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Viability of Organic Production in Rural Counties: County and State-Level Evidence from the United States

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We investigate the determinants of organic farming in the United States. State-level data show that the organic farming sector has grown over the last decade, but growth has been very heterogeneous with few states accounting for most of the growth. Further analyses of county data reveal that favorable natural amenities, water for irrigation, and government payments have a positive effect on most measures of organic farming used here. Results further point out that organic farming operations are more popular among young farmers. Adjacency to metro areas is also an important determinant for the number of organic operations. Organic farming is more important for the agricultural sector of the areas that are somewhat remote but that does not appear to be the case for very remote rural areas.

Key Words: county, organic farming, rural

JEL Classifications: Q10, R58

Organically raised products often return a higher revenue share to farmers than conventional products while promoting sustainable production methods and small-scale agriculture. Some suggest that organic farming on family farms has the potential to revitalize U.S. rural areas and their economies (Vasilikiotis, 2001). Research in the European Union suggests that as a result of an increased consumer demand for organic products, organic farming has already contributed to the economic and social development of many rural areas in Europe (European Commission, 2009). U.S. prospects also look promising: organic production has more than doubled in the United States since the late 1990s and organic sales of foods have almost quintupled, increasing from $3.6 billion in 1997 to $21.1 billion in 2008 (Greene et al., 2009). Although new organic producers have emerged to meet the rapidly growing demand, many handlers of organic product still experience critical shortages of organic products and are unable to meet the demand (Greene et al., 2009).

Studies on organic farming have generally examined organic farming for particular sectors (e.g., Bhuyan and Postel, 2009; Kuminoff and Wossink, 2010) or the characteristics of individual farmer adopters (e.g., De Cock, 2005). However, studies on organic farming at the more aggregate U.S. county level remain largely descriptive. This study examines the determinants of organic farming adoption in rural areas using county- and state-level evidence. Specifically, we investigate the factors that influence

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the number of small and large organic farming operations as well as the importance of organic farming on the whole agricultural sector at the county level.

Our findings suggest that organic farming depends on the quality of natural amenities, but also on the degree of "rurality" as measured by the U.S. Department of Agriculture (USDA) Economic Research Service's (ERS) 2003 definition of rural–urban continuum codes for areas in the United States. Adjacency to a metro area also seems to play a role on the number of organic farmers. The findings of this study may provide useful information to policymakers who seek to enhance their understanding of the organic production sector and promote agricultural sustainability in rural areas.

The rest of the article is organized as follows. Section two provides a description of the empirical strategy. Section three presents the data used. Section four discusses county- and state-level results. Section five concludes and draws policy implications and further research.

Empirical Strategy

We investigate the determinants of organic agriculture at the county level as well as the factors that influence the number of small (less than $5,000 annual sales) and large (more than $5,000 sales) organic operations in a multivariate regression framework. We aim at answering three questions. First, we uncover determinants of the overall "quantity" of organic farming. We use two measures of quantity: the number of organic operations (a measure of the number of households involved in farming) and organic farming acres (a measure of resources dedicated to organic farming) at the county level. Second, we investigate whether the factors that influence the number of small producers and larger organic operations differ significantly. This is important because many believe that smaller-scale agriculture is likely to use sustainable methods and is socially desirable. Finally, we investigate the importance of organic farming revenues measured as the share of organic farming sales over total agricultural sales at the county level (a measure of the importance of the organic sector for agriculture as a whole).

Consequently, we use the number of organic operations, organic acres, number of organic farms with sales of less than $5,000, number of organic farms with sales of more than $5,000, and the ratio of organic farming sales to the total agricultural value at the county and state level as our dependent variables in regression models.

The basic specification assumes that the measures of organic farming are linearly related to a number of observable county attributes[1]:

(1) $y = x\beta + u,$

where y is a measure of organic farming quantity or intensity and x is a vector of observables. Four sets of covariates are included at the county-level regression models describing general agricultural characteristics, socioeconomic factors, the degree of "rurality," and natural characteristics. The variables that describe agricultural characteristics are total cropland, total pasture, government payments, and water extracted for irrigation. The socioeconomic variables are population, average farmer's age and years of experience in farming, percent white, percent Hispanic, percent poor, and median household income for each county. A measure of natural characteristics that accounts for many climatic factors is the natural amenities scale. Finally, we use the USDA-ERS 2003 rural–urban continuum code to control for the degree of "rurality."

