Improving wholesale local food procurement: a farmer choice experiment

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Abstract

Food hubs and wholesalers are an increasingly popular way for farms to sell fresh produce to receive increased profits over direct-to-consumer and retail market channels, but little is known about what drives farmers preferences for accepting orders or not. With many food hubs relying on grants, increasing an understanding of farmer preferences on wholesale orders will help them reach long term financial independence. We administer a choice experiment to farmers that grow fresh vegetables in the United States to evaluate preferences of wholesale sales opportunities across key attributes including profit margin, packing specifications, delivery method, and order size. By analyzing farmer marketing decisions, food hubs can have a better understanding of how to design offers that farms are more likely to accept. The analysis provides evidence of farmer preferences for food hub orders with more flexible packing standards, for crops with high profit margins, on farm pick-up, and a dislike of small orders.

1 Introduction

As diets in the United States are incorporating more fresh fruits and vegetables (Bentley 2017) and there is an increased interest in more regional-based supply chains (Louis et al. 2017), local wholesalers and intermediaries play an ever increasingly important role in facilitating food getting from farms to consumers. Customers such as restaurants or grocery stores (referred to as "end-users" in our study) often see benefits of purchasing from food hubs and wholesalers such as being able to receive a single delivery that can include products from multiple farms and business with products across different food groups. From a farmer perspective, there can be increased labor costs associated with selling to wholesale markets over direct to consumer channels across farm sizes (Bauman, Thilmany McFadden, and Jablonski 2018; Schmit and Leroux 2014).

Food hubs have gained popularity to support regional food systems in a way that promotes economic development by purchasing locally. Additionally, many state they aim to further equitable access to produce in low income and historically marginalized communities but have a challenge in doing this while remaining financially viable (Hoey, Shapiro, and Bielaczyc 2018). Many have turned to non-profit business models and utilize public and/or private grants to remain financially viable (Fischer, Pirog, and Hamm 2015a) and the Unites States government has responded by creating help guides to inform food hubs of public grants they may qualify to apply for (Anon 2012). Cleary et al. (2019) hypothesizes that public investment in food hubs could cause an oversaturation of food hubs and policy needs to be created with this in mind. Giving food hubs more tools to help them reach independent financial viability will help food hubs operate without relying on grants and ensure the public investment is not wasted.

There is an expansive set of literature on how food hubs start and operate (AMS n.d.; Clark and Inwood 2016; Conner et al. 2018) and the profitability of various vegetable market channels

(Christensen et al. 2017; Silva et al. 2015); however, there lacks a clear understanding of how farmers make decisions on selling their products through intermediaries with dictated sale terms. While various types of pre-season sales contracts and pricing structures have been used and explored, there is a lack of clear understanding in what motivates a U.S. vegetable farmer to say yes or no to a possible sale presented by a food hub or wholesaler. To address this gap in the literature, we design and implement a choice experiment to understand what factors drive the decision when a sales opportunity is presented to a farm.

We explicitly examine the relationship between U.S. farms deciding to make a sale to a food hub or wholesaler and what attributes are the most important in making that decision. While the main goal is to provide information to food hubs, the results of this study apply more widely to all wholesalers who purchase from vegetable farms. The experiment focuses on attributes of individual sales that are actionable items, which include packing specifications, delivery methods, crop profit margins, and order size. In addition to the importance of attributes, this analysis tests if socio-economic factors influence how farmers view wholesale opportunities. The results of relative preferences for individual attributes are then used in a discussion on preferred bundles and how food hubs can increase the likelihood of a farmer accepting a contract offer. The results importantly contribute to and expand on the literature examining similar decision-making processes in developing country contexts (e.g., selling produce directly to supermarkets in Kenya (Ochieng, Veettil, and Qaim 2017), coffee sales and agricultural training opportunities in Uganda (Meemken, Veettil, and Qaim 2017), and the sales of sweet peppers in Thailand (Schipmann and Qaim 2011)), but now applied in a growing market (local foods) and developed country (United States) context. Understanding the similarities and differences in results are useful to informed place-based public policy development.

The choice experiment and subsequent analysis show that the four attributes are statistically significant drivers of farmers' utility as it relates to preferences in wholesale transactions. The analysis also provides a better understanding of how food hubs can streamline operations and find long term viability without (or at least with less) reliance on grants. With an increase of public financial support for food hubs over the past 15 years (Anon 2012), this information will be essential in supporting small farms to sell to these types of intermediary markets.

2 Methodology

We design, deploy, and analyze a choice experiment to understand how dictated terms relating to crop profit margin, order size, packing specifications, and delivery method affect farmers preferences for wholesale contract opportunities. In this section we describe the survey instrument and choice activity design, as well as the econometric approach using the data collected.

2.1 Survey Instrument

The survey was generated through Qualtrics software, Version 01/2020 (Qualtrics 2005). Structured in four sections, the survey begins with instructions and basic questions used to inform the choice experiment. The second section contains the choice tasks ordered randomly for each respondent. Next, there is a farm characteristics section focusing especially on the farms current marketing channels. Finally, there is a short personal demographic section asking about the respondents' role on the farm and their history in farming.

