Assessing the performance of food co-ops in the US

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas, February 6 – 9, 2016

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Abstract

Food cooperatives (co-ops) as a key component of the local food network play an increasingly important role in the US food system. Co-ops use various strategies to promote local products, ensure a greater commitment of members, and the profitability and sustainability of the business. This paper assessed the effectiveness of these strategies as perceived and appreciated by co-ops' members using survey data from a national study on eight large food cooperatives in the U.S. The survey identifies a wide range of attributes related to store and product characteristics, and marketing and management strategies. It asks interviewees to rank their co-op on these attributes on a Likert-scale of 0-4. Using Principal Component Analysis, we aggregate and combine information from the large number of rankings into a six major categories. Next, exploiting the hierarchical structure of the data with members nested within their respective co-ops, we use Hierarchical Linear Modeling methods to identify the factors that determine the perceived performance of co-ops. The results show that in general member has a strong positive perception of the performance of their co-ops in term of quality of the products, quality of the management and the service, and the physical quality of the store. We also find there is a lot heterogeneity among co-ops and member socio-demographic and economic characteristics are strongly correlated with their perception.

Key words: Food Network, Food Co-ops Performances, Hierarchical Linear Model

Introduction

There are evidences that preferences of consumers are shifting toward fresh, organic and locally produced products for which they have relatively high willingness-to-pay (Hu, Woods, & Bastin, 2009). The literature identify several factors as a driver of shift in preferences. The rise demand for local and organic foods is partly due to increasing concern to food safety. A study conducted by Liang & Michahelles (2010) in the Northeast regions of US shows that the strongest reasons for sourcing locally include environmental concerns, close relationship with producers, ethical concern and the participation in strengthening local economy. With the surge in consumers' interests in locally produced fresh and organic produces, food cooperatives (co-ops) and structures alike play an increasingly important role in the food system. In a nationwide consumer perception survey, Hartman Group (2008) finds that products purchased from food co-ops are believed to be healthier. Consumers also seem to care more about the origin, the production methods, and the social and environmental impact of their foods.

Co-ops are essential in creating a more locally based, self-reliant food economies. They also contribute to the increase in the supply, the accessibility and the affordability of healthy and fresh foods. In US, the number of food co-ops is increasing rapidly (Deller et al. 2009) and the share of food they supply is ever increasing (Pollan, 2008; Katchova & Woods, 2012). Unlike grocery stores, co-ops have uniquely distinctive business organization, which make them more and more interesting to study. Food co-ops connect together small-scale producers directly to consumers within a community for a mutually beneficial exchange. In general, co-ops within a community start with small investment in initial share by members and an annually membership fee that also serves as income (Deller et al. 2009). As such, co-ops are almost totally owned by members who are often also patrons.

The emergence and recent increase in importance of co-ops as local and regional food networks, and healthier alternatives to global corporate firms drives an increasing attention on the sustainability of their business model. The literature on local food and food co-ops is small but fast growing. (Martinez, 2010) and King (2010) provide a recent overview of the local food system and what differentia it from the mainstream food supply system. Katchova & Woods (2012) using a national survey of food co-ops managers find that food co-ops have a competitive advantage at least in the following aspects: merchandising, farmer assistance, price/quality negotiations, and farmer development factors. Kalogeras et al. (2007) find that the utility of co-ops members depends essentially on the attribute of the co-ops and the member owns characteristics. They argue that the satisfaction of members determines their commitment to the co-ops. In this line, Katchova and Woods (2012), using a survey on co-op member perception on their co-op find that most members rate their co-ops as excellent on various dimensions and the ratings are substantially better that the ratings that general shoppers give to their mainstream grocery stores.

The main finding from the literature on co-ops is that their sustainability depends to some extent on the profitability of the business, but most importantly on the satisfaction of members regarding organizational structure, the management and the business strategies of the co-ops. This satisfaction determines the commitment of members and consequently the viability of co-ops. This paper aims to contribute to the growing literature on food co-ops by evaluating the performance of food co-ops, as perceived by members on wide range of attributes. Building previous works by Katchova and Woods (2012), the paper extends the analysis, using econometric methods, to identify the socio-demographics and economic factors of members that explain their perceptions. The study is conducted from member perspective but integrated structural and organizational, marketing and communication aspects specifics to the cooperative themselves. It uses a consumer

survey of a large sample of seven food co-op members in the US. Members were asked to rate they food co-ops on a very large numbers of attributes using a Likert scale from 0 to 4. In this scale, a score of 0 implies that the co-ops does not have the attribute at all while a score of 4 is given when the member rate the co-op performance with respect to the attribute as Excellent.

Given the large number of attribute collected, we use data reduction method such as the Principal Component Analysis method to aggregate in the data attributed into few clusters of attributes that summarize the most important aspects that matter for co-op members. To understand what explain the variation in member assessment of their food co-ops performance on management and marketing, we develop and estimate a Hierarchical Linear Model in which variation in the score depends both on co-op characteristics and member characteristics. The remainder of the paper is structured as follows. In the next section, we present and discuss the methods used to analyze the data. The section 3 presents the data collection, measurement and some descriptive analysis. In section 4, we present and discuss the finding from the PCA and the main dimensions of food co-ops selected. The section 5 presents the finds from the econometric analysis of the determinant of food co-ops performance. The last section presents some concluding remarks and implications.

Methodology

Aggregation of attributes using Principal Component Analysis

There are several attributes that are important for members in evaluating their co-ops. In this study, we group the attributes in two categories. The first category groups all attributes related to the quality of the management, the physical characteristics of the store and the quality of the products sold. The second group concerns attributes that are related to the marketing and communication

strategies use by the co-ops. In total, we identify 13 management, store characteristics and quality attributes and 16 marketing and communication related attributes. For each attributes, co-ops members were asked to rate and give a score to their co-op on a Likert scale from 0 to 4.