The county-level analysis offers multiple advantages, namely a large number of observations, a large number of covariates observed, and rather recent information (as of 2006–2007). However, we can only observe a snapshot as of year 2007 with our county-level data set. We also use a state-level data set that lacks the detail that we capture in the county data but is able to provide a picture of the growth in the importance of organic farming over the last decade. We provide a description of the main characteristic of organic farming from 2000–2009 at the state level for all U.S. states. More specifically, Figure 1

[1] A number of counties have no organic farming so the dependent variable is zero. In alternative specifications, we treat this as a left censoring issue and estimate each equation as a Tobit. The findings do not change substantially.

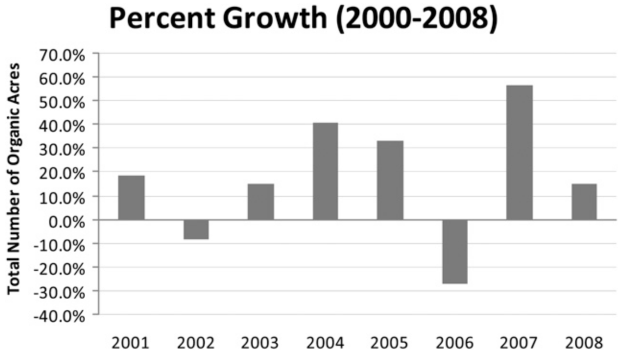

Figure 1. Growth of Organic Acres in the United States (State Level) (SOURCE: USDA)

illustrates the growth of organic farming among the U.S. states for the period 2000–2009 and Figure 2 illustrates the share of organic farming sales on total agricultural sales for 2009.

New Hampshire leads the market with the highest share of agricultural revenues coming from organic sales (with 7.05%). Vermont has the second highest share of organic produce at 6.51% followed by Maine and Massachusetts