Importantly, before completing the choice experiment, is the survey instrument is framed in a specific way. The respondents are asked to imagine the following scenario:

> *"While working during peak season, you receive a call from a wholesaler you know. They have two orders they need to fill, but the customer has asked that*

they are filled by two separate farms. The wholesaler describes the two orders and then gives you the opportunity to pick one you would like to fill. You can also decide to fill neither. You have already fulfilled your committed orders and have enough product to choose either of the presented options without jeopardizing future commitments."

This framing addresses issues that came up while testing the survey. Establishing it is as "peak season" communicates that there are many tasks to do on the farm and extra time is limited to fill additional orders. The framing also implies that the customer dictates that a single farm cannot fill both orders. This is to justify why the farm cannot fill both orders if they have the product available to fill both. Finally, stating that all other orders are already filled and that choosing one of the options presented will not jeopardize having enough product to fill other orders eases worries about possibly not being dependable for regular customers or already agreed upon orders for future produce. While the study is aimed at implications relating to food hubs, the survey refers to a sale to a "wholesaler." This removes the need to further explain what a food hub is compared to other types of wholesalers. This framing establishes a mind set for all farmers as they take the survey as to prevent error from misunderstanding the survey.

2.2 Choice Experiment

This study utilizes a choice experiment to better understand the importance of various factors in relation to farmers selling to wholesalers[1]. Choice theory originates from Lancaster's work on consumer choice (Lancaster 1966) where a good can be defined by the collection of attributes it possesses, and that the collection is what defines the consumers utility of a certain

[1] The study was approved by University IRB under protocol number 1711007607.

good. McFadden (1973) elaborates on this idea by showing that an individual's utility can be modeled based on surveying a larger population, especially when the attributes are qualitative factors. Drawing from McFadden's random utility framework (Mcfadden 1973), the farmers utility associated with a wholesale contract selection is represented as:

$$U_{ij} = V(A_j, S_i) + \varepsilon_{ij} \ , \tag{1}$$

where utility (U) is measured for farmer (i) and contract option (j), which is defined by observable components (V) and an error term capturing unobservable factors that may influence a farmer's choice. The observable components (V) can be separated into two factors: attributes (A) that define each choice set specific to contract option (j), and socioeconomic factors (S) that are specific to each farmer (i).

The process of defining attributes for the choice experiment was conducted following the methodology in Coast et al. (2012). The process consisted of a literature review, interviews with farmers and food hub operators, refining attributes and their descriptions, review of attributes by researchers specializing in choice experiments, and pre-testing the choice experiment with farmers.

Following Coast (2012), none of the attributes should be so important that a single attribute determines the choices made throughout the choice experiment. Food hubs stressed the importance of relationships when buying from farms. Additionally, barriers to encourage farms to sell their product to a customer they never sold to in the past or who they had a negative experience with are large (Schipmann and Qaim 2011). To avoid this attribute dominating how selections were made, it was not included in the choice experiment but asked about in follow up questions after the choice experiment. The specific price of the product was also not included as an attribute since it was the dominant attribute for pre-test participants when included in the choice experiment. In addition to being the dominant factor, price varies across regions and crops, making it difficult to

include it in a survey covering a wide region. Alternatively, a crop's profit margin was included as a measure of profitability that did not dominate decision making during tests of the choice experiment.

The other attribute categories are crop profit margin, delivery method, packing specifications, and order size. Three of the categories (i.e., delivery method, packing specifications, and order size) have three defined levels, and one (i.e., crop profit margin) has two. The descriptions of the attributes and attribute levels are included in Table 1.

Table 1. Choice Experiment attributes and levels

Attribute	**Levels Meaning**	**Variable Name**
Crop Profit Margin	Low Crop Margin	ML
	High Crop Margin	MH
Delivery Method	On-Farm Pick Up	DF
	Delivered to Central Facility	DW
	Delivered to End User	DEU
Packing Specifications	No Defined Standards	PN
	Basic Standards	PB
	Strict Standards with Labeling	PS
Order Size ($)	Small	OS
	Large	OL
	At Capacity	OC

Crop profit margin defines what types of crops are being grown. Most vegetable farms grow a variety of products which all have different profit margins (Galinato and Miles 2013). Conversations with farmers illuminated that when they thought about whether to accept a wholesale order, they often asked what crop it was. With different farmers growing a mix of crops, the survey asks farmers to list their three highest and lowest margin crops to provide context for what high and low crop margin refers to for them and where crop margin is defined as the wholesale price per unit minus the production costs and a portion of the overhead expenses of the

farm. The choice experiment includes high *(MH)* and low *(ML)* margins as two levels of the crop margin attribute.

Delivery method is how the product gets to the customer - either the wholesaler/food hub or the ultimate end user. On-farm pick up (*DF*) is the most convenient for the farmer since the wholesaler comes to them to pick up the product. The second method is delivery by the farmer to a central facility of the wholesaler (*DW*). Many wholesalers have warehouses with staff on-site. Because of this, farmers are often presented with a time range for delivery that is more flexible than an end user would dictate. The final method is delivery by the farmer directly to the end user's location (*DEU*); i.e., the wholesaler's customer such as a restaurant, value-added food business, or small grocery store. Discussions with farmers illuminated that these types of establishments are typically less flexible on delivery times and may not have a loading dock or parking on site.