Empirically, it is practically impossible to analyze meaningfully all these 29 attributes. Also many aspects are closely related or similar. One approach to circumvent this difficulty could to be arbitrarily group attributes into a few numbers of categories. However, this approach will require a subjective knowledge of the similarities or dissimilarities among different attributes. Instead, we rely on the empirical correlation in the data and invoke data reduction techniques such as Principal Component Analysis (PCA) to aggregate them into a few numbers without losing the overall picture provided by the all attributes. In this section, we explain briefly the approach of the PCA and how we apply it in our context.

Data reduction methods, also known as multivariate analysis, typically summarize and re-express the information in large data with fewer dimensions while capturing the maximum possible information from the original variables. In this paper we use Principal Component Analysis (PCA) which seeks to maximize the explained inertia by a set of orthogonal dimensions $z = (z_1, z_2, \dots, z_p)$ expressed as a linear combination $u = \left(u_1, u_2, \dots, u_p\right)'$ of the original variables $y = \left(y_1, y_2, \dots, y_p\right)$ in order to concentrate the analysis on a small number of them. The PCA solution derives the eigenvalues λ which are the variances of the associated factors z. The most important factors are selected using the Kaiser rule which recommends retaining factors with eigenvalues λ exceeding unity. The correlation $F = corr\ (y, u)$ between the original variables and the factors are termed as factor loadings. The subset of variables most highly correlated with a factor

characterizes this factor. These variables are used to name the corresponding factor and interpret its value accordingly.

The PCA produces a small number of new dimensions that captures the variation in the ratings. The score derived from the PCA are continuous variables and capture a continuum of rating. In practice, members were asked to rate the co-ops on a discrete scale. Thus, it might be hard to expect that two ratings different only by a small δ really capture different perceptions. For this reason and for simplicity, we dichotomize the continuous score obtained from the PCA into positive rating and negative rating in the sense of good performance and bad performance. The variables constructed are analysis using Hierarchical Model to account for both member and co-op specific factors in the explanation of the perceived performance. The choice of HLM as modeling technique is motivated by structure of data with members nested within their respective co-ops with the possibility of heterogeneity within and across food co-ops in the performances.

Econometrics method to analyze the determinants of co-ops performance

In this section, we explain the Multilevel Model used to analyze co-ops performance indicex obtained from the PCA. Since our dependent variable is binary, we consider the multilevel logistics model. Our dependent variables include the aggregate score Y_{ij} related to the management, store characteristics and quality of products aspects of food co-ops or marketing and communication strategies of the business by a member i of a co-op j. The variable $Y_{ij} = \log(p_{ij}/1 - p_{ij})$ where p_{ij} represents the probability that the member i ranks positively her co-op j according to the composite indicator derived from the PCA.

The perceived performance depends on the characteristics X of the member but also on the characteristics W of the food co-op she belongs to. With this data structure, the estimation of a

linear model or logistic model of the relationship between Y and X and W poses an econometric challenge (Bryk & Raudenbush, 1992). In fact, some of the main assumptions of OLS are violated. First, the members' assessment of food co-ops performance Y or equivalently the error terms in the regression model are likely to be correlated and inter-dependent. Second, the equality of the variances of errors for all observations in standard regression model is also violated because member of different co-op have different perceptions of their co-ops and different assessments. Finally there is an increase in model misspecification problem and Type I error.

To overcome these estimation issues and to account for the heterogeneity in food co-ops assessments, we take advantage of the hierarchical structure of the data and consider a Hierarchical Model, more specifically the Hierarchical Logistic Model (HLM). We start the estimation with an empty model to determine whether, on average, members from different food co-op evaluate differently their co-op. This model known in the HLM literature as Unconditional Random Intercept Model can be written as:

$$Member\ Level\ 1\ Model \quad : Y_{ij} = \beta_{0j} + u_{ij} \tag{1}$$

$$Co - op\ Level\ 2\ Model \quad : \beta_{0j} = \gamma_{00} + v_{0j} \tag{2}$$

$$Full\ Model \quad : Y_{ij} = \gamma_{00} + v_{0j} + u_{ij} \tag{3}$$

In this model, the intercept γ_{00} is a fixed effect summarizing the average rating score by co-ops members and v_{0j} is a random effect from co-op level. The percentage of variation in the dependent variable attributable to the co-ops level characteristics is $\rho = \frac{\sigma^2(v_{0j})}{\sigma^2(u_{ij})+\sigma^2(v_{0j})}$ and the percentage of variation in the score attributable to member characteristics is 1- ρ. If ρ is not too low, it is important to include co-ops level variables in the model. Also, if 1- ρ is not too low it is important to include first level variables. Incorporating co-ops levels variables is useful to account

for the variation in co-op performances. Thus, we estimate a Random Intercept Model with level 2 predictors as follow:

$$Member\ Level\ 1\ Model: Y_{ij} = \beta_{0j} + u_{ij} \quad (4)$$

$$Co-op\ Level\ 2\ Model: \beta_{0j} = \gamma_{00} + \gamma_{01}W_j + v_{0j} \quad (5)$$

$$Full\ Model: Y_{ij} = \gamma_{00} + \gamma_{01}W_j + v_{0j} + u_{ij} \quad (6)$$

