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Does E-Commerce Help Farmers' Markets? Measuring the Impact of MarketMaker

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Abstract

MarketMaker is one of the most extensive collections of electronic searchable food industry related data engines in the country with over 17,500 profiles of food related enterprises, including more than 7,600 agricultural producers and 1,295 farmers markets. This study examined the impact of MarketMaker on participating farmers' markets. Our findings indicate that about half of the farmers markets have experienced benefits from their participation in the form of new contacts, new customers and vendors, and increase in sales. Through the analysis of factors that affect the increase in farmers' markets sales due to MarketMaker we identified that the components needed for the more successful use of MarketMaker include an established MarketMaker program, an established farmers' market and an active user-manager.

Keywords: e-commerce, direct marketing, supply chain, effectiveness, economic impact, nonparametric methods

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Introduction

Agricultural producers' use of computers and the Internet has increased dramatically in recent years. In 2015, 70% of US farms had Internet access and 73% had access to a computer, compared to 29% and 47% in 1999, respectively (USDA-NASS 2015). Among these farms, 43% used computers for farm business, 19% purchased agricultural inputs over the Internet, and 16% used the Internet to conduct marketing activities. Many aspects of computer and internet use in agriculture may be attributed to e-commerce, defined as the use of the Internet to market, buy and sell goods and services, exchange information via Internet, and create and maintain web-based relationships between participant entities (Fruhling and Digman 2000). For example, Park and Mishra (2003) using data from the 2000 Agricultural Resource Management Survey (ARMS), found that 83% of US farmers used the internet for price tracking, 56% used it to access agricultural information services, and some (unreported percentage) used the Internet to keep records and transmit data to clients. Similarly, Smith et al. (2004), in a study of 517 farmers in the Great Plains states of Kansas, Iowa, Nebraska, and Oklahoma found that 62% of surveyed farmers used the internet to obtain information on commodity markets, 54% used it to gather technical information on inputs, 36% to retrieve financial information, 73% to collect weather information, and 37% to obtain information on agricultural policy.

On the other hand, the use of the internet to buy and sell agricultural products has been less common. As mentioned before, in 2013 only 16% of US farmers used internet to purchase farm inputs. Quality and service concerns have been identified as potential reasons for this unwilligness to buy online (Briggeman and Whitacre 2008). Batte and Ernst (2007) indicated that the difference in purchase prices between in-store and electronic purchases was not significant. At the same time, there is some evidence indicating higher rates of adoption and use of computers and internet among agribusiness firms such as input and service providers. Ehmke et al. (2001) showed that as early as in 2000, 79% of surveyed agribusinesses comprising farm equipment and service companies in Ohio had Internet access and 16% were selling via the Internet. Thus, until recently, the growth of e-commerce in agriculture has been heavily focused on the exchange of information and much less on direct electronic transactions.

Based on its demonstrated impact in industrial retail markets (e.g., Elia et al. 2007), e-commerce is believed to have the potential to increase profitability in agricultural markets by increasing sales, as well as decreasing costs through greater efficiency of operations and lower search costs. Gains in efficiency could result from the reduction of inventory levels, transportation costs, information costs, and order and delivery times (Batte and Ernst 2007; Montealegre et al. 2007). Moreover, the creation of electronic markets that are expected to be more transparent and competitive than physical markets, may attract more consumers and thus increase demand and improve the firm's strategic position with customers seeking specific niche products or having geographical restrictions (Batte and Ernst 2007; Montealegre et al. 2007).

However, due to a relatively new and infant state of e-commerce in agriculture, its impact has not been widely measured and documented. To the best of our knowledge, among numerous agricultural e-commerce platforms, only MarketMaker has received some attention from researchers. For example, Fox (2009) reported that 63% of Ohio registered users including producers, farmers' markets and wineries believed that the MarketMaker site was helping keep more food dollars in the regional economy. Cho and Tobias (2009) found that the average

increase in annual sales attributed to MarketMaker among 374 New York farmers was between $225 and $790. Additionally, 12% of the respondents in their study reported receiving marketing contacts through MarketMaker and using the MarketMaker directory to contact other food industry business partners. Zapata et al. (2011) reported that according to a national survey results, participation in MarketMaker allowed producers to increase their annual sales by about $121. The number of contacts received, new customers gained, and increase in annual sales due to participation in the site were positively related to self-registration on the MarketMaker site, time since registration, and monthly time devoted to the website. Thus, previous studies measured the impact of MarketMaker mostly focusing on changes in sales of participating farmers, which, given the negligible costs of using the site, could approximate its impact on profitability.

