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An Assessment of Market Strategies for Small-Scale Produce Growers

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Abstract

This study examines marketing strategies for small-scale producers by comparing the risk and return properties of direct (farmers' markets) and wholesale marketing channels. Farmers' market prices for fresh produce were collected at sixteen markets in Utah and Colorado. San Francisco terminal market prices were used to represent wholesale prices. A simulation model combined price, yield, and market risk to construct probability distribution functions showing the likelihood of differing levels of profit for eleven marketing options. The results show that risk-averse producers prefer a combination of channels (40% direct/60% wholesale), while risk neutral producers prefer to market exclusively through farmers' markets.

Keywords: risk, return, direct markets, wholesale, fresh produce, small farms

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Introduction

Direct marketing of fresh produce has greatly expanded in the U.S. as evidenced by the growth in the number of farmers' markets from 1755 in 1994 to over 8000 in 2013 (USDA 2014). The Intermountain West has seen some of the highest growth, where 38% of farmers' markets have been in existence less than five years. Although direct markets, such as farmers' markets provide local growers market access and premium pricing, their ability to sustain local production comes into question when an estimated 80% of producers earn $5,000 or less per market season (Ragland and Tropp 2009).

Wholesale markets, a form of intermediate marketing where one or more middlemen is used (Hand 2010), are an established marketing channel in the U.S., accounting for 99.2% of all food purchases (Martinez et al. 2010). Locally-grown fresh produce, although typically associated with direct markets, is also sold through wholesale channels and available at restaurants and grocery retail outlets, such as Wal-Mart and Kroger[1]. Wholesale markets actually account for the majority of local produce revenues, but are supplied primarily by larger farms, defined by USDA as those grossing more than $250,000 annually (Low and Vogel 2011). Through economies of scale, larger growers are able to provide quantities and pricing suitable for wholesalers looking to fill large grocery store and dining establishment orders. More recently, increased consumer demand for local foods has given smaller growers the opportunity to offer their produce to wholesale customers, looking to meet this demand. However, these markets also come with challenges, such as meeting quality and food safety requirements (Gunter et al. 2012). Wholesale markets are attractive to producers due to lower marketing costs, transparent pricing, and less expected risk overall. Choosing between direct markets and wholesale opportunities represent a complex decision for small-scale producers.

Choosing the level of involvement in wholesale and direct markets represents a strategic tradeoff between the higher pricing and revenue uncertainty of farmers' markets as compared to the more predictable, but lower revenues of wholesale markets. Involvement in both channels may serve as a risk management tool, allowing producers to optimize revenue and predictability to meet their needs. However, the preferred level of involvement in each channel with respect to risk and profit maximization will vary due to production capabilities and producer risk tolerance levels.

This study attempts to shed light on this question by using a simulation model based on prices received by fresh produce growers in the region and expected costs of utilizing farmers' market and wholesale channels. The simulation model incorporates non deterministic elements and allows a variety of situations to be considered by combining price, yield, and sales risk, to produce a large number of potential outcomes. These outcomes, summarized by a probability distribution, show the likelihood of differing levels of profit, and provide the framework for comparing marketing decisions. The results will provide insight in to marketing strategies and associated considerations for small-scale producers in the Intermountain West.

[1]Larger grocery chains, such as Wal-Mart, Kroger (Smiths in the West), and Supervalu have incorporated local foods into their long-term strategies. Wal-Mart plans to increase the share of locally grown produce to 9% in the US and 30% in Canada by 2015 and Supervalu buys between 25 and 40% of its produce from local suppliers.

Literature Review

As Lev and Gwin (2010) conclude, the profitability of small-scale producers using direct markets, such as farmers' markets, is not well understood. Several studies discuss the potential profitability of using direct markets citing premiums for fresh produce and the need to produce a variety of high value or specialty crops (Kambara and Shelley 2002, Govindasamy et al. 2003, Kebede and Gan 1999, Conner et al. 2011). Other studies compare producer returns and potential profits between direct and other marketing channels. For example, Park and Lohr (2006) find that producers who diversify marketing channels (direct, direct to retail, and wholesale) or use a single channel (not limited to direct marketing) tend to have higher earnings relative to producers who overlook these marketing options. The study uses an econometric model analyzing the 2001 nationwide Organic Farm Research Foundation's survey data.

