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MARKETING STRATEGIES FOR SMALL SCALE PRODUCERS

By

Irvin Yeager

A paper submitted in the partial fulfillment

of the requirements for the degree

of

MASTERS OF SCIENCE

In

Applied Economics

Approved:

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UTAH STATE UNIVERSITY
Logan, Utah
2013

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ABSTRACT

MARKETING STRATEGIES FOR SMALL SCALE PRODUCERS

By

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Utah State University, 2013

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Department: Applied Economics

This study examines fresh produce marketing for small producers in the U.S. Rocky Mountain region by comparing risk and return attributes for farmers' markets and wholesale outlets. Prices were collected from farmers' markets in Utah and Colorado and San Francisco terminal market prices from USDA NASS were used to represent wholesale prices received by producers. Production and harvesting costs, as well as marketing costs for both outlets are also included in the analysis.

Simulation was used to compare the results of eleven marketing options based on the level of marketing activities in wholesale and farmers' markets. The simulation results were then analyzed using stochastic efficiency with respect to a function (SERF). The results find that risk averse producers will prefer to market to both outlets (portfolio), while risk neutral producers will prefer to market exclusively to farmers' markets.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

Direct marketing, e.g., farmers' market, of produce has seen great expansion in the U.S. as evidenced by farmers' markets tripling in number from 1996 to 2011 to over 7,000 markets (USDA, 2012). The Rocky Mountain region has seen some of the highest growth as 38% of farmers' markets have been in existence less than five years. However their profitability comes into question when an estimated 80% of producers receive $5,000 or less per season (Ragland and Tropp, 2009). Direct markets represent an important source of income as many direct marketers are considered low income (Low and Vogel, 2011).

Wholesale marketing, a form of intermediate marketing or "where one or more middlemen is used" (Hand, 2010) markets is more established in the U.S. as it accounts for 99.2% of all food purchases (Martinez et al. 2010). Local produce, although typically identified by consumers with direct markets, is also found in wholesale markets. Wholesale markets actually account for most of local produce revenues but are primarily supplied by large farms (Low and Vogel, 2011).

These large producers, whose economy of scale suits wholesalers, help fill large orders for various customers such as grocery stores or restaurants. The increasing demand for local foods has given small growers the opportunity to meet this demand by direct marketing their produce to some wholesale customers or wholesalers themselves. These additional markets also come with challenges such as contract agreements from competitors, as well as meeting supply, quality and price requirements (Gunter et al.

2012). Wholesale markets are attractive to producers as there are lower anticipated labor costs, better known pricing, and are often based on contracts expected to have *less risk*. In contrast, they give up premiums from direct markets and may be required to meet USDA produce standards.

Choosing the level of involvement in wholesale and direct markets represents a strategic tradeoff of higher premiums and uncertainty in revenue found in farmers' markets compared to predictable but lower revenues. The involvement in each market also serves as risk management tool as producers can optimize revenue and predictability to meet their needs. This opportunity represents a complex decision as smalls producers have to consider production capabilities and level of involvement in each market with respect to risk and profit maximization.

The study attempts to answer this question by using simulation based on prices received by farmers in the region and expected costs from utilizing farmer's markets and wholesale markets. Simulation allows all a variety of situations to be considered by combining price, yield, and sales risk, and producing a large number of outcomes. These outcomes, summarized by a probability distribution, show the likelihood of different levels of profit, and provide the framework for comparing marketing decisions. The results are expected to provide marketing strategy insight for direct marketers in the Rocky Mountain region.

2. LITERATURE REVIEW

2.1. Direct and Intermediate Marketing

Key studies dealing with specialty crops and small produce farmers will provide a framework for this study. As Lev and Gwin (2010) conclude "direct marketing of agricultural products is not well understood" as many studies discuss potential profitability of using direct markets, such as farmers' markets, most do little to address risk. The literature review will cover current research in direct markets and briefly cover risk direct marketers face.

Sanford and Tweeten's (1988) study on small farmers showed that production of specialty crops in Oklahoma could lead to increased income for producers, but the study was before direct marketing was popular and involved large farmers with 20 acres or more. Kebede and Gan (1999) found similar results for farmers in Alabama, but also stressed an optimal production mix due to labor restraints, costs, and production risk.

Hardesty and Leff (2010) found that wholesale was the most profitable marketing outlet, while farmers' markets were the least profitable, and recommended their use as a marketing and risk management tool to sell surplus produce. The authors attributed much of this result, in part, to the low labor-to-revenue ratio in wholesale markets from savings in transportation, selling and administration. Also to be considered, the study was with producers 20 acres or larger and in California, where most markets are year-round with different market structures.

LeRoux et al. (2010) also examined outlet profitability comparing farm-stands (staffed and unstaffed), wholesale, CSA's (Community Supported Agriculture), farmers' markets but had differing results, finding wholesale to be less profitable than farmers' markets and CSA's. The study also found that factors such as attitudes towards risk, lifestyle preferences, and labor availability played into market selection. This study was performed with four farmers in New York who, although may have had a more similar production season to that in this study, were 7 acres or larger.

Gunter et al. (2012) looked at feasibility for small-scale local producers in Northern Colorado in three different scenarios based on varying levels investment in production, storage, and distribution. The first scenario, based on exclusively utilizing wholesale markets, found it is unsustainable by looking at the first three years of production, but instead recommended a marketing program aggregating crops with multiple producers. The authors also concluded that risk between each option varied due to differing levels of commitment to capital and labor.

Abatekassa and Peterson (2011) found further potential problems in marketing by interviewing potential wholesale outlets, including grocery stores, in Southeast Michigan. Although the outlets in the study were consistently interested in offering local produce, they still expected producers to compete on price, quality, value-added processes, and establish clear supply expectations.

Ward et al. (2011) found that utilizing farmers' markets in the Rocky Mountain region was more profitable than wholesale markets for a producer using one acre of land

with high tunnels and brought an 11.49% modified internal rate of return (MIRR) or value returned above investments over a period of time. It is important to consider the study was based on a double crop of tomatoes and summer squash, high tunnels were used instead of conventional methods, and the sale value of the land was included in profitability measures. Although both tomatoes and summer squash are high value crops, Conner et al. (2011) argue variety in product offering increases overall sales in direct marketing. Growing only two crops also leads to increased production risk, although Ward's study involved the use of risk-managing high tunnels.

