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Comparative Performance of Cooperative Equity Retirement Plans

Jeffrey S. Royer

This paper compares the performance of revolving fund, percentage-of-all-equities, and base capital plans, and special plans for redeeming equity held by estates or based on member age. It also examines how the performance of the base capital plan is affected by changes in the base period, relaxing the equity requirements for underinvested members, and a variable cash patronage refund program. The base capital plan performs better than other systematic plans but places financial burdens on young members. Two modifications can mitigate that problem with only a slight diminution in performance. Special plans benefit cooperatives operating revolving fund plans the most.

Keywords: Agricultural cooperatives, equity retirement, revolving fund plan, percentage-of-all-equities plan, base capital plan, special plans, proportionality

Introduction

Equity allocated to individual members plays a critical role in financing agricultural cooperatives. Although retained earnings not allocated to members have become an increasingly important source of equity in recent years, U.S. Department of Agriculture (USDA) data show that allocated equity still accounted for 56.9 percent of the \$45.0 billion in total equity held in U.S. agricultural cooperatives in 2019 (USDA 2021).

The use of allocated equity usually comes with an expectation that the equity allocated to an individual member will eventually be redeemed in cash as it is replaced by newer allocations. Cooperative principles, which serve as the de facto definition of what cooperatives are and how they differ from other forms of business organization, have implications for the equity retirement practices of cooperatives. Specifically, the principles of service at cost and member ownership imply that members should finance cooperatives in proportion to use and cooperatives have an obligation to retire equity held by inactive and overinvested members (Cobia et al. 1982). Recent articulations of cooperative principles explicitly include

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financing in proportion to patronage.¹ In 1979, the expectation that cooperatives should retire member equity in a timely manner was reinforced by a U.S. General Accounting Office (GAO) report that recommended legislation that would require cooperatives to retire member equity within a prescribed time period if they did not develop better equity retirement programs (GAO 1979). Although federal and state statutes do not contain specific requirements for equity retirement,² proposals calling for mandatory equity retirement have been discussed in both Congress and state legislatures.³

During the past 40 years, researchers have given considerable attention to examining and improving the programs agricultural cooperatives use to accumulate and retire member equity. In particular, papers by Royer and Cobia (1984), Barton and Schmidt (1988), and Kenkel (2020) have focused on comparing the performance of alternative equity retirement plans. Those studies analyzed both systematic equity retirement plans, including the revolving fund plan, the percentage-of-all-equities plan (called the percentage plan herein), and the base capital plan, and special equity retirement plans, including those for redeeming equity held by estates

¹ USDA defines three cooperative principles, including a user-owner principle that implies that members who currently benefit from a cooperative should be the ones who finance it and that the burdens of financing the cooperative should reflect the benefits a member receives (USDA 1987). Barton (1989) goes so far as to present a set of proportional principles, including one that states that equity should be provided in proportion to patronage.

² The state incorporation statutes under which cooperatives are organized govern their relationships with members regarding equity allocations. Under the statutes, the procedures for the redemption of member equity are usually contained in a cooperative's articles of incorporation, bylaws, marketing agreements, or equity certificates. None of the statutes requires a cooperative to adopt a systematic equity retirement plan or specifies a mandatory revolving period or retirement date for equity in general (Baarda 1982). Some statutes include provisions for the mandatory redemption of equity, but those provisions generally apply only to specific circumstances such as the death, withdrawal, or expulsion of a member. In those cases, the board of directors is required to appraise the value of the member's property interests in the cooperative and return them in cash within a specified period of time. However, the cooperative is generally granted considerable discretion in how those interests are defined. The cooperative's bylaws may define property interests narrowly to exclude equity accumulated through patronage (Cobia et al. 1982). For example, model bylaws published by USDA (Frederick 1990) suggest that the property interests to be returned to a member upon termination may be limited to the purchase price of the member's voting share of common stock, or the membership fee in a nonstock cooperative, and may exclude retained patronage investments.