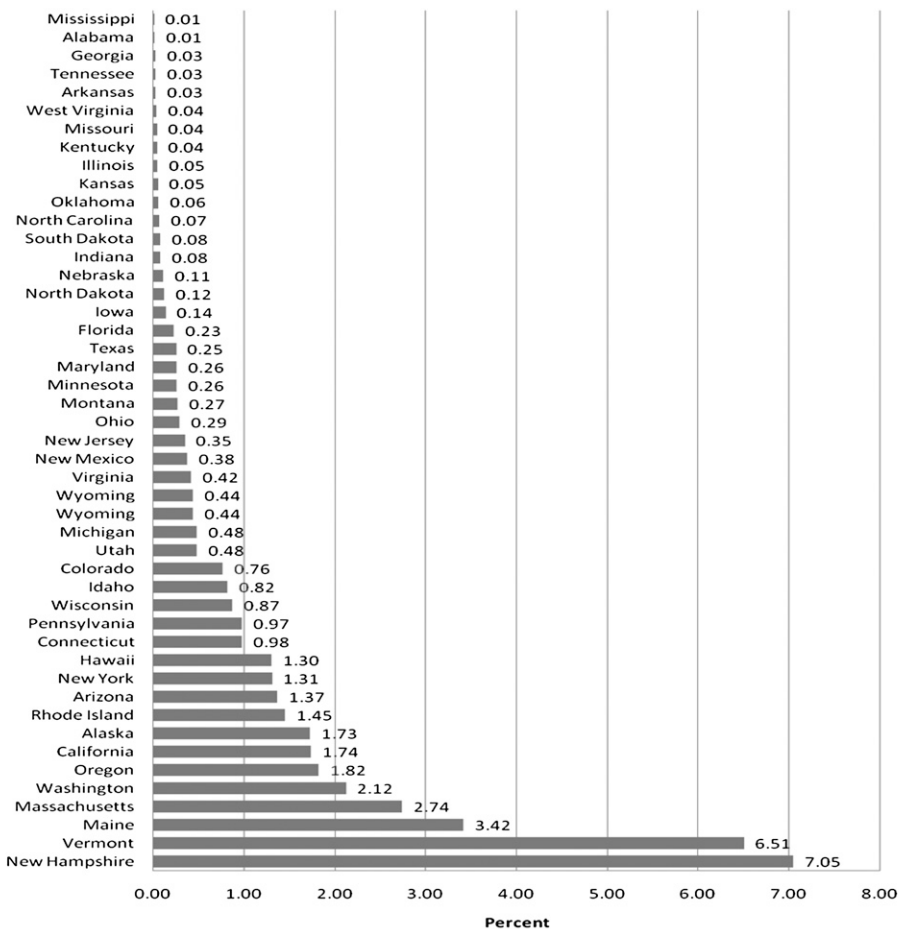

Figure 2. Organic Farming Sales as a Share of Total Agricultural Sales in 2007 (State Level) (SOURCE: USDA)

with 3.42% and 2.74%, respectively. The rest of the states have a low percent share of agricultural product ranging from 0% to 2.12%. There are missing data for Delaware, Louisiana, Nevada, and South Carolina. Therefore, they are excluded from the graph.

Data

The main county- and state-level data used in this study are available from the 2007 Census of Agriculture provided from the USDA and the National Agricultural Statistical Service. Variables collected at the county and state level provide information on organic farming, general agricultural production conditions, socioeconomic conditions, natural characteristics, and the degree of "rurality." The data on organic farming and general agricultural information are extracted from the 2007 Census of Agriculture. The socioeconomic variables are available from the U.S. Census Bureau and the natural characteristics variables are available from the ERS of the USDA. The data used for the purpose of this study at the county level are a cross-section for year 2007. Summary statistics for the county-level variables used in this study are provided in Table 1.

Table 1. Summary Statistics: County Level

Variable Description	Mean	Standard Deviation	Minimum	Maximum
Population	103,653	343,822	281	9,779,254
Natural population increase (number of people)	635	3133	–1065	92,350
All cropland (acres)	135,730	154,050	43	1,310,448
All pasture land (acres)	146,677	322,465	12	6,043,535
Natural amenities scale	0.056	2.306	–6.4	11.17
Government payments ($)	43,423	116,477	0	1,717,000
Missing value for government payments (1 or 0)	0.33	0.47	0	1
Farmer years of experience in farming	21.77	2.79	9.6	30.8
Average age of farm operators	57.22	2.11	46.2	65.4
Gallons of water for irrigation in 2005 (in millions)	19.96	72.31	0	986.45
Percent white	79.50	18.91	2.3	99.4
Percent Hispanic	7.84	13.07	0.2	97.1
Percent poor	15.12	6.35	2.4	55.9
Median household income ($)	42,669	10,911	17,488	107,200
Counties with rural–urban codes from 0–3 (1 or 0)	0.34	0.47	0	1
Counties with a rural–urban code of 4 (1 or 0)	0.07	0.26	0	1
Counties with a rural–urban code of 5 (1 or 0)	0.03	0.18	0	1
Counties with a rural–urban code of 6 (1 or 0)	0.19	0.39	0	1
Counties with a rural–urban code of 7 (1 or 0)	0.14	0.35	0	1
Counties with a rural–urban code of 8 (1 or 0)	0.08	0.27	0	1
Counties with a rural–urban code of 9 (1 or 0)	0.14	0.35	0	1
N	2071			

Note: Unless stated otherwise data refers to year 2007.

To account for "rurality," we generate categories based on the ERS–USDA 2003 rural–urban continuum code. Because very little agricultural production takes place in metro areas, we group metro areas with rural–urban continuum codes between 0 and 3 under one category.[2] A description of the rural–urban continuum codes is provided in Table A.1 of the Appendix.

Results

The first question that we investigate is what influences the number of organic operations and organic acreage. The results for this analysis are provided in Table 2. As previously mentioned, dependent variables in the first and second regression are the number of organic operations and organic acres, respectively.