An interesting aspect of agricultural e-commerce in general and MarketMaker in particular that has not been analyzed in the previous literature is its impact on direct marketing outlets, such as farmers' markets. As an alternative marketing channel, e-commerce may have a substitute relationship with farmers' markets. However, given the fact that most e-commerce venues in agriculture so far have focused on information exchange rather than actual transactions, e-commerce efforts may have a complementary effect through providing information, visibility and awareness to new and existing farmers' markets. Farmers' markets represent a large and rapidly expanding user category of MarketMaker and other e-commerce platforms. Results from the US Census of Agriculture indicate that the value of agricultural products sold directly to individuals for human consumption more than tripled from 1992 to 2012, going from $404 million to $1,310 million. The number of farms selling products directly to the consumer also increased in the same period from 86,432 to 144,530 farms (USDA-NASS 2014). The number of farmers' markets increased from 2,410 in 1996, to 4,385 in 2006, to 8,476 in 2015 (USDA-AMS 2015). Some of the main factors affecting the increase in importance of direct marketing are the consumer's growing interest in fresh products and farm recreation, and the difficult financial situation of small farmers that is compelling them to look for alternative venues to market their products.

The goal of this study was to explore the impact of e-commerce on direct marketing venues through examination of the impact of MarketMaker on farmers' markets. The areas of interaction and impact were first presented in a logic model. The logic model was used to identify measurable metrics that were gauged using a survey of farmer's market managers participating in MarketMaker. The impact of MarketMaker was first measured through market managers' perceived increase in the number of business contacts, number of customers, number of vendors and increase in sales. Parametric and nonparametric methods were used to estimate the average values of these effects. The impact was further analyzed using an interval-censored logistic regression to estimate which factors helped increase farmers' markets' annual sales attributed to MarketMaker. The findings of this study will shed light on the interaction of e-commerce and conventional types of direct marketing in agriculture and can be used for further development and enhancement of these efforts.

MarketMaker and Farmers' Markets

MarketMaker is an interactive e-commerce tool that provides geo-coded food marketing information to food entrepreneurs and customers. The site was created in 2000 by a team of University of Illinois Extension personnel with the intention of building an electronic infrastructure that would easily connect Illinois food producing farmers with economically viable new markets and aiding in the development of quality driven food supply chains. Since then at least twenty other states have joined this project. In the last five years, Iowa, Nebraska, Kentucky, New York, Georgia, Mississippi, Michigan, Ohio, Indiana, South Carolina, Colorado, Arkansas, Florida, Pennsylvania, Louisiana, and Washington DC have launched MarketMaker state sites (Figure 1). At the time of this study in 2011, the MarketMaker sites included nearly 17,500 profiles of food related enterprises including 7,698 producers and 1,295 farmers markets. The site received about one million hits per month from over 86,000 food industry entrepreneurs.

