Journal of Food Distribution Research
Volume 50, Issue 2

Economic Impact of Values-Based Supply Chain Participation on Small and Midsize Produce Farms

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Abstract

Midsize farms can improve economic viability using alternative marketing channels such as values-based supply chains (VBSCs) that market products differentiated by locality, quality, environmental, social, or health claims. We simulated the economic impact of VBSCs using secondary data and survey data from VBSC-participating farms. Across all simulation scenarios, average net economic impacts from VBSC participation was positive, where 47% of farms showed a net benefit, with wholesale-leaning farms benefiting most. VBSC economic benefits may result from lower marketing costs relative to direct marketing and higher prices than conventional wholesale. While most farms showed small or negative net economic impacts, most also reported noneconomic benefits of VBSC participation.

Keywords: direct marketing, economic impact, farm viability, marketing channels, values-based supply chains, wholesale

Introduction

For decades, the U.S. Department of Agriculture (USDA) and researchers have been concerned about the economic viability of U.S. family farms as the sector trends toward concentration into larger farms alongside many small farms (Burns and Kuhn, 2014; Feenstra and Hardesty, 2016). Meanwhile, the decline of small and midsize commercial farms, collectively called Agriculture of the Middle (AOTM), hollows out the midscale sector that accounts for 36% of all farms, 39% of the value of production, and 50% of all agricultural lands (USDA, 2017b). AOTM farms support rural economies through household income, hired labor, and natural resource management and may contribute to food system resilience in the face of climate change, economic disruptions, and other disturbances (Clancy and Ruhf, 2010; Stevenson et al., 2011; Low et al., 2015; Feenstra and Hardesty, 2016; Duncan et al., 2018).

AOTM farms are positioned to improve their economic viability by participating in midscale supply chains selling products that are differentiated by place or production practices (Lev and Stevenson, 2011; Low et al., 2015; Berti and Mulligan, 2016; Matteson, 2017). While significant research attention has focused on local and regional food marketing in the United States, little research has looked into the tradeoffs that farms face when presented with midscale marketing channels that better match AOTM production and marketing scale and diversify farm marketing portfolios (Low et al., 2015; Angelo, Jablonski, and Thilmany, 2016; Bauman, Thilmany, and Jablonski, 2017; Conner et al., 2017).

We examine marketing channel tradeoffs to assess the economic impact of intermediated midscale marketing through values-based supply chain businesses (VBSCs) on a sample of AOTM farms. VBSCs aggregate, process, market, and distribute food products that are differentiated by locality, quality, environmental, social, or health claims at regional levels while engaging in equitable business relationships with producers (Stevenson et al., 2011; Berti and Mulligan, 2016; Feenstra and Hardesty, 2016; Tanaka et al., 2017). Partnering with 17 VBSCs nationwide, we obtained 182 usable survey responses from diversified vegetable and fruit farms that sold a portion of their crops to the partnering VBSC in 2016. Marketing channel studies have focused on farms selling fresh vegetables, berries, fruits, nuts, and other products because they face comparable options and challenges: year-round production of multiple perishable products, direct marketing competition at retail prices, and high financial performance in direct and intermediated marketing channels despite high labor costs (Hardesty and Leff, 2010; LeRoux et al., 2010; Park, Mishra, and Wozniak, 2014; Matteson, 2017; Bauman, Thilmany, and Jablonski, 2017; Bauman, McFadden, and Jablonski, 2018).

Utilizing the Tradeoff Analysis for Multi-Dimensional Impact Assessment framework (TOA-MD) (Antle, Stoorvogel, and Valdivia, 2014), we assess the potential economic impact of VBSC marketing on these AOTM farms. Averaging results across all simulation scenarios, we found that 47% of farms would see a net revenue benefit from VBSC marketing, with higher-sales, wholesale-leaning farms benefiting the most. Farms with a preference for direct marketing tended to experience less positive economic benefits from VBSC participation but may choose to participate for other reasons, including an inability to sell more volume or imperfect product through direct markets, relationship-building to scale up production, or other marketing risk management goals. Our results can inform decisions by midsize farmers considering new marketing channels, decisions by VBSCs and other supply chain partners, and policy decisions that address the declining AOTM.

Marketing Channel Tradeoffs for AOTM Farms

AOTM farms are neither very small nor large; in our sample, the two middle-income categories report gross income of US$100,000–$499,999 and $500,000–$999,999. AOTM farms tend to be family-owned and operated, generally categorized as “farming occupation farms” and “midsize family farms” by the USDA, and use production and marketing strategies that tend to emphasize differentiation of products and marketing channels (Agriculture of the Middle, n.d.; Feenstra and Hardesty, 2016). AOTM farms have been in steady decline for decades. Recent data show that from 2011 to 2016, the number of farms in the “farming occupation farms” and “midsize family farms” typologies fell by 9%, a decline of almost 69,000 farms in five years, compared to a decline of 6% for all farms. Meanwhile, 17,814 large and very large farms were added over the same period, a 42% increase, resulting in continued growth in average farm size in the United States (Burns and Kuhns, 2016; USDA, 2017).

The decline in AOTM farms is a result of multiple, interrelated structural factors that are linked to a lack of midscale marketing channels that fit AOTM production volume, such as local and regional intermediated supply chains that include retail, restaurants, institutions, food hubs, or distributors (Agriculture of the Middle, n.d.; Lev and Stevenson, 2011; Stevenson et al., 2011; Low et al., 2015; Berti and Mulligan, 2016). AOTM farms (over $75,000 gross cash farm income [GCFI] in Low et al., 2015) reported higher local and regional sales from intermediated channels than direct-alone or a mix of channels, with local and regional sales growing to an estimated $6.1 billion in 2012, 55% of which came from farms exclusively using intermediated channels.

Marketing skills, management of variable expenses, and farm scale are important determinants of sales and financial efficiency for farms using direct or intermediated marketing, suggesting that there are economies of scale at play that AOTM farms are equipped to achieve (Park, Mishra, and Wozniak, 2014; Bauman, Thilmany, and Jablonski, 2017). However, there is significant heterogeneity in financial efficiency, profitability, and other metrics of financial performance for those using direct and intermediated channels; some small and midsize farms outperform the highest grossing farms, indicating that matching farm production and marketing scale is a key to success at all farm scales (Bauman, Thilmany, and Jablonski, 2017; Bauman, McFadden, and Jablonski, 2018).

Values-based supply chains (VBSCs) are one type of intermediated midscale marketing option that (i) aggregates, processes, markets, and distributes a significant volume of food products that are differentiated by locality, quality, environmental, social, or health claims; (ii) operates effectively at regional levels; and (iii) distributes profits equitably among the supply chain participants, including producers (Stevenson et al., 2011; Berti and Mulligan, 2016; Feenstra and Hardesty, 2016; Tanaka et al., 2017). Recent research found 278 VBSCs in the United States that market on clearly articulated values claims such as local and environmentally sustainable practices. VBSCs can take the form of food hubs, producer co-operatives, private business entities that operate as processors and/or distributors, or others (Tanaka et al., 2017).