LeRoux et al. (2010) evaluate marketing channel options for small-scale producers in Central New York and compare price, sales volume, costs and market risk of alternative marketing channels. They conclude that a combination of different marketing channels is needed to increase overall performance. However, they do not provide a rigorous test or method to choose the marketing channel. Instead, they develop an index for labor required, sales volume and average profit of alternative marketing channels and calculate the weighted average to assist producer decision making.

Other studies use an estimated cost and return based approach to compare profitability potential across marketing channels, often limiting the analysis to either a point estimate or examine of several scenarios (sensitivity analysis) (Rayburn 2012). For example, Hardesty and Leff (2010) compare marketing costs and returns across alternative marketing channels. They found that wholesale was the most profitable marketing channel, while farmers' markets were the least profitable. The authors attributed this result, in part, to the low labor-to-revenue ratio in wholesale markets from savings in transportation, sales, and administration. The authors also found profits decreased by 53% with only a 20% decrease in produce sold when exclusively using farmers' markets, and thus, recommended their use as a marketing and risk management tool to sell surplus produce. Conversely, Ward et al. (2011) found that utilizing farmers' markets was more profitable than wholesale markets for producers utilizing high tunnels on one acre to produce a double crop of tomatoes and summer squash.

Donnell et al. (2011) through the analysis of five crops typically sold at farmers' markets confirmed that production and marketing risk are significant factors for direct marketers. They use sales levels of 50%, 75% and 100% of production to assess potential revenues. The results show that break-even prices were very sensitive to the amount sold. Finally, Gunter et al. (2012) examined the feasibility of small-scale production in Northern Colorado using three scenarios based on varying levels of investment in production, storage, and distribution. The first scenario, exclusively utilizing wholesale markets, was unsustainable based upon the first three years of production. The authors concluded that risk for each option varied due to differing levels of commitment to capital and labor.

While the comparison of asset risk and return properties is common when choosing financial investments, as well as in decisions-making regarding crop choice and land use in agriculture

(Bishop et al. 2010, Williams et al. 2010), this approach has yet to be used in in the published literature on direct market profitability. Risk, or the "exposure to a proposition in which one is uncertain" (Holton 2004, 22) is customary in agriculture due to continual political, economic, and social change, as well as exposure to weather and market variation. Studies by Lin et al. (1974) and Halter and Mason (1978) suggest that producers consider the additional risk they face and find that producers were generally risk averse by using Arrow-Pratt Absolute Risk Aversion Coefficients (ARAC). Harwood et al. (1999) discuss the various sources of risk in agriculture and state that, "Understanding risk is a starting point to help producers make good management choices in a situation where adversity and loss are possibilities" (p.2). Hence, when choosing the level of involvement in wholesale and direct markets, small-scale producers need to understand the risk involved, or the tradeoff of higher pricing, but uncertain sales in direct markets as compared to more predictable sales volumes, but lower pricing in wholesale markets.

Small-scale producers are often unfamiliar or uncertain about expanding their markets to include wholesale outlets. For example, Curtis et al. (2012) found that only 19% of the producers surveyed at farmers' market in Utah, Nevada, and Idaho also used wholesale markets. Hence, this study compares the risk and return properties of fresh produce sales through direct and wholesale marketing channels to provide an example and aid the producer decision-making process.

Methods

Simulation models, which incorporate stochastic elements, are commonly used to assess production, market, and price risk in traditional agriculture (Richardson et al. 2007a, Richardson et al. 2007b, Watkins et al. 2008, Clark et al. 2010, Curtis et al. 2010). Simulation allows for a variety of situations to be considered by combining price, yield, and sales risk to produce a large number of outcomes. These outcomes, summarized by a probability distribution, show the likelihood of differing levels of profit, and provide the framework for comparing marketing decisions.

