

Intensity of Adoption of Direct Marketing Strategies Among Fruit
and Vegetable Farmers in Tennessee

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ABSTRACT

Consumer interest in fresher foods has increased over the past few years and has stimulated the growth of direct-to-consumer outlets. Tennessee currently hosts many types of direct food outlets, including farmer markets, CSAs, roadside stands, and pick-your-own operations. Using data from a 2011 survey of Tennessee fruit and vegetable producers, factors associated with the percentage of sales fruit and vegetable producers make through direct-to-consumer outlets or intensity of adoption of direct-to-consumer marketing strategies are evaluated using fractional logit and logit regressions. Findings suggest that the percentage of sales a producer makes through direct-to-consumer outlets is associated with farmer age, the use of published University/Extension materials about marketing strategies, percentage of income from farming, and the ability to access other market outlets, such as wholesale and retail, through food hub organizations. These results should be of interest to University/Extension personnel and state agencies attempting to increase producer income by promoting direct-to-consumer marketing strategies.

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Introduction

The 2007 U.S. Census of Agriculture reported that the value of farm products sold directly to individuals for human consumption increased from about \$812 million in 2002 to \$1.2 billion in 2007 (USDA/NASS 2012). Direct-to-consumer marketing strategies include roadside stands, farmer markets, pick-your-own operations, community supported agriculture (CSA), and other direct sales strategies. In Tennessee, the number of farms selling agricultural products directly to consumers increased from 3,392 in 2002 to 3,581 in 2007 (USDA/NASS 2012).

Direct-to-consumer outlets allow producers to connect with consumers, eliminating market middle men and allowing producers to obtain a larger percentage of the sales value (Morgan and Alipoe 2001). From the consumer's standpoint, increased interest in fresher foods – usually grown locally – has stimulated the growth of direct-to-consumer outlets (Govindasamy, Hossain, and Adelaja 1999; Morgan and Alipoe 2001; Uva 2002). Between 2009 and 2012, the number of farmer markets increased by 50% from 5,240, to 7,837 nationwide (Food Environmental Atlas USDA/ERS 2012). The number of farmer markets in Tennessee increased by 42% from 2009 to 2012 (Food Environmental Atlas USDA/NASS 2012).

Fruit and vegetable producers must not only make production decisions, but also decisions about what marketing channels to use when selling their produce (Monson, Mainville, and Kuminoff 2008). Fruit and vegetable farmers will allocate the percentage of sales to be made through direct-to-consumer, intermediate, and retail outlets (Table 1) in order to maximize profits (Monson, Mainville, and Kuminoff 2008; Corsi, Borsotto, and Strøm 2009; LeRoux et al. 2009; Park, Mishra, and Wozniak 2011). The adoption of direct marketing strategies among fruit

and vegetable farmers is of particular importance because these outlets have the potential to increase farm income, especially for smaller operations (Govindasamy, Hossain, and Adelaja 1999; Morgan and Alipoe 2001; Monson, Mainville, and Kuminoff 2008).

The objective of this research is to evaluate the factors affecting the intensity with which fruit and vegetable farmers incorporate direct marketing strategies into their agricultural enterprises, where intensity is measured by the percentage of sales made through direct-to-consumer outlets. Examining the factors affecting the percentage of sales a farmer makes through direct-to-consumer outlets can provide information about the type of farms that are more likely to adopt direct marketing strategies. This information may be useful to Tennessee fruit and vegetable farmers who are considering selling directly to consumers as part of their farm business plan. Additionally, this information may help governmental agencies and other institutions interested in helping producers increase profit margins through the adoption of direct-to-consumer marketing strategies.

Chapter 1: Literature Review

A number of studies evaluate the factors affecting consumer participation in direct-to-consumer outlets (Ladzinski and Toensmeyer 1983; Gallons et al. 1997; Govindamsamy and Nayga 1997; Lehman et al. 1998; Kuches et al. 2000; Henneberry and Agustini 2004; Onianwa, Wheelock, and Mojica 2005; Thilmany, Bond, and Bond 2006). Few studies also examine the factors affecting farmer decisions to adopt direct-to-consumer marketing strategies (Corsi, Borsotto, and Strøm 2009; Narayan and Gillespie 2010; Park, Mishra, and Wozniak 2011) as well as the intensity of adoption of these marketing strategies (Monson, Mainville, and Kuminoff 2008; Uematsu and Mishra 2011). The focus of this research is on the latter.

Corsi, Borsotto, and Strøm (2009) analyze organic farmer choices of marketing chains and the factors affecting these decisions. The analysis uses survey data of all organic farms in the Italian Piedmont region enrolled in the regional official list regulated by the European Council Regulations. A multivariate probit regression is used to evaluate the factors influencing organic producer choices of marketing channels, allowing for farmers to make choices that were not mutually exclusive. The marketing channels evaluated are: 1) sales on the farm; 2) short marketing chains, including farmer markets, specialized organic shops, home delivery, and restaurants; and 3) traditional marketing channels, which includes co-operatives, wholesalers, and supermarkets. Results from this study suggest that greater educational attainment and attending more professional training events are negatively associated with the likelihood of using traditional marketing chains. In contrast, these two variables have a positive effect on the probability of using direct and short marketing chains. Additionally, the authors conclude that

older farmers are more likely to use short marketing chains. Farm size is negatively correlated with the probability of choosing direct and short chains, and positively associated with the likelihood of using traditional marketing chains. Finally, the type of farming, represented by the crops grown on the farm, is associated with the choice of marketing chains. Corsi, Borsotto, and Strøm (2009) conclude that farmers growing cereals, rice, and field crops are more likely to use traditional marketing chains, while farmers growing horticultural products or wine are more likely to use short chains to market their products.