Past marketing channel case studies compared farm profitability for various direct and wholesale channels (Hardesty and Leff, 2010; King et al., 2010; LeRoux et al., 2010; Pesch and Tuck, 2015), while studies using national-level data compared financial performance of farms using direct and intermediated local marketing channels (Park, Mishra, and Wozniak, 2014; Park, 2015; Bauman, Thilmany, and Jablonski, 2017; Ahearn, Liang, and Geotz, 2018; Bauman, McFadden, and Jablonski, 2018). Our analysis contributes to this research by employing results from a survey instrument that provides more detailed data on farm price and cost tradeoffs in marketing channels than national-level data but less detailed financial data than a small case study. To analyze the survey results, we employ the Tradeoff Analysis for Multi-Dimensional Impact Assessment (TOA-MD) framework, a parsimonious simulation approach that has been used extensively to analyze the impacts of technology adoption on an agricultural sector (Antle and Valdivia, 2006; Antle, 2011; Claessens et al., 2012; AgMIP, 2017; Antle et al., 2018). Because it is difficult to obtain specific income, price, and cost data from farmers in a survey, this simulation approach allows us to estimate the distribution of the net economic impact of VBSC participation by combining secondary data with farm survey responses on the direction of farm price and cost differences between direct marketing, VBSCs, and conventional wholesale channels.

When presented with a new technology, in this case a marketing channel with different economic parameters, farmers are assumed to make a rational choice by allocating sales to different channels based on expected economic returns: revenue minus production and marketing costs. Here we treat production volume and costs as predetermined by the farms and only consider the marketing decision, consistent with previous research (Hardesty and Leff, 2010; LeRoux et al., 2010). Thus, farm net returns in market channel studies depend on the mix of marketing channels selected and the prices received in each channel relative to marketing costs, other constraints such as volume and risk, and farm-level characteristics (Neven et al., 2009; Hardesty and Leff, 2010; King et al., 2010; LeRoux et al., 2010; Park, Mishra, and Wozniak, 2014). Producers assess the tradeoffs in each channel, filling demand in their preferred channel then sending additional product to other channels. Furthermore, diversifying the marketing portfolio can reduce marketing risk and increase overall profitability, where the optimal marketing portfolio depends on farm characteristics and operator management skills and preferences (Hardesty and Leff, 2010; LeRoux et al., 2010; Diamond and Barham, 2011; Park, Mishra, and Wozniak, 2014; Bauman, Thilmany, and Jablonski, 2017; Bauman, McFadden, and Jablonski, 2018).

Assessing price tradeoffs, prices are expected to be highest in direct markets, followed by VBSCs, and lowest in conventional wholesale markets (Hardesty and Leff, 2010; King et al., 2010; LeRoux et al., 2010). To some extent, farmers are price makers in direct markets, although their price setting is constrained by competition with other farm direct marketers and consumer willingness to pay above supermarket prices, resulting in direct marketing pricing that is competitive with retail but where producers retain all of the consumers' dollar (Gunderson and Earl, 2010; Day-Farnsworth and Morales, 2011; Park, Mishra, and Wozniak, 2014; Low et al., 2015; Martinez, 2016; Valpiani et al., 2016; Trant et al., 2018). In conventional wholesale, prices are based on a globalized market, where farms compete on price and lose their product identity (Day-Farnsworth and Morales, 2011; McLaren, 2015). VBSC channels promise to pay producers higher prices than wholesale, in part because they sell differentiated products, but price premiums are also limited by conventional retail competition and consumer willingness to pay (Swinnen and Vandeplas, 2014; McLaren, 2015). VBSCs also often set prices paid to farmers on producer-reported cost of production or negotiation, with the goal of passing on a higher share of the retail price to producers (King et al., 2010; Day-Farnsworth and Morales, 2011; Diamond and Barham, 2011; Hardesty et al., 2014; Feenstra and Hardesty, 2016; Tropp and Moraghan, 2017).

Marketing costs are also highest in direct markets and lowest in conventional wholesale. Marketing costs include post-harvest costs such as washing, packing, storage, food safety, handling and transportation; selling costs such as negotiating with a buyer and promotion (e.g., samples, farm tours); and costs (e.g., record keeping, inspections, and fees) for third-party certification such as USDA-certified organic, animal welfare, or food safety certifications (Hardesty and Leff, 2010; LeRoux et al., 2010; Christiansen, 2017). Direct marketing costs are substantially higher than VBSC or wholesale channels due to high labor requirements (stocking, making transactions) and nonlabor costs (transportation, infrastructure, vendor fees, packaging, scales, signage, product liability insurance, licensing) (Hardesty and Leff, 2010; LeRoux et al., 2010). VBSCs have lower marketing costs than direct marketing but likely have higher marketing costs than conventional wholesale because farmers may have to maintain higher-quality product, preserve farm identity, or obtain food safety or environmental certifications, depending on the marketing strategy of the VBSC (King et al., 2010; Diamond and Barham, 2011; Hardesty et al., 2014; Feenstra and Hardesty, 2016; Matteson, 2017).

Volume constraints and marketing risks also determine suitability of marketing channels (LeRoux et al., 2010; Matteson, 2017). Direct markets have lower sales volumes and higher risk of sort-outs and unpaid product (Hardesty and Leff, 2010; LeRoux et al., 2010), some of which comes from overproduction for direct market demand (Trant et al., 2018). From 2007 to 2012, total sales in direct markets have leveled off, declining nearly 1%, while the number of direct marketing farms increased by 5.5% (Low et al., 2015; O'Hara and Low, 2016). Direct markets are also limited by climate, proximity to population centers, and other factors (Born and Purcell, 2006; Park, Mishra, and Wozniak, 2014; Ahearn Liang, and Geotz, 2018; Bauman, McFadden, and Jablonski, 2018). Conversely, wholesale markets take large volumes that preclude some small and midsize farms, or they face the risk of not meeting volume commitments (LeRoux et al., 2010). VBSCs that are committed to working with small and midsize farms help manage marketing risks through negotiation on volume and price commitments, long-term business relationships, transparency, predictable and timely payments, and shared values. Farmers report that VBSC participation reduces marketing stress when their VBSC aligns with their values and production choices (Diamond and Barham, 2011; Stevenson et al., 2011; Feenstra and Hardesty, 2016).

