Fresh Vegetable Growers' Risk Perception, Risk Preference and Choice of Marketing Contracts: A Choice Experiment

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Abstract

Growers' preferences for a number of marketing contract attributes as well as the effect of growers' risk perception and risk preferences on the choice of marketing contracts were examined with the use of a choice experiment. The main data source for the study is a mail survey administrated to 315 wholesale tomato growers. The findings validate the transaction cost hypothesis and indicate heterogeneity in preferences. Risk perception and risk preferences had limited impact on contract choice.

Key Words: Marketing contracts, transaction costs, choice of contracts, choice experiment

JEL classifications: Q12, Q13

Introduction

Fresh vegetable production is a high risk farming activity. Fresh vegetable growers, in addition to the traditional sources of risk associated with farming (i.e., production, price, and financial risk), face increased uncertainty due to the characteristics of their products (Cook, 2011; Ligon, 2001; Hueth and Ligon, 1999). Some of those characteristics include: i) the perishability of fresh vegetable production, ii) the lack of traditional policy measures (i.e., price and income support programs) and futures markets, and iii) the importance of quality of production.

Specifically, the perishability of fresh vegetables leads to fewer storage opportunities compared to many agronomic crops (Cook, 2011). As a result, growers are often compelled to accept market prices during or close to their harvesting period. Furthermore, due to the absence of traditional policy measures and futures markets, producers depend heavily on market forces, where prices are highly variable (Hueth and Ligon, 1999). Finally, if a vegetable production does not meet the buyer's (consumer, retailer and intermediaries) standards, then the grower often has to sell at a lower price, if at all, to avoid further loss of revenue.

Fresh vegetable growers have limited opportunities to mitigate this risk. A possible option towards this goal is the adoption of marketing contracts. Marketing contracts typically refer to a written or oral agreement between a grower and a buyer who sets a price and possible price adjustments, including quality specifications and a delivery period schedule (MacDonald et al., 2004; Katchova and Miranda, 2004). Under this type of agreement, producers assume all risk related to production (yield, quality, etc.) and input prices, but share risk related to output market price with the buyer (MacDonald et al., 2004).

A number of arguments have been presented in the literature to explain the increased use of contractual arrangements. First, contract agreements help both parties to better manage risk (Wolf et al., 2001; MacDonald, 2004). Second, the incentives/penalties embodied in a contractual agreement may act as catalysts to induce a particular behavior, i.e. provide better product quality (Hueth and Ligon, 1999; Wolf et al., 2001). Calvin et al. (2001) highlighted several reasons that shippers have for contracting. Among the most important ones, according to ERS marketing study interviews (Calvin et al., 2001) are the secured markets and the maintenance of future relationships with buyers. Last but not least, contractual arrangements can help growers and buyers in their resource allocation decisions due to the predictability introduced into production (Hueth et al., 1999).

Although extensive research has been conducted regarding several aspects of contractual agreements in agriculture, the literature regarding estimation of growers' preferences and their willingness to accept/pay for different marketing contracts attributes is limited. A notable exception is Hudson and Lusk (2004), who used discrete choice experiments (DCE) to estimate the marginal values of six attributes (expected income, price risk shifted, autonomy, asset specificity, provision of inputs, length of contract) of hypothetical contracts using a sample of 49 growers from Mississippi and Texas. The findings of their study indicate that risk avoidance and transaction costs play a major role in the choice of contractual agreement. Furthermore, the study highlights the heterogeneity of preferences among growers.

DCE analysis refers to a broad range of survey-based statistical techniques used by scholars in order to draw inferences for important questions such as: i) consumers' preferences, ii) tradeoffs that consumers are willing to make in order to enjoy specific attributes, iii) how consumers may react to introduction of new products or changes in existing ones, and iv) market- share predictions (Green et al., 2001; Louviere et al., 2010)[1]. Since marketing contracts can be described in terms of several distinct attributes, using DCE analysis in order to estimate the marginal value of them to growers is justifiable.

The objective of the study is twofold. First, the study seeks to examine growers' preferences for a number of marketing contract attributes. Second, it investigates the effect of growers' risk perceptions and risk preferences on the choice of a marketing contract agreement.

The marketing contract attributes examined include different levels of price, volume requirements, transaction costs, and penalties. Elicitation of growers' risk preference is achieved with the use of a "multiple price lists" design where growers are presented with several lottery choices and are asked to select one (Binswanger, 1980, 1981). Growers' risk perception is determined through a number of Likert scale questions.

A mail survey questionnaire was used to gather data from tomato producers and consisted of five sections. Supplementary data used included tomato prices and yields in order to design reasonable contract options for the choice experiment. Those data were obtained from the USDA Ag Marketing Service Atlanta Terminal Market and with the use of biophysical simulation, respectively. Growers' preferences toward marketing contracts are estimated using mixed- logit modeling. This approach allows the relaxation

[1] Discrete choice experiments (DCE) are referred in Green et al. (2001) as choice based conjoint analysis.

of the restrictive independence from irrelevant attributes assumption and accounts for heterogeneity in preferences.