³ For example, a bill passed by the U.S. House of Representatives, but not by the Senate, would have included a provision in the Revenue Act of 1969 requiring cooperatives to redeem the noncash portion of patronage refunds within 15 years (GAO 1979).

or based on a member's age.⁴ The studies utilized several criteria to evaluate the performance of equity retirement plans, including proportionality, member cash flow, and capital requirements. Chief among those criteria is proportionality, which measures the extent to which members provide equity in proportion to their use of a cooperative.

In the studies, members were assumed to have identical histories of patronage and investment, and to be uniformly distributed over time. In addition, the ratio of new equity investments to patronage was assumed constant. Under those assumptions, a single relationship between patronage and member age could be used to represent the changes in both patronage and investment that occur during the course of an individual member's farming career and the distribution of total patronage and investments across all members according to age. The assumptions also imply a steady-state system in which growth in allocated equity is zero.⁵

Using the age-patronage relationship to represent equity retirement both over time and across members is a convenient way to construct a framework for comparing the performance of equity retirement plans. However, the approach does

⁴ Under a systematic equity retirement plan, member equity is retired on a regular basis according to generally applied criteria that can be taken into account in the cooperative's financial budgeting process. In the revolving fund plan, equity is retired on a first-in/first-out basis as the oldest allocations are replaced by new ones. In the percentage plan, a percentage of all member equity is redeemed each year regardless of when it was allocated. In a base capital plan, each member's equity requirement is readjusted annually according to the cooperative's capital needs and the proportion of its business attributable to the member during a moving base period. Members who are underinvested continue to make equity contributions in the form of retained patronage refunds, per-unit capital retain deductions, or direct cash investments. Overinvestment members may no longer be required to make equity investments and may begin receiving at least partial redemption of excess investments. Under special equity retirement plans, equity is retired on an irregular basis in response to particular circumstances that cannot generally be taken into account in the budgeting process. Special plans include plans that redeem equity held by estates or by members who are of a certain age or are no longer farming. The most recent USDA survey of the equity retirement practices of U.S. agricultural cooperatives (Eversull 2010) found that 44.3 percent of local cooperatives that redeemed member equity in 2008 employed revolving fund plans. Of those that redeemed equity, 11.0 percent used percentage plans and 3.5 percent used base capital plans. The equity held by estates was redeemed by 44.3 percent of the cooperatives, and 26.9 percent of the organizations redeemed equity based on member age. Often, special plans for retiring the equity held by estates or members of a particular age were used in conjunction with systematic plans. In some cases, a cooperative may operate more than one systematic plan as the result of a merger or because it is in the process of transitioning from one plan to another.

⁵ Base capital plans were not included in the Royer and Cobia (1984) analysis because of computational similarities between the base capital and revolving fund plans under the condition of no growth. Specifically, if overinvestments are immediately redeemed, a base capital plan with a base period of x years will operate in the same manner as a revolving fund plan with a revolving period of x years. A proof is available from the author.

not take into account the economic variables that affect a cooperative's ability to accumulate and retire member equity. For example, the approach does not permit consideration of growth in allocated equity, which is important for three reasons. First, equity growth is normally expected; in fact, cooperatives typically plan for and pursue growth. Second, the rate of growth in allocated equity is one of the economic variables that determine a cooperative's ability to accumulate and retire equity, as this paper discusses. Third, growth can create situations in which a cooperative's business volume and demand for equity are increasing while an individual member's patronage is declining, as during the later years of a farming career. Such a situation can have important implications for the proportionality of equity retirement plans.

This paper takes a different approach for analyzing the performance of equity retirement plans. Although it employs an age-patronage relationship similar to those used in earlier studies, the relationship is only used to represent how a typical member's patronage and investment change over time. The relationship is not used to determine the amount of equity the cooperative accumulates or retires. Instead, equity accumulation and retirement are determined according to a set of key economic variables, including the rate of growth. The values for those variables are calculated for a typical cooperative from USDA data. This approach allows growth in allocated equity to be incorporated into the analysis, consistent with the growth evident in the data.

The analysis reported here focuses on comparing the performance of the revolving fund, percentage, and base capital systematic equity retirement plans and special plans for redeeming equity held by estates or based on member age. The paper also examines how the performance of the base capital plan is affected by changes in the length of the base period, relaxing the equity requirements for underinvested members, and operating a variable cash patronage refund program in conjunction with the plan.