Methods

Survey

We conducted a survey to assess farmers' reasons for, perceptions of, experiences in, and impacts from participating in VBSC marketing channels. The survey was designed for the target population of small to midscale U.S. commercial farms that marketed through a VBSC in 2016. We reached out to more than 30 VBSC businesses, of which 19 agreed to share their supplier lists. Administered by the Social and Economic Sciences Research Center at Washington State University, 1,954 farms were contacted during February through May 2017 following Dillman's Tailored Design Method (Dillman, Smyth, and Christian, 2014), which entails introductory contact, first and second mailing of the questionnaire, and three reminders. The survey was available in hard copy and online, in both English and Spanish. We received 445 responses (27.4% of those that farmed in 2016). In our analysis, we use responses from diversified vegetable farms that sold to 17 of the partnering VBSCs in 2016. Of 274 qualifying responses, 182 responded to key questions and were usable. Statistical patterns in the data were detected using analysis of variance (ANOVA) and χ^2 tests.

TOA-MD Simulation

Using the TOA-MD framework, we define the impact of VBSC participation on farm net returns for an individual farm as farm net returns with VBSC participation (V_1) minus farm net returns without VBSC participation (V_0) (Roy, 1951):

(1) $$Impact = V_1 - V_0.$$

In our case, farm net returns with VBSC participation (V_1) are observed. This return is equal to revenue minus marketing costs from each of the three main channel types: direct marketing (d), wholesale (w), and VBSC (v), where c_m ($m = d$, w, and v) is the ratio of costs to revenue and R_m is revenue from each marketing channel:

(2) $$V_1 = (1 - c_d)R_d + (1 - c_w)R_w + (1 - c_v)R_v.$$

The unobserved counterfactual is farm net returns without VBSC participation, V_0. We assume that without the VBSC channel, the farm allocates VBSC sales to direct marketing and conventional wholesale channels. As such, approximating V_0 requires assumptions on the proportion of VBSC sales that would be allocated to each channel and the price differences between channels. Then, we calculate V_0, where δ is the proportion of VBSC sales allocated to direct marketing, $1 - \delta$ is the proportion of VBSC sales allocated to wholesale channels, and p_m ($m = d, w,$ and v) is the price received in each channel:

(3) $$V_0 = (1 - c_d)R_d + (1 - c_w)R_w + \delta(1 - c_d)R_v\left(\frac{p_d}{p_v}\right) + \left(1 - \delta\right)(1 - c_w)R_v\left(\frac{p_w}{p_v}\right).$$

Equation (3) shows the three pieces of information required to estimate VBSC impact on farm net returns: cost-to-revenue ratios in each marketing channel (c_m), the percentage of allocation between the two alternative marketing channels (δ, $1 - \delta$), and relative prices between the marketing channels (p_m). Model parameters were obtained from secondary data and farm-specific reports obtained from the VBSC farmer survey (see Results).

The impact of VBSC marketing on farm net returns (equation 1) is the difference between the net revenue reported from VBSC participation (equation 2) versus the same product sold through only direct and conventional wholesale channels (equation 3). Thus, equation (4) represents the estimated impact of VBSC participation:

(4) $$Impact = (1 - c_v)R_v - \left[\delta(1 - c_d\right)R_v\left(\frac{p_d}{p_v}\right) + \left(1 - \delta\right)(1 - c_w)R_v\left(\frac{p_w}{p_v}\right)]$$

The goal of simulation is to obtain the most plausible estimate of the average impact of VBSCs across farms in our sample and the percentage of these farms that benefit from VBSC participation. Because survey responses did not indicate specific magnitudes of these key parameters, equation (1) is simulated for each farm under five scenarios of how VBSC prices compare with direct and wholesale prices to test the sensitivity of results across a range of plausible economic conditions. Each scenario is simulated for 1,000 iterations per farm, resulting in 182,000 simulated impacts. The scenario-specific mean impact is calculated as the mean of impacts across all farms and iterations. The percentage of farms benefiting from VBSCs is defined as the percentage of positive impact values across all farms and iterations in a given scenario. The simulation is carried out using STATA (Stata Corp, 2017).

Results

VBSC Farm Survey and Secondary Data

Table 1 shows select statistics for our sample of farms. The mean operated area in the sample is 264.6 acres, but many farms have much smaller areas, as indicated by the high standard deviation. While the sample includes farms from across the United States, the most represented regions are the Pacific (36%) and the Northeast (27%), both of which were identified by Bauman, McFadden, and Jablonski (2018) as having better market conditions for direct and intermediated sales.

Table 1. Summary Statistics on Survey Respondents

Survey Respondents' Farm and Marketing Characteristics		
Mean operated farm acres (*N* = 182)	264.6 (808.9)	
Percentage of total sales to VBSC (*N* = 182)	25.1%	
Gross cash farm income (*N* = 182)	Percentage of Farms	Percentage Sales to VBSC
$0–$99,999	28.0%	36.8%
$100,000–$499,999	33.0%	24.2%
$500,000–$999,999	11.0%	16.8%
$1,000,000 or more	28.0%	17.7%
Channel choices (*N* = 182)	Percentage of Farms	
Sells to wholesale	64.8%	
Sells to grower/farmer co-operatives	30.8%	
Sells to food co-operatives	45.1%	
Sells direct to consumers	78.0%	
Sells to retailers	76.9%	
U.S. location (*N* = 178)	Percentage of Farms	
Great Lakes, Heartland, Upper Midwest	14.0%	
Northeast	27.0%	
Northwest	14.0%	
Pacific	36.0%	
Other	9.0%	

To simulate the VBSC impact on each farm, we first construct the value of VBSC sales for each farm by randomly drawing a farm income value from the reported income ranges for each farm in each iteration (1,000 iterations per farm). Small and midscale farms (<$500,000 GCFI) account for 61% of our sample (Table 1). For the 28% of farms that reported income above $1 million (with no upper bound), we assigned a randomly drawn income value between $1 million and $3.6 million, based on the $2.3 million mean farm income for large and very large (>$1 million GCFI) U.S. vegetable farms (USDA, 2015).

Next, we multiply the income value by the reported percentage of sales made to VBSCs, which gives each farm's VBSC revenue (R_v) in each iteration. On average, VBSC sales make up about one-quarter of total farm sales. In addition to the partnering VBSCs, 78% of farms sell direct to consumers, 77% sell direct to retailers, 65% sell to wholesalers, 45% sell to food co-operatives, and 31% sell to grower/farmer co-operatives (Table 1). While our analysis only includes data on the tradeoffs between VBSCs, direct marketing, and conventional wholesale, it is important to recognize that farms have multiple intermediated marketing options.

Survey data were also used to specify each farm's ratio of costs to revenue for each marketing channel (c_m, $m = d, v,$ and w) and the price ratios (p_d/p_v and p_w/p_v) used in the simulation. Each farm reported whether prices and costs were higher, the same, or lower between the VBSC and other channels; however, the magnitude of differences was not reported. Table 2 summarizes the comparisons with direct marketing in the left half and with conventional wholesale in the right half. The survey included separate questions for labor and nonlabor cost components of post-harvest, marketing, and certification costs, which are combined in the table to determine whether costs can be classified as strictly higher, the same, or lower. The "undetermined" in Table 2 refers to responses where farms reported that either the labor or nonlabor cost component was higher while the other was lower.