The use of DCE techniques to examine fresh vegetable marketing contracts is a primary contribution of this study to the literature. In comparison with Hudson and Lusk (2004), the present study focuses on a specific crop (tomatoes) and group of growers (wholesale tomato growers), but the results have implications for both growers and to a broader range of stakeholders who can benefit from the insights offered by this study. These specifications allow the evaluation of more concrete contractual agreements. Last but not least, it is the first effort to examine how growers' risk perceptions affects their choice of contracts.

The findings of the study can provide useful insights both to policy makers and to the vegetable production industry. This is so for several reasons. Consumer interest in locally-sourced foods has increased dramatically, and marketing contracts are one method for restaurants and retailers to develop a reliable supply of local produce. Thus, a better understanding of farmers' preferences can increase the adoption of mutually beneficial contracts. Second, information regarding farmers' acceptance and perceived tradeoffs between the different attributes in interaction with their risk perception and risk preferences levels will provide useful intuition in better understanding how different producers view this emerging market. Finally, the study will further examine the importance of transaction costs in contractual agreements, which may give guidance to relevant policy.

Data Collection and Survey Design

The main data source for the study is a mail survey. The survey was administered to a sample of wholesale tomato producers in four states: Kentucky, Illinois, Ohio and

Indiana. Growers who direct market the majority of their produce were excluded from the sample since they are less likely to operate under contractual agreements (MacDonald et al., 2004). Mailing information for the growers was gathered from the Market Maker web sites within these respective states, after obtaining permission to use the data base of the site. A total of 315 mailing addresses were retrieved.

From the 315 surveys, ten were returned for insufficient or wrong addresses and five were no longer farmers, leading to an effective survey group of 300 growers. In order to mitigate non-response bias problems, the three wave survey design (survey - reminder - survey) proposed by Dillman (1978) was implemented. A monetary incentive ($25) was offered with the intention of boosting the response rate. The overall response rate was 18.3% (55 returned surveys) with an effective response rate of 16.3% (49 surveys). The sample size and the response rates for each state are presented in Table 1. Descriptive statistics are reported in Table 2.

The study sample includes a greater percentage of women operators and slightly younger growers compared to 2007 census of agriculture (Table 2). Furthermore, the average acres with tomatoes in the study compare closely to the average of total harvested acres with tomatoes from the 2007 census of agriculture. The final form of the survey questionnaire (i.e., wording, ordering of questions etc.) is the result of several focus group discussions with vegetable growers, extension specialists, and persons involved with marketing of fresh vegetables. Two of the major focus groups took place during the 2011 Kentucky Farm Bureau Convention and the 2012 Kentucky Fruit and Vegetable Trade Show.

The survey questionnaire consisted of five sections. First, general questions about the characteristics of the farm were solicited. The next section incorporated questions regarding growers' perceptions and experience with marketing contracts. The third section asked questions related to growers' risk comfort levels. The choice experiment is included in the fourth section. The survey concluded with questions on demographic characteristics.

The importance of various factors in growers' decisions to participate, or not, in a marketing contract agreement is also examined in the second section of the survey instrument. More than 50% of growers indicated reduced price risk and secure income among the most important reasons for participating in a marketing contract agreement (Table 3). Considering the price volatility of fresh vegetable production, those preferences are not surprising. Conversely, 28 out of 49 respondents indicated unsatisfying price terms among the most important factors that may discourage them from participating in marketing contracts. Furthermore, a significant portion of respondents indicated that the difficulty of satisfying the quality and quantity requirements imposed in a marketing contract may discourage them from participating in such an agreement (Table 4).

Two types of questions were used to elicit growers' risk comfort levels (third section of the questionnaire). The first type of question was based on expected utility and the second type consisted of a self-rating. The former approach is based on an allocation game suggested by Gneezy and Potters (1997), Charness and Gneezy (2010), and Binswanger (1980, 1981). This approach is used to elicit growers' risk preference. The latter is a series of Likert- scale questions based on Pennings and Garcia (2001). This approach is used to elicit growers' risk perception.

Conjoint experiment and selection of attributes

One of the first steps required in order to conduct a DCE analysis is the choice of product attributes and their corresponding levels that will be used in the study (Green et al., 2001). The following includes a discussion regarding the selection of contract attributes used in the study and of their levels.

The focus of the study on marketing contracts and on fresh vegetable production, in conjunction with previous literature and the discussions that took place during the focus groups, are the main factors that influenced the selection of attributes for the choice experiment. Under a marketing contract, in contrast to production contracts, growers bear all the risk associated with production (yield, quality) and input prices and share some or all of the output price risk (MacDonald et al., 2004; Ligon, 2001; Vavra, 2009). This is depicted in the choice experiment with the inclusion of volume and quality requirements and by eliminating possible requirements regarding varieties, production practices etc.

In detail, the choice profiles used in the study consisted of the following eight attributes: early period price, peak period price, late period price, early period volume, peak period volume, late period volume, certification cost, and penalties. The first seven attributes have three levels each and the penalties four levels. A description of these attributes and their levels is reported in Table 5. In addition to the previously mentioned contract attributes, an important requirement of the examined contracts relates to quality of tomatoes. Specifically, the examined contracts refer to U.S.D.A. number 1 grade tomatoes.