Because the disparity index used to measure proportionality in the Royer and Cobia (1984) and Barton and Schmidt (1988) analyses is based on an assumption that the cooperative's equity is fixed, that measure cannot be applied to cases in which there is growth. This analysis employs an alternative measure of proportionality that allows for equity growth. It also applies several other concepts not previously used to evaluate the performance of equity retirement plans. In particular, this paper introduces the use of opportunity costs to represent the costs the cooperative incurs when members are underinvested relative to patronage as well as the costs members incur when they are overinvested. This paper also offers explanations for the low use of base capital plans, and the high incidence of special plans among cooperatives with revolving fund plans.

Models

The analysis is based on the financial interactions between a typical cooperative and member. The member purchases farm inputs or markets farm commodities through the cooperative and receives patronage refunds. The noncash portions of the patronage refunds are retained by the cooperative to provide equity capital that is allocated to the member and eventually redeemed in cash as it is replaced by newer allocations.

The cooperative and member are modeled separately. The cooperative model is based on a growth model of an agricultural cooperative in which the accumulation and retirement of member allocated equity is related to the values of several key economic variables. The member model is based on an age-sales function estimated from cross-sectional data in a manner similar to several earlier studies. The interactions between the cooperative and member are represented in spreadsheet models that simulate the accumulation and retirement of member equity on an annual basis for the various equity retirement plans.

Because the focus of this paper is on the accumulation and retirement of equity allocated to members, the equity in the models consists exclusively of allocated equity. Unallocated equity from retained earnings is not considered except in the calculation of the rate of return on equity used in the analysis.

Cooperative Model

The accumulation and retirement of allocated equity by the cooperative is based on a growth model (Royer 1993) in which the ability of the cooperative to retire or revolve allocated equity is related to the proportion of patronage refunds paid in cash (c), the rate of return on equity (r_e), and the rate of equity growth (g). The values of those variables are assumed to remain constant during the period of analysis, as they are in the spreadsheet models used to simulate the operation of the equity retirement plans.

In the cooperative model, retained patronage refunds serve as a source for both equity retirement and growth. Specifically, a fundamental relationship in the model states that equity retirement and equity growth must equal retained patronage refunds:

$$ER_t + gE_{t-1} = (1 - c)r_e E_{t-1} \quad (1)$$

where ER_t is equity retired in year t and E_{t-1} is equity at the end of the previous year (beginning of year t). The second term on the left represents equity growth, and the term on the right represents retained patronage refunds.

Other relationships important to equity financing can be derived from equation (1). Solving for ER_t , funds available for equity retirement in year t are the residual of net income after the payment of cash patronage refunds and equity growth:

$$ER_t = [(1-c)r_e - g]E_{t-1} \text{ for } g \geq 0. \quad (2)$$

The rate at which the cooperative retires equity is determined by dividing equation (2) by E_{t-1} :

$$\dot{E} = \frac{ER_t}{E_{t-1}} = (1-c)r_e - g \text{ for } g \geq 0. \quad (3)$$

For a cooperative operating a revolving fund, it can be shown (Royer 1993) that the length of the revolving period is

$$T = -\frac{\log\left[1 - \frac{g}{(1-c)r_e}\right]}{\log(1+g)} \text{ for } (1-c)r_e > g \quad (4)$$

when $g > 0$.⁶

Most of the parameters used in this model are based on data on U.S. agricultural cooperatives contained in the annual USDA reports of cooperative statistics (USDA 2021, and earlier). Table 1 shows the data used to calculate the rates of return on allocated and total equity and the rate of equity growth. The rates of return on equity were calculated by dividing net income after taxes by equity in the previous year in a manner consistent with the model. Thus, the rates of return on allocated equity are usually greater than those reported by USDA.

