# The Use of Wireless Capability at Farmers Markets: Results from a Choice Experiment Study

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## 1. Introduction

Farmers' markets provide an increasingly important sales venue for small and medium sized specialty crop vendors. In Washington State (WA) sales at farmers' markets have exploded in recent years, increasing from total annual sales of $5 million in 1997 to an estimated $65 million in 2008. During this same period, the total number of markets doubled to 114 markets (USDA, AMS 2010). These markets are increasingly critical to the survival of many small and mid-sized specialty crop operations across WA who turned to direct marketing as a means of capturing higher returns.

At most markets, all purchases are made in cash. Research with market customers found that "running out of cash" is one of the biggest reasons for limiting market purchases (Lev and Stephenson, 2001). Basic food benefits, which amounted to more than $588.6 million for WA residents in 2007, cannot be accepted at farmers' markets without electronic card readers. Technology that could dramatically increase the sales volume at markets by allowing shoppers to pay with credit/debit cards or use EBT is currently unavailable to most WA farmers' markets. In 2010, only 20% of the WA State Famers Market Association member markets accepted credit or debit card payments (Ordonez, 2010). Developing the technological capacity at farmers markets to accept electronic payments could increase sales volumes and expand access to locally grown specialty crops for greater numbers of consumers. A consumer poll by Ostrom and Jussaume (2007) indicated that 80% of WA respondents would like to increase their purchases of local fresh fruits and vegetables.

In 2008, the WA State legislature passed the Local Farms-Healthy Kids act which goal was to "strengthen the connections between the state's agricultural industry and the state's food

procurement procedures in order to expand local agricultural markets, improve the nutrition of children and other at-risk consumers, and have a positive impact on the environment". Under this framework, in 2009 a Farmers Market Technology Improvement Pilot Project was established to increase access to fresh fruits, vegetables, quality meat, and dairy for WA residents and to increase the number of food stamp beneficiaries through electronic benefits transfer (EBT) at farmers markets.

The implementation of the wireless capacity in these programs consisted of having one wireless machine located in a central location (in most cases at the market manager's booth), and to have customers exchanging an electronic payment for wooden tokens. These tokens have imprinted the market logo, so customers can exchange tokens for products at one market only. In most cases, tokens represented values for $1, $5, and $10. At the vendors' booth, customers exchange the tokens for products. At the end of the day, vendors return the tokens to the market manager, and s/he keeps records of the tokens each vendor returned. Managers return the cash equivalent to the amount of tokens returned every week or every two weeks. In most cases, the vendors pay the transaction fees (Ordonez, 2010).

This pilot project successfully assisted 20 WA farmers markets "to develop the capability to accept wireless electronic payment cards, including EBT." Results from this pilot project indicate that introducing EBT/credit/debit technologies at farmers' markets may increase sales by approximately 10 percent or by about $15,786 per market and per season (Ordonez, 2010).

In light of the potential benefits of electronic card reading technology, this article investigates the economic benefits of current EBT/credit/debit technologies for selected WA farmers' markets. Using a survey across 12 farmers' markets, we elucidate the perceived

benefits of the technology by conducting a choice experiment for farmers' market vendor, and customers. In the survey, we elicited vendors' perceived values for wireless machines' features; and customers' perceived values for different market's features, including having wireless capacity at the market. In addition to the choice experiment, the survey included questions on subject characteristics including perceptions of EBT/credit/debit technology, product specific sales and purchase information, experience with farmers' markets, and demographics.

Our results indicate that the most important feature of wireless capability providers for vendors was customer service, followed by the quality of the technology. As for customers, local farmers, quality of the food, and the use of wireless capability were cited as the most valued market features. We consider this information valuable for market managers, vendors, and policy makers; as it increases the understanding of the type of technology most suitable for farmers markets and allows assessing clientele perceptions towards this technology.

The remainder of this article is organized as follows. Section 2 describes the methods used to collect data and estimation strategy. Section 3 presents results. We give some concluding remarks in section 4.

## 2. Methods

Discrete choice experiments (DCE) are a form of conjoint analysis used to elicit the relative importance of various product attributes in consumers' choice process (Lusk, Roosen, and Fox, 2003; Adamowicz et al., 1998). This approach assumes consumers derive utility from the product attributes rather than the good itself (Lancaster, 1966) and is consistent with the random utility theory (Ben-Akiva and Lerman, 1985). DCE are also used when policy outcomes might be described in term of attributes, and there is interest in estimating the value associated to

these attributes' levels (Ferrini and Scarpa, 2007). In this paper, we use this latter dimension of DCEs and estimate the relative value farmers' markets vendors perceive for wireless technology features and the relative value customers assign to farmers markets' features.