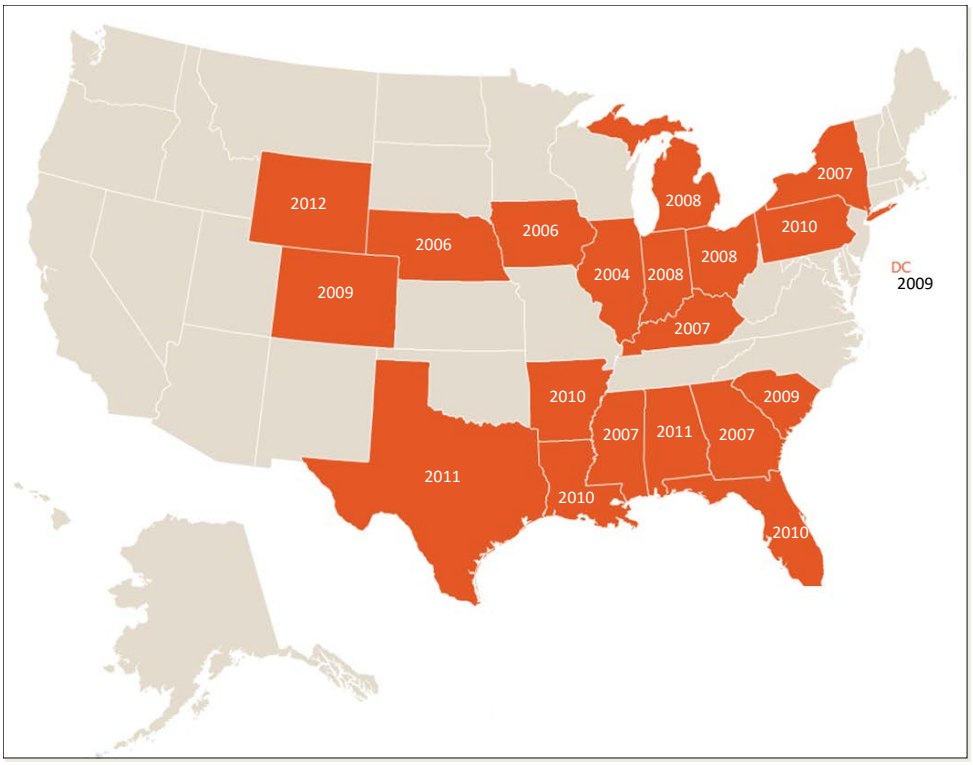

Figure 1. MarketMaker launch year by state.
Source. Adapted from the MarketMaker portal

As an electronic farm directory/food marketing tool, MarketMaker could be compared to a number of similar websites, namely Local Harvest, Farm Locator, Eat Well Guide, Rural Bounty, Local Farm Link, Chef Collaborative, Agricultural Business, Green People, Pick Your Own, Farm Bureau, USDA and various state locally grown promotion websites and local food directories. Differently from food marketing websites, such as Local Harvest, MarketMaker did not have a selling feature, meaning that one could not purchase products directly through the website. In contrast to farm directory websites, such as Farm Locator, Rural Bounty, Chef Collaborative, Agricultural Business and Pick Your Own, MarketMaker provided the benefit of

geo-mapping the information about consumers, producers, and retail outlets. For example, MarketMaker provided the ability to map consumer data related to six different demographic characteristics. Thus, for farmers, it provided information to help better target consumers and identify potential businesses with which to collaborate. For consumers and intermediaries—households, processors, handlers, retail, and wholesale companies—MarketMaker provided information to inform decisions about where to purchase products or how to identify upstream opportunities for adding value before final sale.

Farmers' markets are a special type of MarketMaker users that could take advantage of the site in their quest to grow new and expand existing farmers' markets. In many situations, the binding constraint for the initiation and/or development of farmers' markets is the number of producers willing and able to supply the products. Farmers' market managers could use MarketMaker to identify and manage the number of vendors participating in these markets. On the other hand, for the long-term success of the farmers' market, it is essential that the market is supported and well attended by a sufficient number of consumers. In this case, access to demographic and geocoded data about consumers' incomes and food preferences available through MarketMaker could help identify the best location and combination of suitable products that would best serve the needs of consumers. MarketMaker allows social media efforts as well as potential to link directly with farmers' markets thereby increasing awareness among consumers and producers about new and existing farmers' markets and their offerings.

The impact and interaction of MarketMaker with the farmers' markets is shown using a logic model in Figure 2 (see Appendix).[1] This logic model describes the linkages among project inputs, activities, outputs and outcomes. MarketMaker inputs on the national and state levels include human resources, adequate technological expertise to support program requirements, and availability of related public and private data (i.e. National Census and independent studies) as well as funds to support planned activities (i.e. training, promotion, networking, etc.). These inputs are used to conduct a series of activities such as development, updating and improvement of the content, usability and functionality of the site. MarketMaker purchases, gathers, manages, and distributes relevant existing data (i.e. socio-demographic characteristics, consumers' preferences, etc.) to farmers' market managers looking for specific vendors capable of providing specific niche products at the market. MarketMaker conducts training and promotional sessions at national, state and regional levels in order to create awareness and prepare farmers' market managers as well as participating vendors to successfully participate in MarketMaker. The adequate combination of inputs and activities will lead to accomplishment of desired outputs, which include signup and participation of new producers and farmers' markets in the MarketMaker program, as well as maintaining a comprehensive and up-to-date database of program participants. The outcomes of the program in the short term include creation of initial web presence for some farmers' markets, additional web presence for others, as well as increased interest among consumers and producers in participating in farmers' markets and MarketMaker. The intermediate-term outcomes are observed in the number of new contacts (e-mail, phone calls) generated through MarketMaker, the number of additional vendors through MarketMaker