Narayan and Gillespie (2010) use the results of a 2008 survey of Louisiana crawfish producers to study the impact of farm production, demographics, and pre-selling practices on the marketing choices of crawfish producers. Four marketing choices are evaluated using individual probit regressions: selling to a processor, selling to a wholesaler, selling to a retailer, and selling directly to a consumer. Results from this study suggest that producers with low levels of education and a higher proportion of income from farming are more likely to sell their product directly to consumers. In contrast, farmers with college degrees and a higher percentage of income from off-farm sources are more likely to sell through wholesalers. Older crawfish producers are more likely to sell their product to processors and less likely to market their product through wholesalers. Finally, producers who clean their crawfish are more likely to sell their product directly to consumers, while producers grading their crawfish have a higher probability of using wholesalers as a marketing outlet.

Park, Mishra, and Wozniak (2011) investigate the factors affecting farmer decisions to sell produce through direct-to-consumer outlets, intermediate and retail outlets, and combinations

of all. They also evaluate the impact of direct sales choice on financial performance. They use a national data set from the 2008 Agricultural Resource Management Survey (ARMS) that is managed by the Economic Research Service (ERS) and collected by the National Agricultural Statistics Service (NASS) to conduct this analysis. Using a sample selection model, they first evaluate factors affecting the choice of marketing outlets, and then the impact of this decision on farm earnings. The marketing strategies evaluated are: 1) use of direct-to-consumer outlets such as farmer markets, u-pick operations, and CSAs; 2) use of intermediary and retail outlets such as local grocery stores, regional distributor, and state branding programs; and 3) use of all direct-to-consumer, intermediary and retail outlets. Results from this study suggest that farmers who have an internet connection and are using the internet for farm-related commerce are more likely to use intermediary and retail outlets. Results also indicate that farmers with more diversified operations and those who use the internet for farm-related commerce are more likely to use direct-to-consumer outlets. Finally, farmers purchasing a higher number of inputs close to their location are less likely to use intermediate retail, or both direct-to-consumer and intermediate retail outlets.

Monson, Mainville, and Kuminoff (2008) evaluate factors affecting farmer dependency on direct-to-consumer marketing strategies in terms of the share of direct-to-consumer sales of total farm sales. Small fruit and specialty-crop producers in Virginia were surveyed in 2006, and an ordered logit regression is used to determine the factors affecting the intensity of adoption of direct marketing strategies measured by the share of direct sales in total farm sales. They find that farm and household size, and farm income from high-value markets, specifically small fruits, have a negative effect on farmer reliance on direct-to-consumer outlets to sell their

produce. They also find that a producer using organic production methods, but who is not USDA-certified, is more likely to have a higher share of direct-to-consumer sales to total farm sales.

Using data from the 2008 Agricultural Resource Management Survey, Uematsu and Mishra (2011) evaluate the factors affecting the total number of direct marketing strategies (i.e., road side stores, on-farm stores, farmer markets, regional distributors, state branding programs, direct sales to local grocery stores, restaurants or other retailers, and community supported agriculture (CSA)) adopted by a farmer or intensity of adoption of direct marketing strategies. Using a zero-inflated negative binomial model they find that greater educational attainment, farming as primary occupation, farming as a primary occupation for the respondent's spouse, seeking advice from Natural Resource Conservation Service (NRCS) agents, receiving payments from the Conservation Reserve Program (CPR), and having internet access at their farm are all positively associated with the adoption of direct marketing strategies. Additionally, farmers with livestock, high value, and other field crops farms are likely to more intensively adopt direct marketing strategies than cotton and cash grain farmers. Farming experience in years, total acres operated, direct payments received by the farm in dollars, and farm location relative to the NASS Midwest region (i.e., Southern Plains and West regions) are all found to negatively affect adoption intensity of direct marketing strategies.

Only a few studies (Monson, Mainville, and Kuminoff 2008; and Uematsu and Mishra 2011) evaluate the intensity at which farmers integrate direct marketing strategies into their business plans and these studies differ in the way intensity of adoption is measured. Monson,

Mainville, and Kuminoff (2008) measure intensity of adoption by the share of direct marketing sales in total farm sales while Uematsu and Mishra (2011) measure it as the number of direct marketing strategies used or adopted. In this study, the issue of intensity of adoption is evaluated for fruit and vegetable farmers in Tennessee using the approach adopted by Monson, Mainville, and Kuminoff (2008), adding to the scarce literature evaluating this issue. Additionally, an econometric approach that differs from the one presented in Monson, Mainville, and Kuminoff (2008) is used to identify the factors affecting intensity of adoption of direct marketing strategies.

Chapter 2: Methods and Procedures

Data

The data used in this research were collected from a 2011 survey of Tennessee fruit and vegetable producers. The survey list frame was provided by the USDA National Agricultural Statistics Service (NASS). The survey, a cover letter explaining the relevance of the survey, and a pre-paid postage return envelope were mailed to 1,954 producers on February 2, 2011. About three weeks later, reminder postcards were sent. A month later, a second wave of surveys was mailed to first round non-responders. A total of 587 questionnaires were completed and returned for a response rate of 30%. After eliminating respondents who, by the time of the survey, were not producing fruits and vegetables anymore, there were 517 observations for analysis. Questions related to marketing outlets (i.e., direct to consumers, direct to intermediaries, and direct to retail outlets) used by fruit and vegetable producers; the percentage of fruit and vegetables sales delivered to each marketing outlet; and general farmer and farm business characteristics were also included in this survey. Percentage of sales made through direct-to-consumer outlets were used as a measure of intensity of adoption of direct marketing strategies. Farmer's age, education, use of University/Extension publications associated with marketing strategies, size of fruit and vegetable operation, percentage of income from farming, and farm location were used in the analysis of direct marketing strategies adoption intensity (Table 2). Secondary data concerning the number of food hub organizations operating in a county were collected from the Food Environmental Atlas (Food Environmental Atlas USDA/NASS 2012).

