held by farms for various purposes other than cattle production, which is the main use for land enrolled in PRF insurance. To exclude pastureland for which PRF enrollment would be highly unlikely, currently or in the future, we dropped all farms of less than 50 acres of total farmland (land used for crops, grazing, and/or other agricultural purposes)—about 13 percent of all observations. We also excluded lands that

[1] Programs that could potentially cover pastureland include Acreage Grazing Payments, AILFP – Apportioned, American Indian – Livestock Feed, Cattle Feed Program, LIP – Contract Growers, Livestock Assistance Program, Livestock Compensation Program, Livestock Emergency Assistance, Livestock Indemnity Program, National Wool Act, Pasture Flood Compensation, Pasture Recovery Program, 05-07 Livestock Compensation, 05-07 Livestock Indemnity Program, Feed Indemnity Program, Livestock Assistance Grant, Livestock Forage Program, Emergency Feed, WAMLAP II – Apportioned, WAMLAP III – Apportioned, Wool & Mohair Market Loss Assistance, and Lamb Meat Adjustment Assist.

Table 1. Data Summary

	Mean	Std. Dev.	Observations
Pastureland value (dollars per acre)	2,053	2,164	43,904
Average government payment (dollars per acre)	0.53	1.59	43,904
Average livestock return (dollars per acre)	0.86	2.26	43,860
Average feed cost (dollars per acre)	0.23	0.76	43,853
Average livestock expense (dollars per acre)	0.18	0.60	43,798
Percent of pastureland that is irrigated	0.01	0.07	43,904
Tract size (acres)	222	648	43,861
County population	49,543	131,591	43,904
State housing index	283	80	43,904

Note: Estimation employs survey weights for all variables.

had an extremely low (less than $50 per acre, 0.3 percent of all observations) or extremely high (more than $15,000 per acre, 4.8 percent of the all observations) value since they most likely would not be used for livestock production or were characterized by factors other than livestock production that exerted a significant influence on value. The final sample covering 2005 through 2010 was comprised of 43,904 observations.

Summary statistics for each variable are reported in Table 1 and are calculated using survey weights. The average per-acre pastureland value is $2,053. Average returns and expenses for livestock are less than $1 per acre. The small average return may be due to several factors associated with the data. Land classified as pasture by USDA may be used for more than one purpose, and dividing a county's returns by the total acres of pasture would drive down the average. Furthermore, historically, more than half of U.S. farm households that specialized in livestock production have had negative farm incomes when farms that specialize in dairy production are excluded (Economic Research Service 2013). And while we dropped farms that operate less than 50 acres, those farms are reflected in the county averages. In addition, the tract fixed effects and housing price index used in our analysis also control for nonagricultural and recreational uses of pastureland. The average government payment of $0.53 per acre is not that much smaller than the average return, likely due to factors previously discussed, and is skewed because it includes large government payments in the wake of Hurricane Katrina for a few counties. The median government payment in our study is actually zero. One percent of the pastureland included in the data set is irrigated and the average tract is 222 acres in size.

To estimate how the incidence of PRF insurance implied in equation 1 occurs in practice, we estimate several iterations of the model in which we vary the calculation of expected returns and include additional fixed effects. As previously stated, the capitalization model assumes that the price of farmland is determined by the present value of all future *expected* cash flows attached to use of the land. One of the primary challenges associated with the capitalization model is that expected cash flows are unobservable. Consequently, economists often use previously observed cash flows as a proxy for expected values. The construction of expected values is relatively subjective, and to ensure that the estimated impacts of PRF insurance availability are robust, we vary the definition of expected cash flows using an arithmetic average of previous cash flows ranging from the preceding two years to the preceding five years as in Goodwin, Mishra, and Ortalo-Magné (2011).

We further consider that land values may vary by region based on differences in weather and technological developments. To control for this possibility, we add region-time fixed effects using the five farm-production expenditure regions defined by USDA's National Agricultural Statistics Service (2012). We also take into account that land markets may take some time to recognize or incorporate the value of publicly supported insurance. Land market participants might not value the program until they have seen it function, and certainty about the permanence of the program may increase over time. We include a variable representing counties that had PRF insurance for at least three years, which captures counties that became eligible in 2007 and 2008. The three-year measure was selected to maximize our measure of "long term" while still including more than the first cohort of counties enrolled in the initial year of eligibility.