[1] Logic models are frequently used as project planning and evaluation tools. A detailed description of logic models development and use can be found in W.K. Kellogg Foundation (2004). Applications of logic models in the academic literature are found in areas such as research and development (Jordan and Mortensen 1997), and industrial modernization (Torvatn 1999).

and changes in their composition, the number of additional customers found through MarketMaker, as well as the number of new business partnerships formed through MarketMaker. In the long-term, MarketMaker portends to increase participation of both producers and consumers in farmers' markets which will help insure success and sustainability of farmers' markets. This outcome can be measured by evaluating the changes in total sales, changes in prices received and quantities sold, as well as changes in the costs of operation of farmers' markets and ultimately profitability.

Farmers' Market Use of MarketMaker

The data on the metrics developed using the logic model described above were collected in a survey conducted in May – June 2011, in which farmers' market managers were asked about their perceptions regarding the impact of MarketMaker. The survey was distributed by email to all 1,295 farmers' market managers registered on MarketMaker websites in fifteen participant states at that time: Arkansas, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Michigan, Mississippi, Nebraska, New York, Ohio, South Carolina, and Washington DC. The overall response rate of the survey was 10.2% (common for online surveys according to Hamilton 2003) and it generated 132 usable observations. The sample frame size, number of respondents, and response rates by MarketMaker participant state is shown in Table 1.[2] The states with the highest response rate were Louisiana (17.5%) and Ohio (14.9%), and those with the lowest response rate were Nebraska (3.0%) and Illinois (7.3%).

In order to simplify the respondent's task and to encourage a response, most of the demographic and business information, as well as outcome measures (e.g., number of new contacts found through MarketMaker) were collected using a discrete number of categories, hence the calculation of the mean value of these variables required the use of special statistical techniques (Bhat 1994; Carpio et al. 2008; Stewart 1983).[3] Results demonstrate that the parametric estimate of the mean of the demographic and business information variables were contained in the interval formed by the lower and upper nonparametric estimates of the mean, which confirms the robustness of these findings. Thus we focus mainly on the estimated parametric mean in our discussion.

[2] Low response rates have traditionally been linked to lack of representativeness and bias in surveys results. However, several recent empirical studies analyzing the links between low response rates and low survey accuracy suggest a very weak or non-existent relation between the two (Keeter et al. 2000; Curtis et al. 2000; Brick et al. 2003; Keeter et al. 2006; Holbrook et al. 2008). Since MarketMaker does not collect data about the characteristics of participating users, it is not possible to compare the characteristics of our sample with that of the population of interest to explore the non-response bias.

[3] For specific estimation details please refer to Zapata et al. (2011) and Zapata (2012).

Table 1. Survey sample frame size; number of respondents; and response rate by state.

State	Sample Frame Size	Number of Respondents	Response Rate
Arkansas	38	4	10.53
Colorado	85	9	10.59
District of Columbia	7	1	14.29
Florida	101	7	6.93
Georgia	96	12	12.50
Illinois	219	16	7.31
Indiana	49	7	14.29
Iowa	115	14	12.17
Louisiana	40	7	17.50
Michigan	115	11	9.57
Mississippi	47	6	12.77
Nebraska	33	1	3.03
New York	209	18	8.61
Ohio	101	15	14.85
South Carolina	40	4	10.00
Total	**1,295**	**132**	**10.19**

Table 2 shows that the average age of farmer's market manager responding to this survey was fifty-one years and nearly 73% were female. Regarding characteristics of their farmers' market, survey respondents indicated that operations generate, on average, about $135,820 in total annual sales and the average annual costs are about $10,680. Survey results also revealed that, on average, participating farmers' markets have been in operation for 8.5 years and most of them (63%) operate once a week.

Table 3 demonstrates that most of the farmers' market managers responding to the survey (66%) indicated they had registered on the site by themselves, 8% indicated that they were registered by someone else, and 26% did not know how they became registered in MarketMaker. This finding may be explained by the fact that in some states farmers' market lists provided by State Departments of Agriculture were used to initially populate the MarketMaker database. On average, respondents have been registered on the site for 18.8 months. About 34% of respondents have been registered for less than twelve months, 34% have been registered between twelve and twenty-four months, and 31% have been registered for more than twenty-four months (Table 3).