Conceptual Framework

Fruit and vegetable producers are assumed to be rational decision makers who maximize the discounted expected profits from farming. Producer uncertainty about future income from fruit and vegetable production may induce them to diversify marketing strategies to improve their profit margins. The producer's decision to incorporate direct-to-consumer marketing strategies in his/her business plan can be understood as an attempt to boost profits from farming through access to higher prices and an increase in consumer base and sales (Govindasamy, Hossain, and Adelaja 1999; Monson, Mainville, and Kuminoff 2008; Narayan and Gillespie 2010; Park, Mishra, and Wozniak 2011). Additionally, producers may perceive adoption of these marketing strategies as an opportunity to contribute to the wellness of their community, as they give access to local, and maybe, fresher foods to community members (Govindasamy and Nayga 1997; Low and Vogel 2011).

The intensity at which farmers incorporate direct marketing strategies in their farming enterprises or the percentage of sales (y_p) they allocate to direct-to-consumer outlets (i.e., farmer markets, roadside stands, community supported agriculture, pick-your-own, and other direct-to-consumer outlets) is determined such that profits from farming are maximized (LeRoux et al. 2009). The expected profits from allocating a percentage of sales to direct-to-consumer outlets may be affected by farmer and farm business characteristics such as percentage of income from farming, farm size, and farm location (Monson, Mainville, and Kuminoff 2008; Uematsu and Mishra 2011).

Given that a large percentage of farmers (Table 2) considered in this study make 100% of their sales through direct-to-consumer outlets or have the highest adoption intensity, factors affecting the decision to make 100% of produce sales through direct-to-consumer outlets are also evaluated as a specific case of the intensity of adoption of direct marketing strategies. Using a random utility model, let $E[U(\pi_{100\%})]$ ($E[U(\pi_{<100\%})]$) be the expected utility of profit from making 100% of sales (less than 100%) through direct-to-consumer outlets. Defining $U_{100\%}^* = E[U(\pi_{100\%})] - E[U(\pi_{<100\%})]$, we could say that farmers will make 100% of their sales using direct marketing strategies if $U_{100\%}^* \geq 0$. The latent variable $U_{100\%}^*$ is hypothesized to be a function of observed exogenous variables (x_i) such that:

$$(1) \quad U_{i100\%}^* = \beta_{100\%}' x_i + \varepsilon_{100\%i},$$

where x_i is a vector of observed producer, farm, and location characteristics, $\beta_{100\%}$ is a vector of unknown parameters associated with these variables, and $\varepsilon_{100\%i}$ is an error term.

Methods

Fractional Logit Regression

As explained in the previous section the intensity with which farmers adopt direct market strategies is measured by the percentage of sales made through direct-to-consumer outlets (y_p). This variable is confined to the (0, 1) interval. We would like to relate each level of adoption intensity y_p to a set of explanatory variables. Given the condition that the predicted value of y_p must be within the unit interval, a common approach is to use the log-odds transformation of y_p

(i.e., $y^* = \ln(y_p/1 - y_p)$). There are, however, a few problems with this approach. The log-odds approach cannot be used if y_p takes on the values of zero or one, because at these values the log-odds ratio is undefined. In addition, it is difficult to recapture the expected value of y_p from the estimated log-odds ratio without making additional assumptions (Papke and Wooldridge 1996).

As an alternative Papke and Wooldridge (1996) propose a fractional logit model that directly estimates $E(y_p | x)$ such as it is restricted to the interval between zero and one. We choose the latter approach to evaluate the factors affecting the intensity of adoption of direct marketing strategies. The percentage of fruit and vegetables sales producers make through direct-to-consumer outlets can be modeled as,

$$(2) \quad E(y_p | x) = \frac{\exp(\beta'x)}{[1 + \exp(\beta'x)]},$$

where $E(y_p | x)$ is the expected percentage of sales to be made through direct-to-consumer outlets, x is a vector of producer, farm, and location characteristics, β is a vector of unknown parameters, and the right hand side expression in equation (2) is just the logistic distribution function. This approach restricts the predicted value of y_p to be within the interval (0, 1). The effect of the j explanatory variable on the expected percentage of produce sales farmers make through direct-to-consumer outlets can be represented by

$$(3) \quad \frac{\partial E(y_p | x)}{\partial x_j} = \beta_j \frac{\exp(\beta'x)}{[1 + \exp(\beta'x)]^2}.$$

Papke and Wooldridge (1996) propose a quasi-maximum likelihood procedure to obtain parameter estimates and the associated robust standard errors. The Bernoulli log-likelihood function used in this procedure can be represented as,

$$(4) \quad l_i(\beta) = y_p \log[E(y_p | x)] + (1 - y_p) \log[1 - E(y_p | x)] .$$

Logit Regression

A logit regression was used to evaluate the effect of farmer, farm business, and location characteristics on the decisions of producers to make 100% of produce sales through direct-to-consumer outlets. Note that $U_{100\%}^*$, as defined in the conceptual framework section, is an unobservable variable, but a producer's decision to make 100% of produce sales through direct-to-consumer outlets is observable such that,

$$(5) \quad y_{i100\%} = \begin{cases} 1 & \text{if } U_{i100\%}^* \geq 0 \\ 0 & \text{if } U_{i100\%}^* < 0 \end{cases} ,$$

where $y_{i100\%} = 1$ if the producer chooses to make 100% of the produce sales using direct marketing strategies, $y_{i100\%} = 0$ otherwise.