W denotes co-ops levels variables and includes the size of the co-op in terms of number of members, number of local grower-vendors, annual sales; it also the type of product offered and the age of the co-op in term of how long it exists. γ_{00}, and γ_{01} are the fixed effects and v_{0j} is the random effect. Finally, we incorporate members owns characteristic X to account for their effect in the variation of assessment. The corresponding model is a Random Intercept Model with both levels 1 and 2 predictors and can be written as follow:

$$Member\ Level\ 1\ Model: Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + u_{ij} \quad (7)$$

$$Co-op\ Level\ 2\ Model: \beta_{0j} = \gamma_{00} + \gamma_{01}W_j + v_{0j} \quad (8)$$

$$Full\ Model: Y_{ij} = \gamma_{00} + \gamma_{01}W_j + \gamma_{10}X_{ij} + v_{0j} + u_{ij} \quad (9)$$

X denotes member levels variables and includes socio-economic and demographic data. γ_{00}, γ_{01} and γ_{10} are the fixed effects and v_{0j} and v_{1j} are the random effects. The models can be estimated using Full Maximum Likelihood (FML). The fixed effects are directly estimated while the random effect are summarized using their variances and covariances. A Log likelihood test of the HLM versus Linear Regression or the logistic regression can be computed. AIC and BIC can be used to assess the over quality of the different specifications.

Data and descriptive statistics

The data are obtained from two surveys of food co-ops general managers and food co-ops members in the U.S conducted by Katchova and Wood (2012). In a first step, the food co-ops surveys were administered by mail between December 2010 and March 2011 to a population of about 350 food co-ops across the U.S. About 59 of the responses were usable. In a second step 8 co-ops, of which 7 in the initial 59 surveyed, were selected for an extensive survey of their consumers. The manager survey collects data on the annual sales, the extent to which they follow various business strategies, their perception on various competitive advantages, the number of stores and the year the co-op was founded. The member survey collects data on perception of the performance of their respective for various attributes as well as demographics and socioeconomics characteristics. We merge the data from the general managers' survey with the data from the members' survey.

The table 1 provides some descriptive results on the reported rating of co-ops attributes by the members. Most members rate their co-ops as excellent in most attributes including cleanness and neatness of the store, the quality of the products and the services as well as the local origin and organic nature of the products. Most of the other management, store characteristics and quality of the products attributes are rated as fair or good or excellent. The score for the marketing are communication attributes are more uniformly distributed over the different scale of rating. A large percentage of interviewees report that their co-ops do not have good farmer-related communication strategies or do not do online communication and social media.

Table 1: Distribution (percentage) of the perceived performance of co-op on various attributes

Variable	Not Available	Poor	Fair	Good	Excellent
Management, store characteristics and quality of products					
A clean, neat store	0.06	0.44	1.45	20.24	77.81
High quality fruits and vegetables	0.33	0.67	3.11	23.25	72.64
Courteous, friendly employees	0.06	0.5	3	18.52	77.92

High quality meats	21.52	0.28	1.95	19.52	56.73
Store layout that makes it easy to shop	0.11	2.06	9.57	39.04	49.22
Low prices	0.28	6.9	43.27	43.1	6.45
Paying attention to special requests or needs	15.91	1.28	3.34	23.8	55.67
Fast checkout	0.11	0.61	6.84	37.15	55.28
Having nutrition and health information available for shoppers	3.34	1.06	5.67	35.21	54.73
Offers locally grown produce and other local packaged foods	0.17	0.5	2.11	17.91	79.31
Offers organic food including produce and packaged	0.33	0.61	1.45	16.52	81.09
Convenient location	0.22	1.45	8.84	29.64	59.84
Accurate shelf tags	0.83	0.78	2.22	29.64	66.52
Marketing and communication strategies of the business					
Farmer photos displays	18.3	9.9	28.09	31.15	12.57
Farmer stories displays	17.96	11.0	30.14	30.37	10.51
Use of farm brands	6.67	1.89	10.62	43.83	36.99
End caps or special displays	6.23	1	10.9	46.27	35.6
Product sampling	3.06	3.78	19.8	39.99	33.37
Promotion of seasonal products	1.84	0.95	7.84	40.21	49.17
Cross-promotion with other products	16.24	2.61	21.41	40.77	18.97
Farmer-led sampling	21.02	12.2	27.03	28.7	11.01
Newsletters	1.39	0.95	5.73	33.43	58.51
Social media/Facebook, etc.	32.04	1.89	9.84	29.59	26.64
Website	13.68	0.78	8.73	40.99	35.82
On-site festivals	14.68	1.78	13.63	38.6	31.31
Deli features	10.51	1.61	11.96	38.32	37.6
Sponsorship of off-site local food events	18.52	1.5	10.9	33.43	35.65
Staff knowledge on local products	6.4	0.56	4.73	36.37	51.95
Use of blogs	66.63	2.95	10.34	14.79	5.28

Results

Aggregation of attributes and identification of the main dimension of Food co-op performance

We consider two categories of attributes and conduct two different PCA, one on the set variables related to management, store characteristics and quality of products and the second on the set of variables related to marketing and communication. Before running the PCA, we use the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to check if our variables display a sufficiently high correlation for a valid PCA. The overall KMO index for the group of attributes related to management, store characteristics and quality of products is 0.8571. The overall KMO for the second group of variables is 0.8559. All the individual variables KMO are also larger than 0.70. This suggests that our sample has a satisfactory adequacy for a valid PCA.