The resulting model can be expressed as

(2) $$L_{ijt} = \mathbf{X}_{it}\beta + \delta_1 PRF + \delta_2 PRF_{\geq 3} + f_i + \tau + R_{jt} + \varepsilon_{ijt}.$$

The additional components are the fixed effect, $PRF_{\geq 3}$, for counties that had PRF insurance for at least three years, the associated δ_2 parameter, and the region-time fixed effect, R_{jt}. We use the ARMS farm production regions interacted with year fixed effects. In addition, the land values and regression residuals are now indexed by parcel (i), region (j), and year (t).

Finally, it is important to note that no data are available on tract-level premium subsidies. As a result, our model captures only the price impacts of PRF eligibility. The absolute amounts of subsidies are based on the level of coverage selected by producers, and the same relative levels of subsidies are available to all eligible producers. However, the rate of insurance uptake by counties varies considerably. To ensure that we adequately represent producers' participation, we consider intensity of enrollment in PRF rather than eligibility by including additional fixed effects that indicate high adoption rates in terms of either total acres enrolled or share of pasture acres enrolled. Because we are concerned about the forward-looking possibility of participation rather than current participation, we use an indicator variable for higher rates of participation instead of actual rates, which are more likely to be correlated with unobservable time-variant factors. The underlying assumption is that future participation in PRF coverage is most likely in areas that had a high rate of adoption during the study period. Our final specification is

(3) $$L_{ijt} = \mathbf{X}_{it}\beta + \delta_1 PRF + \delta_3 PRF_{high} + f_i + \tau + \varepsilon_{ijt}$$

where PRF_{high} takes a value of one when an area has a high adoption rate, which is defined as a county in which (i) more than 20 percent or 33 percent of pasture acres were insured under PRF or (ii) more than 50,000 or 100,000 acres were enrolled in the program. These measures capture the counties that had the highest levels of enrollment while ensuring a sufficient number of observations for the high-adoption counties. In 2010, 10 percent of the PRF-eligible counties had enrolled more than 20 percent of their total pasture acres and 5 percent had enrolled more than 33 percent of their total pasture acres. In terms of absolute acres, 14 percent of the PRF-eligible counties had enrolled more than 50,000 acres and 9 percent had enrolled more than 100,000 acres. The share of counties in which enrollment exceeds a certain number or share of acres must be considered in context; some pastureland would not be suitable for PRF enrollment, including pasture owned for residential use. Most of the high-enrollment counties were in states in the southern and northern plains. Drought is more common in those states than in other program states, and production of beef cattle is a major sector of their farm economies.

Results

The estimation results of our fixed-effects models are presented in Table 2. As previously noted, the models represented in equations 1 and 2 are estimated using arithmetic averages of previous cash flows ranging from two preceding years to five preceding years. We report results for the three-year and five-year

Table 2. Results from Fixed-Effects Model

	Equation 1		Equation 2 without Region-Time Effects		Equation 2 with Region-Time Effects	
	Number of Years of Average Previous Cashflow					
	Three	Five	Three	Five	Three	Five
PRF	82.3 * (48.4)	73.0 (48.4)	83.1 * (48.4)	75.2 (48.5)	67.0 (50.8)	65.1 (50.9)
$PRF_{\geq 3}$	—	—	179.8 *** (54.7)	189.4 *** (54.8)	124.4 ** (60.2)	125.1 ** (60.3)
Housing index	7.5 *** (1.7)	7.6 *** (1.7)	7.3 *** (1.7)	7.3 *** (1.7)	8.4 *** (2.1)	8.5 *** (2.1)
Government payments	−15.1 ** (6.1)	−2.4 (7.0)	−14.7 (6.0)	−4.4 (7.0)	−9.9 * (5.8)	−4.3 (7.0)
Livestock returns[a]	−242.3 ** (106.9)	−91.9 (156.9)	−241.4 ** (106.4)	−86.0 (156.6)	−329.3 *** (111.1)	−137.4 (154.8)
Livestock expenses	453.5 *** (165.9)	545.0 ** (277.7)	451.8 *** (165.3)	545.5 ** (275.8)	521.0 *** (172.0)	456.4 * (262.2)
Feed expenses	−56.9 (164.0)	−523.1 (332.4)	−23.1 (162.3)	−496.3 (331.0)	131.1 (151.5)	−273.2 (314.1)
F-statistic	11.2	10.6	10.9	10.3	6.3	6.1
Groups	23,807	23,802	23,807	23,802	23,807	23,802

[a] The negative effects of livestock returns could be due to dividing county livestock returns by the area of pastureland. For example, intensive livestock regions may have low values for pastureland but high farmland values whereas there may be little difference in extensive livestock regions with large amounts of pastureland. Another explanation is that livestock returns could accrue to operations that do not use pasture or that positive returns are more likely to accrue to operations that use pasture but not necessarily other operations in the same period. A similar argument applies to livestock expenses.

