FARMLAND RENTAL RATES: DOES ORGANIC CERTIFICATION MATTER?

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Abstract: We estimate U.S. organic farmers' marginal willingness to pay to rent an acre of certified organic land relative to conventional farmland. Using a selection-on-observables design and farm-level data on farmland rental rates, organic status, and many conditioning variables, we address the role of profitability in mediating the effect of organic status. We find a 26% rental rate premium for organic farmland not driven by higher profits on organic farms. This premium is a modest incentive for landowners but a barrier for tenants to convert to organic farming practices, which may explain limited growth in U.S. organic acreage.

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I. Introduction

Demand for organic food has led a growing number of farms to adopt certified organic production practices. In 2016, 2.7 million acres of farmland were used to produce certified organic crops in the United States. Although these are less than 1% of total U.S. cropland, current organic acreage is the result of 2.5% year-over-year growth from 2008 to 2016 (*National Agricultural Statistics Service 2017*). Growth in U.S. organic acreage has lagged growth in the value of organic production and retail sales. Over the same period, the value of U.S. organic crop production and retail food sales both grew by about 10% annually (*Organic Trade Association 2016; National Agricultural Statistics Service 2017*). Potential explanations for faster growth in the value of organic production relative to acreage include the allocation of organic acres to higher-value crops, organic crop yield growth, and increasing price premiums for organic crops (*Oberholtzer, Dimitri, and Greene 2005; McBride et al. 2015*).

Growth in organic acreage is partly constrained by the organic certification process. Cropland must be farmed according to organic production practices that forbid the use of synthetic fertilizers and pesticides for three years before production can be labeled for sale as organic. This constraint implies land that can produce certified organic crops will be in limited supply in the short run. The combination of higher-value crops, output price premiums, and inelastic farmland supply may generate economic rents that are bid into input prices, so that organic land will be priced at a premium to conventional land. In aggregate, data on U.S. farms appear to bear this out. The USDA Agricultural Resource Management Surveys (*ARMS*) conducted between 2003 and 2011 showed median cash rental rates paid by organic farms for cropland were 23% higher than rental rates paid by conventional farms. Median reported cropland values were 26% higher for organic farms.

Although there is an extensive literature on the value of farmland and the myriad characteristics that give it value (*e.g., Palmquist, 1989; Plantinga, Lubowski, and Stavins, 2002; Borchers, Ifft, and Kuethe, 2014; Severen, Costello, and Deschênes, 2018*), no study has attempted to estimate the value of organic land[1]. Aggregate differences in rental rates and land values between organic and conventional farms could be the result of systematic differences between the types of land in the distribution of soil productivity, distance to output markets, or other factors, rather than certification. For example, California has the most organic cropland acres and the most expensive farmland in the United States. But this relationship could be driven by the productivity

[1] *Technically, output is certified organic, not the land itself. However, we and others such as the USDA National Agricultural Statistics Services refer to land used for producing certified organic crops as "organic land".*

of California land and the high value of the fruit and vegetable crops grown there, along with greater demand for organic versions of those crops relative to field crops like wheat, corn, and soybeans predominant in other parts of the country.

To identify the value of organic certification in the farmland market, we use the ARMS, a comprehensive, repeated cross-section survey of U.S. farms, and a selection-on-observables research design to estimate organic farmers' marginal willingness to rent an acre of organic land relative to similar conventional farmland. This regression model expresses the average per-acre rental rate paid by the farm as a function of the proportion of the farm's acres certified as organic and other covariates. We carefully consider the identification and interpretation of this organic effect given the limitations of our data. Without the ability to use farm-level fixed effects, observe farmers' profit expectations, or adjust for farm-specific soil quality, identification requires that farm-specific deviations from local average soil quality, management ability, and other unobserved determinants of willingness to pay for cropland are uncorrelated with the farm's organic status.

Our assessment of the value of organic certification in the rental market for farmland relies on comparisons between organic and conventional farms. We briefly describe these differences, how they have motivated other research on organic agriculture, and how our study fits into this literature. Our analysis overcomes many of the difficulties in this earlier work by using a large-scale, nationally representative survey of farms conducted by the USDA. We describe regressions to estimate the organic effect, the important observable conditioning variables, and those observed and unobserved factors that cannot or should not enter the regression model.