2.2. Risk in Agriculture

Risk as defined by Holton (2004) "is exposure to a proposition in which one is uncertain (pg 22)." Agriculture deals with its fair share of risk as producers are not only subject to political, economic, and social changes, but can be extra vulnerable to weather and market risks. Studies by Lin et al. (1974) and Halter and Mason (1978) suggested that producers consider the additional risk they face and found that producers were risk averse by using Arrow-Pratt Absolute Risk Aversion Coefficients (ARAC). Harwood et al. (1999) discussed the various sources of risk in agriculture and stated that "Understanding risk is a starting point to help producers make good management choices in a situation where adversity and loss are possibilities."

According to Harwood et al. (1999), there are five sources of risk in farming;

i. Production or yield risk due to uncontrollable weather, rainfall, insects and diseases,

ii. Price or market risk associated with changes in the price of output or inputs and the level of sales,
iii. Institutional risk from changes in policies and regulations,
iv. Human or personal risk due to some disruptive changes, e.g., death, divorce, industry or the health condition of a principal in the farm, and
v. Financial risk due to changes in interest rates on borrowed capital.

Although direct marketers are exposed to all of the risk described above, this study will address risks in the scope of yield, prices received, and level of sales in direct marketing. It is a relatively new topic.

Donnell et al. (2011), by growing five crops typically found at farmers' markets, confirmed that production and marketing risk are significant factors for direct marketers. Donnell et al. (2011) also use sales levels at 50%, 75% and 100% of production to give a better picture of potential revenues. The results show that break-even prices were very sensitive to amount sold.

Hardesty and Leff (2010) estimated 33% of produce in their study did not meet wholesale standards which meant 66% of the sub-standard produce was then sold at farmers' markets. The authors also found profits decreased by 53% with only a 20% decrease in produce sold when exclusively using farmers' markets.

Kebede and Gan (1999) examined sales risk by examining the effects of both 5% and 10% increases and decreases in price received, estimated coefficients of variations (CV) of yields for six common southern U.S. crops, found that higher value crops such as

watermelon were subject to more price risk, and recommended a variety a crops to offset risk in part.

Although direct markets have grown rapidly in the Rocky Mountain region (Ragland and Tropp, 2009), Curtis et al. (2012) found potential for increased wholesale as only 19% of producers surveyed marketed their produce using wholesale methods. Price risk was found in seasonal and week-to-week changes in price, suggesting wholesale marketing can reduce risk for producers through more predictable revenues from contracts.

3. METHODS

3.1. Simulation

While many studies have used an enterprise budget-based[1] approach to analyze market profitability, they often limit themselves to either a conservative estimate or consider what would happen in a good, bad, or fair situation. Simulation allows a variety of situations to be considered by combining price, yield, and sales risk and produce a large number of outcomes. These outcomes, summarized by a probability distribution, show the likelihood of different levels of profit, and provide the framework for comparing marketing decisions.

Stochastic variables are defined as variables the decision maker, in this case produce marketers, cannot control (Richardson, 2006). The simulation model will consider yield, prices received from the farmer's markets and wholesale markets, and level of sales in the farmer's market as stochastic. Let y indicate produce yield and production (q_i) is defined as follows:

(1) $$\tilde{q}_i = a_i \tilde{y}_i,$$

where i = subscript for produce, $\tilde{q}_i$ = (stochastic) production of produce i, a_i = (fixed)[2] planted acreage for produce i, and y_i is the yield per acre for produce i. Note that the tilde

[1] Enterprise budget: An economic goal based on **expected** production, management activities, resource requirements and economic returns (Rayburn, 2012).

[2] We assume that $a_i = 0.2$ acres for each produce iem, and thus $\Sigma a_i = 1$ acre. It is based on the assumption that the producer does not currently have a contract with a wholesale, i.e., has unknown demand for each produce item. Hence the producer will minimize production and marketing risk by growing a variety of products in the case of having to rely on farmers' markets exclusively (Conner et al. 2011).

on variables denotes stochastic variables. The producer can choose what level of involvement in each of the outlets (farmers' markets or wholesale) and that decision can be written as:

(2) $$\tilde{s}_{i,FM} = \tilde{\theta}\alpha\tilde{q}_i \text{ and } \tilde{s}_{i,R} = (1-\alpha)\tilde{q}_i,$$

where $\tilde{s}_{ij}$ = the level of sales of *i*th produce in *j*th outlet, *j* = *FM* and *W*; *FM* = farmers' market, *W* = wholesale, and $\tilde{\theta}$ denotes the probability of the level of sales in farmers' market that is uncertain to the producer who decides the level of α or marketing strategy where that is $0 < \alpha < 1$. When $\alpha = 1$, all the produce is marketed to farmers' markets. When $\alpha = 0$, the farmer sells exclusively wholesale. The net return (π) from marketing is given by:

(3) $$\tilde{\pi} = \sum_i \tilde{p}_{i,FM} \cdot \tilde{s}_{i,FM} - M_{FM} + \sum_i \tilde{p}_{i,W} \cdot \tilde{s}_{i,W} - M_W - C,$$

where $\tilde{\pi}$ = stochastic net return, $\tilde{p}_{ij}$ = stochastic price of *i*th produce in *j*th outlet, M_j = marketing cost in *j*th outlet; subscript *FM* = farmers' market, *W* = wholesale, and *C* = production and harvesting cost. Costs M_j and *C* are fixed as these costs can be readily recognized by farmers fairly accurately in advance and are expected to be somewhat similar for small producers.

Sales, price and yield risk are incorporated into equation (3) by utilizing stochastic simulation by drawing random prices, yield and the level of sales from given normal distributions. Random prices used in equation (3) are generated as follows:

(4) $$\tilde{p}_{ij} = \bar{p}_{ij} + \tilde{v}_{ij},$$

where $\overline{p}_{ij}$ is the mean of the (historical) price of produce i and $\tilde{v}_{ij}$ is the pure stochastic part or pure price disturbance. The random disturbances, $\tilde{v}_{ij}$, in equation (4) are generated as correlation was found in prices (see Data Section) and is treated as described in equation (5) established by Richardson et al. (2000) which allows for the prices to maintain a simultaneous price relationship