Price Tradeoffs

Consistent with the past case studies in the literature, most farms (69%) reported that VBSC prices (p_v) were lower than direct marketing prices (p_d) at venues such as farmers' markets, farm stands, CSAs, or others (Table 2, left half). Compared to conventional wholesale, 37% of farms reported higher prices in VBSCs than wholesale (p_w), while 39% report that prices were the same in both channels, and 24% reported that prices were lower in VBSCs than in wholesale (Table 2, right half).

Cost Tradeoffs

Regardless of prices differences between VBSC and direct marketing outlets, production costs were the same for the majority of farms while marketing costs associated with direct sales tended to be higher, confirming findings by Hardesty and Leff (2010) and LeRoux et al. (2010). Certification costs were reported to be similar (72%) between the direct and VBSC marketing channels (Table 2, left half), while the 14% that reported that VBSC prices were higher than direct marketing prices were the most likely of any price group to report higher production (28%), certification (24%), post-harvest (48%), and marketing (46%) costs, indicating that some may have sought certifications or engaged in other special practices to participate in the VBSC that pays high prices for their products. It would still be rational for those farms to sell to the VBSC if the price premium compensated the higher costs.

The relative costs between VBSC and conventional wholesale are more ambiguous and vary more widely across farms. In all price and cost categories, the most common response was that VBSC and wholesale costs are the same (Table 2, right half). About half of the farms that reported higher

Table 2. Comparison Respondents' Perception of VBSC Prices (p_v) and Costs (c_v) with Direct Marketing Prices (p_d) and Costs (c_d) and Conventional Wholesale Prices (p_w) and Costs (c_w)

VBSC Compared to Direct Marketing Channels						VBSC Compared to Conventional Wholesale Channels					
Output Prices	Costs[a]	Production	Post-Harvest	Marketing & Selling	Certifications	Output Prices	Costs*	Production	Post-Harvest	Marketing & Selling	Certifications
$p_d < p_v$	$c_d < c_v$	28%	48%	46%	24%	$p_w < p_v$	$c_w < c_v$	35%	33%	27%	45%
14%	$c_d \sim c_v$	64%	48%	31%	64%	37%	$c_w \sim c_v$	58%	53%	41%	47%
	$c_d > c_v$	8%	4%	23%	8%		$c_w > c_v$	8%	14%	32%	6%
	Undet.	0%	0%	0%	4%		Undet.	0%	0%	0%	2%
	N[b]	25	25	26	25		N[b]	66	66	66	64
$p_d \sim p_v$	$c_d < c_v$	3%	7%	20%	17%	$p_w \sim p_v$	$c_w < c_v$	6%	9%	7%	8%
16%	$c_d \sim c_v$	87%	87%	63%	70%	39%	$c_w \sim c_v$	91%	84%	71%	86%
	$c_d > c_v$	10%	7%	13%	13%		$c_w > c_v$	3%	7%	20%	6%
	Undet.	0%	0%	3%	0%		Undet.	0%	0%	1%	0%
	N	30	30	30	30		N	70	70	70	71
$p_d > p_v$	$c_d < c_v$	6%	15%	17%	19%	$p_w > p_v$	$c_w < c_v$	9%	19%	23%	15%
69%	$c_d \sim c_v$	69%	46%	18%	72%	24%	$c_w \sim c_v$	77%	62%	40%	79%
	$c_d > c_v$	25%	36%	62%	8%		$c_w > c_v$	14%	17%	35%	5%
	Undet.	0%	3%	4%	1%		Undet.	0%	2%	2%	0%
	N	126	126	125	122		N	43	42	43	39

Note: Highlighted boxes indicate >50%, 40%–50%, and 30%–40%, respectively, of respondents that indicated the given price relationship also indicated the given cost relationship.

[a] Cost comparisons are VBSC costs relative to direct market or conventional wholesale costs, combining responses for labor and nonlabor components of each cost subcategory, e.g., strictly higher cost (>) means costs are strictly higher in VBSC than direct market/conventional wholesale channel; undetermined (undet.) means that survey response indicated either labor or nonlabor cost components of the category were higher while the other was lower, so strict total cost comparisons within the category cannot be determined.

[b] N = number of respondents in each price category that provided adequate responses to determine their cost outcomes.

prices in VBSC than wholesale reported that certification costs were higher in VBSCs, while the remaining farms indicated that certification costs were the same between the channels, pointing to certification being a potential avenue for price premiums in VBSCs.

Price and Cost Ratios

Each farm in each iteration is assigned price ratios (p_d/p_v, p_w/p_v) consistent with their survey response to calculate the unobserved counterfactual farm net returns in equation (3), representing what farms would earn if they were not selling to the VBSC. Where farms indicated the expected price relationships ($p_d/p_v \geq 1$, $p_w/p_v \leq 1$), secondary sources indicate that the ratio of direct marketing to VBSC prices ranges between 1.52 and 2.56 (Table 3; see Appendix A), while the ratio of wholesale to VBSC prices ranges between 0.38 and 0.9 (Table 3; see Appendix A). Where farms reported that price relationships are equal or reversed ($p_d/p_v \leq 1$, $p_w/p_v \geq 1$), plausible ranges are specified. These values are used as a base scenario, and we also test a high-price-disparity scenario and a low-price-disparity scenario to test a large range of plausible price differences between marketing channels (Table 3; see Appendix A).

Table 3. Marketing Channel Price Disparity Scenarios

		VBSC vs. Direct Marketing Channels		VBSC vs. Conventional Wholesale Channels	
Scenario Description	**Reported Relationship between Output Prices**	**Price Ratio Ranges**	**No. of Obs.**	**Price Ratio Ranges**	**No. of Obs.**
Base	Higher in VBSC	0.8–1[a]	26	0.38–0.9[b]	68
	Same	0.9–1.1[a]	30	0.9–1.1[a]	71
	Lower in VBSC	1.52–2.56[a]	126	1–1.2[a]	43
Low price disparity between channels	Higher in VBSC	0.9–1[a]	26	0.72–1.08[c]	68
	Same	0.95–1.05[a]	30	0.95–1.05[a]	71
	Lower in VBSC	1.21–1.82[c]	126	1–1.1[a]	43
High price disparity between channels	Higher in VBSC	0.7–1[a]	26	0.36–0.53[d]	68
	Same	0.85–1.15[a]	30	0.85–1.15[a]	71
	Lower in VBSC	1.73–2.56[b]	126	1–1.3[a]	43

[a] Values assumed based on secondary database lines and to conform to reported price relationships in survey data.
[b] Calculated based on secondary data, see Appendix A.
[c] Low/high end of base scenario ranges, +/− 20% to create range.
[d] Low end of range is same as base scenario (0.36) and high end of range is +40%.