Notes: *** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.10$. Standard errors (in parentheses) are robust to correlation at the county level. Additional variables include county population growth, percent irrigated, tract size, and temporal fixed effects. Coefficients and additional iterations with two-year and four-year average expenses, revenues, and government payments are available from the authors upon request.

averages of livestock expenses, livestock revenues, feed expenses, and government payments.

The results of the simple expression of the model in equation 1 suggest that availability of PRF insurance (*PRF*) has a weakly statistically significant relationship with pastureland values when expectations are modeled using a three-year-average of previously observed values and that the estimated premium for pastureland is approximately $82 per acre.

As previously stated, there is reason to believe that benefits of the PRF pilot program may not be capitalized into pastureland values as soon as it is introduced. We therefore estimate the model with an additional fixed effect that identifies counties in which PRF had been available for at least three years (equation 2). This estimation is done both with and without additional region-time fixed effects. Collectively, these results suggest that existence of PRF insurance has a statistically significant and positive relationship with land values. In counties in which PRF insurance had been available for at least three years, pastureland carried a price premium of between $124 and $189 per acre (6–9 percent) depending on the model. However, the initial indicator variable for insurance availability is statistically significant only in one iteration of the model—three-year-averaged cash flow and no region-time effects. This result is expected since participation in and awareness of PRF would increase over time.

Although our year and tract fixed effects likely capture most of the future agricultural earning potential and nonagricultural factors that influence pasture values, some time-variant factors also have a significant impact on pasture values, as shown in Table 2. Changes in an index of housing values have a large, strongly statistically significant effect on pasture value under all of the model specifications. This finding is consistent with other studies that found that general economic conditions and housing values play a large role in determining the value of farmland (Blank 2007). The impact of government payments is not statistically significant under most of the specifications, perhaps because of the small amount of such payments for the majority of the counties in our study. The relationships between government payments and availability of PRF insurance, while only statistically significant in two specifications, are all negative, which may be a result of the impact of large disasters such as Hurricane Katrina on the nonagricultural components of pasture values (i.e., natural amenities).

Unless the model takes into account the complex relationship between use of pasture and nonpasture production of livestock at a county level, livestock returns and expenses have a paradoxical impact. In our models, the livestock return is not statistically significant for half of our specifications while the livestock expense is positive and statistically significant at the 1 percent level for most of the specifications. The negative effect of livestock returns could be a result of our dividing countywide livestock returns by the total area of pastureland. For example, regions with relatively small areas of intensive livestock production might have low values for pastureland but high values for other types of farmland while there might be little difference in valuation in regions with extensive livestock operations and large amounts of pastureland. Also, livestock returns and expenses could accrue to operations that do not use pasture or positive returns or expenses could be more likely to accrue to operations that use pasture than to other operations in the same period. At a county level, then, livestock expenses might be a better measure of pasture revenue than livestock returns. The impact of feed expenses on pasture value is not statistically significant for any of our specifications.

While the magnitude of the coefficients on government payments could be considered large, the scaling by total pasture acres and generally low average values (see Table 1) should be taken into account. Our use of tract fixed effects likely also plays a role in the magnitude of the coefficients for the time-variant factors. Time-invariant factors such as soil quality would likely be much more effective at capturing potential future income than changes in average county-level revenues and expenses over a relatively short period.

The results suggest a robust and consistent price impact of PRF insurance of more than $100 per acre. These results are best interpreted relative to land values since the average PRF premium subsidy ($1.41 per acre in 2010) is substantially less than the county-level average premium subsidy for operations included in the JAS and hence in our study. If we assume that each observation in our sample received a premium subsidy equivalent to the county average, the average premium subsidy in 2010 would be $3.22 per acre. This is not surprising as our data is weighted to be nationally representative rather than representative of PRF-eligible areas.

While these results should not be extrapolated to estimate aggregate impacts of the PRF program, they provide an estimate of the impact of the program on pastureland included in the JAS survey. We next present the results as a share of pastureland values in addition to the absolute impact.

The results reported in Table 2 only capture implied capitalization of the availability of publicly supported insurance. Although we control for all tract-level characteristics and multiple time-variant characteristics, the results could be driven by unobserved time-variant factors correlated with eligibility. Thus, a more complete model should include data on PRF adoption and examining counties that had high rates of PRF enrollment can strengthen our analysis.