Based on the number of attributes and their levels, a full factorial design corresponds to 8,748 (or $3^7 \times 4$) profiles. In order to reduce this number, a fractional factorial design was implemented. The fractional factorial design corresponds to a sample of the full factorial that retains the main and first order interaction effects (Louviere et al., 2000). The *%mktex* macro algorithm in SAS returned 18 choice sets of two choices. In order to minimize the time to complete the questionnaire and mitigate the fatigue of the participants, those 18 sets were randomly distributed in groups of 6 to 3 versions taking care not to include a clearly superior choice. In addition to the two choices, a third "no contract" choice was added. A sample choice experiment is reported in Figure 1. Each respondent was assigned to only one version of the survey (differ only in choice sets) and made 6 choices. As a result, those a total of 49*6=294 choices made in the data.

The price attribute refers to the monetary amount that the contractors should pay the growers during or before the payment deadline. Among the several price mechanisms suggested in the literature (Hueth and Ligon, 1998; Hueth and Melkonyan, 2004; Hueth and Ligon, 2002; Katchova and Miranda, 2004), a price per pound contingent on quality and period of the year is adopted for the examined contracts. Following Hueth and Ligon (1999) and Hueth and Melkonyan (2004), the payment offered depends on the tomato price of a downstream market. Specifically, USDA-AMS tomato prices from the Atlanta Terminal Market are used in the study as base prices. In order to capture the seasonal price variability of tomatoes and achieve a constant supply flow, three different time periods are used. Early period, refers approximately to the period up to 4 July, the peak period covers July and August, and the late period covers September and October. Following the focus group discussion three different price levels are used for each period (Table 5). The range of prices provided to growers is abstract due to the lack of data from actual contractual agreements.

Regarding volume requirements, the scarcity of detailed yield data leads to the use of biophysical simulation techniques. Specifically, tomato yields for thirty-eight years under different production practices (transplant days and harvesting days) were estimated with the use of the Decision Support System for Agrotechnology Transfer (DSSAT v.4, Hoogenboom et al., 2003). Validation of the simulated yields was made based on previous literature (Ciardi et al., 1998; Heuvelink, 1999) and expert opinion for fresh market tomatoes grown in Kentucky. Specifically, the model parameters and the simulated yields were evaluated with Dr. Timothy Coolong, Extension Vegetable Specialist at the University of Kentucky. The estimated yields were considered higher than what an average producer may achieve but would be expected for experienced wholesale growers. Since growers do not generally contract all of their production (Katchova and Miranda, 2004), the volume requirements specified on the choice profiles correspond to 10%, 15% and 20% of the average yield calculated by DSSAT for each of the three periods (early, peak and late). Similarly with the price per pound, the range of volume requirements is theoretical due to the lack of actual data from real contractual agreements.

One of the most important provisions in a contractual agreement is related to the cost that growers have to face in case they fail to meet their obligations. A grower may face a penalty under the following two circumstances: i) failure to provide the agreed volume and ii) failure to provide the required quality. Analogous to price mechanisms, a number of different cost structures (penalties) have been suggested in the literature (Wolf et al., 2001; Hueth et al., 1999). In the context of the present study, the penalties are reported as price reductions. Four different penalty levels are used in the discrete choice experiment of the survey: 5%, 10%, and 15% of price and terminate contract. The last option (terminate) indicates that the contract will no longer be valid and the grower will have to sell his production in the spot market.

Considering that the price and penalty mechanisms of the examined contracts depend on the quality of the supplied tomatoes, a quality measurement instrument is required in order to eliminate possible disputes among growers and buyers. A number of different quality validation options have been suggested in the literature (Hueth and Ligon, 1999; Wolf et al., 2001).

The certification cost attribute corresponds to the payments that growers may have to provide for third party food-safety audits, one of the possible quality control options. Hatanaka et al. (2005) provide a review regarding the development of third party audits, their benefits and the challenges associated with those. Third party audits can be an expensive quality assurance function that larger buyers may require of their fresh produce suppliers as buyers try to manage food safety risks. Part of the challenge for growers is the variation in certification requirements among buyers. In any case, such audits have become a central element to the discussion regarding marketing arrangements between growers and buyers (Hatanaka et al., 2005; Mahshie, 2009). Actual certification costs can vary, depending on the 3rd party auditor and the buyer requirements. We used three levels of $0 (no requirement), $500, and $1000 to represent possible associated certification expenses based on direction from the growers in the focus groups.

As far as the expected signs are concerned, Hudson and Lusk (2004) illustrated that increases in the expected income from contracts are positively related with the probability of contract adoption. On the other hand, higher transactions cost lead to lower probability of contracting. In the context of this study, the higher the price per pound offered, the higher the expected income for the grower. Thus, the a priori expectation is to have a positive sign associated with price per pound. Penalties and certification cost represent the transaction costs in the examined contracts. The higher they are, the more costly the contract enforcement, suggesting a negative influence in the adoption probability. Finally, the higher the volume requirements are, the more difficult it will be for growers to satisfy the contract agreement, indicating a greater possibility of penalties. Thus, the initial expectation regarding volume requirements is that they will negatively influence the adoption probability.