The determination of an appropriate value for the rate of return on equity is complicated by the fact that many cooperatives accumulate unallocated equity from retained earnings withheld from net income. Although the USDA dataset includes balance sheet data on both allocated and unallocated equity, it does not report the

⁶ The length of the revolving period is $T = 1/[(1-c)r_e]$ when $g = 0$ (Royer 1993). In that case, $\dot{E} = (1-c)r_e$ and $T = 1/\dot{E}$. However, the assertion that $T = 1/\dot{E}$ (Eversull 2010) is correct only when $g = 0$. When $g > 0$, the relationship between \dot{E} and T is more complex as a comparison of equations (3) and (4) demonstrates.

Table 1. Rates of return on equity and rates of equity growth, 2010–19

| Year | Net income after taxes | Allocated equity | Total equity | Return on allocated equity | Return on total equity | Growth in allocated equity | Growth in total equity |
|------------------------|---------------------------|---------------------|-----------------|----------------------------------|---------------------------|----------------------------------|---------------------------|
| | <i>Billion dollars</i> | | | <i>Rate</i> | | | |
| 2009 | 4.016 | 16.190 | 23.807 | | | | |
| 2010 | 3.961 | 17.673 | 25.804 | 0.2447 | 0.1664 | 0.0916 | 0.0839 |
| 2011 | 5.015 | 17.795 | 27.906 | 0.2837 | 0.1943 | 0.0069 | 0.0814 |
| 2012 | 5.521 | 19.169 | 29.860 | 0.3103 | 0.1979 | 0.0772 | 0.0700 |
| 2013 | 5.556 | 21.531 | 34.559 | 0.2899 | 0.1861 | 0.1233 | 0.1574 |
| 2014 | 6.466 | 22.473 | 37.596 | 0.3003 | 0.1871 | 0.0437 | 0.0879 |
| 2015 | 7.030 | 24.229 | 40.514 | 0.3128 | 0.1870 | 0.0782 | 0.0776 |
| 2016 | 6.886 | 24.003 | 40.899 | 0.2842 | 0.1700 | -0.0094 | 0.0095 |
| 2017 | 6.166 | 25.008 | 42.645 | 0.2569 | 0.1508 | 0.0419 | 0.0427 |
| 2018 | 6.790 | 25.936 | 44.417 | 0.2715 | 0.1592 | 0.0371 | 0.0415 |
| 2019 | 7.756 | 26.114 | 45.923 | 0.2990 | 0.1746 | 0.0069 | 0.0339 |
| Average for 2010–19 | 6.115 | 22.393 | 37.012 | 0.2853 | 0.1773 | 0.0497 | 0.0686 |

Source: Data from annual USDA reports of cooperative statistics (USDA 2021, and earlier).

amount of net income that is withheld as retained earnings. Without a correction for retained earnings, the rate of return on allocated equity overstates the ability of the typical cooperative to retire allocated equity. Therefore, the lower rate of return on total equity is preferable because it better represents the ability of the cooperative to retire allocated equity while also accumulating unallocated equity. The same approach was taken in a recent study of capital structure and equity retirement in U.S. farm supply and grain marketing cooperatives (Royer and McKee 2021). In that study, the rate of return on total equity was used to explain the ability of cooperatives to retire allocated equity. The regression coefficients related to the rate of return were highly significant, suggesting its usefulness in the current analysis.

Consequently, the average rate of return on total equity for the 2010–19 period was initially chosen for use. The rate of growth used is the compound rate of growth in allocated equity over the same period. The proportion of cash patronage refunds was calculated from the most recent USDA financial profile of agricultural cooperatives (Eversull 2011).

The spreadsheet models for the revolving fund plans require that the revolving period is assigned an integer value. Substituting the values for r_e , g , and c based on the USDA data into equation (4) yields a revolving period of 16.66 years. That

value was set to 17 years by reducing r_e slightly.⁷ Thus, the parameter values used in the simulations were $r_e = 0.1750$, $g = 0.0490$, and $c = 0.4970$.

Total patronage of the cooperative's members in year t is related to total equity by this relationship:

$$P_t = \frac{r_e}{\pi} E_{t-1} \quad (5)$$

where π is the ratio of net income from sales to total gross revenue. The value of π was calculated from USDA data for the 2013–19 period using net income less service income and other operating income to represent net income from sales.