The packing specification attribute describes what specific instructions are given by the wholesaler as to how the produce should be packed on the farm. No standards (*PN*) means that the end user has not given any specific instructions to the wholesaler and the produce can be packed however the farm typically packs it. Basic standards (*PB*) means that the end user has provided some basic instructions as to how it should be packed; e.g., the size of the boxes, if plastic box liners should be used, or sizes of bunched greens. These are basic restrictions that do not add much time or cost during harvesting and packing. The final option is strict standards (*PS*) that refer to strict guidelines as to how the product should be harvested and packaged. It can include harvest specifications (e.g., length of broccoli stems) or packing specifications (e.g., lettuce heads placed in boxes with the stem up). The wholesaler can also specify that their own labels be placed on the boxes instead of the farm's. Strict packing specifications are often dictated when a wholesaler

wants to combine product from multiple farms without being able to tell they come from different places.

The final attribute category is order size. At the beginning of the survey, respondents are asked to list (in U.S. dollars) what "small" and "large" wholesale orders are during their own peak season. The idea of small *(OS)* and large *(OL)* orders is repeated as the first two levels of the attribute category. A third value, "at capacity" *(OC)*, describes the largest wholesale order amount (in U.S. dollars) the farm could handle during peak season without jeopardizing their other marketing channels and preexisting wholesale orders based on labor and time constraints, but is not an amount they regularly fulfill.

The four attribute categories and their respective factor levels correspond to a full factorial design of 2,916 possible combinations ($2^2 * 3^2 * 3^2 * 3^2$). The design for the choice experiment was created using SAS software, Version 9.4 of the SAS System for Windows. The SAS software optimizes the entire choice activity (composed of two choice sets with four variables each and a neither option) instead of individual choice sets (a group of one of each of the attributes). In doing so, it optimizes 8 attributes (2 choice sets x 4 attributes per choice set). It was determined that 15 choice activities were the minimum number possible to use, but that 18 would greatly improve the D-efficiency of the choice experiment.[2] Since 15 and 18 were the only two options presented by SAS Software that was reasonable for a single respondent to complete without survey fatigue, 18 was selected because of the better D-efficiency.

[2] D-efficiency is commonly used as a way to select a choice experiment design if the full factorial option is not a reasonable option (Hensher, Rose, and Greene 2015). This measure uses the eigenvectors of the matrix representing the design to find the geometric mean of the choice sets. In SAS, this value ranges from 0 to 100 with 100 being ideal. When selecting a design, the option with the D-efficiency closer to 100 is chosen (Kuhfeld 2010)

The resulting model is a fractional factorial design of 18 choice activities, each containing two choice sets and a third "neither" option. In each question, respondents are asked which of the following wholesale contracts they would prefer, with the option of saying that they would not take either offered to them. To control for variation due to ordering, the 18 questions are presented to respondents in randomized order. Based on the "rule of thumb" equation on sample sizes for choice experiments, the minimum number of completed surveys needed to analyze the data were 28 responses (de Bekker-Grob et al. 2015).

2.3 Econometric Approach

A mixed logit (or random parameter logit) analysis is employed to estimate the utility of the attribute categories and specific levels. Like all logit models, the mixed logit model predicts the probability of an outcome happening based on a set of specified conditions and variables. The mixed logit is unique from other logit type models (multinomial, conditional, basic logit) in that it allows for heterogeneity of preferences across respondents as well as over time (Train 2003). It also relaxes restrictions on independence from irrelevant alternatives (IIA) as specified in the logit model. In the mixed logit model, only variables specified as random parameters are estimated with a heterogeneous error term. Allowing for this heterogeneity results in estimations of standard deviations from the mean (Train 2003). These standard deviation estimates demonstrate the magnitude of how varied the preferences are for each attribute across respondents. Statistical significance of the standard deviations confirms heterogeneous preferences and supports the use of the mixed logit model. If theory suggests that preferences will not vary across respondents, it does not need to be included as a random parameter. High crop profit margin *(MH)* is not included as a random parameter for this reason.

This analysis employs dummy variable coding for each attribute level included in the model such that attributes are compared to a base (excluded) level. It is assumed that the deterministic component of utility of the base level is 0 (Hensher, Rose, and Greene 2005). Since this analysis is looking at the probability of farmers selecting sales presented by wholesalers, the base level is represented by the combination of attributes that we believe represents the most attractive bundle to a wholesaler. The utility of other attribute levels and bundle of attributes will be compared to the base levels of low crop profit margin *(ML)*, strict packing standards *(PST)*, at-capacity order size *(OC)*, and delivery to the end user *(DEU)*.

An alternate specific constant *(ASC)* is also used, as is common in mixed logit models (Hole 2007). The coefficient on the *ASC* variable represents the general attitude towards sales to wholesalers. Since there can be variation across respondents as to their preferences on wholesale markets, the *ASC* variable is included as a random parameter in the mixed logit with an estimated standard deviation. The *ASC* is also interacted with various demographic characteristics to estimate the influence of socio-economic factors on the attitude towards wholesale markets (Meemken et al. 2017; Ochieng et al. 2017; Schipmann and Qaim 2011).