Stochastic variables are defined as variables the decision maker, in this case fresh produce marketers, cannot control (Richardson 2006). The simulation model considers yield, price received from farmers' markets and wholesale markets, and the level of sales at farmers' 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 $\tilde{y}_i$ is the (stochastic) yield per acre for produce i. Note that the tilde

[2]We assume that a_i = 0.2 acres for each produce item, and thus Σa_i = 1 acre. It is based on the assumption that the producer does not currently have a contract with a wholesaler, 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 channels[3] (farmers' market or wholesale) and that decision can be written as:

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

where $\tilde{s}_i$ = the level of sales of *i*th produce in *j*th channel, $j = FM$ 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 through farmers' markets and when $\alpha = 0$, the producer sells exclusively wholesale. The net return (π) from marketing is given by:

3) $\tilde{\pi} = \sum_j \sum_i \tilde{p}_{i,j} \cdot \tilde{s}_{i,j} - \sum_j M_j - C$,

where $\tilde{\pi}$ = stochastic net return, $\tilde{p}_{ij}$= stochastic price of *i*th produce in *j*th channel, M_j= marketing cost in *j*th channel; 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 statistical distributions. Random prices used in equation (3) are generated as follows:

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

where $\bar{p}_{ij}$ is the mean of the (historical) price of produce i and $\tilde{v}_{ij}$ is the pure stochastic part or pure price disturbance[4]. The random disturbances, $\tilde{v}_{ij}$, in equation (4) are generated as correlation was found in prices (see Data Overview) 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 where ε's are independent disturbances from normal distributions with mean zero and standard deviation, $\tilde{\varepsilon} \sim iid\ N(0, \sigma_s^2)$ from the historical data. $\tilde{v}_{ij}$'s are correlated disturbances and ρ's are correlation coefficients.

[3]The marketing decision is normally made prior to harvest, as wholesale contracts and farmers' market booth applications must be completed in advance. Thus, the marketing decision is rigid, but not completely so as diverting produce sales to restaurants and/or local grocery outlets may be an option for some producers.

[4]A chi-squared quantiles correlation test was performed to see whether $\tilde{v}_{ij}$ in equation (4) and $\tilde{w}_i$ in equation (5) are distributed multivariate normally. Test results indicate that both $\tilde{v}_{ij}$ and $\tilde{w}_i$ are multivariate normally distributed. P-values are 0.95 (price) and 0.84 (yield), respectively.

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

The GRKS distribution[5] 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), we presume the level of sales is a minimum of 25%, a maximum 75%, with an average of 50%, or $\tilde{\theta} \sim GRKS(min, avg, \max)$.

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:

$$6)\quad \tilde{y}_i = \bar{y}_i + \tilde{w}_i,$$

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:

$$7)\quad \begin{bmatrix} \tilde{w}_1 \\ \tilde{w}_2 \\ \vdots \\ \tilde{w}_5 \end{bmatrix} = \begin{bmatrix} 1 & \rho_{12} & \cdots & \rho_{15} \\ & 1 & \cdots & \rho_{25} \\ & & \ddots & \vdots \\ & & & 1 \end{bmatrix} \begin{bmatrix} \tilde{\mu}_1 \\ \tilde{\mu}_2 \\ \vdots \\ \tilde{\mu}_5 \end{bmatrix},$$

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.

The producer is given the choice of involvement level in each market channel. This study uses eleven representative options to choose from where α is the decision variable in this practice $(0 < \alpha < 1)$.

- M1. All to farmers' market, i.e., $\alpha = 1$
- M2. 90% to farmers' market, 10% to wholesale, i.e., $\alpha = 0.9$
- M3. 80% to farmers' market, 20% to wholesale, i.e., $\alpha = 0.8$
- M4. 70% to farmers' market, 30% to wholesale, i.e., $\alpha = 0.7$

[5]The GRKS (Gray, Richardson, Klose and Schumann) distribution is similar to triangular distribution. It was developed to simulate "subjective probability distribution" with minimal data (Richardson 2006, 5-3). 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, pp.175).