Assuming that the disturbances are generated from the logistic distribution per $\varepsilon_{i100\%}$, the probability of a farmer making 100% of produce sales through direct-to-consumer outlets is

$$(6) \quad \begin{aligned} \Pr(y_{i100\%} = 1) &= \Pr(U_{i100\%}^* > 0) \\ &= \Pr(x'_i \beta_{100\%} + \varepsilon_{i100\%} > 0) = \Pr(\varepsilon_{i100\%} > -x'_i \beta_{100\%}) \\ &= 1 - F(-x'_i \beta_{100\%}), \end{aligned}$$

where $\Pr(y_{i100\%} = 1)$ is the probability a farmer makes 100% of produce sales through direct-to-consumer outlets and F is the cumulative logistic distribution function. The symmetric qualities of the distribution can be used to show that

$$(7) \quad \Pr(y_{i100\%} = 1) = 1 - F(-x'_i \beta_{100\%}) = F(x'_i \beta_{100\%}).$$

The probability of a farmer making 100% of his/her produce sales through direct-to-consumer outlets is

$$(8) \quad \Pr(y_{i100\%} = 1) = F(x'_i \beta_{100\%}) = \frac{1}{(1 + \exp(-x'_i \beta_{100\%}))}.$$

Given the probability stated in equation (8), the likelihood function for the logit regression model is

$$(9) \quad \begin{aligned} L(\beta_{100\%}) &= \prod_i \Pr(y_{i100\%} = 1) \prod_i \Pr(y_{i100\%} = 0) \\ &= \prod_i F(x'_i \beta_{100\%}) \prod_i (1 - F(x'_i \beta_{100\%})). \end{aligned}$$

Then

$$(10) \quad \log L(\beta_{100\%}) = \sum_i \log(F(x'_i \beta_{100\%})) + \sum_i \log(1 - F(x'_i \beta_{100\%})).$$

$$(11) \quad \log L(\beta_{100\%}) = \sum_i \log\left(\frac{1}{(1 + \exp(-x'_i \beta_{100\%}))}\right) + \sum_i \log\left(\frac{\exp(-x'_i \beta_{100\%})}{(1 + \exp(-x'_i \beta_{100\%}))}\right).$$

The marginal effects of (8) for a continuous variable j are calculated as

$$(12) \quad \frac{\partial E(y_{i100\%} = 1)}{\partial E(x_{ij})} = \left(\frac{1}{1 + \exp^{\beta'_{100\%} x_i}} \right) \left(\frac{e^{\beta'_{100\%} x_i}}{1 + e^{\beta'_{100\%} x_i}} \right) \beta_{100\% j},$$

$$= \frac{\beta_{100\% k} e^{\beta'_{100\%} x_i}}{(1 + e^{\beta'_{100\%} x_i})^2}.$$

The marginal effects of (8) for a discrete variable k are calculated as

$$(13) \quad \frac{\partial E(y_{i100\%} = 1)}{\partial E(x_{ik})} = \Pr(y_{i100\%} = 1 | x_k = 1, x_{-k}) - \Pr(y_{i100\%} = 1 | x_k = 0, x_{-k}),$$

where x_{-k} is a vector of all independent variables other than k .

Empirical Model

The empirical model for the intensity of adoption of direct marketing strategies - measured as the percentage of fruit and vegetable sales made through direct-to-consumer outlets - is given by,

$$(14) \quad y_p = \beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 SchoolDegree + \beta_4 Publications + \beta_5 Pf_income + \beta_6 Vegsize + \beta_7 Westtenn + \beta_8 Easttenn + \beta_{10} FoodHub + \varepsilon.$$

The independent variables in equation (14) are defined in Table 2. The same variables are hypothesized to affect the decision to make 100% of produce sales using direct marketing strategies ($y_{i100\%}$).

Producer characteristics hypothesized to affect the intensity of participation in direct marketing strategies are age (*Age*), educational attainment (*SchoolDegree*), and use of University/Extension educational publications regarding produce marketing strategies in the past

five years (*Publications*). The intensity of adoption response to age is hypothesized to be nonlinear, displaying a U-shaped rather than a linear pattern. Brown (2002) and Griffin and Frongillo (2003) found that the majority of producers participating in direct-to-consumer markets are retired individuals trying to supplement their fixed income. It is hypothesized that as age increases farmers expected percentage of sales made through direct-to-consumer outlets may decrease because these strategies may be time intensive and as farmers get older they may have less “energy” to be distributed between farming and marketing activities. This association may be more prominent for part-time farmers. As farmers get close to the retirement age they may have more time available to be devoted to farming activities, including marketing, and therefore may increase the adoption intensity of direct marketing strategies.

Education is expected to be positively correlated with the intensity of adoption of direct marketing strategies. Participation in direct-to-consumer markets requires special skills which may not be directly related to agricultural practices (Uva 2002; Corsi, Borsotto, and Strøm 2009; Uematsu and Mishra 2011). Producers with higher levels of education may have learned how to be more efficient in marketing produce through direct-to-consumer outlets. More educated farmers may just have farming as a hobby and not as a main source of income. Hobby farms are expected to more intensively adopt direct marketing strategies as a way to get back to the land and give back to the community (Monson, Mainville, and Kuminoff 2008). Producers who have a bachelor or graduate degree are expected to have a larger percentage of their sales made through direct-to-consumer outlets.

Use of University/Extension publications is hypothesized to increase the intensity of the adoption of direct marketing strategies. Information plays a key role in marketing. Extension services can be an effective tool in delivering the information needed for farmers to make informed decisions about new marketing strategies (Nowak 1987; Knowler and Bradshaw 2007). Farmers using University/Extension publications are expected to have a larger percentage of their sales being made through direct-to-consumer outlets.

Farm enterprise characteristics included in equations (14) are the percentage of income from farming (*Pf_income*) and the size of the fruit and vegetable operation (*Vegsize*). The percentage of household income from farming is hypothesized to have a negative effect on the expected percentage of sales to be made through direct-to-consumer outlets. Producers who are highly dependent on farm income may be more likely to diversify their portfolio and consider other produce outlets to reduce risk.