$$(5) \qquad \begin{bmatrix} \tilde{v}_{1,FM} \\ \tilde{v}_{2,FM} \\ \vdots \\ \tilde{v}_{5,FM} \\ \tilde{v}_{1,R} \\ \tilde{v}_{2,R} \\ \vdots \\ \tilde{v}_{5,R} \end{bmatrix} = \begin{bmatrix} 1 & \rho_{1FM,2FM} & \cdots & \rho_{1FM,5FM} & \rho_{1FM,1R} & \rho_{1FM,2R} & \cdots & \rho_{1FM,5R} \\ & 1 & \cdots & \rho_{2FM,5FM} & \rho_{2FM,1R} & \rho_{2FM,2R} & \cdots & \rho_{2FM,5R} \\ & & \vdots & & & & \vdots & \\ & & & 1 & \rho_{5FM,1R} & \rho_{5FM,2R} & \cdots & \rho_{5FM,5R} \\ & & & & 1 & \rho_{1R,2R} & \cdots & \rho_{1R,5R} \\ & & & & & 1 & \cdots & \rho_{2R,5R} \\ & & & & & & \ddots & \vdots \\ & & & & & & & 1 \end{bmatrix} \begin{bmatrix} \tilde{\varepsilon}_{1,FM} \\ \tilde{\varepsilon}_{2,FM} \\ \vdots \\ \tilde{\varepsilon}_{5,FM} \\ \tilde{\varepsilon}_{1,R} \\ \tilde{\varepsilon}_{2,R} \\ \vdots \\ \tilde{\varepsilon}_{5,R} \end{bmatrix},$$

where ε's are independent disturbances from normal distributions with mean zero and standard deviation, $\tilde{\varepsilon} \sim iid\ N(0, \sigma_{\varepsilon}^2)$ from the historical data. $\tilde{v}_{ij}$'s are correlated disturbances and ρ's are correlation coefficients.

The GRKS distribution[3] which allows simulation with limited data (Richardson, 2006; Evans and Stalmann, 2006) will be assumed for the level of farmers' market sales, $\tilde{\theta}$, in equation (2). Partially based on the approach used by Donnell et al. (2011)

[3] The GRKS (Gray, Richardson, Klose and Schumann) distribution is similar to triangular distribution. It is developed by Gray, Richardson, Klose and Schumman to simulate "subjective probability distribution" with minimal data (Richardson, 2006, pp5-3). The GRKS distribution has the following useful properties: 50% of observations are less than the midpoint; 95% of the simulated values are between the minimum and the maximum; 2.2% of the simulated values are less than the minimum and more than maximum (Evans and Stallmann, 2006, p.175).

we presume the level of sales is a minimum of 25%, a maximum 75%, with an average of 50%, or $\tilde{\theta} \sim GRKS(\min, \text{avg}, \max)$.

The yield, $\tilde{y}_i$, in equation (1) is simulated using historical data in similar fashion with prices. The stochastic yield is generated using the following equation:

(5) $$\tilde{y}_i = \bar{y}_i + \tilde{w}_i,$$

where $\bar{y}_i$ is the mean of the yield and $\tilde{w}_i$ is the disturbance. Like the stochastic prices, all of the random disturbances, $\tilde{w}_i$, in equation (6) are generated considering correlation among yields such that:

(6) $$\begin{bmatrix} \tilde{w}_1 \\ \tilde{w}_2 \\ \vdots \\ \tilde{w}_5 \end{bmatrix} = \begin{bmatrix} 1 & \rho_{12} & \cdots & \rho_{15} \\ & 1 & \cdots & \rho_{25} \\ & & \ddots & \vdots \\ & & & 1 \end{bmatrix} \begin{bmatrix} \tilde{\mu}_1 \\ \tilde{\mu}_2 \\ \vdots \\ \tilde{\mu}_5 \end{bmatrix}$$

Where μ's are independent disturbances from normal distributions with mean zero and standard deviation, $\tilde{\mu} \sim iid\ N(0, \sigma_\mu^2)$ from the historical yield data.

3.2. Marketing Strategies

As discussed earlier in the paper, the producer is given the choice of involvement level in each outlet. This study will use eleven representative options to choose from where α is the decision variable in this practice (0 < α < 1).

- M1. All to farmers market, i.e., α = 1
- M2. 90% to farmers market, 10% to wholesale, i.e., α = 0.9

- M3. 80% to farmers market, 20% to wholesale, i.e., $\alpha = 0.8$
- M4. 70% to farmers market, 30% to wholesale, i.e., $\alpha = 0.7$
- M5. 60% to farmers market, 40% to wholesale, i.e., $\alpha = 0.6$
- M6. 50% to farmers market, 50% to wholesale, i.e., $\alpha = 0.5$
- M7. 40% to farmers market, 60% to wholesale, i.e., $\alpha = 0.4$
- M8. 30% to farmers market, 70% to wholesale, i.e., $\alpha = 0.3$
- M9. 20% to farmers market, 80% to wholesale, i.e., $\alpha = 0.2$
- M10. 10% to farmers market, 90% to wholesale, i.e., $\alpha = 0.1$
- M11. All to wholesale, i.e., $\alpha = 0$

4. DATA

Farmers' market prices were collected by survey from June to September 2011 in Utah and Colorado by both Utah State University and Colorado State University Cooperative Extension for commonly offered produce items. Five produce items were selected for analysis based on availability of prices and consistency of a like product: tomatoes, cucumbers, green peppers, potatoes, and summer squash. U.S. yield data were collected from USDA NASS. Terminal market prices were also collected from USDA NASS over the same time period as representative for price when selling wholesale as local data are unavailable. Marketing costs are based on local wages and costs of inputs.

Costs to produce and harvest each item were primarily provided by various authors (Carlson et al. 2008, Mayberry 2000, Molinar et al. 2005, Rutgers University 2008, and Stoddard et al. 2007). Table 1 below presents descriptive statistics for each produce item including mean yield in hundred-weight per acre (cwt), standard deviation, and the minimum and maximum yield per acre. It should be noted that each item has similar coefficient of variations (CV) suggesting somewhat similar production risk for each item although green peppers are somewhat higher than the rest and show a relatively large range of production yield.

Table 1: Yield Statistics (cwt/acre)

	Tomatoes	Cucumbers	Squash	Potatoes	GreenPeppers
Average	295.50	189.77	147.55	374.25	295.43
Std. Dev.	14.14	11.60	7.82	21.10	20.28
CV(%)	4.79	6.11	5.30	5.64	6.87
Max	311.00	208.57	160.44	403.85	329.00
Min	268.00	171.81	136.40	335.97	257.00

Figure 1 displays historical yield data used that identifies consistent production yields with green peppers and potatoes showing a slight upward trend. Figure 2 displays the average weekly prices from wholesale and farmers' markets and show that farmers' market price are typically more variable, especially cucumbers and tomatoes. Table 2 describes marketing costs associated with each outlet. It should be noted that the higher costs to market at farmers' markets compared to utilizing wholesale markets represents an important consideration.