When we consider the intensity of PRF participation over time, we find that PRF eligibility alone does not have a statistically significant effect on pastureland values in most cases (Table 3). However, pastureland in counties that have high levels of PRF participation has experienced a statistically significant increase in value on four measures of adoption intensity: an adoption rate of more

Table 3. Results of High-adoption Fixed-Effects Model—Equation 3

	Adoption Rate		Acres Enrolled	
	Greater than 20 Percent	Greater than 33 Percent	Greater than 50,000 Acres	Greater than 100,000 Acres
PRF	80.70*	80.50*	71.84	77.54
	(48.27)	(48.33)	(48.31)	(48.22)
PRF_{high}	38.73	81.40***	147.9***	77.47*
	(44.20)	(41.47)	(52.29)	(43.75)
F-statistic	10.51	10.68	10.74	10.56
Groups	23,802	23,802	23,802	23,802

Note: *** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.10$. Standard errors (in parentheses) are robust to correlation at the county level. Additional variables include feed expenses, livestock expenses, livestock revenues, government payments, county population growth, state-level housing price index, percent irrigated, tract size, and temporal fixed effects. Expenses, revenues, and government payments are calculated using three previous years. Coefficients and additional iterations with two-year, four-year, and five-year average expenses, revenues, and government payments are available from the authors upon request. The results are consistent with our previous conclusions.

than 20 percent of the county's pasture acres, an adoption rate of more than 33 percent of the county's pasture acres, enrollment of more than 50,000 of the county's acres, and enrollment of more than 100,000 of the county's acres. The increase in pasture value varies from $77 to $148 (4–7 percent of land values) depending on the measure of participation intensity. The measures were used to capture the impact of insurance on counties with the greatest likelihood of future PRF participation, and the results are largely consistent with the results for all of the counties (6–9 percent).

The 4–9 percent price impact identified in our study is in line with results of other studies (e.g., the comprehensive literature review of Latruffe and LeMouël (2009)), which found that government farm policies collectively contributed between 12 percent and 40 percent of the value of farmland. The most recent study comparing the effects of individual farm programs that were being implemented during our study period is Goodwin, Mishra, and Ortalo-Magné (2011). If the marginal effects of different government programs on farmland values estimated by Goodwin, Mishra, and Ortalo-Magné (2011) are extrapolated to apply total program payments per acre, the impact on farmland value would range from 1 percent to 7 percent for disaster payments, 1 percent to 3 percent for countercyclical and direct payments, and 1 percent to 15 percent for loan deficiency payments. The ranges depend on the number of previous years used to estimate expected government payments and market returns, and the five-year period generates the greatest estimated impacts. While not directly comparable, our results are generally within these broad ranges.

Several approaches are available for measuring the impacts of policy changes on farmland values. In addition to fixed effects, one can use a difference-in-differences framework, which employs three primary explanatory variables: time, treatment (PRF eligibility in our case), and treatment interacted with time. Since we have panel data, we can further control for all factors that are unique to individual fields, including risk, climate history, and soil characteristics, which, as previously discussed, allows us to make relatively weak assumptions about identification of PRF impacts. The results of a difference-in-differences model are likely to be similar to our results unless some field-level or local factors have a very large impact on selection into the PRF pilot program.

An important caveat to our analysis applies to both approaches—pastureland in counties that became eligible for PRF insurance might be subject to a different price trend than pastureland in ineligible counties. If pasture values increased in PRF-eligible counties at a faster rate than in ineligible counties, our results for the impact of PRF insurance might be biased upward. The average value of pastureland that became eligible for insurance in 2007 versus all other pastureland for 1999 through 2010 is depicted in Figure 1. Land that became PRF-eligible in 2007 had a lower average value than other pastureland, which validates our use of a fixed-effects model, but both sets of land values trend upward at approximately the same rate. This supports our econometric findings since it suggests that the time trends for counties with and without PRF coverage before 2007 did not substantially differ.

While we cannot measure risk and income effects of PRF insurance from our point estimates, we can, with some simple assumptions, calculate "back of the envelope" estimates that give an idea of the potential range of income and risk-reduction effects. We assume that the increase in land value associated with PRF insurance is a result of both an income effect from premium subsidies and a risk-reduction effect from decreased income variability provided by insurance.