*Survey design*

We conducted in-person interviews with a total of 48 vendors and 96 customers at 12 farmers' markets across WA State, from July to October 2011. Because the goal of interviewing vendors and customers was different (i.e., we wanted to know vendors' values for wireless machines features and customers' values for farmers' markets features) the surveys were designed specifically for each type of respondent. The vendors' choice scenarios consisted on presenting three options. The first two presented two different providers of wireless machines, each with a combination of quality of technology, customer service, and fees. The fee levels were consistent with average fees charged by wireless machine providers to farmers markets, and represented four different type of transactions: credit card, debit card used as credit card, debit card used with a PIN number, and EBT). The third option was that vendors would prefer not to have wireless capacity at the market (the none option). We consider these attributes because we assume the system will have one central machine, and that these attributes were of interest to vendors under this system. The consumers' survey presented scenarios with three options, two of them included market characteristics such as local farmers, quality of food, atmosphere, availability of EBT/credit/debit technology, and prices. Prices were conceived for a bundle of goods rather than for one good, to mimic as realistically as possible price levels charged at a farmers' market. These prices are consisting with prices charged at WA farmers markets, and goods in the bundle are consisting with the most demanded food products. The third option was

not to not buy at a farmers market. Examples of scenarios presented to vendors and customers are included in Figures 1 and 2, respectively.

Using the SAS® procedures PROC PLAN and PROC OPTEX we created a main effects plus two-way interaction effects design for each respondent type. We base this choice of design on Lusk and Norwood (2005) who found that this type of design generates more precise willingness-to-pay (WTP) estimates. The D-efficiency criteria obtained were 74.54% and 81.57%, for vendors' and customers' designs, respectively. All attributes used in the scenarios were discrete (two levels) except for the price variable that had three levels. Tables 1 and 2 show the attribute levels used for vendors and customers. In addition to the choice experiment, each survey included questions regarding sales volume for different categories of goods, market characteristics, and demographics.

*Estimation*

The utility decision maker $i$=1,2,…$N$ derives from choosing option $j$ is given by,

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

where $V_{ij}$ and $\varepsilon_{ij}$ are the deterministic and stochastic portion of utility. Note $V_{ij}$ is determined by the respondents $i$, and attribute levels of option $j$. In our case, $j$ = 1, 2, or 3.

The deterministic portion of the utility for the vendors' model is given by,

$$V_{vendors_{ij}} = Option_j + Customer\ service_{ij} + Technology\ quality_{ij} + Fees_{ij} \tag{2}$$

where $i$ represents vendors and $j$, the options presented in each scenario. The deterministic portion of the utility for customers is given by,

$$V_{customer_{km}} = Option_m + Local\ farmers_{km} + Quality\ of\ food_{km} + Amostphere_{km} + Wireless\ capability_{km} + Price_{km} \quad (3)$$

where *k* represents customers and *m*, the options presented in each scenario.

The probability a decision maker *i* will choose option *j* is given by,

$$\text{Prob}\{\text{alternative } j\} = \text{Prob}\{V_{ij} + \varepsilon_{ij} \geq V_{ik} + \varepsilon_{ik};\ \forall k \in C_i = \{\text{alternative 1, 2, or 3}\}\ \} \quad (4)$$

If we assume $\varepsilon_{ij}$ is independently and identically distributed over the *j* options and *N* decision makers, and follows a standard type I extreme value distribution, we can rewrite (4) as,

$$\text{Prob}\{\text{alternative } j\} = \frac{e^{V_{ij}}}{\sum_{k \in C} e^{V_{ik}}} \quad (5)$$

Equation 5 describes a conditional logit model. The conditional logit model assumes that the independence from irrelevant alternatives (IIA) axiom holds. Several other approaches relax the IIA assumption, although in different ways. The mixed logit (ML) model relaxes such assumptions (Train, 2003). In this model specification, preference parameters are assumed to be random within the population with a given distribution (in this case, normal). We allow the marginal utility of each feature to vary randomly within the population and hold the price invariant across individuals.