The first model (1) is specified only in terms of the attributes of the choice experiment, excluding all farmer demographics and farm characteristics:

$$Y_{ijk} = \beta_0 + \beta_1 ASC + \beta_2 MH_{ijk} + \beta_3 PN_{ijk} + \beta_4 PB_{ijk} + \beta_5 DF_{ijk} + \beta_6 DW_{ijk} + \beta_7 OS_{ijk} + \beta_8 OL_{ijk} + \varepsilon_{ijk}\ , \quad (2)$$

where, *Y* is a binary variable defined as 1 if farmer *i* selects contract alternative *j* in choice set *k*, else 0; *ASC, MH, PN, PB, DF, DW, OS,* and *OL* are the alternate specific constant, high crop margin, no defined packing standards, basic standing packing specifications, on-farm pick up,

delivery to central facility, small order size, and large order size, respectively. The *ASC* is a binary variable equal to 1 if one of the two contract options is selected and 0 if neither was selected. Each of the attribute variables are binary and are equal to 1 if the variable is listed as part of alternative *j* in choice set *k* for each farmer (*i*). Each attribute coefficient β_1 - β_7 represents the difference in utility compared to the base level for that specific attribute category (which has a utility of 0). There is also an error term specified for farmer *i* in contract alternative *j* in choice set *k*.

The next three models tests whether various sets of socio-economic variables influence the heterogeneous preferences of farmers relating to wholesale contracts. Model (2) tests if the demographic characteristics of the farmer influence the general viewpoints on wholesale markets (i.e., via interaction with *ASC*):

$$Y_{ijk} = \beta_0 + \beta_1 ASC + \beta_2 MH_{ijk} + \beta_3 PN_{ijk} + \beta_4 PB_{ijk} + \beta_5 DF_{ijk} + \beta_6 DW_{ijk} + \beta_7 OS_{ijk} + \beta_8 OL_{ijk} + \delta_1(ASC \times EXP_i) + \delta_2(ASC \times MALE_i) + \delta_3(ASC \times OWNER_i) + \varepsilon_{ijk}\ , \quad (3)$$

where the variables include years of experience as a farmer (*EXP*), if the respondent identifies as male (*MALE*), and if the respondent owns the farm they currently work at (*OWNER*.

Model (3) tests the influence of farm characteristics on preferences towards wholesale sales:

$$Y_{ijk} = \beta_0 + \beta_1 ASC + \beta_2 MH_{ijk} + \beta_3 PN_{ijk} + \beta_4 PB_{ijk} + \beta_5 DF_{ijk} + \beta_6 DW_{ijk} + \beta_7 OS_{ijk} + \beta_8 OL_{ijk} + \rho_1(ASC \times ACRES_i) + \rho_2(ASC \times FRUIT_i) + \varepsilon_{ijk} \quad (4)$$

where farm characteristics include number of acres in vegetable production (*ACRES*) and if the farm also sells fruit (*FRUIT*).

Model (4) considers voluntary participation in various marketing certifications:

$$Y_{ijk} = \beta_0 + \beta_1 ASC + \beta_2 MH_{ijk} + \beta_3 PN_{ijk} + \beta_4 PB_{ijk} + \beta_5 DF_{ijk} + \beta_6 DW_{ijk} + \beta_7 OS_{ijk} + \beta_8 OL_{ijk} + \sigma_1 (ASC \times ORGANIC_i) + \sigma_2 (ASC \times GAP_i) + \sigma_3 (ASC \times FSMA_i) + \varepsilon_{ijk} \quad (5)$$

where the variables include if the farm is USDA certified organic (*ORGANIC*), if they are Good Agricultural Practices certified (*GAP*), and if they are compliant with the Food Safety Modernization Act (*FSMA*). [3]

The importance of each category when selecting a choice set can be calculated based on the model coefficients (Orme 2002). This also tells us if the choice activity design is well balanced or if some attribute categories dominate others during the decision-making process. Attribute importance is defined as the range in the coefficients of attribute *c* (largest minus smallest) divided by the sum of all the ranges:[4]

$$Importance_c = \frac{Range_c}{Range_{Margin} + Range_{PS} + Range_{OS} + Range_{DS}} \quad (6)$$

where *c* is the attribute category for which the importance being measured and the four coefficients in the denominator represent the range of each of the attribute categories: crop profit margin (*Margin*), packing specifications (*PS*), order size (*OS*), and delivery specifications (*DS*).

[3] Note that FSMA compliant (*FSMA* = 1) indicates the farm has received the certification of compliance, a farm that is FSMA exempt or is not FSMA compliant will code as *FSMA* = 0.
[4] Note that the base level has a utility of zero.

