Received 9 September 2023
Revised 14 February 2024
Accepted 22 February 2024

A comparative study of capital structure compositions in grain marketing and input supply cooperatives

Jasper Grashuis
Department of Agricultural and Applied Economics, University of Missouri-Columbia, Columbia, Missouri, USA, and
Keri Jacobs
University of Missouri, Columbia, Missouri, USA

Abstract

Purpose – The objective of the study is to explore explanations for the capital structure compositions of farmer cooperatives, which have a unique equity structure with allocated equity as well as unallocated equity.
Design/methodology/approach – Data came from a panel of US grain marketing and input supply cooperatives for the 2010–2020 period. The study is concerned with the proportions of debt, allocated equity and unallocated equity, which requires the application of a fractional multinomial panel model to ensure predictions fall within the observed data range (i.e. 0–1).
Findings – Larger cooperatives have relatively high debt proportions. Diversification of the product portfolio has a positive effect on the debt proportion. Profitability is associated with higher debt proportions in input supply cooperatives and higher allocated equity proportions in grain marketing cooperatives. Over time, the proportion of unallocated equity increased. Overall, some results differ across grain marketing and input supply cooperatives.
Practical implications – Increasing proportions of unallocated equity warrant a debate about the future value of ownership and governance by members of farmer cooperatives.
Originality/value – Previous empirical investigations of the capital structure compositions of cooperatives lacked a distinction between allocated and unallocated equity. Our results show that the proportions of the two equity accounts respond differently to given predictors. Furthermore, much of the prior empirical literature fails to separate cooperatives on the basis of economic activities (i.e. marketing, supply and mixed).

Keywords Capital structure, Agricultural cooperative, Panel study
Paper type Research paper

Introduction

A firm's capital structure refers to its use of debt and equity to fund assets. In farmer cooperatives, however, equity is bifurcated into allocated equity (i.e. assigned to individual members) and unallocated equity (i.e. unassigned to individual members). In open membership cooperatives, both types of equity are primarily generated from annual profitability but differ in terms of rights and cost perceptions and return expectations.

In many agricultural cooperatives, annual profits are allocated to members based on each member's proportional business done with or through the cooperative [1]. The profit distribution is called patronage, which can be issued as cash to the member/patron or as equity in the cooperative. The equity issued from patronage is *allocated equity*, and it is non-transferrable, non-appreciable, and redeemed to members at par value at some point in the future at the discretion of the cooperative. Patronage allocations – equity and cash – are a direct benefit of doing business with a cooperative, which is distinct from equity dividends issued by corporations.

As part of the profit allocation decision, cooperatives choose how much of the annual profit to distribute. Based on cooperative and tax law, a cooperative has discretion to

Agricultural Finance Review
Vol. 84 No. 1, 2024
pp. 52-66

0002-1466
DOI 10.1108/AFR-09-2023-0112

distribute less than 100% of member- or patronage-based profits. Profit from non-member and/or non-patronage sources is not allocated as part of patronage. Profit sourced from non-patronage is retained by the cooperative as *unallocated equity*. Unlike allocated equity, unallocated equity has no redemption feature; it is considered permanent equity and the collective (undivided) interest in the cooperative, which is only accessible through demutualization or sometimes upon merger or acquisition. The U.S. Department of Agriculture (1997) provides a full exposition of cooperative profit allocation and equity management.

The result of the profit allocation decision of cooperatives is a three-part capital structure that utilizes debt (long- and short-term), allocated equity, and unallocated equity. Over time, the composition of the three capital sources on the balance sheet of U.S. farmer cooperatives has changed. In 2009, the capital structure of U.S. farmer cooperatives averaged 61% from debt, 26% from allocated equity, and 12% from unallocated equity (USDA, 2011). In 2019, these proportions were 54, 26, and 20%, respectively, illustrating a relative decrease in the use of debt and a relative increase in the use of unallocated equity (USDA, 2021). A long-standing interest in the cooperative finance literature is the decision to hold equity as allocated or unallocated equity as well as the rationale for the use of equity versus debt. Such decisions have been discussed in the context of, among others, performance, principal-agent and control rights theories, and from a philosophical perspective on the role and value of the cooperative (see Boland (2012) and Briggeman *et al.* (2016) for recent discussions).

Especially for unallocated equity, arguments have been made about why its use is more or less attractive to members. According to Royer (1992), the retention of net income as unallocated equity is contrary to the "service at cost" principle of cooperatives, which implies a moral obligation to return all profit to the members. A large proportion of unallocated equity in theory also increases the susceptibility to conversion or liquidation (Kenkel and Briggeman, 2018) as members may only be able to access unallocated equity by demutualizing or liquidating the company. There are two recent examples where members of Calavo (originally a producer-owned avocado marketing cooperative) and Diamond Walnut Growers voted to convert from cooperatives into an investor-owned business organizations, which facilitated member access to unallocated equity (Stanford and Hogeland, 2004; Hardesty, 2009). Additionally, unallocated equity may be less attractive from a firm-level tax efficiency perspective (Briggeman *et al.*, 2016) and have a relatively low impact on revenue (Grashuis, 2020).

With the proportion of unallocated equity in agricultural cooperatives on the rise, there must also be benefits to its use. Unallocated equity, also referred to as permanent capital, has a better cash-flow profile for the cooperative business and offers flexibility to management. Permanent capital may be preferred to allocated equity by lenders for accessing financing to facilitate infrastructure investments. It is also a cushion for absorbing cooperative losses with a lower impact on existing equity redemption obligations (Boland, 2012; Briggeman *et al.*, 2016). Much of the rise in unallocated equity has been attributed to increases in non-member business done by cooperatives, the preference of debt providers to have permanent equity on the balance sheet, and the utilization of a special, limited-use tax provision called the Domestic Production Activities Tax Deduction (DPAD) (Boland, 2012; Briggeman *et al.*, 2016).