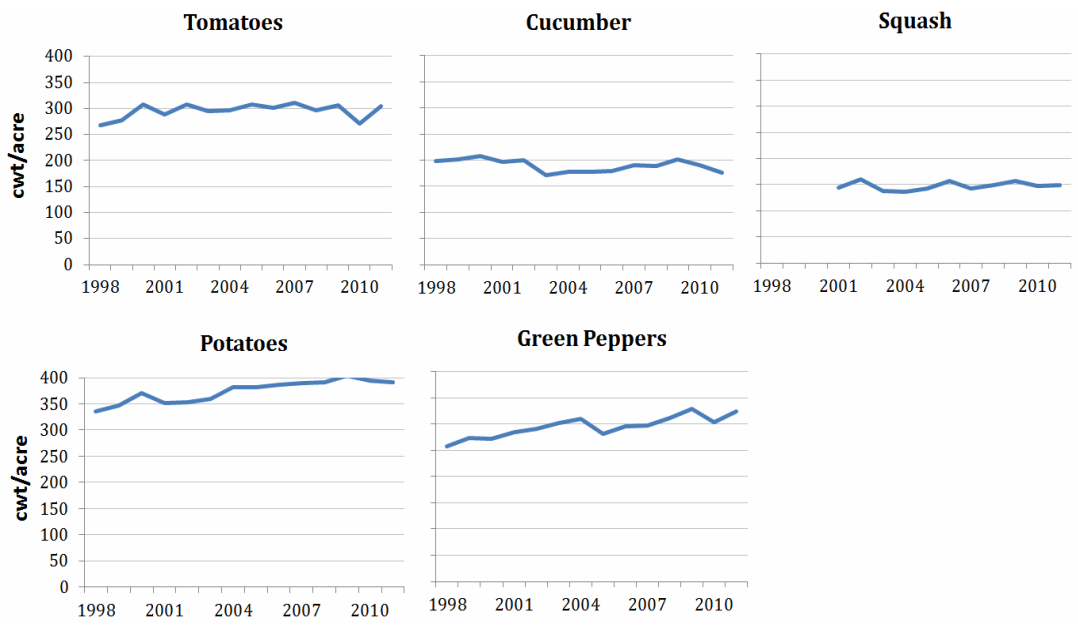

Figure 1: Historical Yield (cwt/acre)

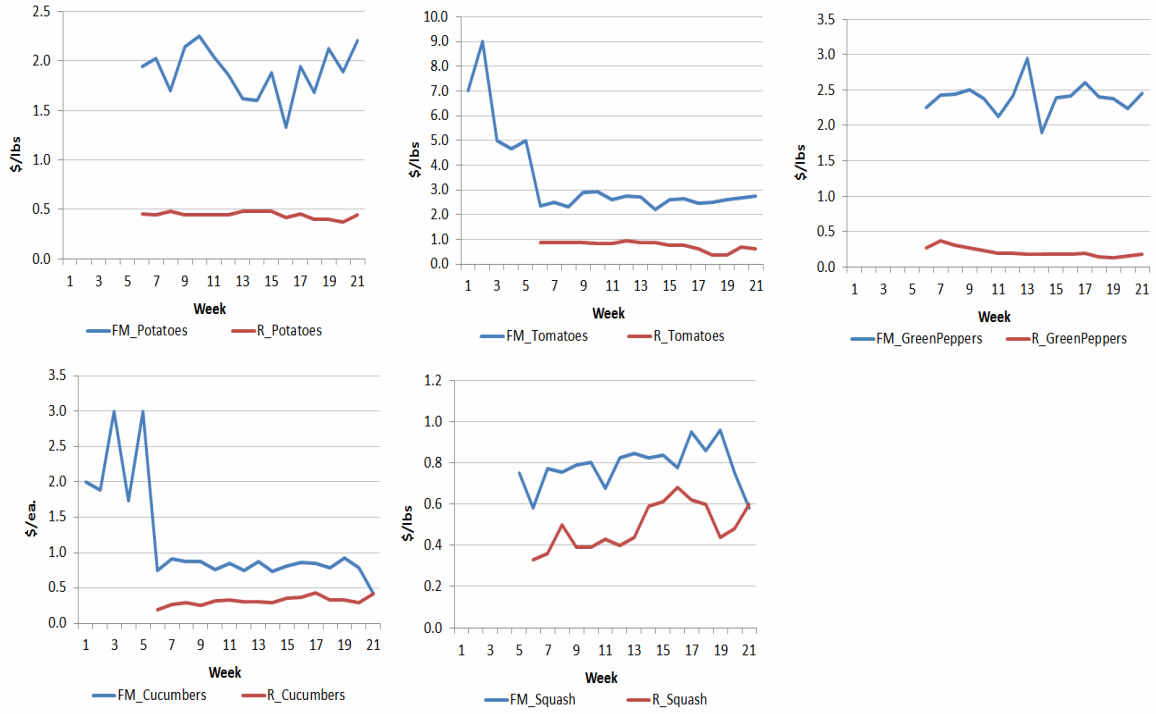

Figure 2: Farmers' Market and Wholesale Produce Prices

Table 2: Marketing Costs ($)

	Farmers' Market	Wholesale
Labor	2560	320
Fuel	250	250
Tables	150	
Signs	50	
Marketing	225	200
Containers	150	150
Total	3385	920

The coefficient of variation of price for each item in each market was also found. An important part of the decision for producers is understanding the variability of prices for each market as it indicates of how well income can be predicted. Figure 3 shows examines price variability and as expected, price variation is greater for farmers' markets for three items with tomatoes and cucumbers particularly high. The higher variability suggests less predictable revenues for producers but offers a higher profit ceiling. Wholesale produce prices, which as group has lower CV's, offer producers more stable revenue, but sacrifice potential profits levels. The level of involvement in each market represents an important tradeoff as producers have different attitudes toward risk, preferences, and resources. The following section will address level of involvement based on producers attitude towards risk.