Fruit and vegetable farm size is hypothesized to be negatively correlated with the intensity of adoption of direct marketing strategies. Smaller operations are more likely to rely on direct-to-consumer outlets, perhaps because these operations may not be able to consistently produce quality fruits and vegetables or meet the high volume demands of intermediary or retail outlets (Gale 1997; Brown 2002; Low and Vogel 2011). Larger operations tend to rely on intermediary or retail outlets because they can reduce their costs of labor by leaving the more labor-intensive production and marketing activities to these outlets; they can grow more produce to meet the high volume demands of these markets; and they can overcome barriers to entry to these lucrative markets (Monson, Mainville, and Kuminoff 2008; Low and Vogel 2011). For

example, larger fruit and vegetable operations can spread the fixed costs of food safety certification, logistics, and other investments that are commonly required by retail outlets over a larger production volume (Monson, Mainville, and Kuminoff 2008). Therefore, as the size of the fruit and vegetable operation increases, the percentage of fruit and vegetable sales made through direct-to-consumer outlets is hypothesized to decrease. Small fruit and vegetable operations are hypothesized to generally reach the highest adoption intensity, i.e., having 100% of their sales made through direct-to-consumer outlets.

Two characteristics of the area in which the producer operates are included in the empirical models. The first is the region in Tennessee where the producer operation is located, indicated by binary variables for East (*Easttenn*), Middle (*Midttenn*), and West (*Westtenn*) Tennessee. The second is the existence of food hub organizations in a county, specified as a binary variable for counties having at least one self-identified food-hub organization serving its community (*FoodHub*). Monson, Mainville, and Kuminoff (2008) found regional differences to affect the intensity of adoption of direct marketing strategies measured by the number of direct marketing strategies used to sell products. Geographic location could influence the expected percentage of sales a farmer will make through direct-to-consumer outlets in a number of ways. Direct-to-consumer sales drivers are affected by regional characteristics such as proximity to farmer markets and to farmland (Low and Vogel 2011). Therefore, geographic location may explain producer direct marketing opportunities. It is hypothesized that producers located in regions producing more fruit and vegetables and other specialty crops, and closer to farmer markets and farmer-to-grocer's marketing channels are expected to sell a higher percentage of their produce using direct marketing strategies (Low and Vogel 2011).

Food hub organizations help connect producers and consumers by facilitating aggregation, marketing, and distribution of products from local farmers to retailers, restaurants, institutions, and wholesalers. Through the development of scale efficiency and the improvement of food distribution, food hubs may allow small producers to access intermediary or retail outlets that otherwise would be impossible for them to reach because of the barriers they face when trying to access these markets (Matson, Sullins, and Cook 2013). Food hubs may also measure the building capacity for a group of farmers looking to increase their market opportunities and profits by reaching a customer base larger than that served by direct markets (Matson, Sullins, and Cook 2013). It is expected that fruit and vegetable farms located in a county served by a food hub may have a lower percentage of their sales made through direct-to-consumer outlets, given that they may have the opportunity to sell their produce through other marketing outlets.

Chapter 3: Results and Discussion

Sample Overview and Descriptive Statistics

The descriptive statistics of the producer, producer operation, and location characteristics are presented in Table 2 (n=430). The average age of respondents is 61 years old, close to the average farmer age in Tennessee (58 years) according to the 2007 Census of Agriculture (USDA/NASS). About 45% of respondents have a bachelor or graduate degree. On average, 28% of respondents use University/Extension publications to obtain information about how to better market their produce within the past five years.

Approximately 70% of the respondents report earning less than 25% of their income from farming. Additionally, the average size of the fruit and vegetable operations is 12.23 acres. About 40% of the fruit and vegetable operations are located in East Tennessee, 16% in West Tennessee, and 44% in Middle Tennessee. Only 4.2% of the farms are located in counties that are served by food hubs.

The average percentage of sales respondents make through direct-to-consumer outlets is 75%. About 56% of the respondents sell 100% of their fruit and vegetables through direct-to-consumer outlets. On average, producers who make 100% of their sales through direct-to-consumer outlets are older (62 years) than those making less than this percentage of the sales through direct-to-consumer outlets (60 years). As expected, older fruit and vegetable producers tend to rely heavily on direct-to-consumer outlets to sell their produce (Corsi, Borsotto, and Strøm 2009).

The proportion of respondents earning 25% or less of their household income from farming is significantly higher among farmers who make 100% of their produce sales through direct-to-consumer outlets than among those who do not (81% and 56%, respectively). In addition, the size of the fruit and vegetable operation tends to be smaller for respondents who make 100% of their produce sales through a direct-to-consumer outlet than those who do not (7.8 and 17.9 acres, respectively). Smaller fruit and vegetable operations are generally more likely to face significant marketing barriers (e.g., quantities produced are too small, cannot afford insurance required by clients) to selling their fruits and vegetables through intermediary or retail outlets (Gale 1997; Brown 2002; Monson, Mainville, and Kuminoff 2008; Low and Vogel 2011). Therefore, as hypothesized, smaller producers are more likely to reach the highest intensity of adoption of direct marketing strategies.

Additionally, differences between the location characteristics are evident. About 45% of producers making 100% of their sales through direct-to-consumer outlets have their primary farming operation located in East Tennessee. Only 34% of producers making less than 100% of their fruit and vegetable sales through direct-to-consumer outlets have their primary operations in East Tennessee. Finally, about 2.4% of respondents making 100% of their produce sales through direct-to-consumer outlets have their primary operation located in a county that is served by a food hub organization, while about 6.3% of respondents making less than 100% of their sales through these outlets have access to food hub organizations in the county where their operation is located. As expected, food hub organizations may provide greater opportunities for producers to access other market outlets such as retail, wholesale, or institutions.

Fractional Logit Regression Analysis: Parameters and Marginal Effects

Parameter estimates and marginal effects associated with the explanatory variables included in the fractional logit regression are presented in Table 4. The results suggest that producer, producer operation, and location characteristics are important factors influencing the percentage of fruit and vegetable sales made from direct-to-consumer outlets or the intensity of the adoption of direct marketing strategies.

