Are all farms better-off growing organic? An unconditional quantile regression approach

Aditya R. Khanal[1] and Ashok Mishra[2]

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[1] Assistant Professor of Agribusiness, Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, TN; e-mail: akhanal1@tnstate.edu.
[2] Kemper and Ethel Marley Foundation Chair and Professor, Morrison School of Agribusiness, Arizona State University, AZ.

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Abstract

We investigated the impact of participation in certified organic production on farm earnings and net cash farm incomes of the US farm households. Using a nation-wide dataset and an unconditional quantile regression approach, we found a significant heterogeneous effect across different quantiles of farm earnings. Our results suggest that the effect of certified organic production is positive across the unconditional quantiles of net cash farm income but the effect is significantly larger for the farms with larger operations while smaller operations have low or non-significant effects.

Introduction

The demand for organically grown food products has been increasing in the US. For example, total sales of organic products increased from $11 billion in 2004 to about $28 billion in 2012 (Osteen et al., 2012; Greene 2013). Online news sources suggest that food retailers and wholesalers, such as Whole Foods, Kroger, Wal-mart, Sam's Club, and Costco are experiencing significant increases in the demand and sales of organically produced foods in recent years (Patton and Giammona 2015). Organic food production is one of the fastest growing segments of American agriculture. United States Department of Agriculture (USDA) has a goal to promote certified organic producers and local food systems. With significant increases in demand for organic foods, interesting question to investigate are a) is this increase in demand for organic foods pushing American farmers to switch to organic food production? and b) do all farmers derive economic profits? An appropriate data and quantitative analysis is required to answer these questions.

This study investigates these issues by analyzing the earnings and net farm income structure of organic producers in the US. Unlike previous studies that rely on average estimates or mean-based coefficients, we accounted for the entire distribution of earnings among US organic producers. Specifically, this paper examines the impact of participation decision in certified organic production on the entire distribution of farm earnings using the unconditional quantile regression (UQR) approach. UQR approach allows us to quantify the impacts of organic production at different spectrum of the farm's earnings. Unlike conditional quantile regression which is conditional on the distribution of outcome and depends on the level of other conditioning variables in the quantile, UQR approach allows us to investigate the influence of a specific decision, program or policy (in our case certified organic production) on the unconditional distribution of outcome, irrespective of the other variables. Note that the unconditional effect is often an interest for policy makers.

Over the last decade, there has been an increasing trend in the demand for organic products due to growing demand for healthy products in the US. Organic market overview (USDA, ERS) shows that consumer demand for organic products is in double-digit growth, organic products are available in nearly 20,000 natural food stores accounting for around 4 percentage of total U.S. food sales. Organic products are well-known for their health-related benefits, but they are also considered eco-friendly on environmental aspects. Environmental benefits of organic farming mainly include: improved water and soil quality, reduced nutrient pollution and increased carbon sequestration (Greene et al., 2010; O'Riordan and Cobb, 2001). Noting these aspects, US Department of Agriculture aims to expand research and development in organic agriculture through different programs (USDA ERS, 2014).

Many farmers are undergoing the transition from conventional to organic farming. Between 2005 and 2011, certified organic cropland expanded nearly 80 percent, to 3.1 million acres. However, the overall adoption level for certified organic cropland and pasture land is about 0.8 and 0.5 percent of all U.S. cropland and pasturelands, respectively in 2011. This rate, however, has expected to have expanded in recent years but not to the extent that the demand has grown. There has been a number of empirical studies that investigated the organic agriculture. However, most of them are concentrated into consumer side—willingness to pay for organic food, organic sales growth and market expansion etc. Therefore the studies related to production side of organic farming: production, certification, and cost structure on producer perspectives and the research questions on economic profits of organic production needs closer attention. Uematsu and Mishra (2012) found that the U.S. organic farmers incur significantly higher production costs than conventional farmers; the value of sales and gross farm income were higher for certified organic farmers but they also experienced a higher production expenses than conventional farmers. Though Uematsu and Mishra's (2012) study provides an insight into the impact of organic farming on farm incomes, it uses average treatment effects which lacks to disentangle the effect of organic production on different spectrum of sales and net farm income distribution. Note that the effects of certified organic farming may differ across different size of operation; study of differential impacts of organic farming on different spectrum of farm earnings allows us to understand the most benefited types of farms from organic farming.

Our analysis provides an unbiased estimate of the impact of certified organic farming on farm earnings and reveals that there is a heterogeneous effect across the distribution of farm earnings. Specifically, the effect on total farm sales and net cash farm incomes associated with organic farming is different in magnitude, though positive, for bottom quantiles and top quantiles. In terms of net cash farm income, our findings suggest that the larger farms with high volume sales are the most benefited from organic farming while small farms have low or no significant increase. We also investigate the other demographic factors that significantly affect farm earnings. The practical implication of our findings could provide an insight to policy makers: programs aiming higher adoption for organic certification and promoting organic farming should emphasize on easing cost and certification hurdles for small to medium sized farmers. To the best of our knowledge, our empirical analysis is the first one to provide an appropriate unconditional heterogenous effect of organic farming accounting for entire distribution of farm earnings and net cash farm incomes.