II. Why Organic?

Organic cropland is the result of a certification decision made by farmers and landowners. This decision can be likened to other improvements made to farmland. such as investments in drainage, where the farmer chooses a production technology with uncertain future payments. Because the improvement is tied to the land, in the sense that control and use of the land is necessary to receive the benefits generated by the investment, the investment should affect the land value.

Many existing economic comparisons of organic and conventional cropping systems are based on data from long-run experimental trials. For example, most studies included in the meta-analysis of Crowder and Reganold (2015) used experimental data. In these trials, researchers replicate conventional and organic production of a given crop in the context of a long-run crop rotation with input use, rotation crops, and other parameters determined by the researcher. The economic portion of these studies carefully measure differences in input use and crop yield, use assumed prices to value crop revenues and input costs, and compare calculated profits (e.*g., Delate et al. 2003; Delbridge et al. 2013*).

Because output prices are identical across observations in these studies within a treatment group (*organic versus conventional*), researchers often assess the "benefit" of organic price premiums by comparing calculated profits at organic and conventional price levels. For example, this allowed Crowder and Reganold (2015) to attribute their finding of higher organic profitability to these premiums.

The external validity of experimental organic-conventional economic comparisons depend on the degree to which management decisions made by the researcher at the outset of the experiment match the ongoing management decisions made by farmers at various points in the rotation's production cycle in response to the changing set of equilibrium prices. While organic treatments are subject to known constraints on input use imposed by certification (*particularly prohibitions on synthetic fertilizers, pesticides, and genetically modified organisms*) the constraints of the experiment do not allow the researcher to adjust these cropping systems to changing market conditions that may not be common across all farms. In general, the weakness of these experimental studies is that they do not account for these market and farm adjustments.

Conversion decisions

The validity of observational comparisons relies crucially on the relevance of an available counterfactual. Because the ideal control group of conventional farms would look like observed organic farms in a parallel universe where those farms did not convert to organic, it is important to understand the certification process and the incentives facing farms who certify as organic. Once a farm manager chooses to certify, there is a 36-month transition period during which the USDA National Organic Program regulations require that land must be farmed according to organic practices but production cannot be sold as organic. During this time, farms incur the costs of organic farming generally lower yields and higher production costs without augmenting revenue through the organic price premium. The transition period creates a lag between the conversion decision and subsequent market adjustments related to input and output prices. Moreover, the lag generates rigidity in the land market, so we can rule out reverse causality more land cannot be converted immediately in response to higher organic profit.

An extensive but inconclusive literature on the certification decision suggests motives for certification are heterogeneous; both economic and noneconomic motives affect certification (*Darnhofer, Schneeberger, and Freyer, 2005; Chouinard et al., 2008; Cranfield, Henson, and Hollida,y 2010; Kallas, Serra, and Gil, 2010; Khaledi et al.,* *2010; Peterson et al., 2012; Veldstra, Alexander, and Marshall, 2014; Trujillo-Barrera, Pennings, and Hofenk, 2016*). Government programs, the establishment of which may be exogenous to farm-level conversion decisions, provide extremely limited incentive to undergo organic certification.

III. Agricultural Resource Management Survey Dataset

To examine the relationship between organic agriculture, farm profitability, and farmland prices, we primarily use data from the farm-level ARMS. To draw meaningful inference in comparisons of organic and conventional cropland, we need a large sample. Finding one is difficult because there are relatively few organic farms and relatively little organic cropland in the United States, even in regions where organic farming is more popular. Since the mid-1990s, the ARMS has annually surveyed a sample of approximately 20,000 farm operations. This is a far larger and more frequent sample than any other existing data source. The ARMS asks the same questions of organic and conventional farms. Other data on organic farm finances, such as the USDA Certified Organic Survey, collect data on organic farms only, so comparisons with conventional agriculture are not feasible.

Our analysis uses ARMS phase 3 data, which focus on characteristics of the farm business and the farm operator's household. This includes accounting and financial information on revenues, costs, assets, and liabilities. Other survey questions address business and financial decision making, use of crop insurance and government subsidies, off-farm income, and demographic information. The ARMS sampling procedure ensures the data are nationally and regionally representative of the population of U.S. farms with respect to the distribution of farm size and commodities produced (*though the survey sample may not be representative of all subgroups, for example, U.S. organic farms*).