Table 2. Description and summary statistics of respondents characteristics

Variable Name (Units)	Category	Category Proportion	Mean	
			Nonparametric lower and upper bounds	Parametric
Gender	1=Female	72.53		0.73
	0=Male	27.47		
Age				51.00
Total annual sales ($1,000)	Less than 10	29.90	(97.63, 214.84)	135.82
	10 to 50	27.84		
	50 to 100	12.37		
	100 to 250	16.49		
	250 to 500	6.19		
	500 to 1,000	3.09		
	Over 1,000	4.12		
Annual cost of operation ($1000)	Less than 1	28.43	(7.82, 17.73)	10.68
	1 to 5	27.45		
	5 to 10	19.61		
	10 to 20	6.86		
	20 to 50	9.80		
	More than 50	7.84		
Years of operation	Less than 2	7.69	(6.43, 12.43)	8.54
	2 to 3	14.42		
	3 to 4	12.50		
	4 to 10	29.81		
	10 to 15	15.38		
	More than 15	20.19		
Time of operation	Daily	1.92		
	2 to 3 times a week	11.54		
	Once a week	63.46		
	Once a month	1.92		
	2 to 4 months a year	5.77		
	5 to 8 months a year	11.54		
	8 to 12 months a year	3.85		

Table 3. Registration and time spent on MarketMaker.

Variable Name (Units)	Category	Category Proportion	Mean	
			Nonparametric lower and upper bounds	Parametric
Registration type	Self-registered	65.75		
	registered by someone else	8.22		
	don't know	26.03		
Time registered on MarketMaker (Months)	Less than 1	4.29	(14.32, 24.81)	18.84
	1 to 6	18.57		
	7 to 12	11.43		
	12 to 24	34.29		
	24 to 36	20.00		
	36 to 48	8.57		
	More than 48	2.86		
Time spend on MarketMaker activities (Minutes/month)	Less than 30	76.81	(30.88, 85.75)	50.04
	30 to 60	13.04		
	61 to 120	2.90		
	121 to 300	2.90		
	301 to 600	1.45		
	More than 600	2.90		
Overall satisfaction	Very satisfied	8.22		
	Satisfied	28.77		
	Neutral	60.27		
	Dissatisfied	1.37		
	Very dissatisfied	1.37		

With respect to the time devoted to the website, farmers' market managers registered on MarketMaker spend about fifty minutes per month managing their account, with nearly 77% of the respondents devoting less than thirty minutes per month on MarketMaker related activities (Table 3). Participants were also asked about their overall satisfaction with MarketMaker. Survey results demonstrate that 37% of farmers' market managers were very satisfied or satisfied with MarketMaker, 60% had a neutral perception, and 2.7% were very dissatisfied or dissatisfied with MarketMaker. Farmers' market managers report various degrees of intensity with respect to the use of MarketMaker features (Table 4). The features that were most commonly used (sometimes and frequently) are the "log on to check or update profile" (22% of users), and "search for new vendors" (23%). Less commonly used features included "search for products" and "reach out to customers," which were used sometimes or frequently by about 19% and 14% of users, respectively.

Table 4. MarketMaker features and their rate of use by participants.

Feature	Never	Rarely	Sometimes	Frequently
Log on to Check or Update Profile	0.39	0.40	0.20	0.02
Search for Products	0.50	0.31	0.15	0.04
Search for new vendors	0.54	0.23	0.19	0.04
Reach out to customers	0.55	0.32	0.12	0.02
Other	0.78	0.13	0.04	0.04

Table 5 describes survey findings regarding the outcomes of farmers' market participation in MarketMaker. All the outcomes are highly censored with large proportions of responders reporting zero outcomes. Moreover, all the outcomes but the change in sales variable are discrete (i.e., counts). Thus, the normal distribution assumption required for parametric mean estimation is likely to be violated for these data. Therefore, we evaluate and discuss these findings in terms of the lower and upper bounds of their nonparametric means which are robust to any distributional misspecifications. Respondents indicated that since registration, as a result of their participation with MarketMaker, they have been contacted, on average, about 0.8 to 2.1 times by customers and vendors.[4] However, 69% of farmers' market managers in our sample have not yet received any contacts due to MarketMaker. In terms of the number of new vendors gained, respondents indicated that their participation in MarketMaker has helped them obtain an average of 0.4 to 1.2 new vendors (76% indicated that they have not yet gained new vendors through the site). Participants also reported that as a result of their participation with MarketMaker they have gained, on average, 1.2 to 5.0 new customers, (63% of the respondents have not yet obtained new customers).