An important output of the PCA is the eigenvalues which capture the individual contribution

of each factor to the overall inertia of the data. The eigenvalues and their contributions in the explained variation resulting from the PCA are presented the table A1 and A2 of the appendix for the first and second groups of variables respectively. Figure 1 and 2 present the corresponding scree plots. We adopt the Kaiser's rule that recommends retaining in the rest of the analysis only factors with eigenvalues λ exceeding unity. Thus, three factors with eigenvalues λ exceeding unity are retained for each analysis. These three factors explained together 46% of the variation in the data for the first PCA (PCA 1) and 49% of the variation in the data for the second PCA (PCA2). Also, all the remaining factors explain, individually, considerably less variation. Given the large number of variables in our data with discrete values, these percentages of variation explained are generally considered acceptable.

We apply orthogonal varimax rotation to the factor loadings matrix in order to make most factors loading on the retained factors while preserving their independence. Table A3 and A4 present the component loadings which represent the correlation between the components and original variable. Figures 3 and 4 are graphical presentations of the factors loadings.

Figure 1 Scree plot of eigenvalues after PCA1

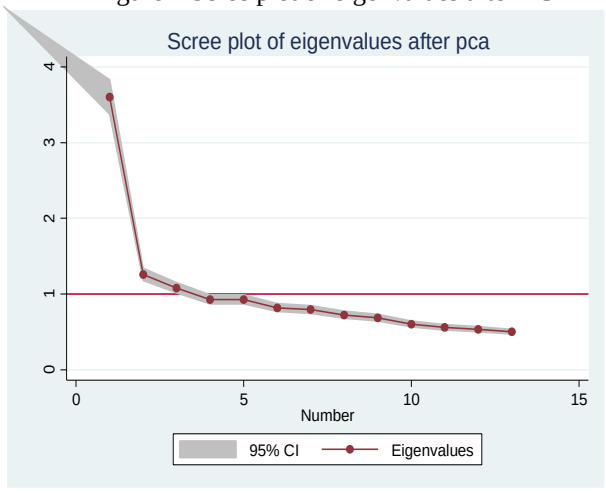


Figure 2: Scree plot of eigenvalues after PCA2

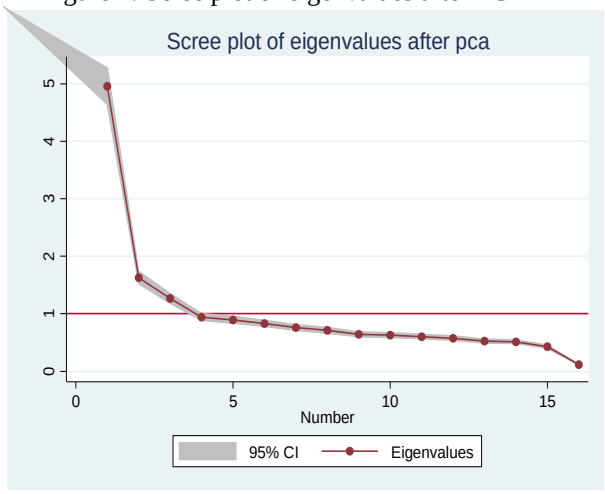
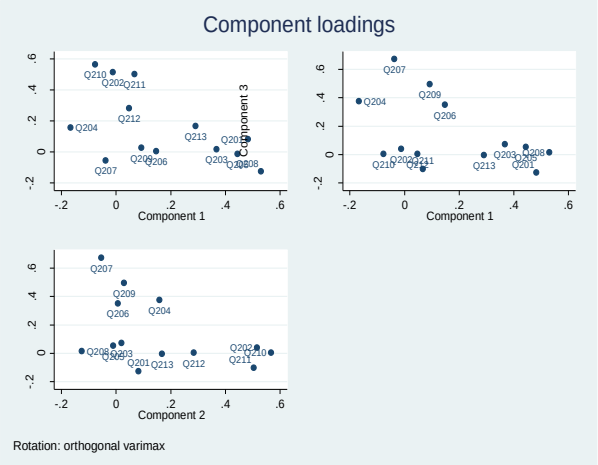
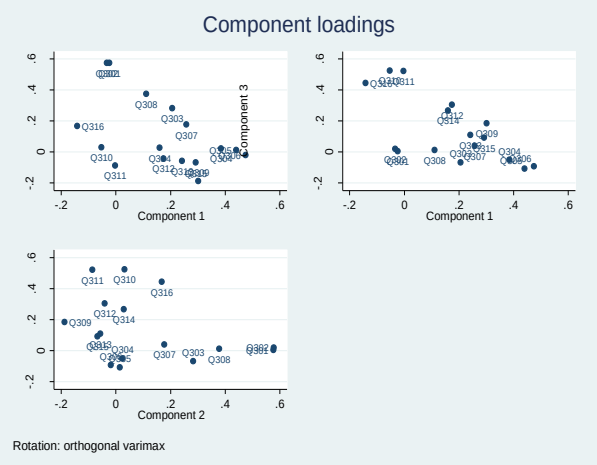


Figure 4: Component loadings after rotations PCA1

Figure 5: Component loadings after rotations PCA2





The first PCA is performed on the variables related to management, store characteristics and quality of products. The variables with high correlation with the first factors are the cleanness and neatness of the store, accuracy of the shelf tags, easiness of the store layout for shopping, quality of the employees as well as some quality variable related to product. This first factor is difficult to name because it captures most of the variation in the data. However, based on the variables with the highest correlation with this factor, we can characterize it as a factor capturing mostly variables related to the store characteristics. The second factor is associated to the high quality of products (meat, fruits and vegetables) served and the extent to which the produce are organic and locally grown. We characterize this factor as capturing the quality of the produces sold in the store. The third factors is positively correlated to the low price of the items sold, the management quality in terms of paying attention to special requests of costumers, providing nutrition and health information and fast checkout. We characterize this third factor as capturing the quality of the management and the service to the members.