In the nine-year period for which we consider ARMS data, there are 184,315 farm-level observations. Of these, 4,039 are farms with some positive number of certified organic harvested acres in the survey year. For brevity, we call these organic farms. Although the ARMS is designed to be nationally representative of the population of U.S. farms, organic farms in the ARMS under this definition are only a random sample of organic farms. Conventional farms in the ARMS are not designed to be a suitable control or comparison group for these organic farms.

Because we are looking to make meaningful comparisons of farmland rental rates for organic and conventional farms, we limit the sample for our analysis as follows. We eliminate farms that produced less than $5,000 of crops in the survey year, because this is the threshold at which farms must certify if they sell their output as organic. We remove farms if the largest portion of their sales is from livestock, woody trees, or nursery crops. These are farms for which cropland is not a significant input.

We make two final sample adjustments to facilitate our analysis. First, we limit our sample to farms that cash rent land (*that is, farms renting at least some land for which they pay the landlord a fixed rental payment*). Cash rental rates are preferable as a measure of the current price of land in our application for several reasons. As per-period prices, rental rates respond primarily to changes in current expected returns, rather than changes in expectations about long-run returns, discount rates, or the option value of nonagricultural land uses (*Kirwan, 2009*).

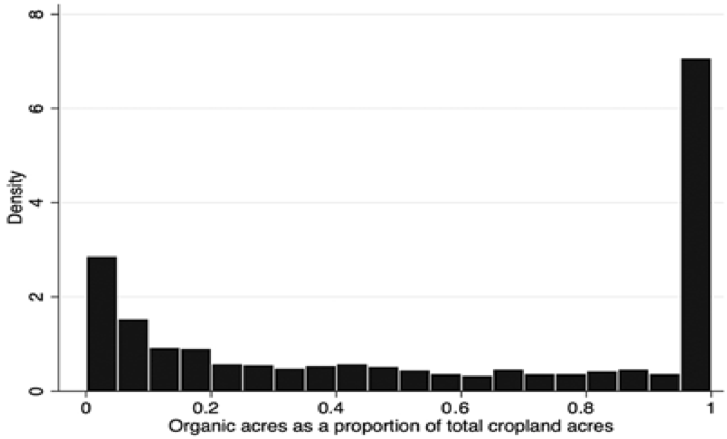
Second, we drop farms located in National Agricultural Statistics Service crop reporting districts (*CRDs*) where the ARMS survey contains no organic farms so we can estimate CRD fixed effects. There are 181 such CRDs. Comparisons of organic and conventional farms require both farm types in all locations (*otherwise average outcomes are subsumed in the CRD-specific fixed effect*). These districts group counties in a state by geography, climate, and cropping practices. U.S. states contain between 1 district (*as in many small Northeastern states*) and 15 (*as in Texas*). Most major crop-producing states have seven to nine districts. Dropping noncash-renting farms eliminates 28,683 observations, and dropping nonorganic CRDs removes another 7,390 observations from our data.

In our estimation sample, we have 37,535 observations, of which 1,051 have organic acres. It is an oversimplification to consider these two groups as treatment and control. Because any single farm operation may grow both conventional and organic crops, the "treatment" of organic certification is not binary at the farm level. We define the organic status of farm i in CRD j at year t, Org_{ijt} as the ratio of certified organic crop acres to total cropland acres:

$$Org_{ijt} = \frac{Organic\ cropland\ Acres}{Total\ Cropland\ Acres} \quad (1)$$

Only 2.8% of the farms in our sample have any organic cropland acres. Of the farms with any organic acreage, growing both organic and conventional crops is fairly common. Figure 1 displays the distribution of organic status on these farms. Approximately one-third of the farms with any organic cropland certify all of their crop acres. The remaining farms exhibit widely varying degrees of certification with a cluster of farms certifying only a small portion *(<20%)* of their cropland (*Figure 1*).