Econometric Models

The conceptual foundation of DCE models lies on the seminal work of Lancaster (1966). In detail, Lancaster's theory of demand posits that consumers gain utility from the characteristics that a good possesses rather than the "actual" good. Additionally, McFadden's (1974) random utility theory (RUT) provides the theoretical background that connects consumers' selection of an alternative and their utility (Louviere et al., 2000). Specifically, based on RUT, an individual's (i) utility from choosing an alternative j in the t-th choice set can be expressed as a combination of two elements: one deterministic and one stochastic. This can be denoted as:

$$(1)\ U_{ijt} = X_{ijt}\beta + \varepsilon_{ijt}$$

where β is a vector of unobserved parameters that will be estimated, X_{ijt} is a vector of observed variables, and ε_{ijt} is the random error term. The individual (i) will choose the alternative j that will generate the highest utility.

The selection of the most appropriate statistical technique for the analysis of the data (i.e., conditional logit, multinomial probit, nested logit, etc.) depends on the assumptions that the researcher will make regarding the error term and on the experimental design of the DCE.

Specifically, under the assumption that the error term is independent and identically distributed, with an largest extreme value Type I distribution, then the probability that the individual (*i*) will choose the *j* alternative can be formulated as:

$$(2)\ P_{ijt} = \frac{e^{X_{ijt}\beta}}{\sum_{k=1}^{j} e^{X_{ikt}\beta}}$$

This corresponds to the conditional logit model (MacFadden, 1973). One important restriction associated with the conditional logit model is the assumption of independence of irrelevant alternatives (IIA) (Louviere et al., 2000).

The mixed logit model (or random parameters logit) is an extension of the basic multinomial logit model (Train, 2003) that allows the relaxation of the restrictive IIA assumption. Furthermore, a number of additional desirable properties of mixed logit formulation have been discussed in the literature. First, the model accounts for heterogeneity in preferences (Louviere et al., 2000). Second, it allows for correlation of unobserved factors over time (Train, 2003). Third, the model does not restrict the distribution of random components to normal. A number of other distributions can be used, depending on the analysts' assumptions. Lastly, the mixed logit model allows researchers to consider the panel data nature of most repeated choice data such as in this study.

In contrast to conditional logit, in a mixed logit model, the unobserved vector of coefficients β varies in the population following a distribution function $f(\mu, v)$, with μ representing the mean and v the variance of the distribution. The objective of the mixed logit is the estimation of μ and v instead of β. As shown in Train (2003), the unconditional choice probability of mixed logit is expressed as:

$$(3)\ P_{ijt} = \int \frac{e^{x_{ijt}\beta}}{\sum_{k=1}^{j} e^{x_{ikt}\beta}} h(\beta) d(\beta)$$

where, $h(\beta)$ is the density function for the random parameters β. Due to the fact there is no closed form solution for equation (3), the integral is calculated using simulation techniques.

Empirical Results

The results obtained from the econometric estimation in conjunction with a discussion of them are presented in this section. In addition to the main effects estimation, both for conditional and mixed logit models, interaction terms between contract attributes and growers' risk perception and risk preferences are estimated. Two approaches are used for the interpretation of the results. First, the statistical significance and the signs of the coefficients are discussed. Second, a monetary interpretation based on marginal values is provided. Following Hu et al. (2009), the marginal value (MV) in a mixed logit model is calculated as:

$$(4)\ MV = -\frac{\beta_{attribute} + \beta_{attribute*D}D}{\beta_{price+}\,\beta_{attribute*D}D}$$

where $\beta_{attribute}$ and β_{price} are the coefficients associated with a contract attribute and a price (early, peak, late season) respectively. D is a vector of risk preference or risk perception variables, and $\beta_{attribute*D}$ is estimated coefficient of the interaction term between attributes and the estimated risk variables. Under the marketing contract framework examined, MV can be generally interpreted as the amount by which the price per pound offered should be increased or decreased in order for a grower to accept a marginal increment in one of the contract attributes (i.e. 1% increase in the penalty levels).

The results of the basic estimation, without any interaction terms, for the conditional and mixed logit models are reported in Table 6. Following the a priori expectations and in line with Hudson and Lusk (2004), the early price ($/lb.) attribute has a statistically significant and positive coefficient. Thus, ceteris paribus, growers show preference for contracts offering higher price for tomatoes expecting to reach the market early in the season (before July 4). Taking into account the greater yield risk associated with early planting, due to weather conditions, this finding is not surprising.

The penalty and certification cost variables represent the transaction costs (cost of monitoring and enforcement) of the examined contracts. The highly statistically significant negative coefficients of these two attributes indicate the considerable negative impact they have on growers' utility. Specifically for certification cost, this negative impact on utility can be attributed to two factors. First, growers seek to avoid higher transaction costs, since this will result in reduced income. Second, it may indicate growers' reluctance to increase their dependence on quality determination from the buyer or third party audits. Especially if there is no scientific base for this quality verification[2] the penalties may be activated easily, which would result in reduction of growers' income or even termination of the contract. Lastly, these findings provide further empirical validation for the transaction cost theory (Allen and Lueck, 1995).