The basis for choosing quantile regression approach in our analysis is motivated by a significant degree of heterogeneity observed while we plot the farm earnings by participation in organic farming using a national level data from the 2012 Agricultural Resource Management Survey from USDA/ ERS. Figure 1 shows violin plots of total value of farm sales for organic producers compared to the non-organic (conventional) producers. A quantile approach is justified based on the significant degree of heterogeneity in the earnings distribution with groups of farmers clustering in upper and lower tails.

The remainder of the paper is organized as follows. In the next section, we discuss empirical framework and econometric model. Then we provide discussion about the data used in this study and present our results. The last section summarizes our findings and concludes.

Empirical Framework

Let y_i be a total value of farm sales (earnings) for farm household i. Then determinants of y_i are represented by following equation:

$$y_i = X_i\beta + d_i + c_i + \varepsilon_i \qquad (1)$$

where X_i represents the observed characteristics, c_i represent unobserved characteristics and ε_i is the stochastic error component. Following Card and de la Rice (2006) and Park (2015), let the term d_i in above equation represent earning premium (or discount) earned by the farmer and assume d_i depends on farm-level covariates (Z_i) and an indicator of the producer's participation in certified organic production and sales (O_i).

$$d_i = O_i\alpha + Z_i\theta \quad (2)$$

Combining equation (1) and (2), we obtain:

$$y_i = X_i\beta + O_i\alpha + Z_i\theta + c_i + \varepsilon_i \quad (3)$$

We assume that the unobserved characteristics are uncorrelated with the participation in organic production. Under this assumption, equation (3) can be estimated using a class of estimators such as ordinary least squares (OLS) or quantile regressions. Next, we present the distinct advantage of using unconditional quantile regression (UQR) approach over OLS.

Econometric Approach

In this section, we provide discussion about our econometric approach. We motivate our approach by documenting a significant degree of heterogeneity in farm earnings. Figure 1 shows violin plots of farm earnings by participants and non-participants of organic farming. Violin plots combine box plots and density traces in one diagram so that we can see the center, spread, asymmetry, and distribution of data—peaks and bumps in one place. Violin plots show that the largest share of producers with organic sales cluster at lower and mid-levels of total farm sales. If we use ordinary least squares (OLS) estimators, we cannot capture such heterogeneity because OLS are based on location shift models (Heckman, 1979) which estimate conditional means of dependent variable (y) given independent variable (x)—with a very restrictive assumption that conditional distribution of y are identical at any values of x, except for the means, which are to be estimated by least squares. Note that the only change in the conditional distribution of y due to change in x in OLS model is its relative location, which is determined by conditional mean.

Unlike OLS, quantile regression approach estimates for the potential scale shift and allows analyst to drop the assumption that variables operate the same at the upper and lower tails of the distribution as at the mean. One may think that separate regressions could be run by different segments of population but note that segmenting the population results in smaller sample sizes for each regression. As opposed to such regressions, the quantile regression method weights different portions of the sample to generate coefficient estimates, increasing power to detect differences in the upper and lower tails.

The use of unconditional quantile regression (UQR) proposed by Firpo (2009) provides a distinct advantage over the ordinary least squares (OLS) and the traditional quantile approach (Koenker and Bassett, 1978). First, the unconditional effect from UQR measures the full impact of the participation on organic farming on farm earnings because unconditional quantile is evaluated marginally over the distribution of the vector of independent variables and does not change with the set of covariates available for conditioning. Second, UQR addresses a broader issue than conditional effects that measure how farm earnings are conditioned on other variables such as gender of operator, family labors etc. The traditional approach developed by Koenker and Bassett, 1978 is a conditional quantile regression model which cannot address policy issues that depend on the unconditional statistical properties of the response variable.

Both conditional and unconditional quantile regression models allow the explanatory variables to have different impacts across the distribution of the outcome variable. However the distinction is that the parameter estimate from the UQR measures the change in farm earnings at the q^{th} quantile while traditional conditional quantile regression measures the change in conditional farm earnings (conditional on explanatory variables) at q^{th} quantile. The conditional quantile regression model assesses the impact of a covariate on a quantile, conditional on specific values of the other explanatory variables included in the model (Park, 2015; Mishra et al. 2015). Specifically, conditional quantile measures: $\frac{\partial Y_{Earnings}(qth|O,X)}{\partial O}$ while UQR measures $\frac{\partial Y_{Earnings}(qth)}{\partial O}$, which are different.