Age of the producer (*Age*) and the squared term of age (Age^2), the use of University/Extension publications about fruit and vegetable marketing strategies in the past five years (*Publications*), whether earned income from farming is less than 25% (*Pf_income*), and existence of a food hub organization in the county where the farm operation is located (*FoodHub*) has statistically significant effects on the expected percentage of produce that is sold through direct-to-consumer outlets or intensity of adoption of direct marketing strategies. An increase in farmer age leads to a lower intensity of adoption of direct marketing strategies, although that intensity decreases in a quadratic, rather than a linear manner. The relationship between age and intensity of adoption displayed is a U-shaped pattern reaching its minimum at 46 years. Therefore, fruit and vegetable farmers older than 46 years tend to increase the percentage of sales they make through direct-to-consumer outlets. This result is expected as farmers getting closer to their retirement age or slowing down in their off-farm jobs are more likely to adopt direct marketing strategies (Brown 2002; Griffin and Frongillo 2003). The positive coefficient associated with the use of University/Extension publications related to marketing strategies suggests that fruit and vegetable farmers who use University/Extension

publications have a higher intensity of adoption or make a higher percentage of their produce sales through direct-to-consumer outlets compared to those not using these publications. Farmers using University/Extension publications have an expected percentage of sales to be made through direct-to-consumer outlets that is 11% higher than those farmers not using these publications.

Farmers with 25% or less of their income from farming tend to make a higher percentage of their produce sales through direct-to-consumer outlets compared to those with more than 25% of income from farming. Producers earning 25% or less of their income from farming have an intensity of adoption of direct marketing strategies that is 9% higher than those farmers earning more than 25% of their income from farming. As hypothesized, producers with a relatively small percentage of income from farming are more likely to rely on direct marketing strategies. Alternatively, this finding might imply greater diversity of income and less need to diversify farm income and/or greater off-farm commitments and less time to manage multiple marketing strategies. These producers are less likely to diversify their portfolios, making a large percentage of their produce sales through direct-to-consumer outlets.

Finally, farmers whose primary operation is located in a county served by a food hub organization have a lower percentage of their fruit and vegetable sales made through direct-to-consumer outlets compared to those not located in a county with those characteristics. As expected, food hubs may provide opportunities for farmers looking to access wholesale, retail or institutional outlets to sell their produce. In summary, farmers older than 46 years old, using University/Extension publications to obtain information on how to better market produce in the

past five years, with a percentage of income from farming of 25% or less, or who have their farming operation located in a county with no access to a food hub organization tend to make a larger percentage of their fruit and vegetable sales through direct-to-consumer outlets or tend to more intensively adopt direct marketing strategies.

Logit Regression Analysis: Parameters and Marginal Effects

Estimated parameters and marginal effects related to the regression analysis for high intensity of adoption or the model assessing the factors associated with producer decision to make 100% of produce sales through direct-to-consumer outlets are presented in Table 5. This analysis shows that use of University/Extension publications for marketing information (*Publications*), percentage of income from farming (*Pf_income*), and primary farm location (*Easttenn*) are positively associated with the likelihood of making 100% of produce sales through direct-to-consumer outlets.

Results suggest that producers who use University/Extension publications are 11% more likely to make 100% of their produce sales through direct-to-consumer outlets. If 25% or less of earned income is from farming, producers are 27% more likely to make 100% of fruit and vegetable sales through direct-to-consumer outlets. This result follows the same logic explained for the fractional logit model. Producers with a relatively small percentage of income from farming may be more likely to rely only on direct marketing strategies. These producers may be trying to supplement fixed income (Brown 2002; Griffin and Frongillo 2003). Producers whose income does not primarily depend on farming activities may have a lower need to diversify their marketing strategies. If the primary operation is located in East Tennessee, producers are 14%

more likely than middle Tennessee producers to make 100% of produce sales using direct marketing strategies.

Conclusion

Consumer interest in fresher foods has increased over the past few years stimulating growth of direct-to-consumer outlets. Tennessee currently hosts many direct outlets such as farmer markets, CSAs, roadside stands, pick-your-own operations, and other direct marketing opportunities. The goal of this research was to evaluate factors effecting Tennessee fruit and vegetable producer intensity of adoption of direct marketing strategies. In this study, fractional logit and logit regressions were used to evaluate the factors affecting the percentage of sales made through direct-to-consumer outlets.

The factors significantly affecting producer intensity of adoption of direct marketing strategies are age, use of University/Extension publications, percentage of income from farming, and access to food hub organizations. Results point to the importance of Extension as a source of information for producers to make decisions regarding the proportion of produce sales to be allocated to direct-to-consumer outlets. Governmental agencies, such as the Tennessee Department of Agriculture and University/Extension, should continue producing publications intended to help producers increase profit margins through the adoption of direct-to-consumer marketing strategies. It is important to notice that part-time farmers getting closer to retirement age are those who tend to increase their intensity of adoption of direct marketing strategies. Understanding that this may be the clientele in need of information about how to better use direct marketing strategies to increase profits may help Extension personnel develop educational materials that better target these types of farmers.

Finally, food hub organizations seem to help fruit and vegetable producers access wholesale, retail and institutional outlets to sell their produce and therefore decrease dependency on direct-to-consumer outlets. Although direct marketing strategies help producers get a higher percentage of the sales value, diversification of marketing outlets to sell produce, or access to other outlets through food hubs, may also have a positive impact on farm profits. Thus, governmental agencies interested in increasing market opportunities for Tennessee fruit and vegetable producers should consider supporting the creation of food hubs.

Fruit and vegetable operations in East Tennessee are more likely to make 100% of produce sales through direct-to-consumer than farm operations located in Middle Tennessee. Further research is needed concerning regional differences affecting consumer decisions to partake in direct-to-consumer outlets. With a more complete picture of direct-to-consumer markets (supply and demand), Extension services as well as state agencies may be better able to equip farmers with information that will allow fruit and vegetable producers to be successful when selling their produce through direct-to-consumer outlets.