Several variables appear to influence the number of organic operations at the county level. As expected, the number of organic operations increases with a higher population and more overall agricultural land. Pasture land, on the other hand, is negatively associated with the number of operations after overall agricultural land and population are held constant. Similarly, organic operations are strongly positively correlated with the natural amenities scale. Government payments are also positively and significantly associated with the number of organic operations. Farmers' years of experience in agriculture do not influence the number of organic operations, but the average age of farm operators, on the other hand, is negatively correlated with the number of organic operations. This observation suggests that organic farming is being embraced by young farmers who are more eager to try new ways of farming. Water for irrigation also contributes in the number of organic operations. Generally, counties with higher household incomes contribute to more organic farm operations, perhaps as a result of a higher consumer demand for organic products that tend to have higher prices compared with their conventional counterparts.

Now we shift focus on the results in terms of "rurality," which should be interpreted with respect to those counties with a rural–urban continuum code of 7 (urban population of 2,500 to 19,999, not adjacent to a metro area). Surprisingly, counties located in areas with a code between 0 and 3 have more organic operations than counties with a rural–urban code of 7.[3] This could be attributable to proximity to large cities. In addition, counties with a code of 6 have substantially more organic operations. Similarly, counties with a code of 6 are adjacent to a metro area and naturally more organic operations are expected in these areas compared with the control counties (code 7), which are not adjacent to a metro area. Thus, proximity to a metro area seems to play an important role when it comes to the number of organic operations at the county level. In fact, metro areas generally have a higher number of farmers' markets (as a result of a higher population) and organic products are generally more perishable than conventional agricultural products.

The second regression model investigates factors that influence the number of organic acres. Total cropland, pasture land, natural amenities, irrigation water, and government payments appear to be positively correlated with the size of organic acreage at the county level. The natural amenities scale appears to be the most important determinant of organic acres. Median household income does not have a strong positive effect on the number of organic acres. Lastly, "rurality" does not appear to have similar associations with organic acres as it does with the number of operations.

We also provide some insights on the size of organic operations and the importance of organic farming at the county level in Table 3. Many believe that organic farming can be a way of life for many small farmers. In fact, small and medium farms play a central role in the sustainable agriculture literature. For this purpose, the first and second regressions in Table 3 contain the number of operations with annual sales of less than $5,000 (i.e., small organic

[2] Counties under the 0–3 rural continuum code category comprise 34% of the total sample.

[3] Note that this is after holding population, population growth, and total agricultural area constant.

Table 2. Determinants of the Number of Organic Operations and Organic Acreage

	Operations		Organic Acres	
Variable Description	Coefficient	Standard Error	Coefficient	Standard Error
Population (1,000)	0.0137***	0.0039	–0.8830	0.6454
Population increase (no. of people)	–0.0005	0.0004	0.0935	0.0696
All cropland (1,000 acres)	0.0194***	0.0033	6.2439***	0.5429
All pasture land (1,000 acres)	–0.0029**	0.0014	0.7933***	0.2247
Natural amenities scale	3.147***	0.234	376.7***	38.805
Government payments ($1,000)	0.0261**	0.0035	4.0277***	0.5756
Missing value government payments (1 or 0)	1.581*	0.846	227.372	140.273
Farmer years of experience in farming	0.088	0.196	21.016	32.506
Average age of farm operators	–0.947***	0.215	–137.7***	35.654
Irrigation water in 2005 (million gallons)	0.0121**	0.0061	5.1165***	1.0058
Percent white	0.1217***	0.0356	–2.2273	5.9018
Percent Hispanic	0.0679***	0.0424	–19.62***	7.0347
Percent poor	0.1705	0.1268	13.7785	21.0154
Median household income ($)	0.0003***	0.0001	0.0200*	0.0113
Rural–urban code from 0–3 (1 or 0)	3.7364***	1.3904	11.1935	230.5190
Rural–urban code of 4 (1 or 0)	5.8798***	1.7691	9.2022	293.3036
Rural–urban code of 5 (1 or 0)	1.1896	2.3734	–101.54	393.4953
Rural–urban code of 6 (1 or 0)	3.8293***	1.3540	38.8373	224.4782
Rural–urban code of 8 (1 or 0)	1.5393	1.7192	404.043	285.0341
Rural–urban code of 9 (1 or 0)	–0.0429	1.4561	–50.177	241.4145
Constant	27.89**	14.33	6334.7***	2376.26
N	2071		2071	
R^2	0.24		0.20	

Notes: Unless stated otherwise, data refer to year 2007.
*, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

operations) and those with sales of more than $5,000 (i.e., large organic operations) as their dependent variables, respectively.