Figure 1. Distribution of Organic Status for Farms with Some Organic Acres



Source: Authors' calculations

IV. Econometrical Model

Our goal is to properly specify an econometric model that accurately estimates the marginal willingness to rent an acre of organic farmland. We consider the relationship between organic certification and farmland rental rates using comparisons of organic and conventional farms. We observe r_{ijt}, the farmland cash rental rate paid by farm i in CRD j at year t. We also observe the proportion of the farm's cropland acres used to harvest certified organic crops, Org_{ijt}. Ideally, we could treat organic status as randomly assigned and estimate the average treatment effect, γ,

$$r_{ijt} = \beta_0 + \gamma Org_{ijt} + \varepsilon_{ijt} \quad (2)$$

Because within-farm variation in organic status is unavailable, we construct a control group from observed conventional farms. We first control for time-invariant unobservables and temporal variation at some level of spatial aggregation above the farm-level. We add spatial fixed effects to the model in equation (3) and include time fixed effects to flexibly address changes in the value of all agricultural land over time,

$$r_{ijt} = \gamma Org_{ijt} + f_j + d_t + \varepsilon_{ijt} \quad (3)$$

In addition to spatial and temporal fixed effects, we condition our comparisons of organic and conventional farms on a vector of other observable variables, X_{ijt}, related to land rental rates, so that we estimate the following regression equation:

$$r_{ijt} = \gamma Org_{ijt} + X_{ijt}\beta + f_j + d_t + \varepsilon_{ijt} \quad (4)$$

Variables in the vector of controls X_{ijt} should be related to land rental rates and correlated with a farm's organic status to bring us closer to conditional independence.

Some of these variables are time-invariant characteristics of the farm or county that would have been captured by farm or county fixed effects had we been able to include them. Specifically at the county level, we control for proximity to urban centers using the Urban Rural Index, average household income, soil productivity, proportion of cropland irrigated, and the number of organic farms. Some of these controls are related to the demand for organic farmland and competitiveness of the local farmland market (*urban-rural indicators, income, number of organic farms in 2002*). Others are related to agronomic differences across counties that might be correlated with the presence of organic farms and rental rates.

1. Identification in the Presence of Variables Determined after Treatment

Using a selection-on-observables design that adjusts for the (*plausibly exogenous*) confounders given above requires us to consider what variables might still be omitted from equation (4). Because farmland rental rates are driven by expected farm profits, it would be tempting to control for farm-level revenues and costs that we observe in the ARMS.

If profit is a "bad control" in the terminoogy of Angrist and Pischke (2009) but important for our understanding of the relationship between organic status and land rental rates, how should we use this information? We partition X_{ijt} into a vector of pretreatment-determined variables Xpre and posttreatment-determined variables Xpost that include profit observed at t.

Simply including posttreatment variables including observed profit as controls as in

$$r_{ijt} = \gamma Org_{ijt} + X^{pre}\beta^{pre} + X^{post}\beta^{post}f_i + d_t + \varepsilon_{ijt} \tag{5}$$

risks biasing our estimates. To see why, consider the interpretation of the coefficient γ in equation (5). Here γ estimates the effect of organic certification holding organic and conventional per-acre profitability at similar levels. This is explicitly not the comparison we want to make, since we expect organic certification may affect the relationship between profitability and willingness to pay for farmland. For example, we do not want to compare farmland rental rates for farms with the same level of expected profit, but to compare farms with the same level of expected profit under a given production system (*conventional or organic*).

V. Results

We estimate the single-stage, single-equation regressions following equations (2)-(5) using ordinary least squares. Although we emphasize estimation of γ, the coefficient associated with organic status, we consider differences in explanatory power across these regressions as a way to understand the considerable cross-farm heterogeneity found in our data. We know that differences in farmland rental rates are driven by local factors obscured in national summary statistics, so preliminary regressions help us understand the source of variation in farmland rental rates. Table 1 contains these regression results. Column (2) shows results of regressing the farmland rental rate on only the organic treatment variable; this estimate suggests there is a significant 72% difference in rental rates between conventional and organic cropland, but the regression holds little overall explanatory power.