References

Brown, A. 2002. "Farmers' Market Research 1940-2000: An Inventory and Review."

American Journal of Alternative Agriculture 17(4): 167-176

Corsi, A., P. Borsotto, I. Borri, and S. Strøm. 2009. "Diversification of the Marketing

Chains Among Organic Producers." Paper presented at IAAE Conference, Beijing

China, 16-22 August.

Gale, Fred. 1997. "Direct Farm Marketing as a Rural Development Tool." *Rural*

Development Perspectives 12(2): 19-25.

Gallons, J., U. C. Toensmeyer, J. R. Bacon, and C. L. German. 1997. "An Analysis of

Consumer Characteristics Concerning Direct Marketing of Fresh Produce in

Delaware: A Case Study." *Journal of Food Distribution Research* 28(1): 98-106.

Govindasamy, R., and R. M. Nayga, Jr. 1997. "Determinants of Farmer-to-Consumer

Direct Market Visits by Type of Facility: A Logit Analysis." *Agricultural and*

Resource Economics Review 28(1):31-38.

Govindasamy, R., F. Hossain, and A. Adelaja. 1999. "Income of Farmers Who Use

Direct Marketing." *Agricultural and Resource Economics Review* 28(1):76-83.

- Griffin, M. R. and E. A. Frongillo. (2003). "Experiences and Perspectives of Farmers From Upstate New York Farmers' Markets." *Agriculture and Human Values* 20:189-203.
- Henneberry, S. R., and H. N. Agustini. 2004. "An Analysis of Oklahoma Direct Marketing Outlets: Case Study of Produce Farmers' Markets." Paper presented at SAEA annual meeting, Tulsa OK, 14-18 February.
- Knowler, D., and B. Bradshaw. 2007. "Farmer's Adoption of Conservation Agriculture: A Review and Synthesis of Recent Research." *Food Policy* 32(1):25-48.
- Kuches, K., C. Ulrich, C. Toensmeyer, C. L. German, and J. Kuklish. 2000. The Impact of Respondents' Characteristics on Purchasing Decisions. *Journal of Food Distribution Research*, 31(1):131-138.
- Ladzinski, K. M., and U. C. Toensmeyer. 1983. "Importance of Direct Markets for Consumers in their Fresh Vegetable and Fruit Purchases." *Journal of Food Distribution Research* 14 (3):3-11.
- Lehman, J., J. R. Bacon, U. Toensmeyer, J. Pesek, and C. German. 1998. "An Analysis of Consumer Preferences for Delaware Farmer Direct Markets." *Journal of Food Distribution Research* 29(1):84-90.

- LeRoux, M. N., T. M. Schmit, M. Roth, and D. H. Streeter. 2009. "Evaluating Marketing Channel Options for Small-Scale Fruit and Vegetable Producers: Case Study Evidence from Central New York." Dept. of Applied Economics and Management. Extension Bulletin 2009-03. Cornell University.
- Low, S.A., and Vogel, S. "Direct and Intermediated Marketing of Local Foods in the United States." Washington DC: U.S. Department of Agriculture, ERS Economic Research Rep. 128, November, 2011.
- Matson, J., M. Sullins, and C. Cook. "The Role of Food Hubs in Local Food Marketing." U.S. Department of Agriculture, Rural Development Service Rep. 73, January, 2013.
- Monson, J., D. Mainville, and N. Kuminoff. 2008. "The Decision to Direct Market: An Analysis of Small Fruit and Specialty-Product Markets in Virginia." *Journal of Food Distribution Research* 39(2):1-11.
- Morgan, T. and D. Alipoe. 2001. "Factors Affecting the Number and Type of Small-Farm Direct Marketing Outlets in Mississippi." *Journal of Food Distribution Research* 32:125-132.
- Narayan, N. P., and J. M. Gillespie. 2010. "Factors Influencing Producers' Marketing Decisions in the Louisiana Crawfish Industry." Paper presented at SAEA annual meeting, Orlando Florida, 6-9 February.

- Nowak, P. J. 1987. "The Adoption of Agricultural Conservation Technologies: Economic and Diffusion Explanations." *Rural Sociology* 52(2):208-220.
- Onianwa, O., G. Wheelock, and M. Mojica. 2005. "An Analysis of the Determinants of Farmer-to-Consumer Direct-Market Shoppers." *Journal of Food Distribution Research* 36(1):130-134.
- Papke, L. E., and J. M. Wooldridge. 1996. "Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates." *Journal of Applied Econometrics* 11(6): 619-632.
- Park., T. A., A. K. Mishra, and S. J. Wozniak. 2011. "Farm Operator Benefits from Direct Marketing Strategies: How Does Local Food Impact Farm Financial Performance?" Paper presented at AAEE annual meeting, Pittsburgh PA, 24-26 July.
- Thilmany, D., J. K. Bond, and C. A. Bond. 2006. "Direct Marketing of Fresh Produce: Understanding Consumer Interest in Product and Process-Based Attributes." Paper presented at AAEE annual meeting, Long Beach CA, 23-26 July.
- Uematsu, H., and A. K. Mishra. 2011. "Use of Direct Marketing Strategies by Farmers and Their Impact on Farm Business Income." *Agricultural and Resource Economics Review* 40(1):1-19.
- Uva, W. L. 2002. "An Analysis of Vegetable Farms' Direct Marketing Activities in New York State." *Journal of Food Distribution* 33(1):186-189.

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA/NASS).

2007 Census of Agriculture, Available at

<http://www.agcensus.usda.gov/Publications/2007/index.asp> [Accessed September 12, 2012].