The average annual increase in sales due to participation in MarketMaker was estimated to be between 0.72% to 6.42% (43% of the participants have not yet experienced any increase in annual sales). Relative to the average annual sales of $135,820, these figures indicate average increase in annual sales between $977 to $8,720 per farmers' market. It is important to note that the increase in sales in the farmers' market is likely due to the combined effect of attracting new vendors and new customers.

[4] These values likely represent a lower bound of actual MarketMaker contacts due to attribution bias, since with the lack of interaction (especially between new customers and farmers' market managers) new contacts rarely communicate their source of information.

Table 5. Farmers' market managers' perceived effect of participating in MarketMaker.

Variable Name	Category	Category Proportion	Nonparametric Mean lower and upper bounds
Marketing contacts	0	69.33	(0.77, 2.13)
	1 to 5	24.00	
	6 to 10	4.00	
	11 to 20	2.67	
New vendors	0	76.40	(0.42, 1.21)
	1 to 4	19.10	
	5 to 10	4.49	
New customers or buyers	0	63.41	(1.22, 5.00)
	1 to 10	31.71	
	11 to 25	2.44	
	26 to 50	2.44	
Increase in annual sales	0%	42.86	(0.72, 6.42)
	1% to 10%	50.00	
	10% to 19%	7.14	

Note. Marketing contacts, new vendors and new customers refer to the total contacts, vendors and customers gained since the Farmers' Market became registered on the MarketMaker website.

Among farmers' markets that believe they have experienced increase in sales, most (50% of the whole sample) believed sales went up in the range of 1% – 10%, and some (7% of the whole sample) believed sales went up by 10%-19%. In the remainder of this study we focus on the impact of the MarketMaker on farmers' markets sales and examine the factors that affect this impact. Since sales measure some of the longer term outcomes, they would encompass several shorter term outcomes discussed in this section and thus represent a more comprehensive measure of MarketMaker impact.

Factors Affecting the Impact of MarketMaker on Farmers' Market Sales

Estimation Methods

The choice of the estimation procedure for assessing the factors that affect the impact of MarketMaker on farmers' market sales was driven by the nature of the dependent variable. The data on changes in sales of farmers' markets due to MarketMaker was collected in discrete interval format as shown in Table 5. Since the OLS estimation of this type of data results in asymptotic bias (Stewart 1983), we followed a maximum likelihood procedure developed by Bhat (1994) to compute a continuous and reliable value for changes in sales. This approach is suitable for data collected within broad intervals.

Denoting the true (but unobserved) value of the variable of interest for the i[th] individual as y_i and the boundary values for the k[th] interval selected as A_{k-1} and A_k, the probability that y_i is in the k[th] interval is given by:

$$(1) \quad \mathrm{P}\left(\mathrm{A_{k\text{-}1}} \leq \mathrm{y_i} \leq \mathrm{A_k}\right) = \mathrm{F(A_k)\text{-}F(A_{k\text{-}1})} \qquad \mathrm{i} = 1,2,\ldots.\mathrm{N},$$

where F(.) is the underlying probability distribution of variable *y* (Day 2007; Turnbull 1976).

The probability of observing a particular set of responses in a random sample of N individuals from the population of interest is then given by the likelihood function:

$$(2) \quad \mathrm{L} = \prod_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{F(A_k)\text{-}F(A_{k\text{-}1})}.$$

In order to express the likelihood function in terms of the interval options available to the respondent, we create a dummy variable d_{ik} which indicates whether an individual chooses the k[th] interval among K options. Using this indicator variable and the generic likelihood function in (equation 2) the resulting log-likelihood function is:

$$(3) \quad \ln L = \sum_{i=1}^{N} ln \sum_{k=1}^{K} d_{ik}[\mathrm{F}(A_k) - \mathrm{F}(A_{k-1})].$$

The parametric procedure assumes that the variable y follows a normal distribution with mean μ and variance σ^2. Consequently, the log-likelihood function can be written as:

$$(4) \quad \ln L = \sum_{i=1}^{N} ln \sum_{k=1}^{K} d_{ik}[\Phi\left(\frac{A_k-\mu}{\sigma}\right) - \Phi(\frac{A_{k-1}-\mu}{\sigma})],$$

where F(.) in equation 3 has been replaced by the cumulative standard normal $\Phi(.)$. Parameter estimates for μ and σ can then be obtained by using maximum likelihood estimation procedures. Moreover, the parameter μ can be modeled as a function of explanatory variables. In particular, the parameter μ can be expressed as $\mu = \boldsymbol{X_i}\boldsymbol{\beta}$, where $\boldsymbol{X_i}$ is a vector of explanatory variables (including 1 for the intercept) and $\boldsymbol{\beta}$ the corresponding vector of parameters.