Coefficients of the first two regression models suggest that the number of small and large organic operations at the county level is positively and significantly (at the 99% level and above) correlated with population, cropland, pasture land, government payments, and the natural amenities scale.[4] However, there appear to be differences on the effect of the amount of water available for irrigation. The number of large organic operations increases with more water availability, whereas the number of small organic operations does not appear to be influenced by water irrigation. Thus, as expected, larger operations do depend on water availability because farming is usually the main occupation for larger farm operators. Once again, adjacency to an urban area seems to be an important factor for both small and larger organic farms. For the latter, adjacency to a larger metro area (rural continuum code of 4) is more important than for smaller organic farms, which can survive even in more rural areas because they have smaller sales.

[4] Information on government payments was withheld in many cases to avoid disclosing information on individual farms. We construct a "missing government payments" variable so that we do not lose many observations as a result of these missing values.

Table 3. Determinants of the Size of Organic Operations and the Importance of Organic Farming

	Small Operations		Large Operations		Share of Organic Sales	
Variable description	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Population (1,000)	0.0090***	0.0031	0.0092***	0.0026	0.0000	0.0000
Population increase (no. of people)	–0.0003	0.0003	–0.0004	0.0003	0.0000	0.0000
All cropland (1,000 acres)	0.0116***	0.0026	0.0118**	0.0022		
All pasture land (1,000 acres)	–0.0026**	0.0011	–0.0018**	0.0009		
Natural amenities scale	2.1711***	0.1848	1.8203***	0.1568	0.0013***	0.0002
Government payments ($1,000)	0.0172***	0.0027	0.0131***	0.0023	0.0000	0.0042
Missing value government payments (1 or 0)	1.4557**	0.6679	0.8729	0.5670	0.0000***	0.0000
Farmer years of experience in farming	0.1225	0.1548	0.0287	0.1314	0.0012*	0.0006
Average age of farm operators	–0.5748***	0.1698	–0.5900***	0.1441	0.0004***	0.0001
Irrigation water in 2005 (million gallons)	0.0020	0.0048	0.0117***	0.0041	–0.0004**	0.0002
Percent white	0.0529*	0.0281	0.0802***	0.0239	0.0001*	0.0000
Percent Hispanic	0.0375	0.0335	0.0554**	0.0284	0.0000	0.0000
Percent poor	0.0175	0.1001	0.1596*	0.0849	0.0001	0.0001
Median household income ($1,000)	0.1446***	0.0539	0.2064***	0.0457	0.0001**	0.0000
Rural–urban code from 0–3 (1 or 0)	1.8880*	1.0977	2.1391**	0.9317	–0.0006	0.0010
Rural–urban code of 4 (1 or 0)	3.7068	1.3966	2.6234**	1.1855	–0.0002	0.0013
Rural–urban code of 5 (1 or 0)	1.1437	1.8737	0.1187	1.5905	0.0055***	0.0018
Rural–urban code of 6 (1 or 0)	2.0298*	1.0689	2.1048**	0.9073	0.0008	0.0010
Rural–urban code of 8 (1 or 0)	1.1432	1.3573	0.6672	1.1521	–0.0004	0.0013
Rural–urban code of 9 (1 or 0)	0.1337	1.1496	0.0932	0.9758	–0.0014	0.0011
Constant	19.58*	11.32	15.57	9.60	0.01	0.01
N	2071		2071		2058	
R^2	0.18		0.22		0.06	

Notes: Unless stated otherwise data refers to year 2007.

*, ** and *** indicate statistical significance at the 10, 5 and 1 percent level, respectively.