The UQR approach used in this paper is implemented using the recentered influence function (RIF). The recentered influence function unconditional quantile is based on the concept of the influence function developed from the field of robust statistics and summarized in Hampel et al. (2005). The influence function summarizes the impact of an individual observation on a given distributional statistic such as a median, inter-quantile range, or any quantile. The RIF is designed to measure how a change in the underlying distribution affects a distributional statistic $\nu\ (F)$ (in this paper, the quantile q_q) and is essentially a linear approximation to the nonlinear function of a distributional statistic (q_q). Firpo et al. (2009) show that marginal effects for the statistic of interest (a quantile) can be obtained by averaging the RIF regression function with respect to the change in the distribution of the covariates. The linear RIF regression function for the producer is represented as:

$$E\left[RIF\left(y_i; q_q\right)\middle|X, Z\right) = X_i\beta + O_i\alpha + Z_i\theta + c_i + \varepsilon_i \qquad (4)$$

where α represents the marginal effect of participation in organic farming on the relevant distributional statistic, here the quantile q_q. Firpo et al. (2009) has shown the unconditional property of the RIF regression such that results from RIF regression have a similar interpretation as coefficients from an OLS regression. The parameter estimates we obtained from the RIF regression model are estimates of unconditional quantile marginal effects. The RIF estimator is $\sqrt{n}$ consistent, asymptotically normal, and efficient (Frölich and Melly, 2013). Quantile regressions are also robust to outliers. Using RIF regression in this paper, we estimate the marginal effect on farm earnings (sales) at the q^{th} quantile associated with a small change in a given explanatory variable.

Data

This study uses data from the nationwide Agricultural Resource Management Survey (ARMS), developed by Economic Research Service and the National Agricultural Statistical Service. The ARMS survey provides information about agricultural production, resources, and environment as well as costs and returns for different activities. It also provides information about demographics, financial conditions, and characteristics of farm households, their production, marketing, and management as well as off-farm incomes. Data are collected from the senior farm operator who makes most of the day-to-day management decisions. We use the data from 2012 ARMS cost and returns survey. 2012 survey questionnaire have a separate section to gather information about organic farming, organic acreage and sales. In this study, organic farmers are defined as the farmers who participated in certified organic crops production and generated organic sales. Our sample consists of 18,728 farm business households with around 306 organically certified producers.

Table 1 shows the variable description and summary statistics for the variables used in this study. We include variables representing demographic, farm and farmer characteristics, diversity, and geographical locations in this study. We presented the mean values of the variables for the entire sample, certified organic farms and conventional farms. On the basis of mean comparison presented in table 1, certified organic farms had higher total farm sales, had relatively younger and more educated operators, were more diversified (as indicated by entropy index) than the conventional farms. Significantly higher proportion of organic farms (28%) were involved in direct sales than conventional (only 5% were involved). Additionally, higher proportion of organic farms had an access to Internet and were involved in marketing contracts than conventional farms. Higher proportion of conventional farms, on the other hand, were involved in off-farm works as compared to the organic farms.

Results and Discussion

We apply recentered influential function (RIF) regression model to provide estimates of unconditional quantile marginal effects. We presented the effect of participation in organic farming on two indicators of farm earnings and profits: total value of farm sales (table 2) and net cash farm income (table 3). Table 2 reports unconditional quantile regression estimators of the logarithms of total sales (total value of the farm sales) on participation in organic farming for the 0.25, 0.35, 0.50, 0.75, 0.85, and 0.95 quantiles with controls for operator demographics, farm characteristics, and geographic location of the farm. Similarly, table 3 reports unconditional quantile regression estimators of the logarithms of net cash farm income (can also referred as farm profit) on participation in organic farming for 0.25, 0.35, 0.50, 0.75, 0.85, and 0.95 quantiles with controls for operator demographics, farm characteristics, geographic location of the farm. An important finding from our quantile regression analysis is that the impact of participation in organic farming is significantly different across different quantiles of distribution indicating the heterogeneous effect of the participation depending on the structure of farm earnings. Overall the impact of the participation on organic farming is positive on total farm sales (table 2) and net cash farm income (table 3) indicating that involvement in organic farming is associated with an increase in total farm sales and net cash farm incomes.

The proportional impact of the participation in organic farming, a discrete variable on total sales and net cash farm income is measured as $p_i = [\exp(\alpha_i) - 1]$ where α_i is the coefficient of the organic farming variable (Thorton and Innes, 1989). These estimates provide a descriptive comparison of the farm earnings and profits distribution for the farmers. Based on the UQR for total farm sales and net cash farm income, the top quantiles (75^{th}, 85^{th} and 95^{th}) have the highest impact of the organic participation. This indicates that the impact is highest for the farms generating higher farm sales. Notice that after 50th quantile, the increase in total farm sales and net cash farm income associated with organic farming tend to grow larger as increase in total farm sales and net cash farm income. For example, for farm households involved in organic farming, the increase in total sales at 75th quantile (table 2, column 5) is about 35% [percent impact= exp(0.30)-1], 85th quantile is about 71% (table 2, column 6) compared to the farms with no organic farming. The impact increases even further at 95th quantile (table 2, column 7). Interestingly, even the farms generating smaller total sales but involved in organic farming (the bottom 25th quantile) could generate significantly higher total sales compared to farms not involved in organic farming (table 2, column 2). However, involvement in organic farming is not necessarily increasing the net cash farm income on bottom quantiles as the effect is not statistically significant (table 2, column 2, 3, and 4).