The second PCA concerns promotion, marketing and communication strategies. The variables most associated with the first factor include product sampling, promotion of seasonal products, end caps or special displays and use of newsletters. We characterize this factor as on site promotion

strategies with higher value corresponding to positive perception of the co-ops members. Farmer photos displays, Farmer stories displays, use of farm brands and Farmer-centered samplings are the variables most represented on the second factor. This factor can be characterized as farmer-centered promotion strategies. The third factor is related to online communication strategies with Social media/Facebook, website and blogs being the variable most represented.

Figures A1 and A2 I the appendix present the loading of members on the first three dimensions. In the figure 8 (a)-(f), we present the kernel density estimates of the scores. The distribution of the new dimensions obtained from the PCA seems all to be centered on 0 with important variations across individuals. As we argue before, the continuous nature of the new score contrasts with the discrete nature of the original ratings on the individual attributes. A cut off point of 0 is arguably a good candidate to split the score into positive (good) and negative (bad) perceived performance.

Next, we can analysis the binary values in order to conduct a disaggregated analysis on the determinant of co-ops performance as perceived by their members. We use a Hierarchical Logistic Model described in the methodology section. As before we distinguish the set of attributes related to management, store characteristics and quality of products from the set of attributes related to marketing and communication strategies.

Determinants of performance on management, store characteristics and quality of products

To analyse the factors that explain the variation in members' perceived performance of their food co-ops, we develop and estimate a Hierarchical Logistic Model in which variation in the score depends both on co-op characteristics and member characteristics. We start by an `empty' model corresponding to the equations (1)-(3) of the methodology section. The results presented in columns (1), (4) and (7) of table 2 suggest that there is small but not significantly different from

zero variation from co-op level characteristics in the member perception both for the management, store characteristics and product quality dimensions. Columns (2), (5) and (8) add co-ops level variables in the model while columns (3), (6) and (9) estimate the full model with both co-ops levels and members' levels predictors. There is a slight drop in the variance of the residual when additional controls variables are added. The AIC and BIC suggest that the full model has a better fit of the data. Thus we will concentrate the interpretation of the results on these models.

The results for the determinant of the management, store characteristics and products quality of the co-ops show that there are number of variables that have a significant power in explaining co-op performance as perceived by their members. We find that larger co-ops in term of number of growers and vendors, and size of the personnel tend to receive lower ratings with respect to the quality of the store. However, when it comes to quality of the products sold, the rating are much higher. This could be explained by the fact large co-ops are not really seen as community-business thus less positively rated. However, large number of member certainly implies a great variety of products in display and thus greater choice set for members which is certainly much appreciated. We also find increase in the membership of co-ops in consumers is positively associated on their performance with store characteristics but negatively with the performance on product quality. Large number of consumers implies a great diversity of preferences to satisfy which could be hard to achieve. Also, the longer a co-op exists and has been operating, the greater is it experience and its ability to adjust many characteristics of the store of to please members, but this does not necessarily translated into higher quality products. Interestingly, we found that none the variables related to the co-ops are significant in explaining member perception of the quality of the management and the service. It should be noted however that the variables we collected and include in the analysis are essentially related to the store and non to the manager or the personnel.

Besides, co-ops related variables, there are numbers of factors associated to members that explain co-ops performance. For instance, we find that female, highly educated and white members tends to be negative in their ratings. This effect is significant for the dimension related to store characteristics. However, older members and members who have a long and great shopping relationship with the co-ops purchasing large quantity of goods tend to be more clement in their ratings. There is no significant effect of the member income and the place of residence for the quality of the products and the management but being in rural areas is associated with a negative rating on the store characteristics

Table 7: Hierarchical Logistic Model for the determinant of the performance on management, store characteristics and quality of products

	Store characteristics			Quality of the products			Quality of the management and the service		
	(1)	(3)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fixed Effects									
Constant	0.2175	-1.6137***	-0.7106	0.6626***	1.7387***	1.7022**	0.2826***	-0.5731	-1.1563*
	(0.1870)	(0.4155)	(0.6953)	(0.1492)	(0.4318)	(0.7034)	(0.0473)	(0.4157)	(0.6617)
Number of local		-0.0027***	-0.0035***		0.0039***	0.0032***		0.0011	0.0013
grower- vendors		(0.0009)	(0.0010)		(0.0010)	(0.0011)		(0.0009)	(0.0010)
Number of stores		0.1119	0.2049		-0.0911	-0.0409		-0.0788	-0.0831
		(0.1243)	(0.1407)		(0.1199)	(0.1344)		(0.1179)	(0.1317)
Number of		0.0084***	0.0088***		-0.0093***	-0.0077***		0.0025	0.0025
members		(0.0017)	(0.0020)		(0.0017)	(0.0020)		(0.0016)	(0.0019)
Number of		-0.0136***	-0.0151***		0.0083***	0.0060***		-0.0018	-0.0026
employee FTEs		(0.0015)	(0.0018)		(0.0016)	(0.0018)		(0.0015)	(0.0017)
demd		0.0746***	0.0760***		-0.0376**	-0.0271		0.0223	0.0254
		(0.0159)	(0.0180)		(0.0157)	(0.0177)		(0.0156)	(0.0175)
Member gender			-0.3482***			-0.1968			-0.3586***
			(0.1269)			(0.1284)			(0.1215)
Place of residence			-0.3919***			-0.0793			-0.0595
			(0.1142)			(0.1144)			(0.1082)
Ethnicity			-0.2640*			-0.1614			-0.1471
			(0.1540)			(0.1568)			(0.1484)
Education level			-0.7212*			-0.2929			-0.0508
			(0.4119)			(0.3912)			(0.3576)
Member age			0.0008			-0.0045			0.0089**
			(0.0047)			(0.0048)			(0.0045)
Member Annual			-0.0000			0.0000			0.0000
income			(0.0000)			(0.0000)			(0.0000)
Duration of			0.0020			-0.0098			0.0035
membership			(0.0089)			(0.0086)			(0.0084)
Total purchase			0.0062***			0.0086***			0.0061***
from of the co-op			(0.0021)			(0.0021)			(0.0020)
Random Effects									
Var (_cons)	0.21460	4.11E-22	1.41E-18	0.12351	1.21E-23	3.23E-21	2.73E-15	2.48E-19	7.08E-20
	(0.12538)	(2.12E-12)	(1.28E-10)	(0.07789)	(3.50E-13)	6.18E-12)	(1.03E-08)	v4.72E-11)	(2.71E-11)
AIC	2386.825	2375.566	2044.67	2320.811	2311.708	2000.968	2496.552	2498.525	2184.451
BIC	2397.843	2414.128	2125.373	2331.828	2350.269	2081.672	2507.57	2537.087	2265.155
Observations	1,824	1,824	1,604	1,824	1,824	1,604	1,824	1,824	1,604
Number of groups	7	7	7	7	7	7	7	7	7