Because farms did not report the magnitude of price and cost differences, secondary data are used to construct marketing cost-to-revenue ratio ranges for the simulation (Table 4) (Hardesty and Leff, 2010; LeRoux et al., 2010; King et al., 2010; Christiansen, 2017). The ranges of cost ratios overlap to allow for all reported cost relationships in the survey. We obtain VBSC net returns by multiplying VBSC revenue (R_v) in each iteration by a randomly drawn VBSC marketing cost ratio from the range in Table 4. Then, each farm's cost-to-revenue ratios for direct marketing and conventional wholesale (c_d, c_w) are randomly drawn in each iteration from the ranges in Table 4 to be consistent with the farm's reported cost relationships between channels and assigned VBSC marketing cost ratio.

Table 4. Marketing Channel Ratio of Marketing Costs to Revenue

Channel Type	Marketing Cost to Revenue Ratio Range	Source
All marketing channels	0.30–0.49	Christiansen (2017) and Hardesty and Leff (2010)
Wholesale marketing	0.20–0.50	Christiansen (2017); Hardesty and Leff (2010); King et al. (2010); and LeRoux et al. (2010)
Direct marketing	0.25–0.75	Christiansen (2017); Hardesty and Leff (2010); King et al. (2010); and LeRoux et al. (2010); direct marketing channels have a wider range, chose values between 25th and 75th percentiles from studies and consistent with expected relationship that direct marketing costs are higher than wholesale costs.

Allocation of VBSC Sales

Direct market allocation percentages (δ) are based on farmers' survey responses, in which they ranked the importance of each marketing channel, whether they had sold to each channel in the last year, and whether they planned to increase sales to various channels in future years. The secondary data indicate that the amount of additional product that can be sold through direct markets is bounded because of plateauing direct market sales in recent years (Low et al., 2015; O'Hara and Low, 2016). Table 5 shows the direct market allocation ranges for farms based on income level and revealed preference for direct markets: farms have a lower allocation percentage to direct markets if (i) they ranked direct marketing as less important than wholesale marketing and (ii) they have high income, which implies a limited ability to move additional high product volume through direct markets. Farms are randomly assigned a percentage for direct market allocation in each iteration based on their income and marketing preference responses (δ) from Table 5, then the remaining VBSC sales are allocated to conventional wholesale ($1-\delta$) to calculate the farm's counterfactual net returns without VBSC participation (equation 3) in each iteration.

Table 5. Direct Market Allocation Scenarios

	Sells Direct, Plans to Increase Direct, Prefers Direct to Wholesale		Sells Direct, Plans to Increase Direct		Others	
Income Group	*N*	Direct Allocation	*N*	Direct Allocation	*N*	Direct Allocation
\$0–\$99,999	22	0.20–0.80	8	0.10–0.50	21	0–0.10
\$100,000–\$499,999	29	0.20–0.80	9	0.10–0.50	22	0–0.10
\$500,000–\$999,999	9	0.10–0.50	3	0.05–0.25	8	0–0.05
\$1,000,000 or more	9	0.05–0.20	15	0–0.10	27	0–0.05

TOA-MD Analysis Results for VBSC Impact on Farm Net Returns

Each farm's net return with and without VBSC participation is calculated 1,000 times to find the distribution of possible farm net return outcomes for each farm, which is done for all 182 farms, abiding by their reported income, percentage of sales to VBSCs, price and cost tradeoffs between VBSCs, direct marketing, and conventional wholesale, and their preference and ability to sell more product through direct channels in the absence of their VBSC. This Monte Carlo–style simulation exercise using the TOA-MD framework simulates a distribution of vegetable and fruit farms with the characteristics of those that participated in VBSC marketing, giving us insight into the range of possible net economic benefits conferred by VBSC participation for this or a similar population of farms. Equation (1) is simulated under five combinations of base, low, and high price disparity scenarios (Table 6).

Table 6 summarizes the simulation results across income groups and price scenarios. The upper panel of Table 6 shows the average impact of VBSC participation for each income group and scenario. Comparing different scenarios, average VBSC impacts range from −$3,992 in Scenario D (high price disparity between direct and VBSC, similar prices between wholesale and VBSC) to $19,450 in Scenario E (similar prices between direct and VBSC, high price disparity between wholesale and VBSC), with an average net impact of $7,873 across all scenarios. The farms reporting the lowest income ($0–$99,999) have mean impacts between −$1,006 and $421, with an average negative impact across all scenarios, while the farms reporting the highest income ($1,000,000 or more) have mean impacts ranging from −$5,857 to $59,723, with an average positive impact across all scenarios.

The lower panel of Table 6 shows the percentage of iterations with 0 or positive impact for each scenario in each income group. The percentage of farms benefiting from VBSCs is lowest for midsize farms with income of $500,000–$999,999—only 29%–51% of farms show net benefits—and highest for farms with income of at least $1,000,000, showing 44%–65% benefiting. For the two middle income groups, results signal that the impact distributions are not symmetric in certain scenarios. In other words, there may be more "losers" than "gainers" from pursuing VBSC sales, but the aggregate gains in net income outweigh the aggregate losses.

For each income group, the lowest mean impact occurs in scenario D, a situation in which direct market prices are considerably higher than VBSC prices and wholesale prices only slightly lower than VBSC prices. About one-third of midscale farms have positive net benefits in this scenario, possibly because they are still allocating a significant percentage of their sales to direct markets (Table 5); without VBSCs, the simulation assumed that they would be able to increase their direct market sales to take advantage of the higher prices. Meanwhile, scenario E, a situation in which direct market prices are only slightly above VBSC prices and wholesale prices are considerably lower than VBSC prices, shows the highest net impact. Here, middle-income farms fare considerably better with VBSCs, likely with little ability to obtain high price premiums in direct markets, the VBSCs outperform a higher wholesale allocation with relatively lower prices. These cases illustrate the importance of the actual magnitude of price differences between channels when evaluating channel benefits and the value of including multiple price scenarios in the simulation.

Table 6. Simulation Results by Farm Gross Income and Price Scenario

Gross Income	*N*	Iterations	Scenario A		Scenario B		Scenario C		Scenario D		Scenario E		All Scenarios	
Mean Impact of VBSC on Farm Net Returns (US$)														
$0–$99,999	51	1000	−408	(17)	−436	(11)	−148	(22)	−1,006	(14)	421	(20)	−315	(8)
$100,000–$499,999	60	1000	−1,050	(82)	−765	(50)	477	(100)	−4,615	(71)	4,328	(89)	−325	(36)
$500,000–$999,999	20	1000	2,829	(255)	−2,050	(147)	7,708	(349)	−4,985	(159)	10,642	(349)	2,829	(121)
$1,000,000 or more	51	1000	30,684	(580)	−3,573	(324)	57,439	(810)	−5,857	(329)	59,723	(803)	27,683	(278)
	182		8,449	(170)	−1,601	(94)	17,058	(240)	−3,992	(97)	19,450	(238)	7,873	(81)
Percentage of Farms Benefiting from VBSC														
$0–$99,999	51	1000	45.7%		44.7%		46.6%		35.8%		55.0%		45.5%	
$100,000–$499,999	60	1000	42.4%		44.6%		44.2%		32.6%		55.6%		43.9%	
$500,000–$999,999	20	1000	41.8%		37.7%		45.3%		28.7%		51.1%		40.9%	
$1,000,000 or more	51	1000	60.4%		47.4%		62.9%		44.2%		64.6%		55.9%	
	182		48.3%		44.6%		50.2%		36.3%		57.4%		47.4%	

Note: Standard errors of mean estimates are reported in parentheses. The percentage of farms benefiting from VBSC is the percentage of positive impact values across all iterations and all farms in each income group. Scenario Definitions: A: Base; B: All low-price disparity; C: All high-price disparity; D: High disparity direct–VBSC, low disparity wholesale–VBSC; E: Low disparity direct–VBSC, high disparity wholesale–VBSC (see Table 3 for ranges).