Despite the perennial contemplation and ongoing debate about the causes and consequences of evolving balance sheet compositions of U.S. agricultural cooperatives, there is little applied research to inform the discussion. Recent exceptions come from Li *et al.* (2015), who observed a positive effect of efficiency and profitability on the proportion of debt of farmer cooperatives in Iowa. However, they also found a tendency to use equity for long-term investments, which could be interpreted either as a long-term debt constraint or a perception of member equity as "costless". An analysis by Royer (2017) demonstrated how the return to members is maximized by so-called "pure plans" characterized by 100%

allocated equity or 100% unallocated equity. Such compositions are extremely rare in practice. Using simulation, Royer (2019) also illustrated the relatively high cost of financing using member equity, as indicated by the cooperative firm-level return on equity (ROE). Subsequent empirical work confirmed the negative relationship of ROE to the proportion of equity on the balance sheet of USA input supply cooperatives and grain marketing cooperatives (Royer and McKee, 2020). Importantly, Royer (2019), Royer and McKee (2020), and other studies did not distinguish between allocated equity and unallocated equity.

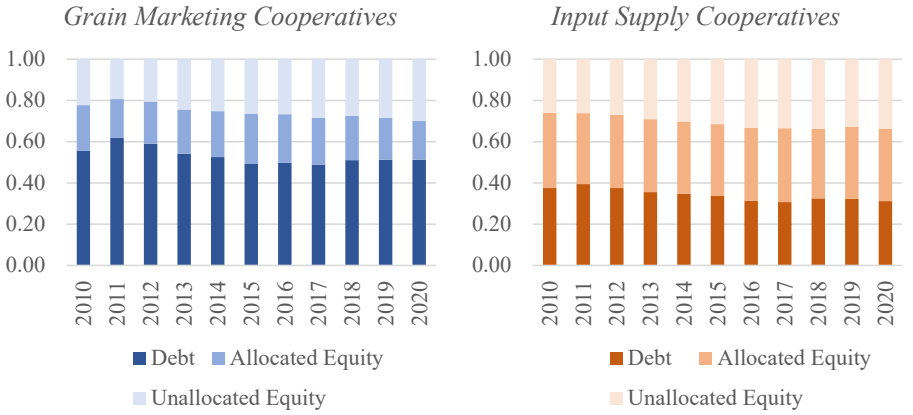
In this article, we build on the work of Royer and McKee (2020) with an objective to explain variability in the capital structures of agricultural cooperatives. Specifically, we explore the relationships of various firm-level characteristics to the proportions of debt, allocated equity, and unallocated equity for a panel of U.S. input supply and grain marketing cooperatives for the 2010–2020 period. We incorporate the rationale of Soboh *et al.* (2009) and Limnios *et al.* (2018), acknowledging empirically that there exist fundamental differences in the objectives and preferences of marketing and input supply cooperatives and their members, which in part stems from each type's transactional relationship with their member: marketing cooperatives are output-oriented and supply cooperatives are input-oriented. We assert, as has the prior literature, that this unique orientation may influence balance sheet compositions. Our work contributes to the cooperative finance literature in two dimensions: (1) it permits the distinction between allocated and unallocated equity in understanding the composition of the capital structures of agricultural cooperatives, and (2) it allows for differential sensitivities of debt and equity sources across marketing and input supply cooperatives.

Methodology

Data

We use secondary data collected by Cooperative Programs, which is housed in the USDA Rural Development program. Cooperative Programs conducts annual surveys of the full population of approximately 2,000 U.S. farmer, rancher, and fishery cooperatives. USDA (2021) reports the results from the surveys in aggregated form. Our study is focused on grain marketing cooperatives and input supply cooperatives, which represent 51.2% and 42.1%, respectively, of agricultural cooperatives in the U.S. in 2021. For purposes of our analysis, a cooperative is categorized as a grain marketing cooperative if grain sales contributed the most to total sales, or as an input supply cooperative if feed, fertilizer, petroleum, seed, and other input sales contributed the most to total sales [2]. Cooperatives with only a single observation during the 2010–2020 period are also dropped. Thus, our panel consists of 465 grain marketing cooperatives and 769 input supply cooperatives. The average grain marketing cooperative is in the panel for 7.07 out of 11 years, and the average input supply cooperative is in the panel for 6.98 years [3]. These data are collected via annual voluntary survey of farmer cooperatives, and a cooperative leaving the data does not necessarily imply they stopped operating, only that they did not submit their survey data.

There are three outcome variables of interest: (1) the ratio of debt to total assets, (2) the ratio of allocated equity to total assets, and (3) the ratio of unallocated equity to total assets. Figure 1 reports the average proportions of debt, allocated equity, and unallocated equity by cooperative type and year. While the proportion of debt is substantially higher for grain marketing cooperatives than input supply cooperatives, both experienced a decrease of approximately 10% points throughout the 2010–2020 period. The proportion of allocated equity also decreased for both grain marketing cooperatives and input supply cooperatives. Correspondingly, the decreases in the proportions of debt and allocated equity have been compensated by increases in the proportion of unallocated equity. The average grain marketing cooperative increased its proportion of unallocated equity from 22% in 2010 to



Source(s): Authors' own work

Figure 1. Capital structure compositions of grain marketing cooperatives and input supply cooperatives during the 2010–2020 period

30% in 2020. For input supply cooperatives, the proportion of unallocated equity increased from 26% to 34% between 2010 and 2020.

The explanatory variables in our analysis are profitability, interest rate, diversification, and firm size (see Table 1), which have been included on the basis of data availability and empirical evidence.

(1) *Profitability.* The profitability of the cooperative is indicated by its ROE, which is the ratio of net income to total equity. Following Royer and McKee (2020), ROE is also a proxy for the cost of equity, which is earmarked to be revolved or redeemed at some point in the future. Theoretically, an increase in the cost of equity is associated with a decrease in the use thereof. As such, the expected relationships of profitability to the proportions of debt and allocated equity are positive and negative, respectively [4].