Table 1. Farmland Rental Rate Regression Results

Equation	(2)	(3)	(4)	(5)
Organic status	0.723*** (0.157)	0.354*** (0.115)	0.346*** (0.102)	0.273*** (0.079)
Soil productivity			1.051*** (0.094)	0.821*** (0.087)
Organic farms in county			0.001 (0.001)	0.001 (0.001)
County percent irrigated			0.625*** (0.064)	0.363*** (0.057)
County household income			0.248*** (0.068)	0.181*** (0.066)
Crop diversity Gini			1.323*** (0.227)	1.192*** (0.208)
Fixed costs			0.053*** (0.009)	0.004 (0.009)
Subsidy receipts			0.035*** (0.005)	0.022*** (0.005)
Off-farm income			0.026*** (0.003)	0.024*** (0.003)
Debt-to-asset ratio			0.005*** (0.001)	0.004*** (0.001)
Operator age			0.004*** (0.001)	0.003*** (0.001)
Conservation payments			0.046*** (0.006)	0.018*** (0.006)
Production revenue				0.295*** (0.016)
Variable costs				0.118*** (0.017)
Crop insurance indemnities				0.014*** (0.003)
R-squared	0.004	0.485	0.515	0.560

*Notes: Standard errors are in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.*
Source: Authors' calculations

Table 1, column (3) shows the results of regressing rental rate on the organic treatment variable and a set of fixed effects. Recall that fixed effects include year, farm type, crop reporting district, and urban proximity index. These fixed effects, particularly spatial fixed effects at the crop reporting district level, do much of the heavy lifting in terms of the explanatory power of the regression; the R2 increases from close to 0 to nearly 0.5.

Column (4) includes all pretreatment variables (*i.e., all variables with values we believe are determined independently from farm-level organic status*). Each additional variable is statistically significant, although the coefficients for debt-to-asset ratio and operator age are sufficiently small to constrain their economic meaning to nearly nothing. The crop diversity Gini coefficient is a strong positive predictor of rental rate. Column (5) includes farm revenue- and cost-related variables determined after treatment that may be influenced by organic status. All posttreatment regressors revenue, variable costs, crop insurance indemnities, and conservation subsidy payments are statistically significant predictors of observed farmland rental rates.

Interpretation of the coefficient estimates in Table 1 depends on the set of conditioning variables and how each variable is expressed or transformed. Because we use an IHS transformation of the rental rate variable and many of the covariates, interpreting regression coefficients as elasticities or semi-elasticities may result in bias, as demonstrated by Bellemare and Wichman (2020). To address that potential bias, we adjust the coefficients of all variables from our preferred regression, as shown in column (5), using formulas described by Bellemare and Wichman (2020). Table 2 shows the results of those calculations. The majority of the regressors including organic status are measured either as indexes ranging from 0 to 1 or proportions with a similar range. Other variables reported in IHS of their dollar (*or $/acre*) values such as household income, production revenue, and variable costs are interpreted as elasticities. We estimate an organic certification semi-elasticity of willingness-to-pay for farmland of 0.255; we expect a 10 percentage point increase in organic status to be associated with a 2.6% increase in the farmland rental rate. If we extrapolate this estimate linearly to the case where a farm with 0 organic acres were to fully certify all acres and production, we would expect that farm to pay 26% higher cash rent.

Location accounts for much of the observed variation in rental rates across U.S. farms, but other factors help predict intraregional differences. A key predictor of rental rates is soil productivity; a 10 percentage point increase in the county-level soil productivity index is associated with a 6.6% increase in rental rate paid at the farm level. Other variables exhibiting (*significant, positive*) correlation with rental rates include irrigation, cropping diversity, county-level income, and farm-specific revenues and input expenditures. All farm-level, income-related variables production revenue, variable costs, subsidy receipts, crop insurance indemnities, and off-farm income have statistically significant elasticities in Table 2.