Table 7 shows how price differentials differ for farms negatively and positively impacted by their VBSC participation. Of negatively impacted farms, 80% receive lower VBSC prices than direct market prices, as expected, but only 36% of those farms reported that their costs were lower in VBSCs than in direct markets. For positively impacted farms, the price and cost differences between direct markets and VBSCs were more uniform, where higher costs in VBSCs correspond to higher prices as well. For positively impacted farms reporting lower VBSC than direct market prices, cost differences were ambiguous. While VBSCs are unlikely to offer prices as high as direct markets, they could focus on lowering costs for farmers to improve net economic benefit to their participating farms.

Table 7. Percentage of Losers and Gainers from VBSC Participation that Reported Price and Cost Relationships between VBSC and Direct Markets and Conventional Wholesale Channels

VBSC vs. Direct Marketing Channels						**VBSC vs. Wholesale Marketing Channels**					
Compared to Direct, VBSC Prices Are			**Compared to Direct, VBSC Costs Are**			**Compared to Wholesale, VBSC Prices Are**			**Compared to Wholesale, VBSC Costs Are**		
Higher	**Same**	**Lower**	**Higher**	**Ambig.**	**Lower**	**Higher**	**Same**	**Lower**	**Higher**	**Ambig.**	**Lower**
Losers: Mean impact all scenarios < 0 (N = 111)											
6%	14%	80%	20%	44%	36%	14%	52%	34%	19%	68%	14%
Gainers: Mean impact all scenarios ≥ 0 (N = 71)											
27%	21%	52%	27%	41%	32%	75%	18%	7%	39%	30%	31%

Note: Highlighted boxes focus on the highest concentration of price-cost relationships; [dark grey box] indicates a high spread between price and costs in the channel associated with the losers and the gainers, while [light grey box] indicates a low spread between price and costs in the channels associated with losers and gainers.

There seems to be a much stronger price effect for conventional wholesale results. VBSC prices are reported to be higher by 75% of the positively impacted farms, while only 39% report that VBSC costs are higher; thus, many benefit from the price premium offered by VBSCs without incurring additional costs. For the negatively impacted farms, only 14% report higher prices in VBSCs than wholesale markets, while their cost differences are ambiguous. Relative to wholesale channels, VBSCs can benefit farms when they are able to maintain higher prices than conventional wholesale markets.

Survey Results for Nonmonetary Impacts of VBSC Participation

Farms consider more than prices and costs when choosing marketing channels. As LeRoux et al. (2010) point out, risk and volume are key considerations. Farmers also have preferences for marketing channels based on values, lifestyle, stress, and marketing experience. Given the inherent risk management benefit of a diverse marketing portfolio, VBSCs are another option with different characteristics to add to the mix.

Survey respondents were asked, "What benefits do you feel that marketing through (VBSC) offers?" and "What challenges do you face from selling through (VBSC)?" for their particular VBSC partner. Large majorities of all farmer respondents (not limited to those used in the simulation exercise) agreed with several benefits (Table 8), including "fits with my values," "access to new and larger markets," "predictable and/or timely payments," and "strengthened identity in the marketplace," each receiving agreement from over two-thirds of respondents. A slim majority reported "receive a premium for my products" as a benefit, which aligns with their responses to the price comparison with conventional wholesale. The only challenge that over 50% of the respondents agreed with was "[VBSC] won't take enough volume," indicating a desire to sell more through the VBSC given the opportunity. Although farmers indicated that certification costs were generally higher in VBSCs, they were not identified as a challenge in the survey, with food safety regulations, required production practices, organic certification, labor standards, and animal welfare standards at the bottom of the challenges list.

Table 8. Survey Reported Benefits and Challenges of VBSC Marketing

Benefit of VBSC	**Percentage Agree**
Fits with my values (*N* = 222)	87.8%
Access to new and larger markets (*N* = 227)	80.6%
Predictable and/or timely payments (*N* = 227)	79.3%
Strengthened identity in the marketplace (*N* = 225)	72.0%
My environmental values are communicated to consumers (*N* = 217)	65.0%
My commitment to the well-being of my community is communicated to consumers (*N* = 213)	63.8%
Marketing services (*N* = 226)	58.4%
Receive a premium for my products (*N* = 227)	53.3%
Strengthened connections with other businesses in the supply chain (*N* = 226)	47.3%
Network with other farmers (*N* = 225)	35.1%
Technical assistance regarding farming practices (*N* = 224)	13.4%
VBSC Challenges	**Percentage Agree**
They won't take enough volume (*N* = 132)	68.9%
Transportation and delivery logistics (*N* = 134)	35.8%
I don't have enough volume (*N* = 131)	26.0%
Variable and/or delayed payments (*N* = 134)	23.9%
Quality standards (*N* = 132)	22.0%
Finding enough, qualified labor (*N* = 134)	21.6%
Food safety regulations (*N* = 134)	18.7%
Required production practices (*N* = 134)	17.2%
Organic certification (*N* = 130)	7.7%
Labor standards (*N* = 134)	6.7%
Animal welfare standards (*N* = 116)	1.7%

Discussion and Conclusion

The simulation results indicate that average total net economic impacts from VBSC participation are positive, but slightly less than half of participants show a net economic benefit from participation. This is a plausible outcome for this sample of farms participating in VBSCs, considering that over half of local and regional marketing farms at the national level reported negative returns and only the top quartile in all farm scale categories reported positive returns on assets (Bauman, McFadden, and Jablonski, 2018). For AOTM farms, the net benefit from VBSC participation averaged across farms and scenarios was positive but suggests that fewer than half of farms gain more than the loss accrued by the remaining half. VBSC gains depend on the relative prices and costs of the marketing channel options, but the nonmonetary aspects of VBSCs are also important to farm participation.