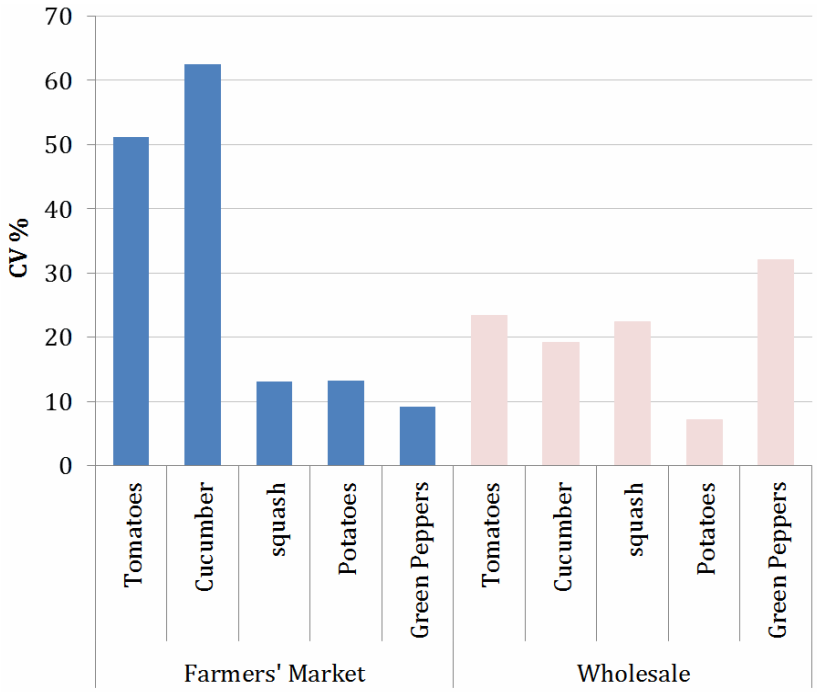

Figure 3: Coefficient of Variation of Price

5. Results and Discussion

All stochastic variables were simulated 1000 times to compute the net return in equation (3), generate the probability distribution function (PDF) for the net return found in Figure 4, and respective statistics in Table 3 .

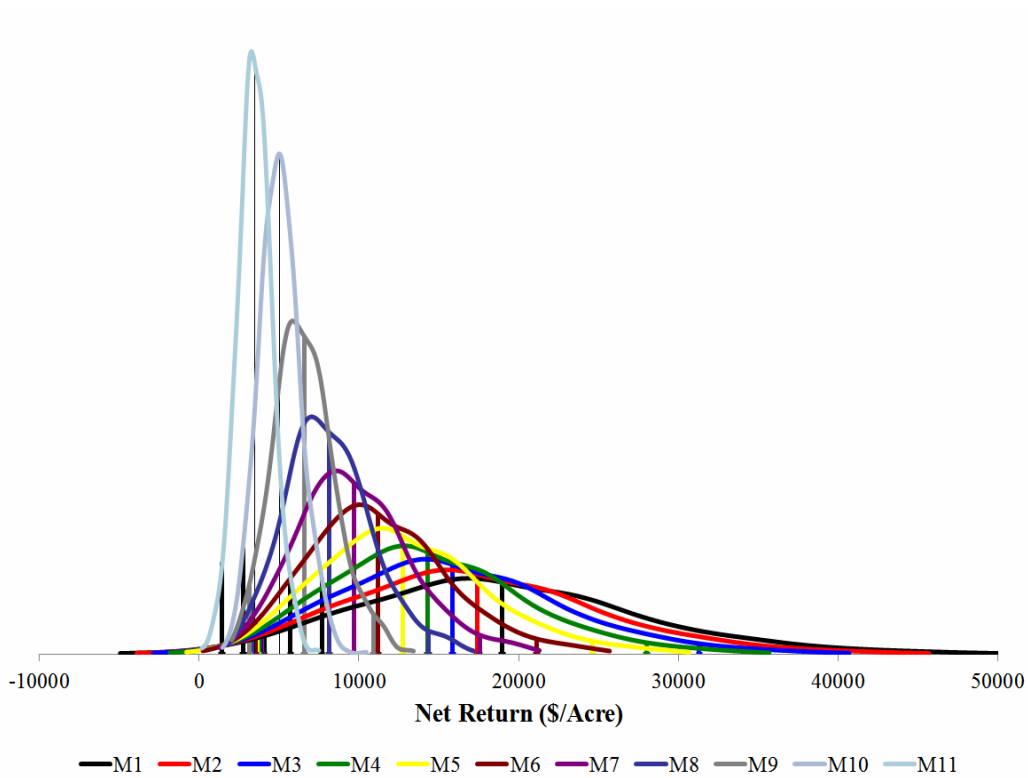

Figure 4: Simulated Profit Returns Probability Density Function

Note: Vertical axis (not presented with numbers) is probability and the area under the PDF presents the probability of the interval of net returns. Mathematically, $\Pr[a \leq \text{net return} \leq] = \int_a^b f(x)dx$. Roughly speaking, the average net return is found around the peak of the distribution and the variance is represented by the spread of the distribution. For example, M1 has a high average net return (≈ $20k) and a large variance of the net return, i.e., high risk, while M11 has a low average net return (≈ $5k) and a low variance of the net return, i.e., low risk.

Table 3: Summary of Net Returns from Simulation ($/acre)

	Mean	StDev	CV	Min	Max
M1. All to Farmers Market (FM)	18,954	8,727	46.04	-4,936	50,690
M2. 90 to FM and 10 to W	17,409	7,851	45.10	-3,899	45,690
M3. 80 to FM and 20 to W	15,865	6,977	43.98	-2,863	40,691
M4. 70 to FM and 30 to W	14,320	6,105	42.64	-1,827	35,692
M5. 60 to FM and 40 to W	12,775	5,238	41.00	-790	30,693
M6. 50:50 to FM and W	11,230	4,376	38.97	246	25,694
M7. 40 to FM and 60 to W	9,685	3,525	36.39	1,283	21,300
M8. 30 to FM and 70 to W	8,140	2,694	33.10	1,823	17,174
M9. 20 to FM and 80 to W	6,595	1,911	28.98	2,044	13,429
M10. 10 to FM and 90 to W	5,050	1,267	25.09	1,470	10,470
M11. All to Wholesale (W)	3,505	1,057	30.16	164	7,512

Note:

1. Marketing strategies, M1 – M11. Numbers in M1 – M11 represent the percentage of produces to each marketing channel, for example, M2. 90 to FM and 10 to W indicates that farmers ship 90% of their produces to FM and 10% to wholesalers.
2. Numbers in Mean, StDev, Min, and Max are net returns in $/acre. CV is the coefficient of variation of net returns in %.

Although a simple visual comparison of marketing strategies found in Figure 4 would be able to provide producers with a rough and ready answer, Table 3 gives more insight into the consequences of each decision, for example, M1 which has the highest mean profit also has the largest simulated loss (minimum).