The random variable "no contract" represents the third alternative in the choice sets. It is selected by growers if they would rather not choose any of the two contract alternatives offered. For both model estimations (conditional and mixed logit), the variable "no contract" is not statistically significant. This finding indicates that, on average, growers do not suffer utility loss if they do not have the option to participate in a marketing contract agreement. However, under the mixed logit formulation, the standard deviation estimate of this coefficient is statistically significant. This result, in agreement with Hudson and Lusk (2004), indicates unobserved preference heterogeneity among growers.

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[2] i.e. it is not uncommon to have multiple demands placed in to growers (Mahshie, 2009)

Regarding volume requirements, none of those described in this experiment (early, peak, late period volume) had a significant impact on growers' utility (Table 6). Considering that the volume requirements included in the examined contracts do not exceed 20% of possible yield per acre, this finding is not surprising.

The mixed logit formulation provided a slightly better fit as measured by the McFadden R^2. The incorporation of the random variable (no contract) which indicated the existence of unobserved heterogeneity in growers' preferences can explain this increase.

Estimated marginal values (MV) resulting from the mixed logit formulation indicate that, in order to accept a 1% increase in penalty levels, growers must be compensated by $0.003/ lb. higher early price (Table 7). Considering the range of offered early price in the present study is $0.62/lb. - $0.72/lb. then, on average, growers want 0.4%-0.5% higher early price to accept 1% increase in penalty levels. Similarly, the average MV of $0.0004 for certification cost (Table 7) indicated that growers must be offered a 0.05% - 0.06% higher early price in order to accept a $1 increase in the expenditures associated with certification cost.

Growers' risk perception, risk preferences and choice of contracts

The second objective of the study is to investigate how growers' risk perception and risk preferences affect their selection of marketing contracts. The present section discusses the techniques used to elicit growers' risk preferences and risk perception as well as the results from the subsequent econometric estimation.

An interesting strand of the contract literature refers to the examination of growers' risk preferences and whether or not these affect the choice of contracts. Thus far, research findings regarding this issue are mixed. For instance, Ackerberg and

Botticini (2002) and Hudson and Lusk (2004) indicate that risk is an important determinant of contract choice. On the other hand, findings from Allen and Lueck (1995, 1999) illustrate that risk preferences do not have significant impact on the choice of contracts.

Growers' wealth, yield coefficient of variation, and risk transferred to the buyer are among the proxies used in the aforementioned studies to estimate growers' risk preferences. The present paper uses a multiple price list design, following previous work (Binswanger (1980, 1981; Gneezy and Potters, 1997; Charness and Gneezy, 2010). in order to draw inferences regarding growers' risk preferences. Specifically, in this experiment, growers were asked to select among two different hypothetical tomato plant varieties. The two plants have different levels of resistance to disease and, depending on whether or not the disease occurs, different economic returns. The probability that a disease will occur is 50%. Growers were presented with a set of six possible payoffs and were asked to select one (Figure 2).

In accordance with Binswanger (1980), higher expected returns were offered at the cost of higher variance. The corresponding risk classification levels and the estimated partial risk aversion coefficient are reported at Table 8. Under the assumption that growers' exhibit constant partial risk aversion, the partial risk aversion coefficient can be estimated using a utility function of the following form (Binswanger, 1980):

$$(5)\ U = (1 - S)M^{1-s}$$

Where *M* is the certainty equivalent and *S* is the approximate partial risk aversion coefficient[3]. In line with Lusk and Coble (2005), the measured used in the analysis as an

[3] In order to calculate S (Table 8) we have to solve for the indifference point among two consecutive choices using equation 5. For instance, for choices A and B the S is calculated from the following equation: $50^{(1-s)} + 50^{(1-s)} = 40^{(1-s)} + 70^{(1-s)}$. This equation can be solved in Excel or in Mathematica after graphing the equations to estimate where the functions crosses the x-axes.

individual's risk aversion coefficient (*S*) is the midpoint of the possible minimum and maximum range of S[4]. Another alternative is to use the geometric average; however both approaches gave similar results.

In addition to growers' risk preferences, their risk perception is also required in order to elicit optimal risk behavior (Lusk and Coble, 2005). Three Likert-scale questions from Pennings and Garcia (2001) were used to elicit growers risk perception (Table 9). A measure of growers' risk perception is obtained by the sum of responses to questions 1-3 (Lusk and Coble, 2005).

After the elicitation of growers' general risk perception and risk preferences, three specifications of the mixed logit framework were estimated (Table 10). In contrast to the main effects model, discussed previously, these specifications include grower-specific information that will provide a better interpretation of their preferences. In detail, growers' general risk perception (Model 1), risk preference (Model 2), and an interaction term between risk preferences and risk perception (Model 3) are included in the estimation as interaction terms. In all the three model formulations, the "no contract" attribute is assumed to have a random coefficient.