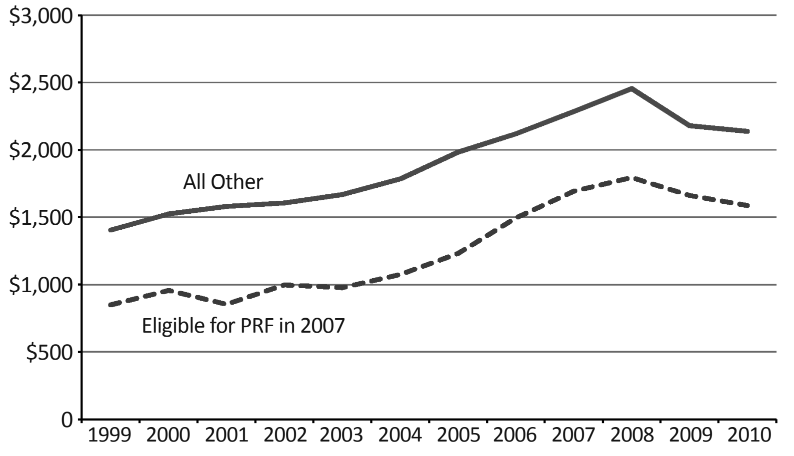

Figure 1. Average Pastureland Value per Acre for Counties Eligible in 2007 vs. All Other Counties, 1999–2010

Note: The effect of PRF insurance is relatively small and occurred over time; therefore, we do not necessarily expect to visualize the difference in the graph. The purpose of this graph is to show the common trend of land values before PRF was available.

We use the standard capitalization formula (income divided by discount rate) to estimate the potential impact of premium subsidies (the present value of all future premium subsidy payments). According to our assumption, the difference between the point coefficient ($125) on having been eligible for PRF insurance for at least three years and the capitalized premium subsidy is the impact of risk reduction on farmland values. We use the county average premium subsidy from the PRF-eligible JAS observations in 2010 ($3.22), which is greater than the average PRF premium subsidy per acre (likely due to our sample having more observations in counties that had higher average premium subsidies). Therefore, our rough estimates of the income and risk-reduction effects should not be interpreted as representative of effects for the entire PRF program. We consider discount rates of 3 percent, 5 percent, and 7 percent that reflect potential differences in interest rates, time preferences, and risk preferences. The three discount rates imply premium-subsidy / risk-reduction effects of $128/–$4 (3 percent rate), $65/$61 (5 percent rate), and $46/$79 (7 percent rate). Although the actual discount rates are not known, low interest rates in recent years support our use of relatively moderate discounts. Overall, these estimates suggest that PRF insurance most likely influences pasture values through both an income effect and a risk-reduction effect unless actual discount rates are very low.

Conclusion

Publicly supported insurance programs have been widely adopted by producers of major crops and some specialty crops, but little is known about the impact of the insurance programs on farmland values. This study takes advantage of a new insurance product for pastureland that was rolled out gradually beginning in 2007. We use a panel of nationally representative, confidential, farmer-reported pastureland values obtained from USDA's JAS. Our results suggest that introduction of the PRF Insurance Pilot Program is associated with higher pastureland values. The model was estimated in various forms to ensure robustness, and the results suggest a premium in the range of 4–9 percent of the average pasture value. A caution when interpreting these findings is that the potential impacts of this program may be small compared to market returns, which have seen substantial increases in recent years; the value of U.S. pastureland increased 67 percent between 2005 and 2011.

The impact identified in our study is applicable to PRF-eligible land in the JAS and should not be used to estimate the program's total impact. However, our results suggest that pasture insurance is valuable to producers and hence to land markets and that landowners are beneficiaries of federal subsidies of pasture insurance. While our results provide support for the notion that PRF insurance is indeed valuable to producers, they also indicate that effects of subsidized federal crop insurance on land value may be similar to the effects of other farm programs.

The Agricultural Act of 2014 eliminated direct payments and strengthened crop insurance and other new programs intended to mitigate price and revenue risks. While this study does not compare the impacts of direct payments and subsidized insurance on cropland values, it demonstrates that insurance can have a significant impact on agricultural land values that is broadly in the range of other types of farm policies. Other studies have shown that agricultural payments that are linked to land are more likely to be capitalized into farmland values (e.g., Latruffe and LeMouël 2009) than payments that are linked to prices, which suggests that insurance programs have a smaller impact than direct payments. Further research is needed to definitively answer this question.

Some further caveats are important when interpreting our results. The PRF program currently is relatively small, and even at 48 million acres enrolled in 2012, it has not yet been adopted for pasture at the same level as insurance products that cover many major agricultural commodities. Consequently, the impacts on pasture value may be limited unless the program continues to expand. While the pilot nature of the program allowed for a unique approach to identifying the impact of subsidized insurance on farm values, the validity of the findings for larger publicly supported crop insurance products needs to be further explored. Future studies would also be useful in validating our main identification assumption—that tract fixed effects and other control variables adequately control for selection into the PRF pilot program. While identifying the impact of crop insurance on farmland values entails many empirical challenges, our results suggest that the impacts may be significant. Continued research on the impact of the broader federal crop insurance program on farmland values and rents will provide important guidance to policymakers as insurance is likely to play an even larger role in the farm safety net in years to come.

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