(2) *Interest rate.* The interest rate is calculated as the ratio of interest expense to total debt. The interest rate serves as an indicator of the cost of debt. Analogous to the cost of equity indicator, an increase in the interest rate is theoretically associated with a decrease in proportion of debt. Correspondingly, the interest rate is expected to relate positively to the proportions of allocated equity and unallocated equity (Royer and McKee, 2020).

(3) *Diversification.* Portfolio diversification is measured as 1 – the ratio of sales in the largest sales category to total sales. For example, if a cooperative has $100 in sales of which $75 is from grain marketing, then the degree of diversification is 1 – (75/100) = 0.25. The

Variable	Measurement	Grain marketing 2020 (N = 222)	Input supply 2020 (N = 393)
Return on equity	net income/total equity	0.07	0.08
Interest rate	interest expense/total sales	0.02	0.02
Diversification	1 – (share of largest sales category/100)	0.73	0.90
Size group 1	1 if less than 25th percentile of total sales	0.25	0.25
Size group 2	1 if between 25th and 50th percentiles of total sales	0.25	0.25
Size group 3	1 if between 50th and 75th percentiles of total sales	0.25	0.25
Size group 4	1 if more than 75th percentile of total sales	0.25	0.25

Source(s): Authors' own work

Table 1. Model variables and summary statistics

measure has several possible interpretations, including risk management (Zeuli, 1999). Diversified cooperatives have less variable or more predictable performance (Pokharel *et al.*, 2020), which should be appealing to lenders and thus suggests a positive relationship of diversification to the proportion of debt. Alternatively, diversification is also indicative of potential member heterogeneity (Höhler and Kühl, 2018), which complicates equity management (e.g. Siebert and Park, 2010).

(4) *Firm size.* Size, measured as total sales, is included primarily as a control variable. However, its role as an explanatory variable is to yield insights into differential equity management propensities and debt access realities between smaller and larger cooperatives. All else equal, size is expected to have an inverse relationship to debt (Lerman and Parliament, 1991; Pederson, 2018; Chaddad *et al.*, 2005). In consideration of potential non-linearities in the relationship of size to capital structure compositions, we follow the approach of Grashuis and Franken (2020) and create a categorical variable with four groups based on quartiles of total assets.

Empirical model

Because the three outcome variables are fractions with values more than or equal to 0 and less than or equal to 1, it is necessary to specify a model with capacity to keep predicted values in the unit interval. Papke and Wooldridge (1996) proposed a model for the estimation of the conditional mean of a fractional outcome variable on the basis of quasi-maximum likelihood. Later, Papke and Wooldridge (2008) extended the application of the model to panel data. Mullahy (2015) developed a multivariate generalization of the model by Papke and Wooldridge (1996).

The general form of the multinomial logit model is specified as

$$E(y_{ij}|z_i) = G(z_i\beta) = \frac{\exp(z_i\beta_j)}{\sum_{k=1}^{J}\exp(z_i\beta_k)} \tag{1}$$

where y is the fractional outcome variable of observation unit i, z is the vector of predictors, and β is the vector of unknown parameters. Furthermore, $G(\cdot)$ is the logit function satisfying $0 < G(z_i\beta) < 1, j = 1, 2, 3$, and $\sum_j y_{ij} = 1$. When considering the specifics of our study, we adapt Eq. (1) to derive at the following model:

$$\begin{aligned} E(y_{ijt}|z_{it}) &= G(z_{it}\beta_j) \\ &= G(\beta_0 + \beta_1 Return\,on\,Equity_{t-1} + \beta_2 Interest\,Rate_{t-1} + \beta_3 Diversification_{t-1} \\ &\quad + \beta_4 Size_{t-1} + \beta_5 Year) \end{aligned} \tag{2}$$

where all the symbols are the same as before. Except for the year variable, all the predictors are lagged by one period to promote a causal interpretation of the parameter estimates. Because marketing and input supply cooperatives may have different objectives and orientations (Soboh *et al.*, 2009), particularly as it relates to balance sheet and capital structure management, Eq. (2) is estimated separately for the samples of grain marketing cooperatives and input supply cooperatives. Eq. (2) is estimated by means of the fmlogit Stata package developed by Buis (2008).

Results

The results of the fractional multinomial panel model based on Eq. (2) are reported in Table 2, with estimates based on the sample of grain marketing cooperatives in the left column and

Table 2.
Results of the fractional multinomial panel model

	Grain marketing cooperatives						Input supply cooperatives					
	Allocated equity			Unallocated equity			Allocated equity			Unallocated equity		
	β	S.E.	*p*	β	S.E.	*p*	β	S.E.	*p*	β	S.E.	*p*
Return on equity$_{t-1}$	0.665	0.330	0.044	−0.078	0.097	0.416	−0.345	0.170	0.042	−0.490	0.189	0.009
Interest rate$_{t-1}$	2.015	0.798	0.012	2.908	0.695	0.000	−1.270	0.899	0.158	−5.000	0.808	0.000
Diversification$_{t-1}$	0.440	0.118	0.000	−0.319	0.105	0.002	−1.137	0.083	0.000	−0.653	0.082	0.000
Size$_{t-1}$												
Group 2	−0.501	0.052	0.000	−0.266	0.049	0.000	−0.330	0.043	0.000	−0.313	0.046	0.000
Group 3	−0.436	0.052	0.000	−0.418	0.047	0.000	−0.613	0.040	0.000	−0.506	0.044	0.000
Group 4	−0.583	0.050	0.000	−0.317	0.048	0.000	−0.928	0.043	0.000	−0.547	0.044	0.000
Year												
2012	0.090	0.066	0.175	0.107	0.064	0.095	0.032	0.055	0.562	0.085	0.059	0.146
2013	0.269	0.060	0.000	0.336	0.060	0.000	0.155	0.053	0.003	0.239	0.057	0.000
2014	0.342	0.064	0.000	0.408	0.063	0.000	0.187	0.055	0.001	0.325	0.058	0.000
2015	0.528	0.070	0.000	0.545	0.064	0.000	0.228	0.056	0.000	0.373	0.060	0.000
2016	0.493	0.073	0.000	0.499	0.064	0.000	0.272	0.057	0.000	0.455	0.060	0.000
2017	0.483	0.077	0.000	0.607	0.067	0.000	0.309	0.057	0.000	0.499	0.060	0.000
2018	0.369	0.078	0.000	0.543	0.069	0.000	0.215	0.059	0.000	0.473	0.062	0.000
2019	0.323	0.081	0.000	0.550	0.067	0.000	0.221	0.059	0.000	0.435	0.064	0.000
2020	0.252	0.076	0.001	0.584	0.071	0.000	0.277	0.062	0.000	0.458	0.067	0.000
Intercept	−1.083	0.086	0.000	−0.850	0.069	0.000	0.505	0.053	0.000	0.171	0.056	0.002
N	2,664						4,221					
Wald $\chi^2(30)$	515.95						1333.64					
Log Pseudolikelihood	−2664.2						−4549.4					