U. S. Department of Agriculture, National Agricultural Statistics Service (USDA/NASS).

2013. Census of Agriculture, Available at <http://www.ers.usda.gov/data->

[products/atlas-of-rural-and-small-town-america/download-the-data.aspx](http://www.ers.usda.gov/data-products/atlas-of-rural-and-small-town-america/download-the-data.aspx)

[Accessed February 9, 2013].

Appendix

Table 1. Marketing Outlets Descriptions.

Marketing Outlet	Description
<i>Direct-to-Consumer Outlets</i>	Farmer markets, Community Supported Agriculture (CSA), roadside stands, pick-your-own, other direct sales
<i>Intermediate Outlets</i>	Grower cooperatives, wholesale buyers/brokers/packers, other farmers, other intermediaries
<i>Retail Outlets</i>	Grocery stores, food cooperatives, restaurants, institutions(e,g., schools and hospitals), other retail outlets

Table 2. Description of Variables Used in the Model Evaluating Factors Affecting Farmer Adoption Intensity of Direct-to-Consumer Marketing Strategies (n=430).

Variable	Description	Mean
A. Dependent Variable		
y_p	percentage of fruit and vegetable sales made through direct-to-consumer outlets	0.7451
$y_{100\%}$	=1 if 100% of produce sales are made through direct-to-consumer outlets, 0 otherwise	0.5628
B. Independent Variables		
<i>Age</i>	age in years	61.1442
<i>Age</i> ²	age in years squared	3879.1950
<i>SchoolDegree</i>	=1 if bachelor's or graduate degree is the highest level of education, zero otherwise	0.4535
<i>Publications</i>	=1 if used University/Extension publications in the past five years, zero otherwise	0.2767
<i>Pf_income</i>	=1 if less than 25% of household income comes from farming, zero otherwise	0.7000
<i>Vegsize</i>	size of the fruit and vegetable operation in acres	12.2323
<i>Westtenn</i>	=1 if primary operation is located in West Tennessee, zero otherwise	0.1605
<i>Easttenn</i>	=1 if primary operation is located in East Tennessee, zero otherwise	0.4023
<i>FoodHub</i>	=1 if there is a Food Hub organization serving the county where the farm operation is located, zero otherwise.	0.0419

Table 3. Variable Means for Farmers Making 100% of Produce Sales Through Direct-to-Consumer Outlets and Those Making Less Than 100% of Their Produce Sales Through These Outlets.

Independent Variables ^a	Selling <i>all</i> produce through direct-to-consumer outlets (n=242) mean	Selling <i>less than 100%</i> of produce through direct-to- consumer outlets (n=188) mean
<i>Age</i>	62.0868*	59.9309
<i>SchoolDegree</i>	0.4835*	0.4149
<i>Publications</i>	0.3017	0.2447
<i>Pf_income</i>	0.8058***	0.5638
<i>Vegsize</i>	7.7665***	17.9809
<i>Westtenn</i>	0.1612	0.1596
<i>Easttenn</i>	0.4545**	0.3351
<i>FoodHub</i>	0.0248**	0.0638

*, **, *** denotes significance at the 10%, 5%, and 1% levels respectively based on t-tests.

^a For variable definitions see Table 2.

Table 4. Estimated Parameters and Marginal Effects From Fractional Logit Regression Evaluating Factors Affecting Intensity of Adoption of Direct Marketing Strategies.

Independent Variables ^a	Fractional Logit Model	
	Estimated Parameters ^b	Marginal Effects ^b
<i>Age</i>	-0.0986* (0.0537)	-0.0182* (0.0099)
<i>Age</i> ²	0.0009* (0.0005)	0.0002* (0.0001)
<i>SchoolDegree</i>	0.0353 (0.1998)	0.0065 (0.0369)
<i>Publications</i>	0.6080** (0.2378)	0.1123** (0.0436)
<i>Pf_income</i>	0.4910** (0.2038)	0.0907** (0.0371)
<i>Vegsize</i>	-0.0005 (0.0021)	-0.0001 (0.0004)
<i>Westtenn</i>	0.3997 (0.2847)	0.0739 (0.0527)
<i>Easttenn</i>	0.2508 (0.2171)	0.0463 (0.0401)
<i>FoodHub</i>	-1.1128** (0.4502)	-0.2056** (0.0835)
<i>N</i>		430
<i>Log Pseudo Likelihood</i>		- 213.7608
<i>AIC</i>		1.0407

*, **, *** denotes significance at the 10%, 5%, and 1% levels respectively.

^a For variable definitions see Table 2.

^b Standard errors are in parenthesis.

Table 5. Estimated Parameters and Marginal Effects from Logit Regression Evaluating Factors Affecting Farmer Decision to Make 100% of Produce Sales through Direct-to-Consumer Outlets.

Logit Model		
Independent Variables ^a	Estimated Parameters ^b	Marginal Effects ^b
<i>Age</i>	-0.0369 (0.0612)	-0.0091 (0.0150)
<i>Age</i> ²	0.0004 (0.0005)	0.0001 (0.0001)
<i>SchoolDegree</i>	0.0375 (0.2140)	0.0092 (0.0526)
<i>Publications</i>	0.4362* (0.2415)	0.1071* (0.0593)
<i>Pf_income</i>	1.1144*** (0.2341)	0.2738*** (0.0576)
<i>Vegsize</i>	-0.0057 (0.0043)	-0.0014 (0.0011)
<i>Westtenn</i>	0.2235 (0.3056)	0.0549 (0.0751)
<i>Easttenn</i>	0.5870*** (0.2287)	0.1442*** (0.0562)
<i>FoodHub</i>	-0.6863 (0.5984)	-0.1686 (0.1472)
<i>N</i>		430
<i>Log Pseudo Likelihood</i>		-270.8793
<i>AIC</i>		1.3064

*, **, *** denotes significance at the 10%, 5%, and 1% levels respectively.

^a For variable definitions see Table 2.

^b Standard errors are in parenthesis.

Vita

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