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 . The dependent variables are dummy variables with 1 corresponding to a positive score as measure by the factor obtained from the PCA

Determinants of co-ops' performance on marketing and communication strategies

The results of the Hierarchical Logistic Model applied on the set of attributed related to co-op performance on marketing and communication strategies are presented in the tables 3. This disaggregated analysis highlights important features not observed in the analysis for the attributes related to the store, the product and the management. We find that the number of growers-vendors is positively associated with high perceived performance for all components but this effect is significant at conventional levels for the dimension related to on-site promotion strategies. We also find that, the number of store in the co-ops network has a negative association with the perceived performance online communication strategy and a positive association with the perceived performance on farmers centered promotion strategies. These results suggest that having a great number of stores which allow organizations on of site activities centered on producers to attract shoppers should not divert co-ops from using active online technologies for promotion and communication. Another finding is related to the negative linking between the number of members and the perceived performance on farmers centered promotion strategies on one hand and it is positive link with online communication strategies. An opposite relationship is observed for the number of personnel f the co-op. The results for the characteristics of members in the disaggregated analysis are similar to those for the previous analysis with minor variation across components.

Table 3: Hierarchical Logistic Model for the determinant of the performance on marketing and communication strategies

	On site promotion strategies			Farmers centered promotion strategies			Online communication strategies		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fixed Effects									
Constant	0.1296***	-0.2624	-0.3595	0.3002	0.3426	1.5377**	0.2683**	-0.9823**	0.0489
	(0.0469)	(0.4063)	(0.6549)	(0.2465)	(0.4608)	(0.7593)	(0.1336)	(0.4099)	(0.6602)
Number of local		0.0005	-0.0002		0.0019**	0.0012		0.0029***	0.0021**
grower- vendors		(0.0009)	(0.0010)		(0.0009)	(0.0010)		(0.0009)	(0.0010)
Number of stores		-0.0209	0.0108		0.3364***	0.4558***		-0.2932**	-0.2456*
		(0.1168)	(0.1311)		(0.1189)	(0.1337)		(0.1174)	(0.1309)
Number of		0.0001	-0.0001		-0.0101***	-0.0078***		0.0046***	0.0061***
members		(0.0016)	(0.0019)		(0.0016)	(0.0019)		(0.0016)	(0.0019)
Number of		-0.0007	-0.0014		0.0082***	0.0062***		-0.0026*	-0.0045***
employee FTEs		(0.0015)	(0.0017)		(0.0015)	(0.0017)		(0.0015)	(0.0017)
Co-op age		0.0118	0.0162		-0.0234	-0.0113		0.0311**	0.0358**
		(0.0153)	(0.0173)		(0.0166)	(0.0192)		(0.0154)	(0.0172)
Member gender			-0.4794***			-0.2338*			-0.3380***
			(0.1219)			(0.1246)			(0.1215)
Place of residence			0.0099			0.1295			-0.0253
			(0.1079)			(0.1099)			(0.1079)
Ethnicity			-0.6094***			-0.0556			-0.1155
			(0.1496)			(0.1525)			(0.1491)
Education level			-0.1558			-1.1511***			-0.5271
			(0.3565)			(0.4190)			(0.3700)
Member age			0.0008			-0.0150***			-0.0139***
			(0.0045)			(0.0046)			(0.0045)
Member Annual			0.0000			-0.0000			0.0000
income			(0.0000)			(0.0000)			(0.0000)
Duration of			0.0004			0.0000			0.0096
membership			(0.0083)			(0.0085)			(0.0083)
Total purchase			0.0061***			0.0037*			0.0011
from of the co-op			(0.0020)			(0.0020)			(0.0020)
Random Effects									
Var (_cons)	1.98E-22	2.52E-21	7.94E-22	0.390008	1.24E-14	7.67E-18	0.09079	1.44E-19	1.52E-15
	(1.40E-12)	(4.72E-12)	(2.89E-12)	(0.23846)	(1.59E-08)	(3.74E-10)	(0.072418)	(3.85E-11)	(4.36E-09)
AIC	2524.962	2533.002	2194.279	2450.522	2442.585	2111.557	2514.88	2507.79	2197.596
BIC	2535.979	2571.563	2274.983	2461.54	2481.146	2192.261	2525.897	2546.352	2278.3
Observations	1,824	1,824	1,604	1,824	1,824	1,604	1,824	1,824	1,604
Number of groups	7	7	7	7	7	7	7	7	7

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 . The dependent variables are dummy variables with 1 corresponding to a positive score as measure by the factor obtained from the PCA.