The comparison of mean net returns for each strategy doesn't include the risk or variability in net returns. Ranking risky alternatives can be done in several ways, such as comparing standard deviations, maximin, certainty equivalences (Hardaker, 2000) or applying stochastic dominance (Meyer, 1977). Stochastic efficiency with respect to a function (SERF) approach was chosen based on discussions in Hardaker et al. (2004),

which is superior to other approaches as it allows for a comparison of all the alternatives simultaneously. SERF ranks risky alternatives in terms of certainty equivalents[4] (CE) for a specified range of risk aversion coefficients with a predetermined utility function based on the following rules

(7) $F(\pi)$ preferred to $G(\pi)$ at $ARAC$ if $CE_F > CE_G$

$F(\pi)$ indifferent to $G(\pi)$ at $ARAC$ if $CE_F = CE_G$, or

$G(\pi)$ preferred to $F(\pi)$ at $ARAC$ if $CE_F < CE_G$.

where $F(\pi)$ and $G(\pi)$ are cumulative distribution functions (CDF) of net returns from two risky alternatives, *CE* indicates the certainty equivalences, and *ARAC* is the *absolute risk aversion coefficient*. Figure 4 summarizes the *CE* at various *ARAC* assuming a negative exponential utility function[5]

When *ARAC* = 0, the decision maker is risk neutral and higher values of *ARAC* imply risk averse decision makers. We select relative risk aversion coefficients from 0 to 3 as suggested in Anderson and Dillon (1992) and convert the absolute risk aversion

---

[4] Certainty Equivalent: The amount of value someone would accept rather than taking a chance on higher but uncertain return (Varian, 1992).

[5] Negative exponential utility function is given by $U(\pi) = 1 - \exp(-ARAC \cdot \pi)$, where ARAC > 0 (Hardaker, Anderson and Lien, 2004, p.103). Negative exponential utility function exhibits constant absolute risk aversion (CARA), which is given by ARAC. This function has been used extensively in decision analysis. Note that this function can be estimated from a single CE, and it is particularly useful in analysis where the distribution of returns is normal (Hardaker, Hurine, Anderson and Lien, 2004, p.103). The certainty equivalent (CE) of a risky prospect is the sure sum with the same utility as the expected utility of the prospect. In other words the CE over risk aversion coefficient is given by $CE(\pi, ARAC) = U^{-1}(\pi, ARAC)$. The CE depends on the type of utility function. The CE for negative exponential utility function is calculated as $CE(\pi, ARAC) = \ln\left[\left(\frac{1}{n}\sum_{i=1}^{n}\exp(-ARAC\pi_i)\right)^{1/ARAC}\right]$ (Hardaker et al, 2004, p257, eq (3)).

coefficients using standard deviation of net return as suggested in McCarl and Bessler (1989), ranging from 0 to 0.00114[6]. In other words, an *ARAC* greater than 0.00114 in Figure 5 indicates the decision maker is very risk averse.

Figure 5 below explains how each strategy appeals to producers on risk preference using *CE* in equation (8). Risk neutral farmer (*ARAC* = 0) prefers M1 (all to farmers' markets) which has the highest *CE*, while an extremely risk averse producer would be expected to prefer strategy M7 or M8. It should be noted that Figure 4 displays other marketing strategies too, and the ranking depends on farmers' attitude toward risk. Based on the results shown in Figure 5, M11 strategy, marketing solely wholesale, is a poor option for any producer. M2, marketing 90% to farmers' markets, has appeal to a risk neutral producer, but not for risk averse producers.

Table 4 summarizes the rank of each strategy based on the SERF approach and other approaches, e.g., mean only, CV, minimum only and minimax. M1 which is preferred by risk neutral producers may have the best mean ranking, but has poor rankings standard deviation and CV ranking showing there is high risk relative to the other options. M3 presents a fairly consistent option as it ranked third in mean, standard deviations, and CV, and is particularly attractive to risk averse producers as it predicts the highest relative returns in a worse-case scenario. M11 ranks poorly as it highest ranking has the lowest mean and profit levels in best and worst-case situations but ranks first in CV.

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[6] Upper bound of ARAC, 0.00114, is determined based on equation (18) in McCarl and Bessler (1989), which is given by ARAC ≤ 5.14/stDev of net return. To do this, simple average of stDev of net returns from eleven marketing strategies is used.

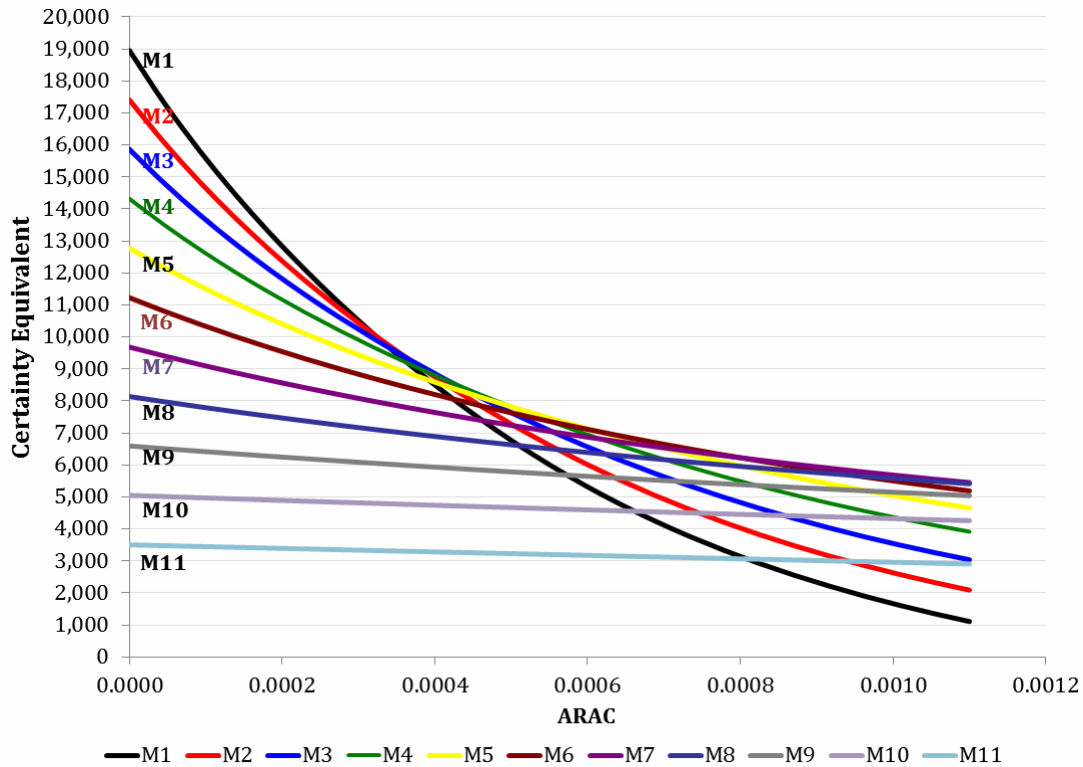

Figure 5: Stochastic Efficiency with Respect to a Function (SERF)