- 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., $\alpha = 0$.

Data Overview

Farmers' market produce prices were collected during the regular season (June to September) 2011 in Utah and Colorado by Utah State University and Colorado State University Cooperative Extension. Five produce items were selected for analysis based on the price availability and consistency of a like product: tomatoes, cucumbers, green peppers, potatoes, and summer squash. Yield data for the five products were provided by USDA NASS[6]. Terminal market prices provided by USDA NASS over the same time period were used as representative wholesale prices as local data were unavailable.

Cost of production data for each item was taken from various studies (Carlson et al. 2008, Mayberry 2000, Molinar et al. 2005, Rutgers University 2008, and Stoddard et al. 2007). Table 1 provides 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 others and show a relatively large range of production yield.

Table 1. Yield statistics (cwt/acre)

	Tomatoes	**Cucumbers**	**Squash**	**Potatoes**	**Green Peppers**
Mean	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
Min	268.00	171.81	136.40	335.97	257.00
Median	299.00	190.03	146.90	382.30	297.00
Max	311.00	208.57	160.44	403.85	329.00

Figure 1 displays historical yield data demonstration the consistent production yields across time with green peppers and potatoes showing a slight upward trend. Figure 2 displays the average weekly prices for the five produce items for both the wholesale and farmers' market channels. Farmers' market prices are typically more variable, especially for cucumbers and tomatoes.

[6]Yield data used in the analysis are aggregated at the state level which may underestimate the true yield risk for an individual producer.

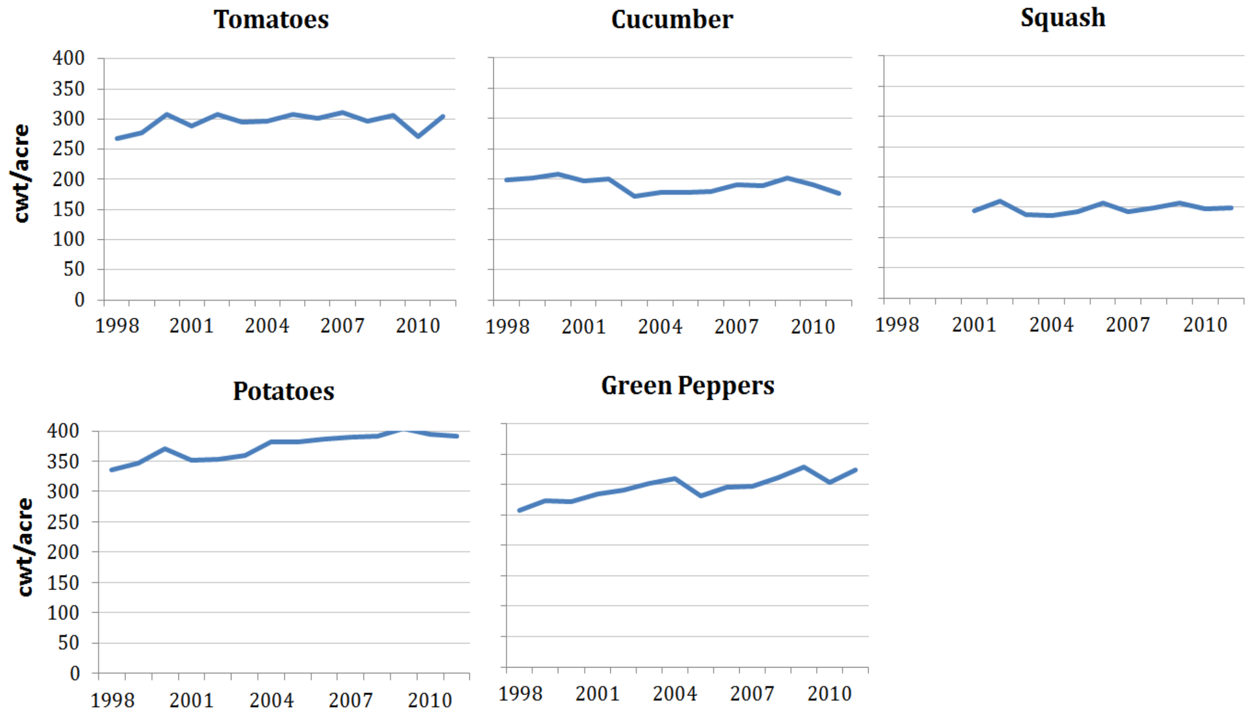

Figure 1. Historical yields 1998-2011 (cwt/acre)