Note(s): Group 1, Marketing Cooperatives: mean proportion of allocated equity is 0.26, and the mean proportion of unallocated equity is 0.28
Group 2, Supply Cooperatives: mean proportion of allocated equity is 0.43, and the mean proportion of unallocated equity is 0.33
Source(s): Authors' own work

those for input supply cooperatives in the right column. Parameter estimates from the fractional multinomial panel model do not have a straightforward interpretation; therefore, as is common, average partial effects (APEs) are provided in Tables 3 and 4. The APEs indicate the change in the composition of one category relative to the changes in the compositions of

Variable	Debt A.P.E.	Debt S.E.	Debt p	Allocated equity A.P.E.	Allocated equity S.E.	Allocated equity p	Unallocated equity A.P.E.	Unallocated equity S.E.	Unallocated equity p
Return on equity$_{t-1}$	−0.064	0.032	0.047	0.114	0.057	0.047	−0.050	0.031	0.109
Interest rate$_{t-1}$	−0.622	0.152	0.000	0.179	0.124	0.148	0.443	0.123	0.000
Diversification$_{t-1}$	−0.006	0.021	0.771	0.090	0.019	0.000	−0.084	0.020	0.000
Size									
Group 2	0.093	0.010	0.000	−0.071	0.009	0.000	−0.022	0.009	0.018
Group 3	0.106	0.010	0.000	−0.054	0.009	0.000	−0.053	0.009	0.000
Group 4	0.109	0.010	0.000	−0.081	0.008	0.000	−0.027	0.009	0.002
Year binary variables									
2012	−0.024	0.012	0.050	0.009	0.010	0.335	0.014	0.010	0.170
2013	−0.074	0.012	0.000	0.028	0.009	0.002	0.046	0.010	0.000
2014	−0.092	0.012	0.000	0.036	0.010	0.000	0.056	0.011	0.000
2015	−0.132	0.013	0.000	0.061	0.011	0.000	0.071	0.011	0.000
2016	−0.121	0.013	0.000	0.057	0.012	0.000	0.064	0.011	0.000
2017	−0.135	0.013	0.000	0.048	0.012	0.000	0.087	0.012	0.000
2018	−0.114	0.014	0.000	0.033	0.012	0.008	0.081	0.013	0.000
2019	−0.110	0.014	0.000	0.025	0.012	0.046	0.085	0.012	0.000
2020	−0.107	0.014	0.000	0.011	0.011	0.319	0.096	0.013	0.000

Note(s): A.P.E. is average partial effect
Source(s): Authors' own work

Table 3. Results of the fractional multinomial panel model (average partial effects) – grain marketing cooperatives

Variable	Debt A.P.E.	Debt S.E.	Debt p	Allocated equity A.P.E.	Allocated equity S.E.	Allocated equity p	Unallocated equity A.P.E.	Unallocated equity S.E.	Unallocated equity p
Return on equity$_{t-1}$	0.092	0.039	0.018	−0.025	0.021	0.251	−0.068	0.025	0.006
Interest rate$_{t-1}$	0.678	0.158	0.000	0.260	0.191	0.174	−0.938	0.166	0.000
Diversification$_{t-1}$	0.203	0.015	0.000	−0.187	0.018	0.000	−0.016	0.017	0.355
Size									
Group 2	0.065	0.007	0.000	−0.039	0.009	0.000	−0.026	0.009	0.004
Group 3	0.120	0.007	0.000	−0.083	0.009	0.000	−0.037	0.009	0.000
Group 4	0.162	0.008	0.000	−0.146	0.009	0.000	−0.016	0.009	0.070
Year binary variables									
2012	−0.013	0.011	0.227	−0.001	0.012	0.946	0.014	0.011	0.208
2013	−0.045	0.010	0.000	0.012	0.012	0.313	0.033	0.011	0.003
2014	−0.058	0.011	0.000	0.010	0.012	0.417	0.048	0.011	0.000
2015	−0.068	0.011	0.000	0.014	0.012	0.250	0.054	0.012	0.000
2016	−0.081	0.011	0.000	0.014	0.012	0.247	0.067	0.012	0.000
2017	−0.090	0.011	0.000	0.017	0.013	0.167	0.072	0.012	0.000
2018	−0.077	0.011	0.000	−0.001	0.013	0.948	0.078	0.013	0.000
2019	−0.073	0.011	0.000	0.005	0.013	0.713	0.069	0.013	0.000
2020	−0.082	0.012	0.000	0.015	0.013	0.266	0.067	0.013	0.000

Note(s): A.P.E. is average partial effect
Source(s): Authors' own work

Table 4. Results of the fractional multinomial panel model (average partial effects) – input supply cooperatives

the other two categories based on a one-unit or marginal increase in the covariate itself. For example, in Table 3, the APE for ROE_{t-1} indicates that a 1% point increase in ROE in the prior period results in an 11.4% point increase in the proportion of allocated equity. Because the sum of the proportions of debt, allocated equity, and unallocated equity must equal 1, the sum of the APEs across each variable is zero. An increase or decrease in one category must be balanced by an increase or decrease in another category. Thus, in this example, following a 1% point increase in ROE in the prior period, the proportional increase in debt is approximately (11.4–5.0) 6.4% points.