Figure 2 shows the impacts of participation in organic farming estimated by three different estimators: OLS, CQR, and UQR. Overall the impact of the participation on organic farming is positive across all estimators. However, note that there are significant differences between estimates of OLS, CQR and UQR. In the case of net cash farm income (figure 2, bottom graph), for example, OLS suggests that around 25% increase in net cash farm income is associated with the involvement in organic farming. However, OLS fails to capture the discrepancies in the upper and lower tails of the net farm income distribution associated with involvement in organic farming. The estimates from CQR and UQR show significant differences in effects across quantiles of net farm income distribution however their estimates differ in magnitude. Recall that CQR provides the effect of organic farming on respective quantile conditional on specific values of the other explanatory variables included in the model while UQR provides the sole effect irrespective of the explanatory variable set and values. Therefore, the effects associated with organic farming presented by CQR could be over- or under-estimated. Figure 2 (bottom graph) shows that the increase in net cash farm income associated with organic farming based on CQR ranges from 9% (bottom quantile) to 101% (top quantile) depending on the income quantile. Estimates from UQR, on the other hand, ranges from 22% (bottom quantile) to 104% (top quantile). Also note from table 3 that the positive effects on bottom three quantiles (25^{th}, 35^{th}, and 50^{th}) were non-significant. Nonetheless the results from both quantile regressions (CQR and UQR) for net cash farm income suggest that the increase in net cash farm income associated with organic farming is higher for the farms generating higher incomes—indicating that the larger gains are for larger farms while smaller farms have either low or non-significant gains in net cash farm income.

Our results suggest that several other factors such as demographics and farm characteristics, marketing strategies, adoption of Internet, on-farm crop diversity, and geographical location significantly influence total farm sales and net cash farm income. We have explained each factors in following paragraphs.

Demographics and farm characteristics

Our results suggest that demographic and farm characteristics: gender and age of the operator, off-farm work of the operator and/or spouse, total land acres in operation, and geographical location of the farm significantly influence total farm sales and net cash farm income. Results suggest that male operators generate higher total farm sales and net cash farm income than female operators. This gender effect is significantly larger for smaller farms than larger farms. Our results from unconditional regression suggests that male operators generate up to 80% more total farm sales and 60% more net cash farm income than female operators. Operator and/or spouse’s off-farm works and the operator’s age, on the other hand, are negatively related to total farm sales and net cash farm income. Our result suggests that a one year increase in age of the operator is associated with up to 2% decrease in total farm sales and net cash farm income on smaller farms (table 2 and 3, column 2: 25th quantile) and around 0.7 to 0.9% decline in large farms (table 2 and 3, column 7: 95th quantile). Similarly, our results suggest that the negative effect of the off-farm works is larger for smaller farms than larger farms—indicating that the households engaged in off-farm work may receive up to 100% less farm sales and 60% less net cash farm income compared to the households not involved in off-work activities.

Additionally, the total land in operation significantly influence both total farm sales and net cash farm income. Our result suggests that a 1% increase in land could result in 0.3 to 0.9 % increase in total farm sales (table 2) and 0.4-0.6 % increase in net cash farm income (table 3). The land effect is bigger for smaller farms and tend to decrease as the amount of total farm sales increase.

Information and marketing

Our results suggest that having a marketing contract and an access to the Internet positively influence total farm sales and net farm incomes while distance to market and direct to consumer marketing negatively influence total farm sales and net farm incomes. As expected, having a marketing contract has strong large effect, larger for bottom spectrum of distribution compared to top, on both total farm sales and net cash farm income (table 2 and table 3). Additionally, having access to the Internet is associated with a significant increase in both total farm sales and net cash farm incomes. A positive effect of the Internet is as expected—Internet helps to gather information about inputs and marketing, ease communication as well as help to build e-commerce (Khanal et al. 2015).

Direct to consumer marketing, on the other hand, is negatively related to total farm sales and net incomes. Unconditional regression coefficients suggest that the negative effect of direct marketing declines as increase in total farm sales and net cash incomes. The findings are consistent with previous studies in the U.S. (Park 2015).

On-farm crop diversity

As indicated by the coefficient on entropy index, the diversity in crops is significantly related to the total farm sales and net cash farm incomes. However, the positive or negative effect of crop diversity depends on the distribution quantile. Note that the effect of diversification is positive on 25th and 35th quantile of the farm sales while it is negative on 75th, 85th, and 95th quantile—which indicates that smaller farms may benefit from crop diversification while larger farms benefit from specialization.