In the context of this study, the variable of interest "change in sales of farmers' markets due to MarketMaker" (*y*) is also censored since a high proportion of respondents reported a 0% change in sales due to Market Maker. Following the logic of the traditional Tobit model, the expected value of change in sales, considering that they are higher or equal to zero, is given by

$E[y] = \Phi\left(\frac{\boldsymbol{X_i}\boldsymbol{\beta}}{\sigma}\right)\boldsymbol{X_i}\boldsymbol{\beta} + \sigma\varphi\left(\frac{\boldsymbol{X_i}\boldsymbol{\beta}}{\sigma}\right)$, where $\varphi(.)$ is the standard normal density function. The marginal effects on this mean values are given by $\frac{\partial E[y]}{\partial \boldsymbol{X_i}} = \boldsymbol{\beta}\Phi\left(\frac{\boldsymbol{X_i}\boldsymbol{\beta}}{\sigma}\right)$ (Greene 2003). The

asymptotic covariance matrix of both the coefficient estimates and the marginal effects was approximated using the non-parametric bootstrapping procedure outlined by Wooldridge (2002, p. 379). A total of 1,000 replications were used to generate standard errors.

Since very little is known about factors that affect the use and impact of e-commerce in agriculture (i.e., the vector $\boldsymbol{X_i}$), we built our hypotheses in this study based on the logic model developed for MarketMaker evaluation. The outcome that we focused on was farmers' market sales due to MarketMaker. This outcome is affected by inputs, activities and outputs. As Figure 2 (see Appendix) indicates, these inputs, activities and outputs were differentiated at the national, state and individual level. At the national level the impact of MarketMaker could differ across the country due to the regional differences in the farmers' markets and the consumer interest in their products, however the regional effects (e.g., North vs. South) could not be hypothesized a priori. States differed widely in terms of MarketMaker activity. As shown in Figure 1, some states have participated in MarketMaker since 2000, while others were very new to this tool. We hypothesized that the length of presence of MarketMaker in the state would have a positive effect on its impact (especially longer term impact such as sales) due to the larger amount of inputs and activities devoted to the project over time.

At the individual level, user characteristics hypothesized to affect the impact of MarketMaker included farmers' market total annual sales, years in operation, the age and gender of the farmers' market manager, and intensity of MarketMaker use. Total farmers' market sales were included to represent the size of the business, which could have a positive effect on the impact of MarketMaker since the costs of learning and implementing e-commerce tools could be spread out across a larger scale of operation. On the other hand, e-commerce could be very effective in identifying niche markets for smaller users, thus the expected relationship between the size of the farmers' market and the impact of MarketMaker was ambiguous. The years in operation variable was included to explore the effect of MarketMaker helping to establish new operations (among the markets that are less than four years old) or expanding existing operations among the older markets. The age of the farmers' market manager was used as a proxy for the level of technical ability. We expected younger managers to be more technologically adept and be able to take a better advantage of MarketMaker. The expected relationship between sales and gender was ambiguous. The extent of participation was deemed an important determinant for MarketMaker impact. "Frequent" users (those who spend more than thirty minutes a month) were expected to gain more benefits from MarketMaker than "passive" users. Variable definitions and the results of the estimation are shown in Table 6.

Estimation Results

The results of the estimation shown in Table 6 demonstrate the impact of the independent variables on the percentage increase in farmers' markets annual sales attributed to MarketMaker. The unconditional mean percentage increase in annual sales was estimated at 4.04% which is within the estimated nonparametric lower and upper bounds of the mean reported in Table 5.