Table 2 describes marketing costs associated with each channel. Marketing costs were based on those reported by fresh producer growers in Utah in a survey conducted in 2011. Costs taken into account were markets fees, labor, transportation, and other inputs. It should be noted that the higher costs to market at farmers' markets as compared to wholesale markets represents an important consideration for producers.

Table 2. Marketing costs by channel ($)

	Farmers' Market	Wholesale
Labor	2,560	320
Fuel	250	250
Tables	150	-
Signs	50	-
Marketing	225	200
Containers	150	150
Total	3,385	920

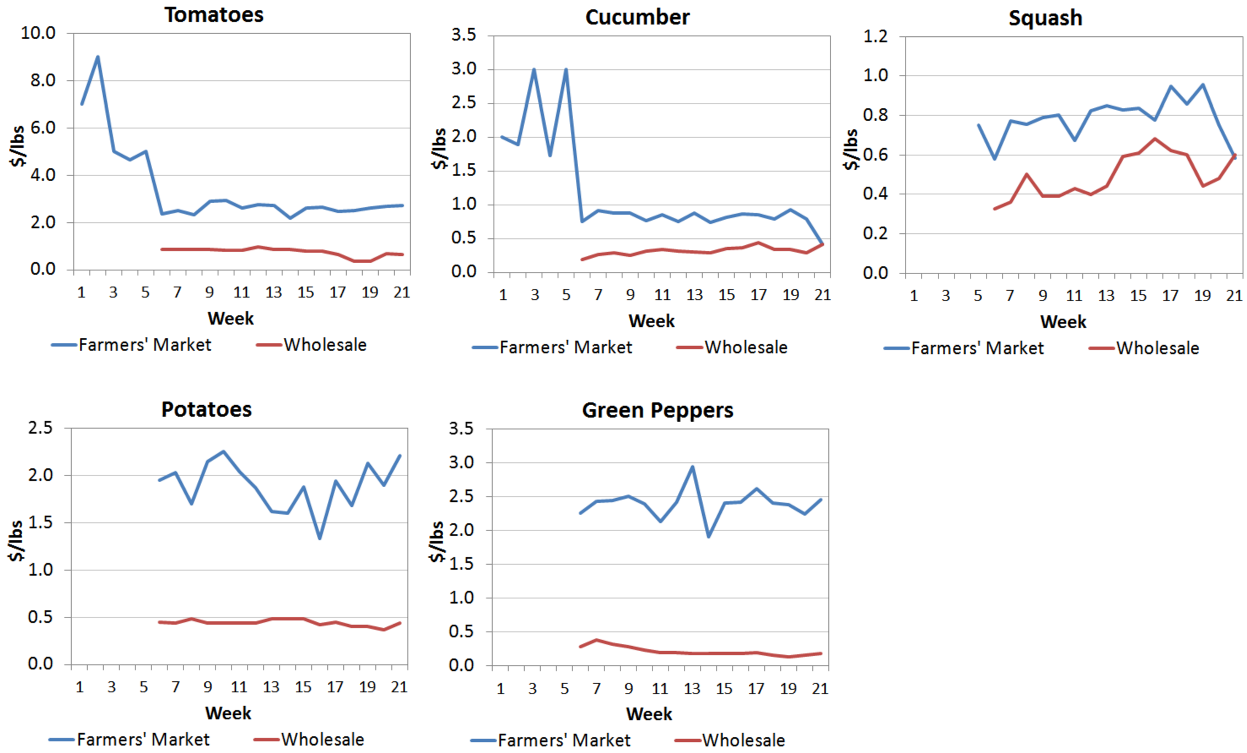

Figure 2. Farmers' market and wholesale produce prices

The coefficient of variation of price for each produce item by market was found. An important part of the decision making process for producers is understanding the variability in prices at each market, as it indicates of how well income can be predicted. Figure 3 shows price variability and as expected, price variation was greater for farmers' markets for three items, with tomatoes and cucumbers particularly high.