Conclusion

There has been increased demand for organic food and increased emphasis on the certified organic production. In this paper, we investigated the effect of involvement in certified organic production on farm earnings and net cash farm incomes of the US farm households. Importantly, we used an unconditional quantile regression approach that estimated the impact on entire distribution of farm earnings to access the differential impact on lower and upper tails. Unconditional effect allows us to understand the sole impact due to involvement in organic farming, irrespective of the effect of other covariates used in the regression. Our results show that the impact of involvement in certified organic production on the unconditional distribution of farm earnings and net cash farm incomes varies across the quantiles. Smaller operations have low or no significant effect as comparted to larger operations. These effects are masked when we use ordinary least square (OLS) methods. Our results suggest that the effect of certified organic production is positive across the unconditional quantiles but the most benefited are the farms with larger operations—the impact estimates on net cash farm income from UQR, ranges from 22% (bottom quantile) to 104% (top quantile). Programs aiming higher adoption for organic certification and promoting organic farming should emphasize on easing organic farming for small farmers, for example, by easing cost and certification procedures, loan and facilities for small to medium sized farmers. Additionally, we found that small to medium sized farms benefit more from crop diversification, marketing contracts, and the use of Internet as compared to larger operations.

References

Card, D., and S. de la Rica. “Firm-Level Contracting and the Structure of Wages in Spain.” Industrial and Labor Relations Review 59(2006):573–592.

Firpo, S., N. M. Fortin, and T. Lemieux. “Unconditional Quantile Regressions.” Econometrica 77 (2009):953–973.

Frölich, M., and B. Melly. “Unconditional Quantile Treatment Effects Under Endogeneity.” Journal of Business & Economic Statistics 31(2013):346–357.

Greene, C., Dimitri, C., Lin, B.-H., McBride, D.W., Oberholtzer, L., Smith, T., 2009. Emerging issues in the U.S. organic industry, economic information bulletin. USDA Economic Research Service, USDA.

Greene, Catherine, Carolyn Dimitri, Lin BiingHwan, William McBride, Lydia Oberholtzer, Travis Smith, and T. J. Cochran. *Emerging issues in the US organic industry*. Nova Science Publishers, Inc., 2010.

Greene, Catherine. "Growth patterns in the US Organic Industry." *Amber Waves* (2013): 1D.

Khanal, Aditya R., Ashok K. Mishra, and Krishna H. Koirala. "Access to the Internet and financial performance of small business households." *Electronic Commerce Research* 15, no. 2 (2015): 159-175.

Koenker, Roger, and Gilbert Bassett Jr. "Regression quantiles."*Econometrica: journal of the Econometric Society* (1978): 33-50.

Mishra, Ashok K., Kh A. Mottaleb, and Samarendu Mohanty. "Impact of off-farm income on food expenditures in rural Bangladesh: an unconditional quantile regression approach." *Agricultural Economics* 46, no. 2 (2015): 139-148.

O'Riordan, Tim, and Dick Cobb. "Assessing the consequences of converting to organic agriculture." *Journal of Agricultural Economics* 52, no. 1 (2001): 22-35.

Osteen, Craig, Jessica Gottlieb, and Utpal Vasavada. "Agricultural resources and environmental indicators." *USDA-ERS Economic Information Bulletin* 98 (2012).

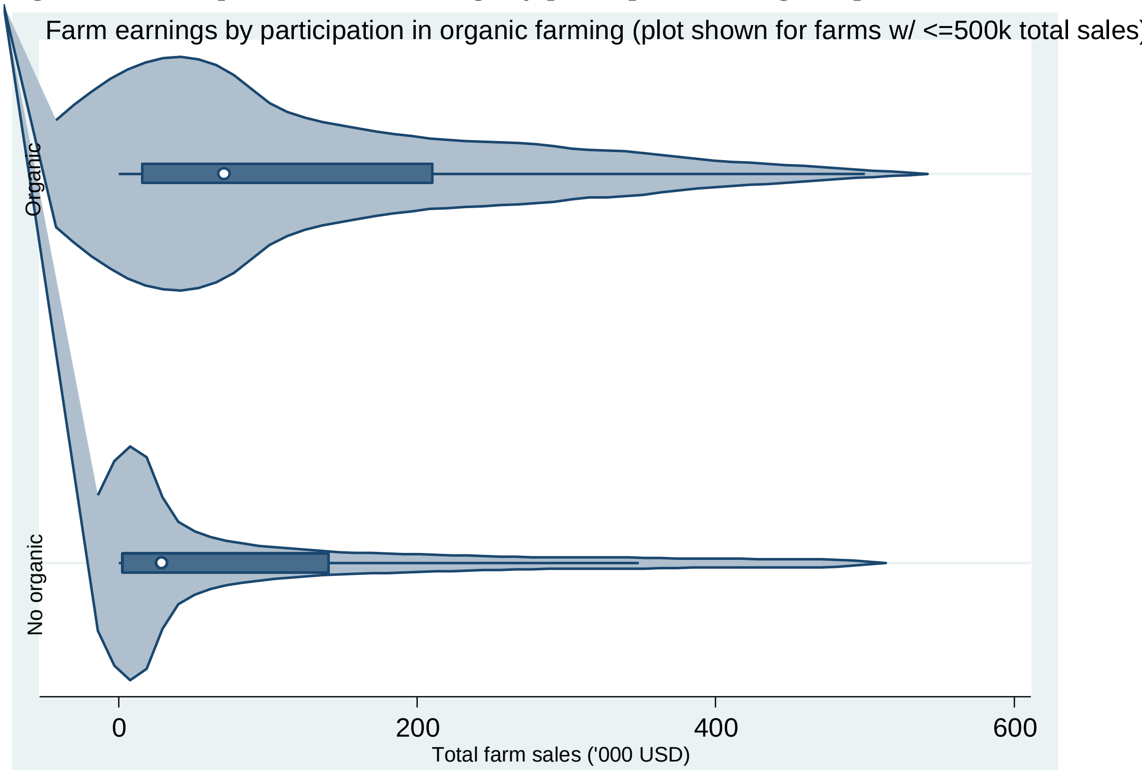
Park, Timothy A. "Direct Marketing and the Structure of Farm Sales: An Unconditional Quantile Regression Approach." *Journal of Agricultural and Resource Economics* 40, no. 2 (2015): 266-284.