Our results clarify who benefits from VBSC participation. First, as direct marketing prices increase relative to the cost of direct marketing and VBSC prices, VBSC participation is unlikely to provide higher farm net returns in cases where farms have direct marketing options. For the farmers in this survey, VBSCs offer lower prices, as expected, but do not seem to consistently lead to lower marketing costs compared to direct marketing. For some portion of farm output, the price–cost tradeoff in VBSCs does appear to be large enough to offset the revenue losses of choosing VBSCs over direct markets, or the VBSC allows farms to realize some revenue from direct marketing sort-outs and unpaid product. If direct market demand is plateauing in their area, farmers may turn to VBSCs as an outlet for additional sales (Born and Purcell, 2006; Park, Mishra, and Wozniak, 2014; Low et al., 2015; Ahearn, Liang, and Geotz, 2018; Bauman, McFadden, and Jablonski, 2018). While some midscale farms have found benefit from "downscaling" into direct markets to diversify their marketing portfolio, their ability to allocate a significant amount of product to direct markets may be limited, making VBSCs an important alternative (Matteson, 2017). The farms in this study specialize in vegetables and fruits, a mainstay of direct markets, where they have experienced success (Park , Mishra, and Wozniak, 2014; Bauman et al., 2017; Bauman, McFadden, and Jablonski, 2018).

VBSC participation may provide higher net returns when farms' alternative options fall in the conventional wholesale category: larger farms and those that specialize in products that are not well-suited to direct marketing. As expected, these gains increase when VBSC prices are relatively high compared to wholesale prices. For those who gained, 75% reported that VBSCs offer higher prices than conventional wholesale, while the cost of VBSC participation was similar (Table 7). VBSC product differentiation through farm certifications seems to be a successful strategy for obtaining price premiums, as the majority of farms reporting higher prices in the VBSC report higher certification costs, and certification costs were not rated as a challenge. Thus, it appears that VBSCs can be a beneficial marketing option compared to conventional wholesale if they can offer higher prices, more consistent payments, product differentiation (e.g., certifications), and positive business relationships (as shown in survey responses).

Across all simulations, VBSC participation had very small positive or negative economic impacts relative to farm income, suggesting that VBSC impacts are transitory for some (or all) farms or they adjust their participation and expectations of all marketing options. In this case, average impacts are close to 0, consistent with the economic theory that firms will enter an industry (or choose a particular practice) up to the point that the expected return is 0. Farms may also adjust their VBSC participation over time if they are in the process of scaling up production; indeed, the second-highest reason for choosing VBSCs was "access to new and larger markets," and the only challenge identified by a majority of farms was "won't take enough volume" (Table 8). When small commercial and midsize farmers scale up, increasing participation in direct markets requires high labor costs; successfully growing their operations requires expanding to higher-volume marketing channels and lowering per unit production costs through investments in mechanization and other infrastructure (Hardesty and Leff, 2010; LeRoux et al., 2010; Low et al., 2015; Ahearn, Liang, and Geotz, 2018; Bauman, McFadden, and Jablonski, 2018; Trant et al., 2018). Considering that a majority of respondents reported low product volume as a challenge, it could be that VBSCs are also growing their businesses. VBSCs and participating farms may be in a mutual growth phase, with the VBSCs developing the demand-side of their business or making strategic business decisions to work with as many farmers as possible to diversify their supply portfolio as they also seek to increase the volume of their businesses.

As for the benefits of VBSC participation for the AOTM sector, we first note that average commercial vegetables farms have relatively high gross income compared to all farms, so the benefits to the higher sales categories in the simulations could be consistent with benefits to some AOTM farms—these could be farms that have scaled up due in part to their VBSC participation. The results may also demonstrate the unique marketing challenges of AOTM fresh produce farms, which prefer direct markets more strongly than their larger counterparts (Tables 1 and 5), resulting in a negligible net benefit of VBSCs across all scenarios. It also provides insights on the assistance that could be provided by VBSCs to AOTM produce farms: As they scale up and move away from direct markets, VBSC marketing gives farms advantages over conventional wholesale if they increase prices relative to marketing costs, reduce marketing risks, and negotiate on volume constraints.

Our survey data and simulation results provide us with valuable categorical relationships between prices and costs across marketing channels to help farmers, VBSC managers, and advisors deliver better marketing information to farms. The results indicate a common thread in the economics of marketing channels: Farms incur larger costs to obtain higher prices, which can benefit farm economic viability. In the case of VBSCs relative to direct and wholesale channels, the key difference may be the spread between price and cost differentials between channels—the farms that showed least financial benefit from VBSCs reported that where prices were lower, accompanying costs were not proportionately lower. It is common that the impact (benefit or loss) is ambiguous when we consider a population of farms; that is, some will gain and some will lose. Furthermore, farms may still choose VBSCs for reasons which are not easily observed or modeled. Farms report choosing VBSCs because they "fit with my values," which could mean offering a marketing outlet that is consistent with their preselected production practices (e.g., sustainable practices, organic, local). Farms may also choose VBSCs for risk reduction and business connections as they grow and expand their business. There is no one perfect marketing mix for any type of farm across all time periods; each farm must evaluate the price–cost and other marketing channels tradeoffs for their own situation (Bauman, McFadden, and Jablonski, 2018). The results show us how the interplay of price and cost relationships between channels translates into channel choice impacts in a real-world farm population.

Acknowledgements

This research was supported by the Agriculture and Food Research Initiative of the National Institute of Food and Agriculture, U.S. Department of Agriculture, Grant No. 2015-68006-25646. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the United States Department of Agriculture.

We thank the farmers who returned surveys, the VBSCs who shared their farmer lists, and the project advisory committee, whose input made this work possible. We would also like to thank our colleagues from the USDA multistate research group NC 1198: Renewing an Agriculture of the Middle: Value Chain Design, Policy Approaches, Environment, and Social Impacts, whose ongoing efforts and comradery inspire and inform the research. We also thank the anonymous reviewers, whose insights strengthened the manuscript.

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Appendix A. Price Scenarios

Because our survey data only indicated whether VBSC prices were higher or lower than direct or conventional wholesale channels, the simulation exercise required us to develop plausible assumptions on price ratios between marketing channels consistent with survey responses to simulate the economic impact of VBSC participation. We use two different approaches to develop a range of plausible price relationships between marketing channels.

The first approach to developing an assumption on marketing channel price ratios uses information from secondary sources and USDA reports on wholesale and retail prices. In general, direct-to-consumer prices appear to be competitive with conventional retail prices (Gunderson and Earl, 2010; Martinez, 2016; Valpiani et al., 2016). Considering these findings, we assume that direct market prices are 10% lower than conventional retail prices, on average, for fruits and vegetables:

(A1) $$p_d = 0.90 p_r,$$

where p_r is retail price and p_d is the direct-to-consumer price for fruits and vegetables.