Estimated coefficients on the attribute levels can be transformed into probabilities of selection relative to the base level. Selected bundles will be spoken about in the analysis. To analyze the utility of a single bundle, we use the coefficients from model (1) to compare the average farm from the sample. The four attributes have 54 possible combinations ($3 \times 3 \times 3 \times 2$). The utility for each permutation is calculated as:

$$U_b = (\beta_2 MH_b) + (\beta_3 PN_b + \beta_4 PB_b) + (\beta_5 DF_b + \beta_6 DW_b) + (\beta_7 OS_b + \beta_8 OL_b) \qquad (7)$$

where the utility of bundle *b* is the summation of the utility for each attribute category (Lemmens n.d.), with attribute category values equal to one if they are included in the bundle and zero if they are not. U_b represents ordinal utility and is transformed into odds (i.e., $Odds_b = \exp(U_b)$). Recognizing the utility of the base bundle is zero, the probability of selecting bundle *b* (P_b) relative to it follows as:[5]

$$P_b = \frac{Odds_b}{Odds_b + Odds_{base}} = \frac{Odds_b}{Odds_b + 1} \qquad (8)$$

3 Data Description

Data were collected through online distribution of the survey through extension agents and partnering agricultural organizations. Over a three-month period, a total of 47 surveys were completed; i.e., 19 more than the minimum required by our survey design.

Characteristics of the farms and the farmers' demographics are shown in **Error! Reference source not found.**. The average amount of farming experience is 16.43 years but ranged from 2 years to 66 years. About 45% of the respondents are male which is lower than 61% of all U.S.

[5] Recall, the base bundle includes a low crop profit margin (*ML*), at-capacity order (*OC*), strict packing standards (*PST*), and sale delivery to the end user (*DEU*).

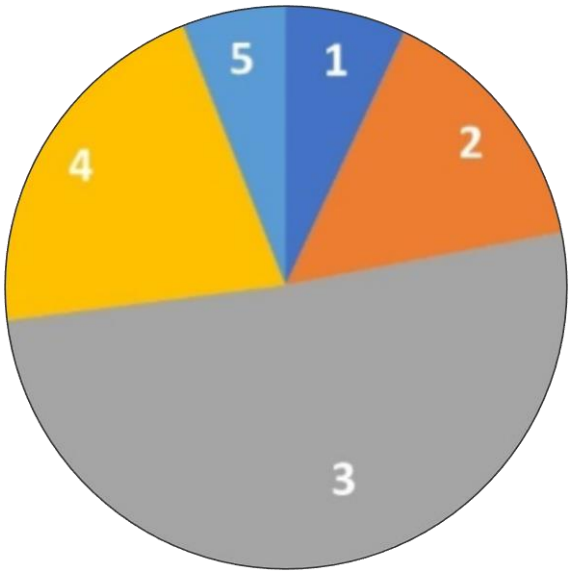
vegetable producers which is reported in the 2017 USDA Agricultural Census (USDA NASS n.d.). While farm owners or managers could respond to the survey, 81% of responses were from owners. The number of acres in vegetable production ranges from 0.25 to 850 acres with an average of about 62 acres, this is lower than the US average of vegetable farms which is 206 acres (USDA NASS n.d.). The responses are from farms across the Midwest, Southeast, and Northeast United States. About 50% of the responses come from farms that grow fruit in addition to vegetables. About 50% of the farms are USDA certified organic. This is much higher than the industry in the United States where 1% are USDA certified organic (Bialik and Walker 2019). Half of the farms (50%) are FSMA compliant and about 20% hold GAP certifications.

Table 2: Descriptive Statistics

	Mean	***SD***	***Minimum***	***Maximum***
Years Farm Experience	16.43	12.74	2.00	66.00
Male (% in sample)	0.45			
Farm Owner (% in sample)	0.81			
Farm Size (Acres Vegetable Production)	61.70	166.45	0.25	850.00
Also Grows Fruit(% in sample)	0.47			
FSMA Compliant (% in sample)	0.47			
GAP Certified (% in sample)	0.21			
USDA Certified Organic (% in sample)	0.47			

About 50% of respondents stated that they sell through at least three of the six marketing channels listed (farmer's markets, community supported agriculture program, directly to businesses, wholesale via intermediaries, to processors, or other), which is the most common answer (Figure 1). This is followed by selling through four, two, one, and five market channels. About 47% of respondents reported selling to wholesalers and intermediaries at the time of the survey. Our sample includes farm characteristics that are more likely to sell to food hubs.

Figure 1: Number of Marketing Methods



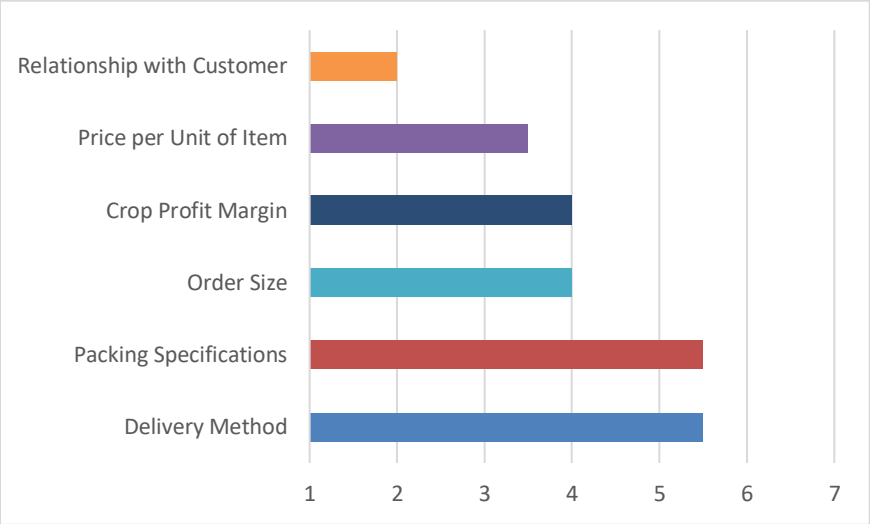
4.1 Stated Preference of Wholesale Contracts