Patton L. and C. Giammona. The New Organic Walmart is Eating Whole Food's Lunch. Bloomberg Businessweek, May 2015. (Accessed: March 2016). Web: http://www.bloomberg.com/news/articles/2015-05-14/whole-foods-walmart-costco-steal-growth-in-organic-groceries

Thornton, R. J., and J. T. Innes. "Interpreting Semilogarithmic Regression Coefficients in Labor Research." Journal of Labor Research.

Uematsu, Hiroki, and Ashok K. Mishra. "Organic farmers or conventional farmers: Where's the money?." *Ecological Economics* 78 (2012): 55-62.

Figure 1: Violin plots of farm earnings by participation in organic production



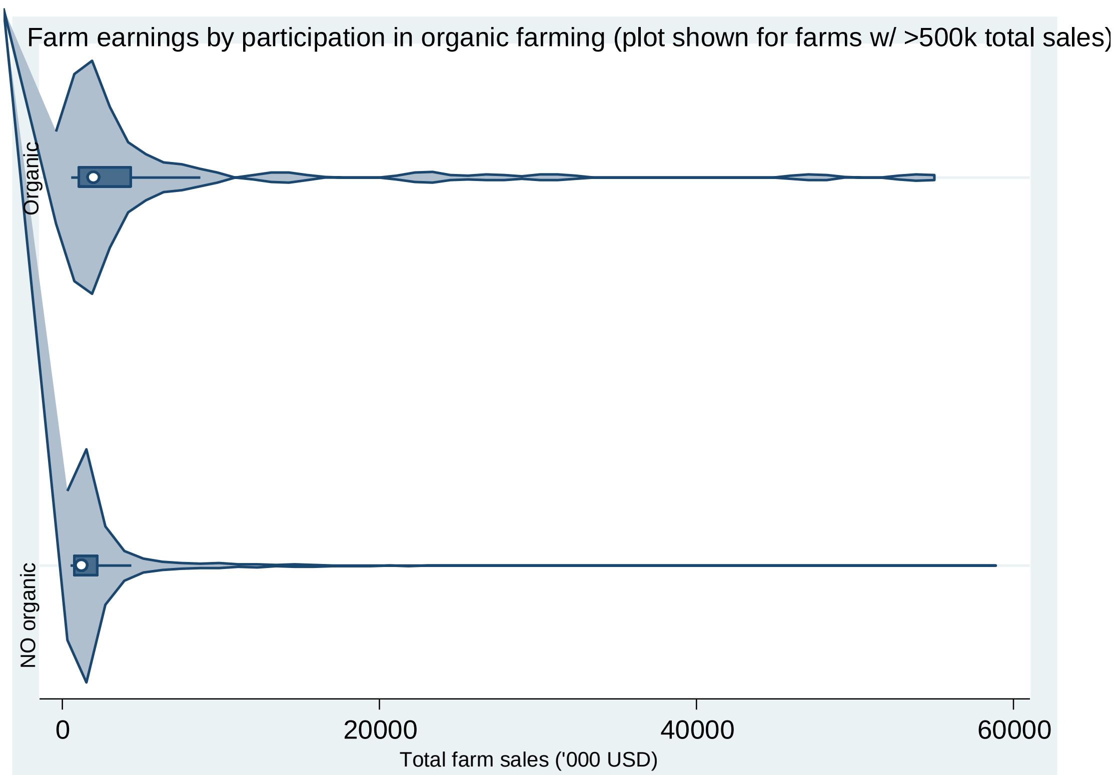


Table 1. Variable Descriptions and Summary Statistics

Variable	Description	Entire Sample	Organic	Conventional
Sales	Total value of farm sales (‘000 of US dollars)	688.81 (2463.99)	2695.97 (12870.08)	663.08 (1995.65)
Male	Farm operator is male (=1 if male, %)	87.2	86.4	87.3
Age	Age of the farm operator (years)	58.71 (12.68)	55.03 (13.37)	58.76 (12.66)
Education	Education of the farm operator (years)	13.89 (2.92)	14.15 (3.65)	13.88 (2.91)
Off-farm income	Farm household has income from off-farm works (=1 if yes, 0 else), %	93	89	93
Acres	Total acres in operation	997.02 (3028.7)	892.75 (4006.13)	998.36 (3014.23)
Marketing Contract	Farm had any marketing contracts for the commodities (=1 if yes, 0 else), %	19	24	18
Direct Sales	Farm had direct to consumer sales (=1 if yes), %	5.4	28	5.1
Distance to Market	Distance to market (in miles)	24.38 (24.19	18.89 (21.29)	24.46
Internet	Have an access to Internet (=1 if yes, 0 else), %	71	73	70
Efficiency	Farming efficiency (Ratio of gross cash farm income to total farm variable costs)	3.60 (22.02)	2.11 (2.00)	3.62 (22.16)
Entropy	Entropy index of diversification (=1 if completely diversified, 0 if not at all)	0.161 (0.14)	0.165 (0.155)	0.161 (0.14)
Atlantic	Farm is located in Atlantic region (1=yes; 0 else)	0.12	0.15	0.12
South	Farm is located in South region (1=yes, 0 else)	0.16	0.05	0.17
Midwest	Farm is located in Midwest region (1=yes, 0 else)	0.34	0.31	0.34
Plains	Farm is located in Plains region (1=yes, 0 else)	0.20	0.05	0.20
West	Farm is located in West region (1=yes, 0 else)	0.17	0.44	0.17

Notes: Descriptive statistics of raw data reported while model is estimated using total value of farm sales (in logarithms) as the dependent variable. Standard deviations appear in parentheses.

Table 2: Unconditional Quantile Regression Results for Farm Earnings