## 3. Results

*Summary statistics*

Summary statistics of the general characteristics of the vendors and customers interviewed are provided in Tables 3 and 4, respectively. Most vendors interviewed (85%) sold fresh vegetables, followed by fresh fruits (60%), and plants, nursery (40%). The decision making at the market is the responsibility of a board of members for 67% of respondents, followed by a manager (38%). On average vendors traveled 38.3 miles from their production site to the market. The stall fee paid to sell at the market is on average $38.69. Vendors have on average 8 years selling at farmers' markets. Sixty percent of vendors interviewed have at least a bachelor degree. Average age is 43 years and 75% of the vendors were Caucasian (see Table 3). Forty three percent of customers responding the survey expressed they used wireless capability to buy at a farmers' markets and that they will buy more due to the accessibility of this payment form. Seventy three percent of customers interviewed usually buy fresh vegetables, followed by fresh fruits (65%) and prepared foods (61%). Fifty percent of the customers interviewed buy at the farmers' market to support a local farmer, to buy healthy food (42%), to buy environmentally friendly food (23%). Only 8% expressed they buy due to the accessibility to use wireless capacity, including the redemption of EBT. The average expected amount to spend per visit at the market was $20.50. Fifty one percent of the respondents visit the market weekly, 19% twice a month. On average, consumers interviewed shopped at farmers' markets for 5 years. Seventy six percent had at least a bachelor degree, the average number of members in the household is 3, the average age is 47 years, and 81% were Caucasian.

*Discrete choice experiment results*

Results from the Hausman test show that the IIA holds for the customers' model ($\chi^2 = 11.71$; p-value=0.07) but does not for the vendors' model ($\chi^2 = 32.41$; p-value<0.01). Thus, we estimated the model parameters using a mixed logit model for the vendors and a conditional logit model for the customers, in both we used the SAS® procedure PROC MDC. Results for both groups are shown in Tables 5 (vendors) and 6 (customers). The alternative specific constants for both options (Option 1 and 2) are both negative and statistically significant. This indicates that respondents' showed a preference for the none option in both vendors and customers models.

In the vendors' model, fees had a negative and statistically significant effect on the probability of choice a wireless machine provider. Quality of the technology and customer service estimates were positive and statistically significant, indicating that vendors will be more inclined to choose providers with better levels of these attributes. The standard deviation estimates for fees and quality were not statistically significant. Vendors stated they were willing to pay $0.24 and $0.31 more in fees (including all four types of transactions: credit card, debit card with a pin, debit card used as a credit card, and an EBT redemption all totaling $20) to have wireless providers offering a high quality of the technology (e.g., machines that will not likely fail and thus no risk of losing sales) and an efficient customer service (e.g., timely resolution of disputes).

The parameter estimate for price in the customers' model was negative and statistically significant indicating that higher prices would decrease the probability of choosing a farmer market. The presence of local farmers, high quality food, entertaining atmosphere, and the accessibility to wireless capability will increase the probability of choosing a market. Customers

stated they were willing to pay $9.09 more for a bundle of food products in a market with local farmers only, $8.61 more at a market offering high quality food products, $3.60 more at a market with an entertaining atmosphere, and $5.32 more at a market offering wireless capacity. These results are aligned with previous responses given by customers interviewed, where 50% of respondents stated that the main reason to buy at a farmer market is to support a local farmer, 42% stated that it was for the healthy food.

## 4. Conclusion

In this study we conducted in-person interviews with farmers' markets vendors to elicit preferences for wireless capacity features including fees, quality of the technology, and providers' customer service. We found that farmers' markets vendors welcome having wireless machines terminals, if these machines are located at one central location and use a system based on the redemption of tokens. Under this system, vendors state that customer service expressed in terms of timely responsiveness to disputes is more important than the quality of the technology that will likely not risk a sale. We also found that farmers' market customers will likely pay premium prices for a bundle of goods if the market consists of local farmers, offers high quality food products, enables customers to use wireless payment forms, and has an entertaining atmosphere.

These results are encouraging to farmers' markets managers and leaders seeking for ways to increase the number of sales and the dollar amount of each sale. Having access to wireless technology at the farmer market is not a simple task to implement. Managers and vendors must face costs and challenges. Besides the costs associated with purchasing the machine and the monthly service fees, the market shall have permanent staff running the machine and have a

reliable accounting system in place to be able to track sales and fees per transaction. The cost of a wireless machine varies from $422 to $596. One must add the cost of an extra battery, carrying case, case of paper, encryption program fee, payment card industry fee, monthly statements, and monthly service fees. All of this amounts $678 to $875 per machine. Yet, to this cost one must add the cost of the wooden tokens, the wage of extra staff to operate the machine, the costs associated with keeping transaction records, and the transaction fees. Thus, an issue faced by the markets is how to handle the extra costs implied by having wireless capacity at the market.