At the end of the survey, farmers are asked directly what their preferred contract bundle is. These stated preferences clearly show that farmers prefer wholesale contracts for crops with high profit margins (Figure 2), which is expected. The stated preferences also show a dislike for small orders and a slight preference for "large" orders over "at capacity" orders. Very few farmers select strict packing standards. Most farmers selected basic standards, but about one third selected a preference for no given packing standards. Three quarters of farmers selected on-farm pick up as the preferred delivery method with the remaining farmers split between delivery at a central facility and at a final customer. This suggests clear preferences for crop margin and delivery method and more varied preferences among the other two attributes.

Figure 2: Stated preferences for wholesale contracts

Respondents ranked the relative importance of the individual attribute categories in the choice experiment in addition to several categories which were not included in the analysis but considered in the development of the choice experiment. A total of seven categories were presented. As seen in **Error! Reference source not found.** the medians of the categories from most important to least important are relationship with customer, price per unit, regularity of orders, crop profit margin, order size, packing specifications, and delivery method. The stated preferences reinforce that relationship with customer, and price per unit are important categories in addition to the ones analyzed in this analysis.

Figure 3: Median stated importance of categories
(1 most important; 7 least important)



4 Results

The results from the econometric models and the subsequent analyses are reported in this section. We begin with the mixed logit model results and follow with the utilities of selected bundles of attributes and part-worth utilities of the attribute categories themselves.

4.1 Mixed Logit Models

As seen in Table 3, estimated coefficients on attribute levels are similar across all mixed logit model specifications. Estimated attribute coefficients are all statistically significant at a 1% level other than large order *(OL)*, which is consistently statistically insignificant. Additionally, the magnitude of the coefficients is similar for attribute variables across model specifications. With many of the standard deviations being statistically significant at either the 5% or 1% levels, the mixed logit model confirms heterogeneous preferences across respondents.

Table 3. Results of Mixed Logit Models

	(1)		(2)		(3)		(4)	
	Basic		Farmer Demographic		Farm Demographics		Marketing Certifications	
Mean Parameters		SE		SE		SE		SE
ML: High Profit Margin	1.827***	0.163	1.851***	0.166	1.881***	0.179	1.862***	0.17
ASC	-0.043	0.486	1.681	1.094	-0.972	0.656	-1.448***	0.552
PB: Basic Standards	2.144***	0.23	2.199***	0.238	2.171***	0.233	2.159***	0.237
PN: No Standards	2.762***	0.238	2.816***	0.255	2.795***	0.261	2.771***	0.245
DW: to Warehouse	0.779***	0.172	0.797***	0.175	0.774***	0.173	0.781***	0.173
DF: On Farm Pick-Up	2.200***	0.225	2.226***	0.228	2.284***	0.256	2.278***	0.243
OL: Large Order	0.008	0.191	0.049	0.188	-0.067	0.2	-0.025	0.196
OS: Small Order	-1.702***	0.269	-1.721***	0.27	-1.698***	0.304	-1.622***	0.276
ASC x Years Experience			-0.033	0.021				
ASC x Male			-0.396	0.515				
ASC x Farm Owner			-1.042	0.649				
ASC x Acres					0.005**	0.003		
ASC x Grows Fruit					0.161	0.614		
ASC x Organic							1.201**	0.53
ASC x GAP Certification							1.552**	0.73
ASC x FSMA Compliant							0.594	0.533
Standard Deviation Parameters								
ASC	2.773***	0.399	3.117***	0.522	2.456***	0.324	2.291***	0.344
PB: Basic Standards	0.560**	0.226	0.664***	0.251	0.546**	0.235	0.623***	0.236
PN: No Standards	0.323	0.465	0.644**	0.275	-0.713	0.488	-0.474	0.409
DW: Delivery to Warehouse	0.152	0.226	0.216	0.229	-0.01	0.422	0.147	0.248
DF: On Farm Pick-Up	0.889***	0.221	0.953***	0.23	0.938***	0.238	1.003***	0.294
OL: Large Order	-0.586***	0.216	-0.516**	0.239	-0.655**	0.267	-0.653**	0.263
OS: Small Order	1.145***	0.267	1.153***	0.275	1.206***	0.269	1.169***	0.291
Observations	2538		2538		2538		2538	
AIC	1035.788		1038.589		1036.251		1038.92	
BIC	1123.375		1143.694		1135.516		1144.024	

* p<0.1 ** p<0.05 *** p<0.01

Models (1) through (3) have *ASC* coefficients which are not significant, while the coefficient in model (4) both significant and negative. In model (4), the interaction between the ASC and the marketing certification account for the variation in viewpoint on wholesale markets for those with those certifications. Therefore, the ASC alone examines the variation in views on wholesale markets for those without those certifications. The coefficient on the *ASC* variable shows that farms without marketing certifications are associated with significantly negative preferences on wholesale markets.