Continuing with ROE, its directional relationship to capital structure composition is not clear in the literature and therefore an empirical question that leaves room for differential inferences based on function. As stated above, for the sample of grain marketing cooperatives, a one percentage point increase in ROE in period $t\text{-}1$ decreases the proportions of debt and, with less confidence, unallocated equity in the following period. The decrease is offset by an increase in allocated equity and a net increase in total equity, which suggests the ROE should be interpreted at face value as a measure of (and perhaps signal for) profitability as opposed to a cost of equity, as suggested by Royer and McKee (2020). The situation is different in the case of input supply cooperatives, for whom a one percentage point increase in ROE in period $t\text{-}1$ is associated with an increase in debt and decrease in unallocated equity, and thus total equity. Here, the interpretation of ROE as a cost of equity is corroborated.

The notion of differential capital structure adjustments between cooperatives with opposite functions (i.e. marketing, input supply) is further reinforced by the estimated effect of the interest rate, which proxies for the cost of carrying debt on the balance sheet. Among the marketing cooperatives, the relationship between the interest rate and debt is as expected. A one percentage point increase in the interest rate in period $t\text{-}1$ is associated with a decrease in the proportion of debt in period t. The decrease in debt is, for the most part, substituted by an increase in the proportion of unallocated equity; the estimated change in the proportion of allocated equity is not statistically significant. The opposite relationship is observed in the case of input supply cooperatives. A one percentage point increase in the interest rate in the previous period increases the proportional use of debt and reduces the proportional use of unallocated equity. One view of the role of the cooperative, particularly input supply cooperatives, is of a quasi-intermediary in providing short-term financing to members. McKee *et al.* (2020) examined the role of input supply cooperatives in financing input demands of members by means of trade credit. According to their results, cooperatives incur debt for the provision of trade credit to help ease liquidity constraints faced by members. Input supply cooperatives may acquire more debt as they seek to stabilize or enhance sales during periods of higher interest rates.

Our last primary covariate is diversification. The closer the ratio is to one, the greater the degree of diversification. We find that diversification is related significantly to the capital structure of cooperatives regardless of function; however, as before, there are differences in the relationships to the capital structure compositions. For grain marketing cooperatives, an increase in the degree of diversification is associated with similar adjustments in allocated and unallocated equity, leaving debt relatively unchanged. The more interesting observation is that increased diversification is associated with an increased proportional use of allocated equity in the case of grain marketing cooperatives. Therefore, as the proportion of revenue from grain marketing decreases, there is a shift toward more allocated equity. Since grain marketing cooperatives use a relatively low amount of allocated equity, this shift could be viewed as a signal of modulation towards a more "dual" or multi-purpose posture.

Empirically, greater diversification among input supply cooperatives has the opposite effect: there is a proportional increase in debt and decrease in allocated equity, which aligns with Zeuli's (1999) interpretation of portfolio diversification as risk management. Input

supply activities are typically more capital intensive and require more service provision than grain marketing. Input supply cooperatives also carry more inventory throughout their operating year, which is not as easily hedged or protected as in commodity markets like grain and oilseeds.

Size has a relatively straightforward relationship to the capital structure compositions of both grain marketing cooperatives and input supply cooperatives. Generally, the larger the cooperative, regardless of function, the greater the use of debt relative to equity. It appears as if the proportional use of allocated equity is reduced more than unallocated equity, particularly among input supply cooperatives. As compared to cooperatives in the first group (i.e. the smallest cooperatives), cooperatives in the other three groups have a significantly higher proportion of debt. In grain marketing cooperatives, the difference is approximately 10% points. The effect of size on the proportion of debt appears to be more linear in the case of input supply cooperatives as the magnitude increases for each group [5]. For both grain marketing cooperatives and input supply cooperatives, the increase in the proportion of debt is compensated by a decrease in both allocated equity and unallocated equity. The proportional reduction of allocated equity is substantially lower in larger cooperatives in the data. Altogether, our result supports the trend analysis of Lerman and Parliament (1991), who expected relatively large cooperatives to finance an increasingly large proportion of their asset base with debt as compared to relatively small cooperatives.

The time variable is also associated with significant changes in the proportions of debt, allocated equity, and unallocated equity. Relative to 2011, which serves as the base category, the proportion of debt decreased while the proportions of allocated equity and unallocated equity both increased over time for grain marketing cooperatives. According to the estimates, the decrease in the proportion of debt stagnated around 2015 and even reverted somewhat in 2017 and later years. At first, the proportions of allocated equity and unallocated equity both increased. However, from 2016 onward, the proportion of allocated equity decreased again. In 2020, the difference in the proportion of allocated equity relative to 2011 even became nonsignificant. Meanwhile, for input supply cooperatives, the proportion of allocated equity never changed significantly. Input supply cooperatives seemed to exchange every one percent decrease in the proportion of debt with a one percent increase in the proportion of unallocated equity.

Robustness check

In the above empirical exercise, cooperatives are categorized based on their largest sales category. If grain comprised the largest sales category, we categorized the cooperative as a grain marketing cooperative; if the aggregate of farm inputs comprised the largest sales category, we categorized the cooperative as an input supply cooperative. However, there is ambiguity with such a categorization, and the reality is that many grain marketing cooperatives have substantial input supply activities, and many input supply cooperatives have substantial grain marketing portfolios. To account for sensitivity to our categorization, we conduct a robustness check using a range of thresholds (i.e. 50%, 67%, and 75%) for the classifications of grain marketing and input supply cooperatives.

Tables 5 and 6 contain the results for grain marketing cooperatives and input supply cooperatives, respectively. By and large, the results with the threshold sub-samples are similar to those with our initial categorization for grain marketing cooperatives. There are no changes in the direction of the covariates' impact on capital structure, and few changes in statistical significance. For example, the estimated impact of diversification on the capital structure compositions increases in magnitude as grain marketing cooperatives with lower proportions of grain sales are trimmed from the sample. The change indicates that diversification is more impactful on the capital structure compositions of less diverse grain marketing cooperatives.