The results of the three estimated models are consistent with the findings of conditional logit and main effects mixed logit formulations, discussed previously. In detail, certification cost and penalty have negative impact on growers' utility, while growers show preference for contracts with higher early price.

Furthermore, findings from Model 1 illustrate that certification cost has a higher negative impact on utility of growers with higher general risk perception (RP) as indicated by the highly statistically significant, negative coefficient of the interaction

[4] Following Binswanger (1981), for the regression analysis alternative F (Table 8) was given a value near zero (0.18) and the value for alternative A was set to 2.47

term “certification cost *RP”. If selection of contracts is primarily driven by growers' general risk perception then, in line with Hanaka's (2005) suggestions, educational or financial assistance can be an important element in altering growers' behavior in favor of marketing contract agreements.

As it can been seen from Model 2 findings (Table 10), growers' risk aversion (RA) did not have any significant impact on their preferences regarding marketing contracts. However, when the interaction term between growers' risk perception and risk aversion is included in the estimation (Model 3, Table 10), the interaction between this term and the certification cost is statistically significant with the expected negative sign.

Marginal values based on the three previously mentioned models are also calculated. In order to gain a better understanding of how different growers' value different contract attributes two levels of risk perception and risk preferences are examined. For risk perception these values are -2 and 2 representing risk seeking and risk averse growers. For risk aversion the selected levels are 0.5 and 2. For comparison purposes marginal values are also estimated for the average levels of risk aversion and risk preferences.

Table 11 reports only the statistically significant results of these estimations. In contrast to the results from Model 1, none of the marginal values estimations for the risk perception interaction term are statistically significant. This finding indicates that the effects may not be large enough to have a perceptible value. On the other hand, the higher the growers' risk aversion coefficient is, the greater compensation (in terms of early price) they should be offered to accept a 1% increase in penalty or a $1 increase in certification cost.

Conclusion

The present study used discrete choice experiments in conjunction with estimation of random utility models to investigate: i) how growers' value different attributes of marketing contracts and ii) how growers' risk perception and preferences affect their selection of marketing contracts. The main data source is a mail survey administrated to 315 wholesale tomato growers in 4 states: Kentucky, Illinois, Ohio and Indiana. Fresh vegetable growers were selected as the sample of the present study due to the increased sources of risk they face and the limited opportunities they have to reduce this uncertainty.

The empirical results in line with our initial hypothesis and with previous literature (i.e. Hudson and Lusk; 2004, Allen and Lueck; 1995) highlight the role of transaction costs as an important determinant of contract choice. Specifically, we find that certification cost requirements (or third party audits) have a significant negative impact on growers' utility concerning the selection of contracts. Furthermore, the findings indicate the existence of unobserved heterogeneity regarding growers' preferences for marketing contracts.

The effect of risk on the selection of contracts is a widely discussed topic in the literature; however, no common consensus has been reached. The present study used a multiple price risk game and a number of Likert scale questions to elicit growers' risk aversion and risk perception, respectively. In contrast with Hudson and Lusk (2004), the results indicate that growers' risk aversion and risk preferences have a limited impact on growers' selection of marketing contracts. Last but not least, buyers who wish to enter into marketing contracts with growers need to provide a high early price, as well as improve the determination of quality criteria, thus reducing the third party audit costs.

Future research may include larger samples and different geographic areas where the use of marketing contracts is more common than in the examined region. If the importance of third party audit cost in these regions, where growers are more familiar with contracts, is lower and risk perception is still a significant determinant of choices, then it may indicate that education can alter growers' preferences.

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Figure 1: Example Choice Set

	Option A				Option B				Option C
Delivery Period	Price ($/lbs)	Volume (pounds/ acre/ week)	Penalty	Certification Cost	Price ($/lbs)	Volume (pounds/ acre/ week)	Penalty	Certification Cost	
Early	$ 0.74	2,200/acre/week	5%	$1000	$0.62	2,600/acre/week	15%	$500	I will not Choose either A or B
Peak	$ 0.53	6,000/acre/week	5%	$1000	$0.55	5,000/acre/week	15%	$500	
Late	$ 0.70	5,100/acre/week	5%	$1000	$0.77	4,300/acre/week	15%	$500	
Please chose only one option		☐ Option A		or ↔		☐ Option B	or ↔		☐ Option C

<u>Figure 2: Risk Preferences elicitation question</u>

Please consider the choice you would make in the following hypothetical situation:
You will be given 150 tomato plants (in 5 bundles of 30 plants each) for free, to use in the coming season. There are two types of plants, A and B, and you can choose any combination of the two that totals 5 bundles.

The A and B plants have different levels of resistance to tomato diseases. The A plants have potentially higher harvests but are more vulnerable to disease. If disease does not occur, the A plants will produce a harvest worth $30 per bundle. However if disease occurs (50% of the time), the A plants' harvest is worthless ($0 per bundle). The B plants are disease-resistant and always produce a harvest worth $10 per bundle.

The following table illustrates the different combinations of type A and B plants that you could receive, and the value of their combined harvests based on the weather. Please **check one box** to indicate which combination of plants you would choose.