As expected, farmers consistently prefer selling through wholesalers crops with higher profit margins over those with lower margins. Both basic packing standards and no packing standards are strongly preferred over strict specifications. The analysis shows a stronger preference for no packing standards) (compared with strict standards) than basic standards (compared with strict standards). The analysis shows that both delivery alternatives are more favorable than delivering the order to the end user, but the magnitude is larger for on farm pick-up than delivering it to a central warehouse. The base level of an at capacity order size is preferred over a small order. The only attribute in the analysis which is not significant is the large order size compared to the at capacity size, there is no statistically significant preference between the two.

The standard deviation parameters represent if there is statistically significant variation in preferences (at the 1%, 5 % or 10% significance level) and what the magnitude of that variation is. The standard deviation of the *ASC* is consistently statistically significant at the 1% level across models. Basic packing standards has heterogenous preferences of about 0.6 in all models. No packing standards is statistically significant in model (2) suggesting that preference differences for no packing standards are related to the demographics of the farmers. Standard deviation parameters for delivery to central warehouse remain insignificant throughout the models where on Farm Pick-

Up is significant at the 1% level across all models. This suggests that while preferences do not vary relating to delivery at central warehouse, they do vary relating to on farm pick-up. Since there are varied preferences for this, it is important for food hubs to understand the preferences of the farm they are offering a sales contract to ensure the contract bundle matches the preference of the farm they want to buy form. Preferences for both large and small order sizes have statistically significant variation across all model specifications.

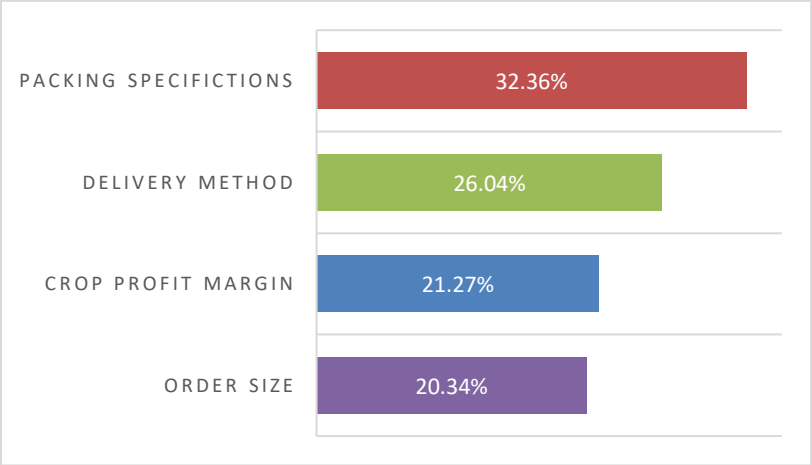
Demographic control variables interacted with the alternate specific constant throughout the various model specifications provide important insight into the general view of wholesale as a market channel. Among the sample for this survey, demographics relating to the farmer are not significant and are not driving differences in preferences. Model (3) displays a positive association between vegetable acres in production *(Acres)* and views on wholesale markets. Both USDA organic certification *(Organic)* and *GAP certification* are positively associated with positive views on wholesale markets. Since GAP certification is required by some buyers, it is unsurprising that farms with those certifications have positive views on wholesale markets.

4.2 Relative Category Importance

The implications from the category importance analysis are twofold: ensuring a balanced survey and understanding the relative importance of the categories during the choice experiment. Based on the definitions of the attributes provided in the choice experiment, packing specifications was the most importrant category at 32.36% importance followed by delivery method (26.04% importance), crop profit margin (21.27% importance), and order size (20.34% importance). These can be seen in figure 4. Packing specifications is the most important category because of the large difference of preference between strict packing standards and no packing standards. Although

there is a difference of importance between the four attribute categories, no single category is dominating compared to the others showing a well balanced choice experiment.