Results from the 2010 pilot program shows that the average increase in sales due to the machines is $15,786 per market and per season (Ordonez, 2010). Our results indicate that customers will likely pay a premium price if they are enabled to use alternative payment forms than cash. This suggests implementing wireless technology may be financially feasible for most markets. This study also implies that marketing campaigns are needed to increase awareness across customers of the use of credit and debit cards at markets and to promote the redemption of food stamps (i.e., EBT) to increase accessibility of local produce to benefit users. Finally, this study is focused on WA, but similar programs are in place in other states across the nation, and market manager and leaders could benefit from the results of this investigation.

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Table 1. Vendor Survey - Attribute Levels

| Features | Levels | | |
|---|---|---|---|
| Fees charged by processor (comprising all transactions: credit card, debit card used as credit, debit card used with a PIN, and EBT redemption) | 0.6% | 1% | 1.4% |
| Likely to lose sale due to poor quality technology or wireless signal | Yes | - | No |
| Customer service | Poor | - | Excellent |

Table 2. Customer Survey - Attribute Levels

| Features | Levels | | |
|---|---|---|---|
| Vendors are local | No | - | Yes |
| Quality of food sold | Poor | - | Excellent |
| Atmosphere | Not entertaining | - | Entertaining |
| Price (for a bundle of 1lb of apples, 1 head of lettuce, 1lb of tomatoes, 4.4 oz of berries, and 1lb of onions) | $8.00 | $8.75 | $9.50 |
| Ability to use EBT/credit/debit card | No | - | Yes |

Table 3. Summary Statistics Farmers' Markets Vendors' Characteristics

| Feature | Mean | Percentage |
|---|---|---|
| Hours per week at market | 6.23 | |
| Weeks operating per season | 21.15 | |
| | | |
| *Type of vendor* | | |
| Farmer | | 100% |
| Reseller | | 8% |
| Farmer processor | | 6% |
| Artisan/crafter | | 4% |
| Prepared food vendor | | 2% |
| Other | | 2% |
| | | |
| *Type of products sold* | | |
| Fresh vegetables | | 85% |
| Fresh fruits | | 60% |
| Plants, nursery | | 40% |
| Cut flowers | | 27% |
| Eggs | | 8% |
| Meat | | 6% |
| Grain flour | | 6% |
| Processed food products | | 4% |
| Fish seafood | | 2% |
| | | |
| *Decision making at the market* | | |
| Board | | 67% |
| Manager | | 38% |
| Owner | | 10% |
| Vendors | | 8% |
| Unknown | | 8% |
| | | |
| *Vendor characteristics* | | |
| Miles traveled | 38.3 | |
| Stall free /day | 38.69 | |
| Years selling at a farmer market | 7.91 | |
| Bachelor degree or more | | 67% |
| Average age | 42.46 | |
| Caucasian | | 75% |

Table 4. Summary Statistics Farmers' Markets Customers' Characteristics

| | Mean | Percentage |
|---|---|---|
| Shopped at markets that accepted wireless payment | | 43% |
| Used wireless technology at farmers' markets | | 29% |
| Found challenges in using wireless | | 4% |
| Buy more at markets with wireless capacity | | 43% |
| | | |
| *Products frequently bought* | | |
| Fresh vegetables | | 73% |
| Fresh fruits | | 65% |
| Prepared foods | | 61% |
| Baked goods | | 34% |
| Cheese dairy | | 20% |
| Coffee | | 20% |
| Cut flowers | | 15% |
| Processed food products | | 14% |
| Other | | 14% |
| Meat | | 13% |
| Eggs | | 9% |
| Plants, nursery | | 7% |
| Fish seafood | | 5% |
| Wine cider | | 5% |
| Grain flour | | 2% |
| | | |
| *Reasons to buy at farmers' markets* | | |
| Support a local farmer | | 50% |
| Healthy food | | 42% |
| Environmentally friendly food | | 23% |
| Tasty food | | 20% |
| Atmosphere | | 17% |
| Seeing friends | | 14% |
| Use wireless capacity including EBT | | 8% |
| Affordable food | | 5% |
| Crafts | | 4% |
| Other | | 4% |
| Prepared foods | | 3% |
| | | |
| *Purchasing habits* | | |
| Average dollar amount to spend | $20.50 | |
| Purchasing frequency | | |
| Weekly | | 51% |
| Twice a month | | 19% |
| Once a month | | 7% |
| Once or twice a season | | 8% |
| This is my first visit | | 10% |
| Other | | 2% |