As stated in the introduction of this study, organic farming is the fastest growing branch of U.S. agriculture. However, it is still a very small part of the agricultural sector. Thus, in the last model of Table 3, the dependent variable is the share of organic sales on the total value of agricultural production at the county level. Once again, the natural amenities scale coefficient is positive and significant suggesting that organic agriculture thrives in counties with relatively better overall natural agricultural amenities. Years of farming experience and the average age of farm operators are positively correlated with the share of organic sales on total agricultural sales. One plausible explanation for this result may be that older farmers operate, on average, larger organic operations. A surprising result is that the more water available for irrigation at the county level, the less important organic agriculture is for that county. Thus, conventional agriculture is more dependent on water for irrigation than organic agriculture. Finally, organic agriculture appears to be more important for counties with a rural continuum code of 5, which are not very rural but are not adjacent to a metro area.

Summary and Conclusions

We investigate the determinants of organic farming at the county level using information on all counties in the United States. We find that the natural amenities index has a positive effect on all measures of organic farming that we used here. Water for irrigation appears to positively affect the number of organic operations, but it is less important for small operations and relatively less important for organic agriculture than conventional. Results indicate out that organic farming operations are more popular among young farmers. However, farmer age and experience appear to be positively related to the share of organic sales.

Most importantly, we find positive associations between government payments and organic farming, suggesting that it may be possible for government programs to encourage organic farming to a notable extent. However, it is not possible in this cross sectional effort to establish a causal link between payments and organic agriculture. We suggest that the issue be investigated further with quasi-experimental methods or longitudinal data.

Another objective of this study was to investigate organic farming controlling for the degree of "rurality." Our findings in this aspect suggest that adjacency to metro areas is an important determinant for the number of organic operations. On the other hand, organic farming is more important for the agricultural sector of the areas. which are more "rural" (with a continuum code of 5). Finally, remote rural areas (those with continuum codes of 8 and 9) do not appear to be favorable for organic farming in any of the aspects investigated in this study.

To our knowledge, this is the first investigation of organic farming at the county level that includes all U.S. counties. The results of this study can be useful to state and private organizations that seek to have a better understanding of the factors that influence organic farming. Most notably, this study provides insights for more analysis of this sort as more and more consumers are driven toward organic farming products.

References

Bhuyan, B., and M. Postel. "Determinants of Organic Dairy Farm Profitability: Some Evidence from the Northeast United States." Selected paper prepared for presentation at the Agricultural and Applied Economics Association's (AAEA) 2009 Joint Annual Meetings, Milwaukee, WI, July 26–29, 2009.

De Cock, L. "Determinants of Organic Farming Conversion." Paper prepared for poster presentation at the XI International Congress of the EAAE (European Association of Agricultural Economists), "The Future of Rural Europe in the Global Agri-Food System," Copenhagen, Denmark, August 24–27, 2005.

Economic Research Service, U.S. Department of Agriculture. Internet site: www.ers.usda.gov/Publications/AER781/ (Accessed October 9, 2010).

European Commission. Organic Farming, Good for Nature, Good for You. Web Publication of the European Commission. 2009. Internet site: http://ec.europa.eu/agriculture/organic/society-economy/rural-development_en (Accessed May 24, 2010).

Greene, C., Dimitri, C., Li, B., McBride, W., Oberholtzer, L., and T. Smith. *Emerging Issues in the U.S. Organic Industry.* EIB-55. U.S. Dept. of Agriculture, Economic Research Service. June 2009.

Kuminoff, N.V., and A. Wossink. "Why Isn't More US Farmland Organic?" *Journal of Agricultural Economics* 61(2010):240–58.

———. Internet site: http://quickstats.nass.usda.gov/?source_desc=CENSUS (Accessed May 5, 2010b).

Vasilikiotis, C. "Can Organic Farming 'Feed the World'?" Energy Bulletin, Published by the University of California, January 31, 2001. Internet site: www.energybulletin.net/node/1469 (Accessed June 16, 2010).

Appendix

Table A.1. Description of the Rural–Urban Continuum Codes (1983–2003)

Code	Description
0	Central counties of metro areas of 1 million population or more
1	Fringe counties of metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500–19,999, adjacent to a metro area
7	Urban population of 2,500–19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

Source: Economic Research Service, U.S. Department of Agriculture (2010).