Figure 4. Relative importance of attribute categories

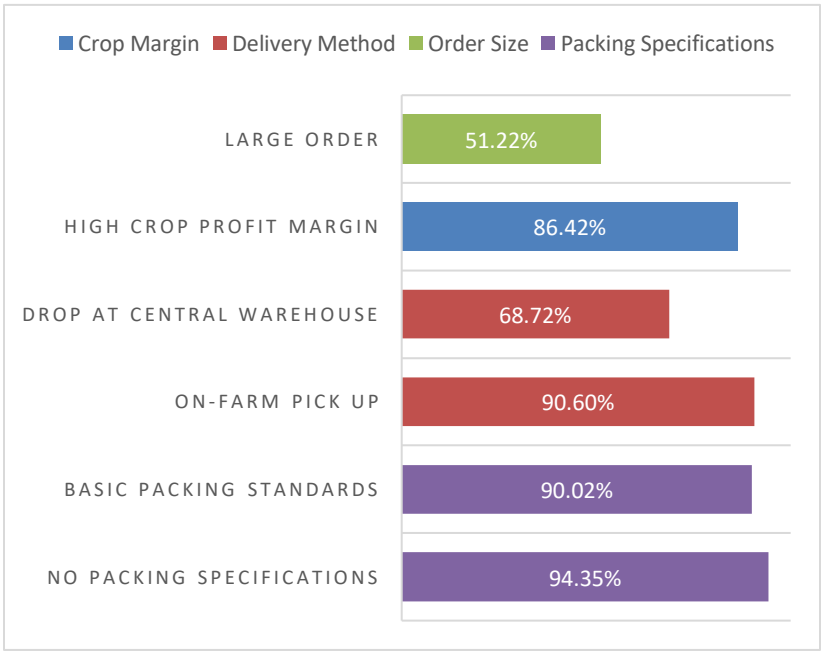


4.3 Bundle Probability Analysis

While understanding the importance of single attributes and categories is important, purchase offers from wholesalers are a bundle of attributes. Because of this, it is important to present preferences for an entire purchase request to provide relevant information to food hubs. With the base level representing the most attractive bundle from the food hub perspective, there are opportunities to increase or decrease farmer utility and the probability of a farm agreeing to a sale. Of the 54 premutations of a sale, 2 have utilities lower than the base level and 51 are higher confirming that the most preferred bundles for the food hubs are some of the least preferred by farmers. The bundle with the lowest utility for farmers is a low crop profit margin, strict packing standards, delivery at end user, and a small order size. The combination which results in the highest utility for farmers is a high crop profit margin, no packing standrds, on-farm pick up, and a large order size. While the preferences are different between the two parties, there are 39 bundles with a probability of selection (compared to the base level) of over 90% showing that small changes from the most preferred bundles by a wholesaler can result in an attractive bundle according to a

farmer. Additionally, if a farmer is unwilling to accept the base level sales conditions, there is an opportunity to greatly increase the probability of them saying yes by changing just one attribute of the bundle. As seen in figure 5, changing to either on-farm pick up, basic packing standards, or no packing specifications will increase the probability of selecting the bundle to over 90% compared to the base level. This representation fo the analysis provides important information for food hubs to be able to craft sales offers that are close to their most preferred bundle, but are much more likely to be accepted by a farmer.

Figure 5: Probability of sale with one attribute changed



5 Discussion & Policy Implications

The results from the analysis have implications for three main groups: researchers, industry stakeholders such as wholesalers/food hubs, and policy makers.

With the majority of similar academic literature being conducted outside of the United States (Meemken et al. 2017; Ochieng et al. 2017; Schipmann and Qaim 2011) this study is the first to measure produce farmers preferences in wholesale contracts in the United States. These

results begin to give an understanding to vegetable farmer preferences when presented with wholesale opportunities and what non-price factors drive decision making. It also sheds light on how various attributes of a sale not commonly studied (packing specifications and delivery method especially) drive decision making within a market channel.

With wholesalers and food hubs purchasing from many different farms, this choice experiment provides guiding principles on the preferences of farmers when offered various contract terms. This information is useful to wholesalers and food hubs who frequently have farmers say no to purchase offers or those just starting out and wanting to increase the odds of farmers selling produce to them. It also provides key information to food hubs and wholesalers if they need to incorporate less preferred attributes in their purchase offers to farmers. For example, if a food hub must have their label present on boxes and strict packing standards on the produce, they can offer on-farm pick up without requiring the farmer to lose much utility. Understanding the preferences of the attributes can help the food hub design a purchase offer which is likely to be accepted by the farmer and thus lead to them being more successful.

While the implications of this study have practical implications for all wholesalers, they are especially relevant to food hubs. While many food hubs are reliant on both public and private grants, the use of grants is not a significant driver of long term financial viability and is hypothesized as a way to cover short term expenses (Fischer, Pirog, and Hamm 2015b). With a number of food hubs closing and facing financial issues (Fischer et al. 2015a), increasing the understanding of the factors that would incentivize vegetable farmers to sell to a food hub, is vital to ensure that food hubs find long term success and the public investment is not wasted.

6 Conclusion

In this paper, we summarized a choice experiment measuring farmers preferences when presented with possible sales opportunities from wholesalers/food hubs. After consulting with farmers and food hubs, the choice experiment was designed and then distributed to farmers across the United States. The subsequent analysis provided an understanding of the varied preferences of the attribute categories in the survey: crop profit margin, order size, delivery method, and packing specifications. Results from a mixed logit analysis of the choice experiment responses were used to estimate the probability of a farmer selecting various sales opportunities as well as measuring the importance of the attribute categories relative to each other.

The results show strong preferences for certain characteristics of the sell opportunity. Large and at capacity orders are preferred over small orders. Farmers prefer selling high crop profit margin crops. There is a strong preference for no packing standards or basic packing standards over strict packing standards. Finally, on farm pick-up is the most preferred delivery method, but dropping produce at a central warehouse is still preferred over delivering to the end user. Additionally, the results show a well-balanced survey design with no attribute category dominating decision making during the choice experiment.

This analysis provides valuable information to wholesale businesses and food hubs to help facilitate transactions between them and the farms they buy from. This analysis provides these businesses a better understanding of farmers preferences and what aspects of a sale they may be flexible on, and which sales terms will be less likely for them to accept. The results from this study will help food hubs operate with less reliance on grants and help them operate profitably long term.

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