Variables	Quantiles						OLS
	25th	35th	50th	75th	85th	95th	
Constant	6.458**	7.655**	9.480**	12.25**	12.99**	14.11**	9.118**
	(22.82)	(28.26)	(40.83)	(70.28)	(75.62)	(70.46)	(64.92)
Organic farming	0.670**	0.412	0.250	0.302*	0.536**	0.791**	0.488**
	(2.78)	(1.59)	(1.09)	(1.87)	(3.11)	(2.97)	(3.86)
Male	0.683**	0.595**	0.430**	0.0286	0.108*	0.111*	0.457**
	(4.51)	(4.40)	(4.13)	(0.40)	(1.73)	(1.68)	(6.95)
Age	-0.0212**	-0.0267**	-0.0253**	-0.0159**	-0.0136**	-0.0094**	-0.0168**
	(-8.71)	(-11.54)	(-12.79)	(-10.74)	(-9.21)	(-5.29)	(-13.42)
Education	-0.0610**	-0.0541**	-0.0342**	-0.00181	0.00199	0.00570	-0.0283**
	(-5.62)	(-5.19)	(-3.92)	(-0.28)	(0.30)	(0.69)	(-5.20)
Off-farm income	-0.926**	-1.052**	-1.085**	-0.652**	-0.492**	-0.569**	-0.754**
	(-12.01)	(-12.83)	(-13.80)	(-8.68)	(-6.08)	(-5.16)	(-14.53)
Acres (in log)	0.925**	0.912**	0.807**	0.514**	0.434**	0.346**	0.705**
	(45.72)	(48.06)	(48.71)	(38.30)	(31.07)	(18.24)	(67.95)
Marketing contra.	1.100**	1.350**	1.374**	0.814**	0.620**	0.315**	0.884**
	(22.43)	(24.89)	(24.77)	(15.31)	(11.09)	(4.62)	(23.25)
Direct sales	-0.762**	-0.658**	-0.426**	-0.251**	-0.102*	-0.0647	-0.540**
	(-5.80)	(-5.67)	(-4.60)	(-4.06)	(-1.69)	(-0.97)	(-8.66)
Distance market	-0.0080**	-0.0091**	-0.0098**	-0.0077**	-0.0075**	-0.0084**	-0.0082**
	(-6.48)	(-7.55)	(-9.20)	(-9.67)	(-9.68)	(-9.32)	(-12.50)
Internet	0.306**	0.501**	0.697**	0.493**	0.365**	0.251**	0.420**
	(3.98)	(6.89)	(11.50)	(11.58)	(8.96)	(5.44)	(11.00)
Entropy	2.021**	1.493**	-0.00565	-1.299**	-1.536**	-1.454**	0.362**
	(9.06)	(6.72)	(-0.03)	(-8.33)	(-9.68)	(-7.42)	(2.84)
Efficiency	0.00384	-0.00340	-0.0034**	-0.00014	0.000380	-0.0005	0.00014
	(1.09)	(-1.26)	(-2.21)	(-0.16)	(0.50)	(-0.66)	(0.09)
Atlantic	0.102	0.190*	0.177*	-0.0224	-0.00454	-0.0595	-0.0213
	(0.86)	(1.70)	(1.89)	(-0.30)	(-0.06)	(-0.64)	(-0.37)
Midwest	0.227**	0.295**	0.0307	-0.300**	-0.276**	-0.188**	-0.0894*
	(2.40)	(3.31)	(0.41)	(-5.00)	(-4.35)	(-2.40)	(-1.89)
Plains	-0.570**	-0.573**	-0.823**	-0.837**	-0.703**	-0.510**	-0.738**
	(-5.41)	(-5.83)	(-9.99)	(-13.03)	(-10.59)	(-6.39)	(-14.09)
West	0.516**	0.635**	0.172*	-0.350**	-0.313**	0.0478	0.100*
	(4.65)	(6.12)	(1.95)	(-5.04)	(-4.39)	(0.52)	(1.86)
N	12659	12659	12659	12659	12659	12659	12659

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$
[b] Dependent variable is total value of farm sales (in logarithms). Data from USDA's Agricultural Resource Management Survey.