The USDA reports on the relationship between wholesale and conventional retail prices for the whole of the United States According to the USDA (2016, 2017a), wholesale prices for fruit are 38% of conventional retail and wholesale prices for vegetables are 26% of conventional retail, on average. We use the midpoint of these percentages (32%) to represent the relationship between wholesale and retail prices for fruits and vegetables in general:

(A2) $$p_w = 0.32 p_r.$$

These secondary sources do not provide explicit information on VBSC prices. Based on survey responses, roughly 76% of farms reported that VBSC prices are the same (39%) or greater than (37%) wholesale prices. As such, we assume that VBSC prices are 10% higher than wholesale prices (ratio of 1.10). The ratio of direct market prices to VBSC prices can be calculated using equations (A1) and (A2):

(A3) $$\frac{p_d}{p_v} = \frac{0.90 p_r}{1.10\left(0.32 p_r\right)} = \frac{0.90}{0.352} = 2.56,$$

which is used as an upper bound in the direct-to-VBSC price scenarios in Table 3.

A second approach is to utilize observed prices from different channels across the country to calculate price ratios. A handful of case studies have recorded prices and percentages of the retail price retained by producers for different products in different channel settings and locations across the United States. Table A1 reports these price observations and the percentage of retail price retained by the producer, net of marketing and processing cost.

Table A1. Secondary Data on Prices and Percentage of Retail Price Retained by Farm by Marketing Channel

	Wholesale		Direct Marketing		Intermediated	
Product	**Price (US$/lb)**	**Percentage of Retail Price Retained**	**Price (US$/lb)**	**Percentage of Retail Price Retained**	**Price (US$/lb)**	**Percentage of Retail Price Retained**
Apples (NY)[a]	0.26	35%, 47%, 60%	0.40	80%	0.26	36.00%
Berries (OR)[b]	0.86	27.00%	2.43	73%	2.53	46.40%
Spring mix (CA)[c]	0.79	12.00%	5.92	74%	3.00	50.10%
Cabbage (NY)[d]	0.16	26.00%	0.32	56%	0.19	26.60%
Potato (NY)[e]	0.27	45.30%	0.34	56%	0.22	36.90%
Fruit and vegetable average	0.47	36.00%	1.88	67.80%	1.24	39.20%

[a] The study looked at three mainstream retailers, producing this range based on the retail price at each location and the packing and shipping costs estimated. The producer percentage of mainstream price retained is fairly high because producers were also packer-shippers in this case, so the retained both the wholesale price and packing and shipping (which did not get paid to a third party). Intermediated market was average of sales to a retail store through distribution center, bulk and bagged apples, and selling to school districts through a wholesaler (Cuellar-Healey, 2013; King et al., 2010).

[b] Berries were sold to a retail grocery store as the intermediated buyer; the intermediated retail price was above mainstream retail and above direct marketed prices (King et al., 2010).

[c] Spring Mix was sold to a retail co-op grocery store in this case as the intermediated buyer.

[d] Conventional wholesale price averages three states based on USDA data. Direct was estimated from the retail price reported in the case study, subtracting marketing costs estimated based on Hardesty and Leff (2010) estimates of percentage of revenue spent on farmers' market for midsize farms. This case study did not include details on direct marketing supply chains. Intermediated is a regional sale from farm to wholesaler (Park, Gómez, and Clancy, 2017a,b).

[e] Conventional wholesale prices from national grower–shipper. Direct was estimated from the retail price reported in the case study, subtracting marketing costs estimated based on Hardesty and Leff (2010) estimates of percentage of revenue spent on farmers' market for midsize farms. This case study did not include details on direct marketing supply chains. Intermediated is a regional grower–shipper to wholesaler (Park, Gómez, and Clancy, 2017a).

Table A1 reports wholesale and direct market prices, and the intermediated price is used to represent VBSC prices. The observations on prices and percentage of the retail price retained are averaged to create index prices for each channel (last row). In general, the relative magnitudes of each index value are consistent with the relationships reported by most respondents ($p_d > p_v > p_w$). The price ratios between channels from this approach are calculated using the ratios of the price index values. The ratio of wholesale to VBSC prices is 0.38 and the ratio of percentage retail price retained is 0.92 between these channels. For direct marketing and VBSCs, the ratio of prices is 1.52 and the ratio of percentage retail price retained in 1.73. These ratios are also used in the direct to VBSC price disparity scenarios in Table 3.

These two approaches to approximating the price relationships between channels allow us to develop a range of price ratios that account for plausible price relationships that are higher or lower than the secondary data ranges and that appropriately account for each farms' survey report of price comparisons between channels. For instance, the base scenario for the direct market to VBSC prices for fruits and vegetables ranges from 1.52 to 2.56 based on the above calculations. To account for other price possibilities, we simulate a low price disparity scenario by setting the price ratio range closer to 1, with the farms that reported lower prices in VBSCs assigned a value centered on the low end of the base scenario range (1.52) plus or minus 20%, such that the prices assigned to those farms are strictly lower in VBSCs than direct markets in the simulations. High price disparity scenarios are also constructed by extending the price ranges and using secondary data results. We also construct price disparity scenarios for wholesale and VBSC comparisons using the same techniques (Table 3).

We also investigate whether reported price differences between each marketing channel varied by other farm characteristics. We found no statistically significant differences in reported farm gross income or percentage of sales to VBSCs (Table A2). The only statistically significant difference was that farms with smaller land area tended report that VBSC prices were lower relative to direct markets than farms with larger area (ANOVA *t*-test, $p < 0.01$) (Table A2). These differences are accounted for through the price ratio scenarios that are assigned to each farm based on their survey responses; however, the analysis focuses on farm income as a measure of farm size rather than acreage.

Table A2. Relationship between Farm Characteristics and Output Prices, VBSC to Direct Marketing and Wholesale

	VBSC vs. Direct Marketing				**VBSC vs. Conventional Wholesale**			
	Higher Prices in VBSC	**Same Prices in VBSC**	**Lower Prices in VBSC**	***p*-Value**	**Higher Prices in VBSC**	**Same Prices in VBSC**	**Lower Prices in VBSC**	***p*-Value**
Operated acres	239.1 (609)	674.5 (1,708)	172.3 (384)	0.01	339.8 (1,060)	270.3 (751)	136.5 (246)	0.44
Farm gross income								
$0–$99,999	23.1%	36.7%	27.0%		26.5%	23.9%	37.2%	
$100,000–$499,999	38.5%	13.3%	36.5%		30.9%	36.6%	30.2%	
$500,000–$999,999	15.4%	10.0%	10.3%		10.3%	8.5%	16.3%	
$1,000,000 or more	23.1%	40.0%	26.2%	0.39	32.4%	31.0%	16.3%	0.39
Percentage of total sales to VBSC	33.9%	25.0%	23.3%	0.26	28.9%	23.5%	21.7%	0.40
N	26	30	126		68	71	43	

Note: Operated acres and VBSC sales percentage values are averages. The standard deviation of farm size is shown in parentheses. For farm gross income categories, the percentages represent the percentage of farms in each price category with the corresponding income range (columns add to 100%). For operated acres and VBSC sales percentages, the *p*-values result from ANOVA. For gross income, the *p*-value results from Pearson's χ_2 test using the categorical income variable from the original survey.