	Variable	Debt			Allocated equity			Unallocated equity		
		dy/dx	S.E.	*p*	dy/dx	S.E.	*p*	dy/dx	S.E.	*p*
If grain ≥ *0.50* of revenue	Return on equity$_{t-1}$	−0.059	0.032	0.069	0.111	0.059	0.060	−0.052	0.033	0.112
	Interest rate$_{t-1}$	−0.668	0.163	0.000	0.135	0.141	0.339	0.533	0.129	0.000
	Diversification$_{t-1}$	0.010	0.022	0.651	0.082	0.020	0.000	−0.092	0.021	0.000
	Size									
	Group 2	0.092	0.010	0.000	−0.070	0.009	0.000	−0.022	0.009	0.020
	Group 3	0.108	0.010	0.000	−0.054	0.009	0.000	−0.054	0.009	0.000
	Group 4	0.104	0.010	0.000	−0.078	0.009	0.000	−0.026	0.009	0.004
	Year binary variables	Included								
If grain ≥ *0.67* of revenue	Return on equity$_{t-1}$	−0.034	0.037	0.349	0.093	0.068	0.172	−0.058	0.037	0.111
	Interest rate$_{t-1}$	−0.649	0.205	0.002	0.074	0.215	0.729	0.575	0.159	0.000
	Diversification$_{t-1}$	0.182	0.034	0.000	0.052	0.031	0.094	−0.234	0.033	0.000
	Size									
	Group 2	0.089	0.012	0.000	−0.067	0.011	0.000	−0.023	0.011	0.046
	Group 3	0.097	0.012	0.000	−0.030	0.011	0.007	−0.067	0.011	0.000
	Group 4	0.110	0.013	0.000	−0.055	0.010	0.000	−0.055	0.011	0.000
	Year binary variables	Included								
If grain ≥ *0.75* of revenue	Return on equity$_{t-1}$	−0.055	0.064	0.389	0.209	0.051	0.000	−0.154	0.061	0.011
	Interest rate$_{t-1}$	−0.522	0.269	0.053	−0.109	0.317	0.730	0.631	0.158	0.000
	Diversification$_{t-1}$	0.276	0.056	0.000	0.018	0.048	0.701	−0.294	0.051	0.000
	Size									
	Group 2	0.080	0.015	0.000	−0.085	0.013	0.000	0.005	0.013	0.723
	Group 3	0.083	0.014	0.000	−0.037	0.013	0.005	−0.046	0.012	0.000
	Group 4	0.103	0.015	0.000	−0.054	0.013	0.000	−0.048	0.013	0.000
	Year binary variables	Included								

Note(s): Statistical significance is indicated by the *p*-value
Source(s): Authors' own work

Table 5.
Results of the fractional multinomial panel model with various samples of grain marketing cooperatives

Table 6.
Results of the fractional multinomial panel model with various samples of input supply cooperatives

		Debt			Allocated equity			Unallocated equity		
	Variable	dy/dx	S.E.	*p*	dy/dx	S.E.	*p*	dy/dx	S.E.	*p*
If input supply ≥ *0.50* of revenue	Return on equity$_{t-1}$	0.098	0.040	0.015	−0.033	0.023	0.143	−0.065	0.025	0.008
	Interest rate$_{t-1}$	0.669	0.175	0.000	0.222	0.217	0.305	−0.892	0.179	0.000
	Diversification$_{t-1}$	0.248	0.021	0.000	−0.186	0.026	0.000	−0.062	0.024	0.009
	Size									
	Group 2	0.064	0.008	0.000	−0.034	0.010	0.001	−0.030	0.010	0.002
	Group 3	0.122	0.008	0.000	−0.083	0.009	0.000	−0.039	0.009	0.000
	Group 4	0.161	0.008	0.000	−0.144	0.010	0.000	−0.017	0.010	0.084
	Year binary variables	Included								
If input supply ≥ *0.67* of revenue	Return on equity$_{t-1}$	0.096	0.042	0.021	−0.029	0.023	0.199	−0.067	0.026	0.010
	Interest rate$_{t-1}$	0.689	0.182	0.000	0.231	0.230	0.314	−0.920	0.194	0.000
	Diversification$_{t-1}$	0.327	0.035	0.000	−0.310	0.050	0.000	−0.017	0.040	0.661
	Size									
	Group 2	0.065	0.008	0.000	−0.036	0.011	0.001	−0.030	0.010	0.003
	Group 3	0.125	0.008	0.000	−0.086	0.010	0.000	−0.039	0.010	0.000
	Group 4	0.159	0.009	0.000	−0.153	0.011	0.000	−0.006	0.011	0.565
	Year binary variables	Included								
If input supply ≥ *0.75* of revenue	Return on equity$_{t-1}$	0.102	0.042	0.014	−0.031	0.023	0.167	−0.071	0.026	0.007
	Interest rate$_{t-1}$	0.680	0.181	0.000	0.299	0.226	0.185	−0.979	0.210	0.000
	Diversification$_{t-1}$	0.355	0.049	0.000	−0.436	0.070	0.000	0.081	0.053	0.127
	Size									
	Group 2	0.065	0.008	0.000	−0.033	0.011	0.002	−0.032	0.010	0.003
	Group 3	0.129	0.008	0.000	−0.086	0.010	0.000	−0.043	0.010	0.000
	Group 4	0.151	0.009	0.000	−0.150	0.011	0.000	−0.002	0.011	0.876
	Year binary variables	Included								

Note(s): Statistical significance is indicated by the *p*-value
Source(s): Authors' own work

Meanwhile, there are more distinct differences in the estimated impact of ROE as the sample becomes more exclusive. At the 50% threshold, the proportion of debt decreases significantly at the 90% confidence level. However, the significant relationship is no longer visible at the 67 and 75% thresholds. At the 50 and 67% thresholds, ROE is not significantly related to the proportions of the two equity accounts. At the 75% threshold, however, the estimated impact is not only statistically significant but also relatively large in magnitude. By comparison, the differences in the results for the various sub-samples of input supply cooperatives are quite negligible.