I choose (check one of the six combinations A-F below)	Bundles of 30 type A plants	Bundles of 30 type B plants	If disease does not occur (50%)	If disease occurs (50%)
o A	0	5	$50	$50
o B	1	4	$70	$40
o C	2	3	$90	$30
o D	3	2	$110	$20
o E	4	1	$130	$10
o F	5	0	$150	$0

Table 1: Registered Commercial Tomato Growers and Usable Response Rate by State

State	Registered Growers	Usable Responses	% Usable Response Rate
Illinois	116	17	14.6 %
Indiana	53	12	22.6 %
Kentucky	50	12	24.0 %
Ohio	81	8	9.8 %
n	300	49	16.3%

Source: Market Maker, survey questionnaire

Table 2: Descriptive Statistics Associated with Commercial Tomato Growers

Variable	Average	Std.	Min.	Max.
Gender (1=female)	0.24 (0.17)[a]	0.43	0	1
Age	49. 2 (56)[a]	12.43	30	70
Experience with contracts (1=yes)	0.36	0.48	0	1
Household size	2.4	1.28	1	6
Household income	71,480	33,169	20,000	137,500
Education	15	2.5	5	19
Off farm employment (1= yes)	0.42	0.49	0	1
Acres with Tomatoes	17.5 (17)[a]	85.5	0.125	600
n=49				

Source: Survey questionnaire

[a] Numbers in parenthesis come from 2007 census of agriculture for vegetables, potatoes and melons.

Table 3: Rank the Top Four Reasons That Encourage you to Use Marketing Contracts

		Importance levels (4= most important)			
Factor	Freq.	1	2	3	4
Reduced price risk	29	10.3%	20.7%	31.0%	37.9%
Secured income	39	2.6%	12.8%	41.0%	43.6%
No need to worry about supply channels	23	26.0%	39.1%	8.7%	26.1%
Access new market opportunities	31	25.8%	25.8%	25.8%	22.6%
Bonuses for better quality	19	43.4%	10.5%	10.5%	10.5%
Opportunity to sell higher volumes	30	33.3%	20.0%	20.0%	23.3%
Prior experience with contracts	8	62.5%	12.5%	12.5%	0.0%
Lower distribution cost	13	46.1%	7.7%	7.7%	15.4%
Maintenance of future relationships with buyers	18	44.4%	16.0%	16.7%	5.6%
Other	2	50.0%	0.0%	0.0%	50.0%

Source: Survey questionnaire

Table 4: Rank the Top Four Reasons that Discourage you From Using Marketing Contracts

		Importance levels (4= most important)			
Factor	Freq.	1	2	3	4
Difficult to satisfy quality requirements	32	21.8%	28.1%	21.9%	28.1%
Unhappy with price terms	28	10.7%	10.7%	32.1%	46.4%
Severe penalties	19	15.8%	26.3%	15.8%	42.1%
Inflexibility to pursue other markets	23	34.8%	26.1%	17.4%	21.7%
Cost of enforcement	11	9.0%	36.4%	18.2%	36.4%
Bad previous experience with contracts	12	25.0%	50.0%	16.7%	8.3%
Unhappy with quality terms	19	5.3%	43.4%	26.3%	21.0%
Delivery time	17	23.5%	41.2%	17.6%	17.6%
Method of payment	12	50.0%	16.7%	25.0%	8.3%
Not enough information about contracts	18	16.7%	22.2%	22.2%	38.9%
Difficult to satisfy volume requirements	28	39.3%	14.3%	17.9%	28.6%
Not enough land	12	33.3%	16.7%	16.7%	33.3%
Other	1	100%	0.0%	0.0%	0.0%

Source: Survey questionnaire

Table 5: Choice Based Experiment Attributes and their Levels

Variable	Description	Levels			
		1	2	3	4
Early Price	Price offered for late June-Early July ($/lbs.)	0.62	0.68	0.74	
Peak Price	Price offered for July-August ($/lbs.)	0.53	0.55	0.58	
Late Price	Price offered for September – October ($/lbs.)	0.70	0.77	0.84	
Early Volume	Volume requirements for Late June- Early July (lbs./acre)	2,200	2,400	2,600	
Peak Volume	Volume requirements for July- August (lbs./acre)	5,000	5,500	6,000	
Late Volume	Volume requirements for September- October (lbs./acre)	4,300	4,700	5,100	
Penalties	Price reduction if the contract agreements are not satisfied (% of price)	5%	10%	15%	Terminate
Certification Cost	3^{rd} party audit cost	0	500	1000	

Table 6: Main Effect Conditional and Mixed Logit Estimations

	Conditional Logit		Mixed Logit	
	Coefficient	Std. Error	Coefficient	Std. Error
Early Price	3.51*	1.94	3.76*	2.11
Peak Price	4.38	4.73	5.19	5.27
Late Price	0.54	1.68	1.29	1.87
Early Volume	-0.0002	0.0005	-0.0003	0.0005
Peak Volume	0.000	0.0002	0.0002	0.0002
Late Volume	0.0002	0.0002	0.0002	0.0003
Certification Cost	-0.001***	0.0002	-0.002***	0.0002
Penalty	-0.01***	0.002	-0.011***	0.003
No Contract	5.65	4.31	6.88	4.85
No Contract S.D.			3.18***	0.62
McFadden R^{2a}	0.11		0.12	
n=49*6=294				

*, ** and *** indicate 10%, 5% and 1% significance level respectively.