Notes:

1. The vertical axis represents the certainty equivalent (CE) and the horizontal axis the absolute risk aversion coefficient (ARAC). The CE is the amount of money farmer would accept rather than taking a chance on higher but uncertain net return. The CE varies over the farmer's ARAC.
2. In the graph, the farmer prefer the higher CE, for example, when ARAC = 0 (risk neutral), M1 (black line) is most preferred because it has the highest CE. When ARAC = 0.001 (risk averse), M1 is least preferred because it has the lowest CE.
3. SERF graphs are generated assuming negative exponential utility such that

$$CE(\pi, ARAC) = \ln\left[\left(\frac{1}{n}\sum_{i=1}^{n}\exp(-ARAC\pi_i)\right)^{1/ARAC}\right]$$

A simple averaging of all approaches tells us that M7 is the best, M6 is the second best, and M8 is the third best marketing strategies for risk averse producers. Even though the results recommend M7 as an optimal strategy, considerations to their underlying financial obligations and goals, production skill and capabilities, market access, and lifestyle choice. For example, a risk adverse producer may prefer a strategy similar to M7, but may have to rely on farmers' markets until they are able to secure an appropriate contract with a restaurant.

Table 4: Summary of Rankings*

					SERF		
	Mean Only	CV	Minumum Only	Minimax	Risk Neutral	Rather Risk Averse	Risk Averse
M1. All to Farmers Market (FM)	**1**	11	11	11	**1**	7	11
M2. 90 to FM and 10 to W	2	10	10	10	2	6	10
M3. 80 to FM and 20 to W	3	9	9	9	3	4	8
M4. 70 to FM and 30 to W	4	8	8	8	4	2	7
M5. 60 to FM and 40 to W	5	7	7	7	5	**1**	5
M6. 50:50 to FM and W	6	6	5	6	6	3	3
M7. 40 to FM and 60 to W	7	5	4	5	7	5	**1**
M8. 30 to FM and 70 to W	8	4	2	4	8	8	2
M9. 20 to FM and 80 to W	9	2	**1**	3	9	9	4
M10. 10 to FM and 90 to W	10	**1**	3	2	10	10	6
M11. All to Wholesale (W)	11	3	6	**1**	11	11	9

Mean only: largest mean
CV: smallest CV
Minimum only: largest minimum
Minimax: smallest range between mean and minimum
Risk Neutral: ARAC = 0
Rather Risk Averse: ARAC = 0.0005
Risk Averse: ARAC = 0.0011

* Numbers in the table represent a ranking with the various procedures for selecting the best strategy. Number "1" with red box indicates the best strategy under the each decision making criterion. For example, with Mean Only alternative procedure, the marketing strategy M1 is the best, while, with SERF and risk averse, the marketing strategy M7 is the best.

6. CONCLUSION

In conclusion, local farmers' market prices and costs, combined with historical yield data, were used in simulation to compare mean profit and variation in profit between wholesale marketing and farmers' markets. Eleven options were chosen based varying levels of involvement in each market. The results from the simulation were used to produce a probability distribution function and descriptive statistics that provide basic information about the expected consequences for each option. The results were then analyzed using SERF methods and ARAC coefficients were found to rank each option based on a producer's attitude towards risk.

The results find that M7, or marketing 40% of produce to farmers' market and 60% of produce wholesale each is the most attractive option for risk averse producers as it was consistent in mean expected profit, minimum and variation in profit. Marketing strictly to farmers' markets, or M1 was most attractive to risk neutral producers as it had the highest possible return and highest mean return, but also has high variability. Marketing strictly wholesale was consistently a poor choice as it had the lowest mean, but it should be noted that it ranked third in variability. The results are consistent with previous studies as Gunter et al. (2012) found exclusively marketing wholesale was unprofitable for small producers. The results also suggested a mix marketing strategy as used in Hardesty and Leff's study (2010) was the optimal choice.

Although the analysis recommends strategy M7 marketing for risk averse producers, small producers may still prefer a risk neutral strategy. The level of additional

investment as discussed by Gunter et al. (2012) should be considered. Producers also have differing production and marketing abilities, or the income may represent an unimportant source of income, as is the case for hobby farmers. Risk neutral producers also need to determine the feasibility of completing the amount of transactions, and their expected dollar value, with respect to cost and time used to facilitate each transaction to reach profit goals. Risk averse producers need to consider the likelihood and time involved in establishing contracts as well as managing supplies to meet both market requirements. Risk averse producers should consider Hardesty and Leff's (2010) recommendation of using farmers' markets as tool to make contacts with potential wholesale buyers, as well as establish positive recognition with end consumers to help create demand for their product.

As Curtis et al. (2012) found only 19% of surveyed direct marketers use wholesale methods there is potential for more producers to utilize the market. Further studies in pricing, optimal mix of produce offered and level of sales from farmers' markets can better inform producers. Historical production and marketing costs specific to the Rocky Mountain region would also aid greatly in this study.

As direct marketing becomes more popular in the U.S. and may seem more attractive to producers, the level of involvement in farmers' markets and wholesale markets represents a significant choice for producers. This study frames the choice in a risk management perspective by quantifying and combining market and production

realities specific to the Rocky Mountain region. The results allow producers to directly compare potential marketing decisions and then consider the needs for their farm.

7. REFERENCES

Abatekassa, G, and C. Peterson. 2011. "Market Access for Local Food through the Conventional Food Supply Chain." *International Food and Agribusiness Management Review* 14(1): 63-82.

Anderson, J.R. J.L. Dillon. 1992. *Risk Analysis in Dryland Farming Systems*. Rome, Italy: Food and Agriculture Organization of the United Nations, Farming Systems Management Series No. 2.

Carlson, H.L., K.M. Klonsky, and P. Livingstion. 2008. *Sample Costs to Produce Potatoes Fresh Market: Klamath Basin in the Intermountain Region*. PO-IR-08-1, University of California Cooperative Extension.

Conner, D.S., K.B. Waldman, A.D. Montri, M.W. Hamm, and J.A. Biernbaum. 2011. "Hoophouse Contributions to Economic Viability: Nine Michigan Case Studies." *HortTechnology* 20(5): 877-884.

Curtis, K.R., I. Yeager, B. Black, and D. Drost. 2012. "Potential Benefits of Extended Season Sales through Direct Markets." *Journal of Food Distribution Research* 43(1): 133

Donnell, J., J.T. Biermacher, and S. Upson. 2011. "Economic Potential of Using High Tunnel Hoop Houses to Produce Fruits and Vegetables." Selected Paper, Southern Agricultural Economic Association Annual Meeting, Corpus Christi, TX, February 2011.