Table 2. Elasticities of Farmland Rental Rates with Respect to Changes in Observed Variables

Semi-elasticities	
Organic status	0.255***
	(0.070)
Soil productivity	0.659***
	(0.068)
Organic farms in county	0.000
	(0.001)
County percent irrigated	0.307***
	(0.049)
Crop diversity Gini	0.856***
	(0.148)
Debt-to-asset ratio	0.004***
	(0.001)
Operator age	0.000***
	(0.000)
Elasticities	
County household income	0.195***
	(0.060)
Fixed costs	0.008
	(0.475)
Off-farm income	0.019***
	(0.002)
Conservation payments	0.003***
	(0.001)
Production revenue	0.300***
	(0.014)
Variable costs	0.129***
	(0.014)
Crop insurance indemnities	0.004***
	(0.001)

*Notes: Standard errors are in parentheses. * p < 0.1; ** p < 0.05; *** p < 0.01.*

Source: Authors' calculations

Interpretation of estimated rental rate elasticities with respect to farm income variables is difficult; we include these variables because they may be correlated with the decision to certify as organic and profitability expectations that determine the market price of farmland. We do not expect higher input expenditures to make farmers more aggressive bidders in the land rental market. Instead, these variables are simply important conditioning information when estimated the effect of organic status on rental rates, helping predict intraregional differences in rental rates. Not surprisingly, the magnitude of the relation between production revenue and rental rates is large. We estimate farms with 10% higher production revenue pay 3% more in rent on average. The magnitude of the elasticity is greater for those variables that are directly tied to farmland production, rather than government payments that may not be related to production or off-farm income that may be entirely unrelated.

VI. Conclusions

This study provides the first empirical estimate of the relative value of organic farmland. We find greater organic certification at the farm level increases the rental rate paid, such that organic farms pay 26% more to rent land than do similar conventional farms. This estimate adjusts both for farm-specific characteristics and locational factors that might drive differences in willingness to pay, such as urban proximity, soil characteristics, crop choice, and other factors. Our estimate is not simply the result of broad variation in land prices across space. The prevalence of organic agriculture in places where farmland is expensive, like California, does not explain our result. We also rule out greater per-acre profitability from organic production relative to conventional as a motivation for organic farmers to pay more for land. Consistent with earlier findings from observational data, organic farms do not appear to earn greater per-acre accounting profits on average than their conventional counterparts.

A related explanation for higher organic rental rates lies in tenure security for organic farms on rented land. The asset fixity implied by the rules for organic transition increases the cost of converting farmland. It also may affect the bargaining power held by farm operators in negotiating rental rates with landowners. Because of asset fixity, farmland operators may be willing to pay the organic farmland price premium to rent land to maintain the value of other investments in organic certification and avoid the uncertainty of losing the lease. In work describing the incentives land owners can provide for tenants to use specific sustainable farming methods (*e.g., Cox, 2010; 2011*), tenure security is brought up extensively. Longer-term leases and provisions giving tenants first right of refusal to purchase the land if it is sold are suggested as nudges for tenants to adopt practices that may have long payback periods, similar to organic conversion. For farmers who own land, many of these costs and benefits are internalized. In this way, our work may provide evidence of liquidity and other financial constraints for farmers. One explanation of the persistence of the rental rate premium is that farmers do not have adequate liquid or leverageable assets to purchase land. In the absence of such constraints and assuming competitive markets, land would continue to transition to organic until the economic returns from organic and conventional land were equal.

We can evaluate existing policies and market incentives for adopting organic agriculture in light of the magnitude of our estimated organic farmland price differential. Two examples are subsidies to offset conversion costs, such as the Organic Certification Cost Share Program provided by the USDA and market incentives paid by organic food buyers for production harvested during the three-year organic transition period, such as the QAI Certified Transitional program (*Kashi 2016*). The first is so small that it seems unlikely to meaningfully change behavior. Market incentives during and after organic conversion may be effective if they are substantial when measured in dollars per acre. However, even large incentives may not be sufficient to induce widespread conversion if organic farm operators reap the benefits of the subsidy but lack the capital to acquire land for conversion.

Our results show a 26% rental rate premium for organic land, valued at approximately $29/acre at the average farmland rental rate observed in our data. This premium has been sufficient for at least some certified organic production on rented acres, but many suggest that acreage growth is slow relative to demand for organic foods (*e.g., Delbridge et al. 2017*). To spur more rapid conversion of U.S. farmland from conventional to organic, organic food demanders must provide greater incentives to both farmers and landowners to transition land to organic. That incentive can either be provided by lowering conversion costs or increasing the return on investment through higher organic product premiums. Our findings suggest that there is room for innovation in both areas

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