[a] McFadden R^2 is given by one minus the ratio of unrestricted to restricted log likelihood values

Table 7: Marginal values under Mixed Logit Model

	Early Price		Peak Price		Late Price	
	Mean	Std. Error[a]	Mean	Std. Error	Mean	Std. Error
Early Volume	0.000	0.000	0.000	0.000	0.000	0.000
Peak Volume	0.000	0.000	0.000	0.000	0.000	0.000
Late Volume	0.000	0.000	0.000	0.000	0.000	0.000
Certification Cost	0.0004*	0.0002	0.000	0.000	0.001	0.001
Penalty	0.003*	0.001	0.002	0.002	0.009	0.02
No Contract	-1.8	1.4	-1.3	0.95	-5.3	6.86

* Indicates 10% significance level

[a] The standard errors are estimated using the delta method.

Table 8: The Payoffs and Corresponding Risk Classification

Choice	Low Payoff (Disease occurs)	High Payoff (No disease)	Risk Aversion Class[a]	Approximate Partial Risk Aversion Coefficient (S)	Percentage of Choices in Experiment
A	50	50	Extreme	∞ to 2.48	16.3%
B	40	70	Severe	2.48 to 0.84	22.45%
C	30	90	Intermediate	0.84 to 0.5	34.69%
D	20	110	Moderate	0.5 to 0.33	18.37%
E	10	130	Slight to Neutral	0.33 to 0.19	6.12%
F	0	150	Neutral to Negative	0.19 to -∞	2.04%

[a] Based on Binswanger (1980) classification

Table 9: Growers' Risk Perception: Response to Scale Questions (-4= strongly Disagree, 4= Strongly Agree)

Question	Definition	Mean
1	With respect to the conduct of business I avoid taking risk	0 (2.00)[a]
2	With respect to the conduct of business I prefer certainty to uncertainty	1.5 (1.7)
3	I like "playing it safe"	0.8 (1.8)

n=49

[a] Number in parentheses are standard deviations

Table 10:Mixed Logit Estimations Including Growers' Risk Perception and Risk Preferences Interaction

	Model 1			Model 2			Model 3	
	Coeff.	Std. Error		Coeff	Std. Error		Coeff	Std. Error
Early Price	3.452	2.18	Early Price	4.03*	2.15	Early Price	2.83	2.23
Peak Price	7.414	5.50	Peak Price	6.082	5.38	Peak Price	7.55	5.54
Late Price	1.143	1.90	Late Price	1.564	1.89	Late Price	1.58	1.93
Early Volume	0.000	0.00	Early Volume	-0.001	0.00	Early Volume	0.00	0.00
Early Volume* RP	0.000	0.00	Early Volume* RA	0.000	0.00	Early Volume* RARP	0.00	0.00
Peak Volume	0.000	0.00	Peak Volume	0.000	0.00	Peak Volume	0.00	0.00
Peak Volume*RP	0.000	0.00	Peak Volume*RA	0.000	0.00	Peak Volume*RARP	0.00	0.00
Late Volume	0.000	0.00	Late Volume	0.000	0.00	Late Volume	0.00	0.00
Late Volume *RP	0.000	0.00	Late Volume *RA	0.000	0.00	Late Volume *RARP	0.00	0.00
Certification Cost	-0.001***	0.0003	Certification Cost	-0.001**	0.00	Certification Cost	-0.001***	0.00
Certification Cost*RP	-0.0002**	0.000	Certification Cost*RA	0.000	0.00	Certification Cost*RARP	-0.000*	0.00
Penalty	-0.011***	0.002	Penalty	-0.008*	0.00	Penalty	-0.012***	0.003
Penalty*RP	0.000	0.000	Penalty*RA	-0.004	0.00	Penalty*RARP	0.00	0.00
No Contract	7.5	4.98	No Contract	7.005	4.9	No Contract	6.80	5.03
No Contract S.D.	3.11***	0.62	No Contract S.D.	3.18***	0.62	No Contract S.D.	3.10***	0.62
McFadden R^{2a}	0.14			0.13			0.14	
n=49								

*,**,*** Denote significance levels of 0.01, 0.05 and 0.1 respectively

[a] McFadden R^2 is given by one minus the ratio of unrestricted to restricted log likelihood values

Table 11: Marginal Value Estimates Under Mixed Logit Models

Marginal values associated with Risk Aversion (Model 2)			
	R.A. levels	Early Price ($/pb.)	Std.Error
Certification Cost	0.5	0.0003*	0.0002
	1	0.0004*	0.0002
	2	0.0005*	0.0003
	R.A. levels		
Penalty	0.5	0.002	0.002
	1	0.003*	0.002
	2	0.004*	0.002

* Indicate statistical significance at 10% level