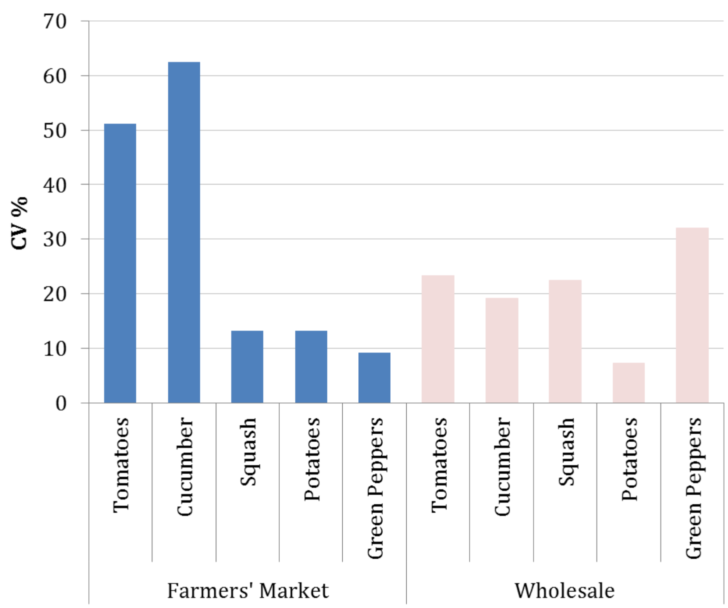

Figure 3. Coefficient of variation in price

The higher variability suggests less predictable revenues for producers, but a higher profit ceiling. Wholesale produce prices, which generally have lower CV's, may offer producers more stable revenues. 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 producer attitudes toward risk.

Results and Discussion

All stochastic variables were simulated 1000 times to compute the net return in equation (3) and generate the probability distribution function (PDF) for the net return (Figure 4 and Table 3) . Although a simple visual comparison of marketing strategies found in Figure 4 would provide producers with a readable answer, Table 3 provides 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 does not 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[7] (CE) for a specified range of risk aversion coefficients with a predetermined utility function based on the following rules:

8) $F(\pi)$ 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* assuming a negative exponential utility function[8] (Figure 4).

[7]Certainty Equivalent (CE) is the value someone would accept rather than taking a chance on a higher, but uncertain return (Varian 1992).

[8] Negative exponential utility function is given by $U(\pi) = 1 - \exp(-ARAC \cdot \pi)$, where $ARAC > 0$ (Hardaker et al. 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 et al. 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 $CE(\pi, ARAC) = \ln[\left(\frac{1}{n}\sum \exp(-ARAC \cdot \pi_i)\right)^{\frac{1}{ARAC}}]$ (Hardaker et al. 2004, pp. 257, eq (3)).