| | | |
|---|---|---|
| Years shopping at farmers' markets | 5.30 | |
| | | |
| *Customers' demographics* | | |
| Bachelor degree or more | | 76% |
| Number of members in household | 3.07 | |
| Average age | 47.14 | |
| Caucasian | | 81% |

Table 5. Parameter Estimates for the Vendors' Mixed Logit model

| Variables | Estimate | Standard error | Standard deviation | Standard error |
|---|---|---|---|---|
| Option 1 | -2.98* | 0.37 | | |
| Option 2 | -3.15* | 0.40 | | |
| Fees | -1.18* | 0.19 | | |
| Technology quality | 1.42* | 0.15 | -0.18 | 0.74 |
| Customer service | 1.82* | 0.17 | 0.01 | 4.23 |
| Log likelihood | -445.03 | | | |
| Number of observations | 576.00 | | | |

Table 6. Parameter Estimates for the Customers' Conditional Logit model

| Variables | Estimate | Standard error |
|---|---|---|
| Option 1 | -6.91* | 0.18 |
| Option 2 | -8.10* | 0.18 |
| Local farmers | 2.74* | 0.26 |
| Food quality | 2.60* | 0.12 |
| Market atmosphere | 1.09* | 0.19 |
| Use wireless capability | 1.60* | 1.30 |
| Price | -0.30* | 1.30 |
| Log likelihood | -720.21 | |
| Number of observations | 1995.00 | |

Table 7. Vendors' Willingness-to-Pay Estimates for Wireless Capability Features and Customers Willingness-to-Pay for Farmers' Markets Features

| Group surveyed | WTP |
|---|---|
| *Vendors* | *WTP (dollars to pay per four transactions 1 with credit card, 1 with debit used as credit, 1 with debit using a PIN, one for EBT redemption)* |
| Technology quality | $0.24 |
| Customer service | $0.31 |
| *Customers* | *WTP (dollars to pay for a bundle of apples (1lb), romaine lettuce (1 unit), tomatoes (1 lb.), berries (4.4 oz.), onions (1 lb.))* |
| Local farmer | $9.09 |
| Food quality | $8.61 |
| Market atmosphere | $3.60 |
| Use wireless capability | $5.32 |

| 1 | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **FEES CHARGED BY PROCESSOR CHARGED BY PROCESSOR**<br>***(each percentage includes ALL fees for 4 transactions: one with credit card, one with debit card, one with debit card using a PIN, one with EBT. Consider that sales for 4 transactions were $20)*** | 1.4% | 0.6% | No Credit/Debit/EBT capability |
| **LIKELY TO LOSE THE SALE**<br>***(due to poor quality technology i.e., wireless signal)*** | Yes | Yes | |
| **CUSTOMER SERVICE**<br>***(timely resolution of disputes i.e., market management gets deposit and pays for your tokens on time)*** | Excellent | Poor | |
| | ☐ ↑<br>**I would choose** | ☐ ↑<br>**I would choose** | ☐ ↑<br>**I would choose** |

**Figure 1. Example of a discrete choice scenario presented to farmers' markets vendors.**

| | Market 1 | Market 2 | Market 3 |
|---|---|---|---|
| **VENDORS ARE LOCAL FARMERS** | Yes | No | Do not buy at a farmer market |
| **QUALITY OF FOOD SOLD** | Poor | Poor | |
| **ATMOSPHERE** | Not Entertaining | Not Entertaining | |
| **PRICE** ***(for one basket containing 1 pound of apples, 1 unit of romaine lettuce, 1 pound of tomatoes, 4.4 oz. of berries, 1 lb. onions)*** | $8.00 | $8.00 | |
| **I CAN USE MY CREDIT OR DEBIT CARD OR FOOD STAMPS** | Yes | No | |
| | **I would choose** | **I would choose** | **I would choose** |

**Figure 2. Example of a discrete choice scenario presented to farmers' markets customers.**