Conclusion

Food cooperatives are growing fast in the US and are also playing an increasingly important role in the local food system. As such it is important that their innovative business model remain profitable and sustainable. A precondition of this success is the satisfaction of co-ops members who are the main customers as well as owners of the co-ops. This study analysed the assessment of co-ops performance by members with respects to number of attributes using survey data from a national study on eight large food cooperatives in the U.S. The survey use the existing literature to identify a number of attributes related to store and product characteristics, and marketing and management strategies and asks members to rank their co-op on these attributes.

The data is analysed using various statistical and economics methods. First, we use data reduction techniques like the Principal Component Analysis to aggregate and combine information from the large number of attributes into a six major categories. Next, exploiting the hierarchical structure of the data with members nested within their respective co-ops, we use Hierarchical Linear Modeling methods to identify the factors that explains the performance of co-ops as perceived by their member. The results show that in general member has a strong positive perception of the performance of their co-ops in term of quality of the products, quality of the management and the service, and the physical quality of the store. We also find there is a lot heterogeneity among co-ops and member socio-demographic and economic characteristics are strongly correlated with their perception.

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Appendix

Table A1: Principal components, eigenvalues, and proportion of variance explained of PCA1

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.60	2.34	0.28	0.28
Comp2	1.26	0.17	0.10	0.37
Comp3	1.08	0.15	0.08	0.46
Comp4	0.93	0.00	0.07	0.53
Comp5	0.92	0.11	0.07	0.60
Comp6	0.82	0.03	0.06	0.66
Comp7	0.79	0.07	0.06	0.72
Comp8	0.72	0.04	0.06	0.78
Comp9	0.68	0.08	0.05	0.83
Comp10	0.60	0.04	0.05	0.88
Comp11	0.56	0.02	0.04	0.92
Comp12	0.53	0.03	0.04	0.96
Comp13	0.50	.	0.04	1.00

Table A2: Principal components, eigenvalues, and proportion of variance explained of PCA2

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.96	3.33	0.31	0.31
Comp2	1.63	0.36	0.10	0.41
Comp3	1.26	0.32	0.08	0.49
Comp4	0.94	0.05	0.06	0.55
Comp5	0.89	0.06	0.06	0.61
Comp6	0.83	0.07	0.05	0.66
Comp7	0.76	0.05	0.05	0.70
Comp8	0.71	0.07	0.04	0.75
Comp9	0.64	0.01	0.04	0.79
Comp10	0.63	0.03	0.04	0.83
Comp11	0.60	0.02	0.04	0.87
Comp12	0.58	0.05	0.04	0.90
Comp13	0.52	0.01	0.03	0.93
Comp14	0.51	0.08	0.03	0.97
Comp15	0.43	0.31	0.03	0.99
Comp16	0.11	.	0.01	1.00

Table 4: Factor loadings and proportion of variance unexplained of PCA1

Variable	Description	Comp1	Comp2	Comp3	Unexplained
Q201	A clean, neat store	0.33	-0.31	-0.22	0.43
Q202	High quality fruits and vegetables	0.33	0.37	-0.15	0.41
Q203	Courteous, friendly employees	0.29	-0.24	0.00	0.63
Q204	High quality meats	0.12	0.29	0.31	0.74
Q205	Store layout that makes it easy to shop	0.32	-0.32	-0.01	0.52
Q206	Low prices	0.23	-0.05	0.30	0.70
Q207	Paying attention to special requests	0.19	0.10	0.64	0.42
Q208	Fast checkout	0.29	-0.46	-0.02	0.43
Q209	Have nutrition and health information	0.26	0.03	0.43	0.55
Q210	Offers locally grown produce and other local packaged foods	0.31	0.44	-0.19	0.38
Q211	Offers organic food of all kinds, including produce and packaged	0.33	0.28	-0.29	0.43
Q212	Convenient location	0.21	0.16	-0.11	0.79
Q213	Accurate shelf tags	0.30	-0.09	-0.11	0.65

Table 6: Factor loadings and proportion of variance unexplained of PCA2

Variable	Description	Comp1	Comp2	Comp3	Unexplained
Q301	Farmer photos displays	-0.02	0.58	0.01	0.18
Q302	Farmer stories displays	-0.03	0.58	0.02	0.17
Q303	Use of farm brands	0.21	0.28	-0.07	0.58
Q304	End caps or special displays	0.38	0.02	-0.05	0.57
Q305	Product sampling	0.44	0.01	-0.11	0.49
Q306	Promotion of seasonal products	0.47	-0.02	-0.09	0.42
Q307	Cross-promotion with other products	0.26	0.18	0.04	0.56
Q308	Farmer-led sampling	0.11	0.38	0.01	0.48
Q309	Newsletters	0.30	-0.19	0.19	0.61
Q310	Social media/Facebook, etc.	-0.05	0.03	0.53	0.43
Q311	Website	0.00	-0.09	0.52	0.46
Q312	On-site festivals	0.17	-0.04	0.31	0.60
Q313	Deli features	0.24	-0.06	0.11	0.76
Q314	Sponsorship of off-site local food events	0.16	0.03	0.27	0.62
Q315	Staff knowledge on local products	0.29	-0.07	0.09	0.70
Q316	Blogs	-0.14	0.17	0.45	0.53