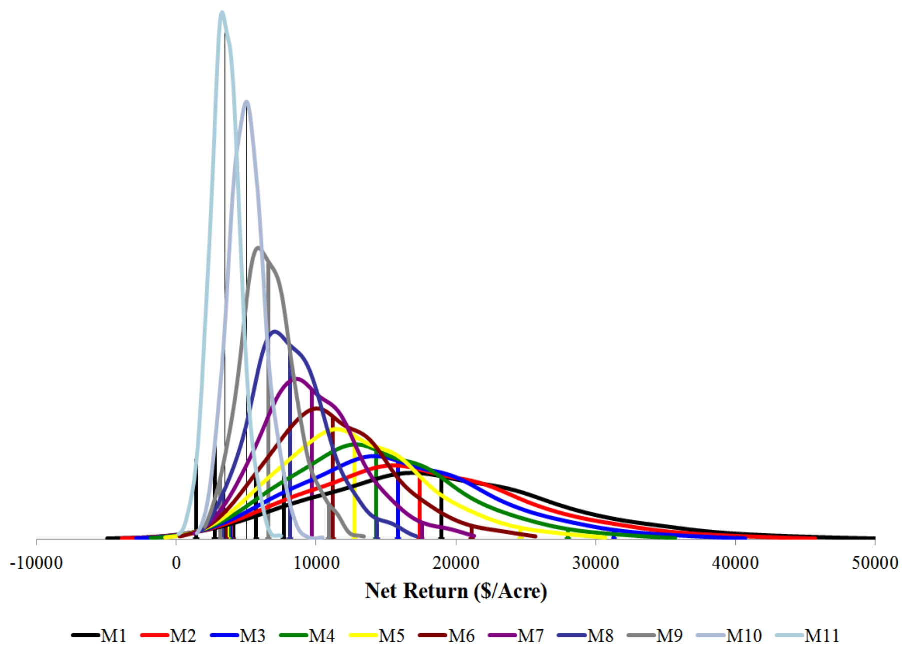

Figure 4. Simulated net returns probability density function

Note. Vertical axis (not presented with numbers) is the probability and the area under the PDF presents the probability of the interval of net returns. Mathematically, $\Pr[a \leq \text{net return} \leq b] = \int_a^b f(x)\,dx$. 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	Std. Dev.	CV (%)	Min	Max
M1. All to Farmers' Market (FM)	18,954	8,727	46.0	–4,936	50,690
M2. 90 to FM and 10 to W	17,409	7,851	45.1	–3,899	45,690
M3. 80 to FM and 20 to W	15,865	6,997	44.0	–2,863	40,691
M4. 70 to FM and 30 to W	14,320	6,105	43.0	–1,827	35,692
M5. 60 to FM and 40 to W	12,775	5,238	41.0	–790	30,693
M6. 50 to FM and 50 to W	11,230	4,376	39.0	246	25,694
M7. 40 to FM and 60 to W	9,685	3,525	36.4	1,283	21,300
M8. 30 to FM and 70 to W	8,140	2,694	33.1	1,823	17,174
M9. 20 to FM and 80 to W	6,595	1,911	29.0	2,044	13,429
M10. 10 to FM and 90 to W	5,050	1,267	25.1	1,470	10,470
M11. All to Wholesale (W)	3,505	1,057	30.2	164	7,512

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

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 coefficients using standard deviation of net return as suggested in McCarl and Bessler (1989), ranging from 0 to 0.00114[9]. In other words, an *ARAC* greater than 0.00114 indicates the decision maker is very risk averse (Figure 5).

Using *CE* in equation (8), each strategy appeals to producers on risk preference. A risk neutral producer (*ARAC* = 0) would prefer 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 other marketing strategies used depend on producer attitudes toward risk (Figure 4). Based on the results, the M11 strategy, marketing solely wholesale is a poor option for any producer (Figure 5). M2, marketing 90% to farmers' markets, has appeal to risk neutral producers, but not for risk averse producers[10].