Discussion and conclusion

Cooperatives have unique characteristics in terms of ownership, governance, and finance stemming from the "member-owned, member-controlled, member-benefitting" approach to collective action. Specifically, profit is distributed as patronage, which results in a unique capital structure with two types of equity: allocated equity and unallocated equity. Although each type has unique features with both advantages and disadvantages, most of the applied research on cooperative finance has not distinguished between the two.

The historical change in the relative use of debt, allocated equity, and unallocated equity to fund assets corroborates the suggestion that cooperatives may hold distinct preferences for allocated and unallocated equity, even compared to debt. The decision of how to proportionally utilize debt, allocated equity, and unallocated equity is in part informed by the need to balance both future and present objectives of the cooperative and its members. The cooperative has competing needs: it must fund current operations and make future investments with an understanding that permanent capital may be more efficient in accessing debt, but it faces members expectations of allocating income to members based on patronage and redeeming that equity in a reasonable amount of time. Furthermore, preferences for debt, allocated equity, and unallocated equity may differ by function as marketing cooperatives and input supply cooperatives have different capital structure compositions, likely because of fundamental differences in objectives and orientations.

In addition, the exact compositions of debt, allocated equity, and unallocated equity may respond differently to changes in profitability, debt interest, diversification, and size. Our empirical analysis facilitates three general findings. First, larger farmer cooperatives use relatively more debt and relatively less allocated equity and unallocated equity. Second, diversification of the product portfolio increases the debt proportion of farmer cooperatives but has an ambiguous effect on equity. Third, higher profitability increases the debt proportion of input supply cooperatives yet increases the allocated equity proportion of grain marketing cooperatives.

Generally, the findings show the benefit, or arguably even the necessity, of separating grain marketing cooperatives and input supply cooperatives in empirical work. Theoretically, marketing cooperatives pursue output maximization and supply cooperatives cost minimization (Soboh *et al.*, 2009). The two objectives are not only fundamentally different but also mutually exclusive in agricultural cooperatives as the equity suppliers are also the customers who buy outputs or sell inputs (Limnios *et al.*, 2018). When performing a pooled regression with observations from both marketing cooperatives and supply cooperatives, estimated relationships are thus likely to be misleading. The effect will be driven by whichever group has the most observations. In terms of cooperative finance, it is also necessary to consider both types of equity. Costs of debt and equity as well as diversification do not necessarily have the same relationship to both allocated equity and unallocated equity.

We note some limitations of our study. First, our analysis is limited to grain marketing cooperatives and input supply cooperatives and may not be generalizable to other farmer cooperatives in the agricultural sector, particularly in case of up-front equity contributions by

members or some differentiated equity management strategy. Second, because of limited data availability, we explain variability in capital structure compositions for the most part in terms of balance sheet and income statement components (i.e. profitability, debt interest rate, diversification). However, other variables – including member characteristics and the cooperative's ability to utilize special tax provisions that influence profit allocation – may also have a bearing on observed proportions of debt, allocated equity, and unallocated equity. An important missing variable in our estimation is the source of income: whether the income is sourced from members or non-members is important because of the relationship to allocated and non-allocated equity. Non-allocatable income gives the cooperative more flexibility in managing capital structure, generally, than does allocatable income. Whether this income source – if it could be observed – mattered to the cooperatives in our sample is unclear. Many cooperatives do not place strict requirements on allocating income from member/patronage sources.

Notes

1. We use member and patron interchangeably in this analysis because, for our purposes, the distinction is not consequential. Whether the profit is allocated to a member who holds patronage rights or a non-member with patronage rights, the result and consequence on equity management is the same.
2. We exclude other types of marketing cooperatives (e.g. dairy, fruits, sugar and other select marketing co-ops) who have different approaches to equity accumulation and management (Kenkel, 2015). These excluded cooperatives either rely on contributed capital directly from members based on members' share of marketed products and which is not related to the cooperative's profitability (e.g. base capital plans, per-unit retains), or they use a pooling marketing system. These approaches to equity management are not comparable to the revolving redemption approaches utilized by grain marketing and input supply cooperatives.
3. A reviewer raised the concern that subjects in our sample for a shorter period may skew results and suggested to impose an inclusion criterion. As a robustness check, we estimated our model using inclusion criteria of >4 years, >5 years and >6 years. We observed no change to the sign, size or significance of key variable estimates among input supply cooperatives and only the ROE_{t-1} estimate significance waned with increasingly strict criteria imposed on the sample of marketing cooperatives.
4. Cooperative net income is generated from either allocatable or non-allocatable sources, which has practical implications for how equity and therefore capital structure evolves. We expand on this in the Discussion and Conclusions section.
5. Alternative linear (total sales) and non-linear measurements (total sales and total sales squared) of size yielded less significant interpretations.

References

Boland, M.A. (2012), "Cooperative finance and equity management", CHS Center for Cooperative Growth Working Paper, CHS, Minneapolis, MN.

Briggeman, B.C., Jacobs, K.L., Kenkel, P. and Mckee, G. (2016), "Current trends in cooperative finance", *Agricultural Finance Review*, Vol. 76 No. 3, pp. 402-410, doi: 10.1108/afr-04-2016-0034.

Buis, M.L. (2008), "FMLOGIT: stata module fitting a fractional multinomial logit model by quasi maximum likelihood", in *Statistical Software Components, S456976*, Department of Economics, Boston College.

Chaddad, F.R., Cook, M.L. and Heckelei, T. (2005), "Testing for the presence of financial constraints in US agricultural cooperatives: an investment behaviour approach", *Journal of Agricultural Economics*, Vol. 56 No. 3, pp. 385-397, doi: 10.1111/j.1477-9552.2005.00027.x.