Figure A1 Member loadings after rotations PCA1

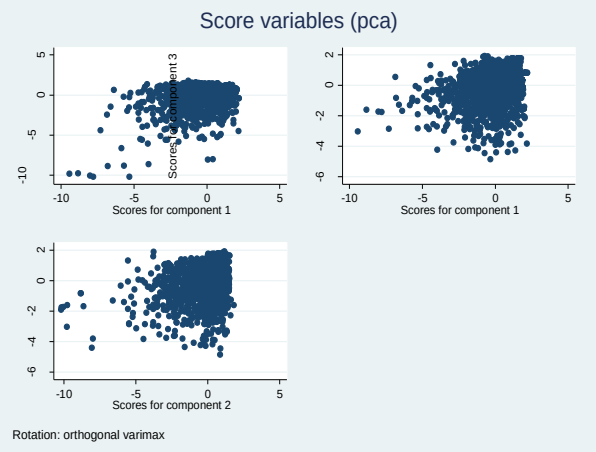


Figure A2: Member loadings after rotations PCA2

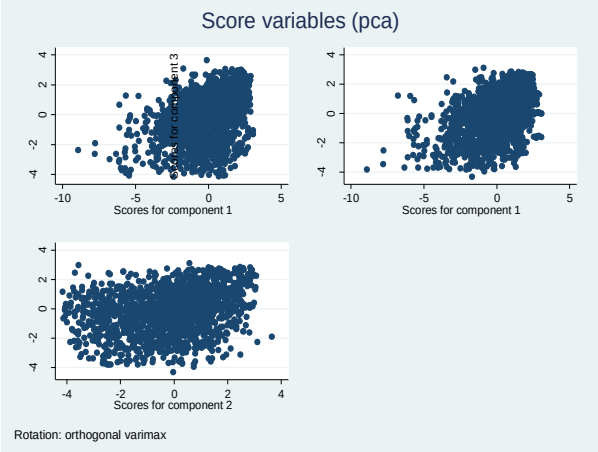
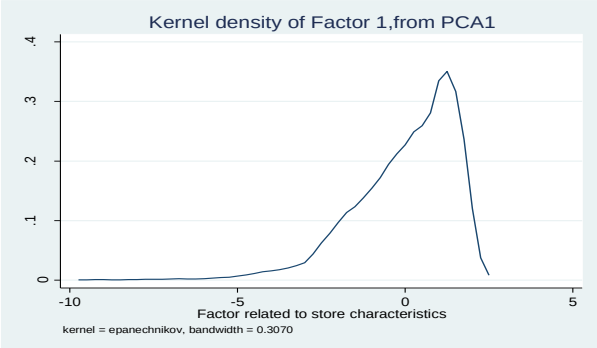


Figure A3 Kernel density of the factors on PAC1 and PCA2

(a)



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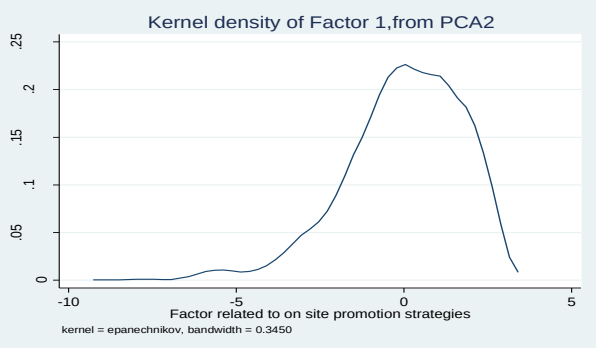

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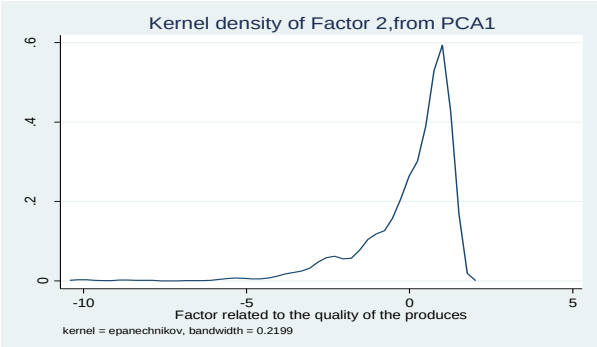
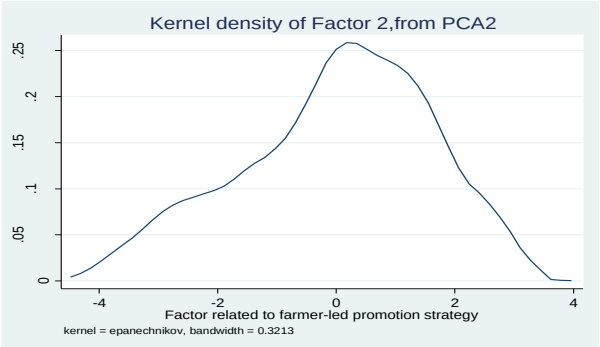
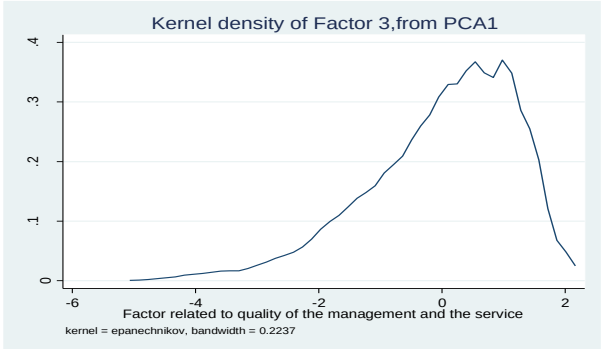


(d)



(e)



(f)