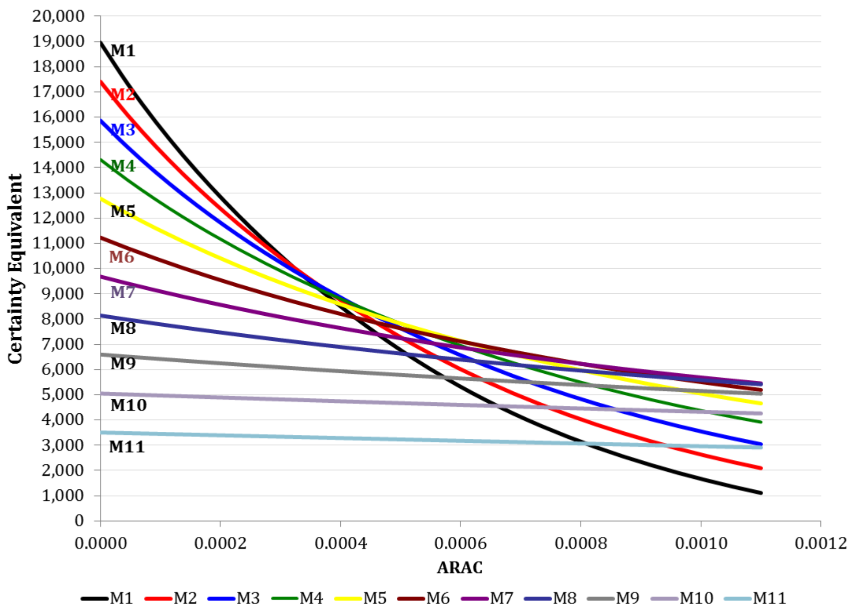

Figure 5. Stochastic Efficiency with Respect to a Function (SERF)

Note. 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 producers would accept rather than taking a chance on higher but uncertain net return. The CE varies over the producer's ARAC.

2. In the graph, the producer prefers 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

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

[9]Upper bound of ARAC, 0.00114 is determined based on equation (18) in McCarl and Bessler (1989), which is given by ARAC ≤ 5.14/St Dev of net return. An average of the standard deviation of net returns from all eleven marketing strategies is used.

[10]The analysis here focuses on small farms where the farm operator may have off-farm employment. Off-farm employment and income is likely to affect their attitude towards risk (producers' ARAC) and the time available for marketing farm products.

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 for standard deviation and CV, 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 its highest ranking has the lowest mean and profit levels in best and worst-case situations, but ranks first in CV.

Although the results recommend strategies M5-M7 for risk averse producers, considerations regarding financial obligations and goals, production skills and capabilities, market access, and lifestyle choice must be made. For example, a risk averse producer may prefer a strategy similar to M7, but may have to rely heavily on farmers' markets until they are able to secure an appropriate contract with a restaurant or grocer.

Table 4. Summary of rankings

	Mean Only	CV	Min Only	Max Only	Risk Neutral	SERF 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 to FM and 50 to 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

Note. 1. Rankings - 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

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

Conclusions

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

The results find that M7 (marketing 40% of output through farmers' markets and 60% through wholesale channels) 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 the most attractive option for risk neutral producers as it had the highest possible return and highest mean return, but also 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, such as Gunter et al. (2012) who found exclusively marketing wholesale was unprofitable for small producers. The results also suggest a mixed marketing strategy is the optimal choice, as in Hardesty and Leff (2010).

Although the analysis recommended strategy M7 for risk averse producers, small-scale producers may still prefer a more risk neutral strategy, or marketing a larger percentage through farmers' markets. This outcome likely due to past experience marketing through direct markets and/or the lack of importance of farming income due to off-farm employment. Current strategies show smaller scale producers (5 acres or less) in the region marketing approximately 80% of their produce through direct markets and the remaining 20% to restaurants (Curtis et al. 2012). Larger producers (70-100 acres) currently use a 50/50 direct/wholesale approach (Olsen and Curtis 2012).

Risk neutral producers selling primarily through direct markets should determine the feasibility of completing the number of transactions at their expected dollar value required to reach profit goals. Risk averse producers should consider the likelihood and time involved in establishing contracts, as well as managing supplies to meet both market requirements. Hardesty and Leff (2010) recommend using farmers' markets as a tool to make contacts with potential wholesale buyers, as well as establish positive recognition with end consumers to help create demand for their product.

Further studies in pricing, optimal mix of produce offered, and level of sales from farmers' markets can better inform producers. As direct marketing becomes more popular in the U.S. and attractive to small-scale producers, the level of involvement in farmers' markets and wholesale marketing channels represents a significant decision for producers. This study frames the marketing decision using a risk management perspective by quantifying and combining market and production realities specific to the Intermountain West. The results allow producers to directly compare potential marketing strategies and then consider the needs of their operation.

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