Grashuis, J. (2020), "Returns to debt and equity in farm producer organizations", *Annals of Public and Cooperative Economics*, Vol. 91 No. 1, pp. 55-69, doi: 10.1111/apce.12260.

Grashuis, J. and Franken, J. (2020), "Exit strategies of farmer co-operatives in the United States: a competing risks analysis", *Journal of Co-operative Organization and Management*, Vol. 8 No. 2, 100119, doi: 10.1016/j.jcom.2020.100119.

Hardesty, S.D. (2009), "The conversion of Diamond Walnut Growers", *Journal of Cooperatives*, Vol. 23, 1142-2016-92774, pp. 40-52.

Höhler, J. and Kühl, R. (2018), "Dimensions of member heterogeneity in cooperatives and their impact on organization–a literature review", *Annals of Public and Cooperative Economics*, Vol. 89 No. 4, pp. 697-712, doi: 10.1111/apce.12177.

Kenkel, P. (2015), "Profit distribution alternatives for agricultural cooperatives", *Journal of Cooperatives*, Vol. 30, 1142-2016-92798, pp. 28-49.

Kenkel, P. and Briggeman, B.C. (2018), "Impact of tax reform on agricultural cooperatives and members", *Journal of Cooperatives*, Vol. 33, 1142-2020-392, pp. 1-28.

Lerman, Z. and Parliament, C. (1991), "Size and industry effects in the performance of agricultural cooperatives", *Agricultural Economics*, Vol. 6 No. 1, pp. 15-29, doi: 10.1111/j.1574-0862.1991.tb00168.x.

Li, Z., Jacobs, K. and Artz, G. (2015), "The cooperative capital constraint revisited", *Agricultural Finance Review*, Vol. 75 No. 2, pp. 253-266.

Limnios, E.M., Mazzarol, T., Soutar, G.N. and Siddique, K.H. (2018), "The member wears Four Hats: a member identification framework for co-operative enterprises", *Journal of Co-operative Organization and Management*, Vol. 6 No. 1, pp. 20-33, doi: 10.1016/j.jcom.2018.03.003.

McKee, G., Jacobs, K.L. and Kagan, A. (2020), "Trade credit use in agricultural cooperatives: pricing and firm performance", *Journal of Cooperatives*, Vol. 35, pp. 74-101.

Mullahy, J. (2015), "Multivariate fractional regression estimation of econometric share models", *Journal of Econometric Methods*, Vol. 4 No. 1, pp. 71-100, doi: 10.1515/jem-2012-0006.

Papke, L.E. and Wooldridge, J.M. (1996), "Econometric methods for fractional response variables with an application to 401 (k) plan participation rates", *Journal of Applied Econometrics*, Vol. 11 No. 6, pp. 619-632, doi: 10.1002/(sici)1099-1255(199611)11:63.0.co;2-1.

Papke, L.E. and Wooldridge, J.M. (2008), "Panel data methods for fractional response variables with an application to test pass rates", *Journal of Econometrics*, Vol. 145 Nos 1-2, pp. 121-133, doi: 10.1016/j.jeconom.2008.05.009.

Pederson, G. (2018), "Cost of capital for agricultural cooperatives", Rural Business-Cooperative Service Research Report 163, Washington, DC, U.S. Department of Agriculture.

Pokharel, K.P., Archer, D.W. and Featherstone, A.M. (2020), "The impact of size and specialization on the financial performance of agricultural cooperatives", *Journal of Co-operative Organization and Management*, Vol. 8 No. 2, 100108, doi: 10.1016/j.jcom.2020.100108.

Royer, J.S. (1992), "Cooperative principles and equity financing: a critical discussion", *Journal of Agricultural Cooperation*, Vol. 7, 1141-2016-92517, pp. 79-98.

Royer, J. (2017), "Financing agricultural cooperatives with retained earnings", *Agricultural Finance Review*, Vol. 77 No. 3, pp. 393-411, doi: 10.1108/afr-06-2016-0060.

Royer, J.S. (2019), "Measuring the cost of capital in cooperative businesses", *Agribusiness*, Vol. 35 No. 2, pp. 249-264, doi: 10.1002/agr.21594.

Royer, J. and McKee, G. (2020), "Optimal capital structure in agricultural cooperatives and implications for equity retirement", *Agricultural Finance Review*, Vol. 81 No. 2, pp. 277-291, doi: 10.1108/afr-03-2020-0044.

Siebert, J.W. and Park, J.L. (2010), "Maintaining a healthy equity structure: a policy change at Producers Cooperative Association", *International Food and Agribusiness Man-Agement Review*, Vol. 13 No. 3, pp. 87-96.

Soboh, R.A., Lansink, A.O., Giesen, G. and Van Dijk, G. (2009), "Performance measurement of the agricultural marketing cooperatives: the gap between theory and practice", *Applied Economic Perspectives and Policy*, Vol. 31 No. 3, pp. 446-469, doi: 10.1111/j.1467-9353.2009.01448.x.

Stanford, L. and Hogeland, J.A. (2004), "Designing organizations for a globalized world: calavo's transition from cooperative to corporation", *American Journal of Agricultural Economics*, Vol. 86 No. 5, pp. 1269-1275, doi: 10.1111/j.0002-9092.2004.00676.x.

U.S. Department of Agriculture (1997), "Managing you cooperative's equity", USDA Rural Development Service, Cooperative Information Report 56, Department of Agriculture, Washington, DC.

U.S. Department of Agriculture (2011), "Agricultural cooperative statistics, 2009", USDA Rural Development Service Report 70.

U.S. Department of Agriculture (2021), "Agricultural cooperative statistics, 2019", USDA Rural Development Service Report 83, U.S. Department of Agriculture, Washington, DC.

Zeuli, K.A. (1999), "New risk-management strategies for agricultural cooperatives", *American Journal of Agricultural Economics*, Vol. 81 No. 5, pp. 1234-1239, doi: 10.2307/1244113.

Corresponding author
Jasper Grashuis can be contacted at: grashuisj@missouri.edu