Evans, G.K., J.I. Stallmann. 2006. "SAFESIM: The Small Area Fiscal Estimation Simulator Edited Johnson," in T.G., D. Otto, and S.C. Deller, *Community Policy Analysis Modeling*, First Edition, Blackwell Publishing.

Gunter, A., D. Thilmany, and M. Sullins. 2012. "What is the New Version of Scale Efficient: A Values-Based Supply Chain Approach." *Journal of Food Distribution Research* 43(1): 27-34.

Hardaker, J.B. 2000. "Some Issues in Dealing with Risk in Agriculture." Working paper, Graduate Department of Agricultural and Resource Economics, University of New England.

Hardaker, J. B., R.B.M. Huirne, J.R.Anderson, and G. Lien. 2004. *Coping With Risk in Agriculture*. Wallingford, Oxfordshire, UK: CABI Publishing.

Hardesty, S. and P. Leff. 2010. "Determining Marketing Costs and Returns in Alternative Marketing Channels." *Renewable Agriculture and Food Systems* 25(1): 24-34.

Harwood, J., R. Heifner, K. Coble, J. Perry, and A. Somwaru. 1999. *Managing Risk in Farming: Concepts, Research and Analysis*, Agricultural Economic Report No.

774, Market and Trade Economics Division and Resource Economics Division, Economic Research Service, U.S. Department of Agriculture.

Halter, A.N. and R. Mason. 1978. "Utility Measurement for Those Who Need to Know." *Western Journal of Agricultural Economics* 3(2): 99-110.

Hand, M. 2010. "Local Food Supply Chains Uses Diverse Business Models to Satisfy Demands." *Amber Waves* 8(4): 18-23.

Holton, G.A. 2004. "Defining Risk." *Financial Analysts Journal* 60(6): 19–25.

Kebede, E. and J. Gan. 1999. "The Economic Potential of Vegetable Production for Limited Resource Farmers in South Central Alabama" *Journa1 of Agribusiness* 17(l): 63-75.

LeRoux, M., D. Streeter, M. Roth, and T. Schmit. 2010. "Evaluating Marketing Channel Options for Small-scale Fruit and Vegetable Producers." *Renewable Agriculture and Food Systems* 25(1): 16-23.

Lev, L. and L. Gwin. 2010. "Filling in the Gaps: Eight Things to Recognize about Farm-Direct Marketing." *Choices* 25(1). Available at http://www.choicesmagazine.org/magazine/article.php?article=110

Lin, W., G.W. Dean, and C.V. Moore. 1974. "An Empirical Test of Utility vs. Profit Maximization in Agricultural Productions." *American Journal of Agricultural Economics* 56(3): 497-508.

Low, S.A. and S. Vogel. 2011. *Direct and Intermediated Marketing of Local Foods in the United States*. Economic Research Report No. (ERR-128), Economic Research Service, U.S. Department of Agriculture.

Martinez, S., M.S. Hand, M. Da Pra, S. Pollack, K. Ralston, T. Smith, S. Vogel, S. Clark, L. Tauer, L. Lohr, S.A. Low, and C. Newman. 2010. *Local Food Systems*: *Concepts, Impacts, and Issues*. Economic Research Report No. (ERR-97), Economic Research Service, U.S. Department of Agriculture.

Mayberry, K. 2000. *Sample Cost to Establish and Produce Bell Peppers – Imperial County* 2000. University of California Cooperative Extension and Imperial County Circular 104-V, University of California Cooperative Extension. Available at http://coststudies.ucdavis.edu/files/bellpeppers.pdf

McCarl, B.A., and D.A. Bessler. 1989. "Estimating an Upper Bound on the Pratt Risk Aversion Coefficient When the Utility Function is Unknown." *Australian Journal of Agricultural Economics* 33(1): 56-63.

Meyer, J. 1977. "Choice among Distributions." *Journal of Economic Theory* 14: 326-336.

Molinar, R.H., M. Yang, K.M. Klonsky, and R.L. De Moura. 2005. *Sample Costs to Produce Summer Squash*, U.C. Small Farm Program, University of California

Cooperative Extension. Available at http://sfp.ucdavis.edu/crops/coststudieshtml/BpSquashSummerSJV20042/

Ragland, E. and Tropp, D. 2009. *USDA National Farmers Market Manager Survey 2006*. Agricultural Marketing Service, U.S. Department of Agriculture. Available at http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5077203

Rayburn, E. 2012. *Enterprise Budgets*. West Virginia University Extension Service. Available at http://www.caf.wvu.edu/~forage/enterprise/enterprise.htm

Richardson, J. W. 2006. *Simulation for Applied Risk Management*. Unnumbered Staff Report, Department of Agricultural Economics, Agricultural and Food Policy Center, Texas A&M University, College Station, Texas.

Richardson, J.W., S.L. Klose, and A.W. Gray. 2000. "An Applied Procedure for Estimating and Simulating Multivariate Empirical (MVE) Probability Distributions in Farm-level Risk Assessment and Policy Analysis." *Journal of Agricultural and Applied Economics* 32(2): 299-315.

Rutgers University. 2008. *Conventional Production Practices: Table 28: Costs and Returns for Cucumber, Per Acre,* Crop Rotational Budgets, Rutgers New Jersey Agricultural Experiment Station. Available at http://aesop.rutgers.edu/~farmmgmt/ne-budgets/conv/cucumbers.html

Stoddard, C.S., M. Lestrange, B. Agerter, K.M. Klonsky, and R.L. De Moura. 2007. "Sample Costs to Produce Fresh Market Tomatoes – San Joaquin Valley." TM-SJ-07, University of California Cooperative Extension. Available at http://coststudies.ucdavis.edu/files/tomatofrmktsj07.pdf

Sanford, S. and L. Tweeten. 1988. "Farm Income Enhancement Potential for Small, Part-time Farming Operations in East Central Oklahoma." *Southern Journal of Agricultural Economics* 20(2): 153-164.

U.S. Department of Agriculture (USDA). 2012. *Know Your Farmer, Know Your Food – Our Mission*, Know Your Farmer Know Your Food Web Blog, US Department of Agriculture. Available at http://www.usda.gov/wps/portal/usda/usdahome?navid=KYF_MISSION (Accessed December, 2012)

Varian, H.R. 1992. *Microeconomic Analysis*. Third Edition, Norton, New York.

Ward, R. D. Drost, and A. Whyte. 2011. "Assessing Profitability of Selected Specialty Crops Grown In High Tunnels" *Journal of Agribusiness* 29: 41-58.