Table 3: Unconditional Quantile Regression Results for Net Cash Farm Income

Variables	Quantiles						OLS
	25th	35th	50th	75th	85th	95th	
Constant	7.325**	7.744**	8.131**	9.712**	10.92**	12.69**	8.366**
	(24.82)	(31.99)	(39.16)	(52.35)	(58.54)	(49.44)	(53.02)
Organic farming	0.203	0.0167	0.00327	0.296*	0.431**	0.714**	0.227*
	(0.85)	(0.08)	(0.02)	(1.69)	(2.24)	(2.30)	(1.71)
Male	0.488**	0.500**	0.324**	0.161**	0.114	-0.112	0.372**
	(2.98)	(3.95)	(3.22)	(2.02)	(1.52)	(-0.96)	(4.64)
Age	-0.0212**	-0.0183**	-0.0138**	-0.009**	-0.00786**	-0.0075**	-0.0133**
	(-8.51)	(-8.82)	(-7.61)	(-5.25)	(-4.61)	(-3.31)	(-9.63)
Education	-0.0199*	-0.00767	0.00744	0.0264**	0.0269**	0.00684	-0.00084
	(-1.81)	(-0.85)	(0.95)	(3.68)	(3.60)	(0.66)	(-0.14)
Off-farm income	-0.633**	-0.623**	-0.586**	-0.443**	-0.456**	-0.324**	-0.553**
	(-8.09)	(-8.82)	(-8.56)	(-5.75)	(-5.49)	(-2.69)	(-10.31)
Acres (in log)	0.651**	0.616**	0.624**	0.545**	0.474**	0.418**	0.590**
	(30.23)	(34.15)	(38.68)	(32.45)	(26.68)	(16.25)	(49.84)
Marketing contra.	0.872**	0.796**	0.856**	0.852**	0.790**	0.565**	0.823**
	(15.98)	(15.88)	(17.30)	(15.47)	(13.42)	(7.17)	(21.46)
Direct sales	-0.463**	-0.357**	-0.209**	-0.0483	0.0239	0.0108	-0.242**
	(-3.21)	(-2.99)	(-2.08)	(-0.56)	(0.28)	(0.10)	(-3.18)
Distance market	-0.0061**	-0.0072**	-0.0073**	-0.008**	-0.00793**	-0.0096**	-0.0070**
	(-4.91)	(-6.63)	(-7.43)	(-7.82)	(-8.47)	(-8.69)	(-9.67)
Internet	0.437**	0.516**	0.534**	0.368**	0.242**	0.222**	0.387**
	(5.56)	(8.01)	(9.75)	(7.73)	(5.18)	(4.01)	(9.20)
Entropy	-0.421*	-0.361*	-0.510**	-0.907**	-1.258**	-1.261**	-0.557**
	(-1.78)	(-1.80)	(-2.84)	(-5.10)	(-6.78)	(-4.93)	(-4.02)
Efficiency	0.00442	0.00290	0.00279	0.00310*	0.00340**	0.0037**	0.00460**
	(1.53)	(0.94)	(1.16)	(1.72)	(2.06)	(2.34)	(3.18)
Atlantic	0.239**	0.254**	0.163**	-0.0225	-0.0585	-0.131	0.119*
	(2.04)	(2.65)	(2.03)	(-0.30)	(-0.74)	(-1.16)	(1.89)
Midwest	0.415**	0.391**	0.314**	0.0648	-0.0517	-0.150	0.227**
	(4.46)	(5.16)	(4.86)	(1.02)	(-0.76)	(-1.51)	(4.38)
Plains	-0.191*	-0.179**	-0.110	-0.322**	-0.364**	-0.451**	-0.246**
	(-1.77)	(-2.05)	(-1.47)	(-4.47)	(-4.80)	(-4.28)	(-4.18)
West	0.523**	0.528**	0.489**	0.101	-0.00240	-0.00377	0.345**
	(4.80)	(5.87)	(6.14)	(1.30)	(-0.03)	(-0.03)	(5.73)
N	8778	8778	8778	8778	8778	8778	8778

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

[b] Dependent variable is total value of farm sales (in logarithms). Data from USDA's Agricultural Resource Management Survey.

Figure 2: Participation in organic farming and farm earnings: impact on total farm sales (top) and net cash farm income (bottom)