Three out of seven variables included in the model were statistically significant at the 10% level. As expected, years of MarketMaker presence in the state were positively related to its impact. For each additional year of MarketMaker presence in the state, the farmers' market sales attributed to MarketMaker increased by 0.46%. This result differentiates the experience of the farmers' markets in the states with established MarketMaker programs from the newer program participants and demonstrates program's potential for new users. Our second finding is that MarketMaker has larger impacts on established farmers' markets. The increase in sales for

established farmers' markets (more than four years in operation) was 1.71% greater than that for the newer ones. This finding suggests that MarketMaker impact on farmers' markets is larger in terms of expanding existing capacity than in helping create a new one. By far the largest determinant of MarketMaker impact was the type of user. Frequent users (those who spend more than thirty minutes per month on their MarketMaker activities) experienced an almost 3.78% larger increase in sales compared to passive users. This result indicates that in order to see the impact of MarketMaker on their operations, users have to invest time and effort in making the program work for them. It also demonstrates the payoff users can expect for their time investment. Overall these findings outline the components needed for the more successful use of MarketMaker by the farmers' markets: an established program, an established market and an active user-manager. With these components in place, MarketMaker can help significantly increase sales at participating farmers' markets.

Table 6. Interval-censored analysis of the factors affecting farmers' market sales attributed to MarketMaker.

Variable	Parameter Estimate	Standard Error	Marginal Effect	Standard Error
Intercept	-0.076	3.613		
Region (South=1, Mid-west=0)	0.058	1.875	0.044	0.073
Years in operation (Less than 4 years =0, More than 4 years =1)[a]	2.247*	1.616	1.714*	1.224
Total sales (Less than $50,000 =0, More than $50,000 =1)	1.301	1.500	0.992	1.167
MM type of user (Frequent user =1, Passive-user=0)	4.950***	1.913	3.776***	1.511
Manager gender (Female=1, Male =0)	-1.339	1.525	-1.0211	1.173
Manager age (Years)	-0.038	0.059	-0.029	0.045
Years of MM presence in the state	0.608*	0.386	0.463*	0.296
Sigma	4.152***	0.813		

Notes. N=56. Dependent variable is percentage increase in sales attributed to MM with the following observed intervals: no increase in sales (24 obs.), 0.01% - 9.99% (28 obs.), 10% - 19% (4 obs.).
[a] Significance levels of 0.01, 0.05 and 0.10 are indicated by ***, ** and *, respectively.

Summary and Conclusions

The goal of this study was to estimate the impact of MarketMaker on farmers' markets. The impact was measured on several levels. First we identified the perceived outcomes through the survey of farmers' market managers. Second we analyzed factors that affect the increase in farmers' markets sales due to MarketMaker participation.

Our survey respondents indicated that as a result of their participation with MarketMaker, farmers' market managers have been contacted, on average, about 0.8 to 2.1 times by customers and vendors and obtained an average of 0.4 to 1.2 new vendors and 1.2 to 5.0 new customers. The average annual increase in sales due to participation in MarketMaker was estimated at about 4.04%, or $5,487.13 per farmers' market. While only about a third of the sample gained new

vendors and contacts, about half of the sample reported increase in sales, suggesting that MarketMaker has been effective in promoting existing farmers' markets.

Through the analysis of factors that affect the increase in farmers' markets sales due to MarketMaker, we identified the components needed for the more successful use of MarketMaker by the farmers' markets, namely, an established MarketMaker program, an established farmers' market and an active user-manager. Thus our findings suggest that the program works when people use it and demonstrate program potential for new users. The fact that more established farmers' markets are able to achieve higher increase in sales than the new ones suggests that MarketMaker is more effective in expanding existing, rather than helping create new capacity. Finally, higher sales among more active users indicate that in order to see the impact of MarketMaker on their operation, users have to invest time and effort in making the program work for them. With these components in place, MarketMaker can help increase sales at participating farmers' markets. Given MarketMaker's relative infancy, our findings establish a track record and demonstrate potential among the more successful users of the program as well as the factors needed for the program to succeed.

Finally, several limitations of this study have to be mentioned along with suggestions for future research. This study focused on the impact of MarketMaker on a single segment of its users, the farmers' markets. Evaluation of the full impact of MarketMaker would require the evaluation of effect on all of its users (which would include farmers, consumers, intermediaries, etc.) and comparing the combined benefits that they receive from the site to the costs of developing and delivering the platform.Given the declining survey response rates observed in the recent literature, future studies will likely face similar challenges that we encountered in this study associated with the low response rates. MarketMaker administrators could help address these challenges and enable evaluation of the non-response bias in the data by collecting basic demographic information of its users. As MarketMaker evaluation studies are moving forward, future studies could use our results as a benchmark to assess changes in its impact over time. Furthermore, broader studies could evaluate the competitive performance of MarketMaker relative to the other e-commerce tools.

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Appendix

Figure 2. MarketMaker Logic Model for Farmers' Markets