Member Model

Economists have long postulated the concept of a farmer life cycle in which economic activity grows during the early years of a farmer's career and then declines in later years (Tauer 2019). However, longitudinal data are unavailable for estimating such a life cycle for use in this analysis. Instead, the age-patronage relationship used here is based on a quadratic age-sales function estimated from cross-sectional data in a manner similar to studies by Barton and Schmidt (1988), Royer and Shihpar (1997), and Kenkel (2020). According to Kenkel, that approach produces a reasonable approximation of the age-sales relationships exhibited in case studies.

The age-sales relationship for the typical member was estimated from data in the *2012 Census of Agriculture* (USDA 2014), the most recent census to report the market value of agricultural products sold by the age of principal operator. Average sales per producer was calculated by dividing the market value of agricultural products sold and government payments by the number of principal operators in each of seven age groups: under 25 years, 25 to 34 years, 35 to 44 years, . . . , 75 years and older. The observations for the census age groups were assumed to occur respectively at ages 20, 30, 40, . . . , and 70, following the approach outlined by Simonon (1989) in a similar application.

This function served as the estimated equation:

$$Sales(Age) = \alpha + \beta_1 Age + \beta_2 Age^2 + \varepsilon \quad (6)$$

⁷ As it turns out, the 17-year revolving period appears to represent U.S. local cooperatives quite well. According to Eversull (2010), when local cooperatives that used revolving fund plans in 2008 were grouped by total assets, the average revolving period ranged from 13 to 18 years, and the most common average was 17 years.

Table 2. Results of regression used to estimate age-sales relationship

| Variable | Estimated coefficient | Standard error | t value | Probability value |
|-------------------------|-----------------------|----------------|---------|-------------------|
| Intercept | -0.2680 | 0.6073 | -0.44 | 0.6889 |
| <i>Age</i> | 0.3595 | 0.0475 | 7.57 | 0.0048 |
| <i>Age</i> ² | -0.0058 | 0.0008 | -7.56 | 0.0048 |
| <i>F</i> statistic | 29.04 | | | 0.0109 |
| <i>R</i> ² | 0.9509 | | | |

where *Sales* is average sales per producer and *Age* is career age (chronological age minus 15 years) such that *Age* = 0 at the onset of the producer's farming career. According to Simonton (1988), the quadratic form in equation (6) has been used frequently to represent the relationship between an individual's age and productivity. The expected signs of the coefficients are $\alpha \geq 0$, $\beta_1 \geq 0$, and $\beta_2 < 0$.

The results of an ordinary least squares regression used to estimate the age-sales relationship are reported in table 2. The estimated coefficients for both *Age* and *Age*² are significant and of the expected signs ($\hat{\beta}_1 > 0$, $\hat{\beta}_2 < 0$). Although the estimated coefficient for the intercept is not of the expected sign ($\hat{\alpha} < 0$), it is not significant. The estimation of an alternative model without an intercept yielded similar values for $\hat{\beta}_1$ and $\hat{\beta}_2$. However, it did not produce as good of a fit, as measured by the root mean squared error. Accordingly, the results shown in table 2 were used to construct the age-sales relationship used in this analysis.⁸

Figure 1 shows the estimated age-sales relationship used in the simulations.⁹ The unlabeled points near the curve represent the census observations included in

⁸ Applying the same regression model to 2002 and 2007 census data (USDA 2004, 2009) suggests that the age-sales relationship was relatively stable over the 2002–12 period. The regressions for 2002 and 2007 produced very similar fits (respective *R*² statistics of 0.9920 and 0.9669). Moreover, the sales predicted by the three models for 20, 30, 40, . . . , and 70 years of age were highly correlated (correlation coefficients of 0.9837 for the correlation between 2002 and 2012 and 0.9877 for the correlation between 2007 and 2012).

⁹ The age-sales relationship assumed for the typical member is intended to resemble the relationships one might commonly observe among lifelong members of the cooperative. It is not meant as an average relationship representative of the organization's overall membership because the age-sales relationships of individual members are expected to differ substantially from one another in terms

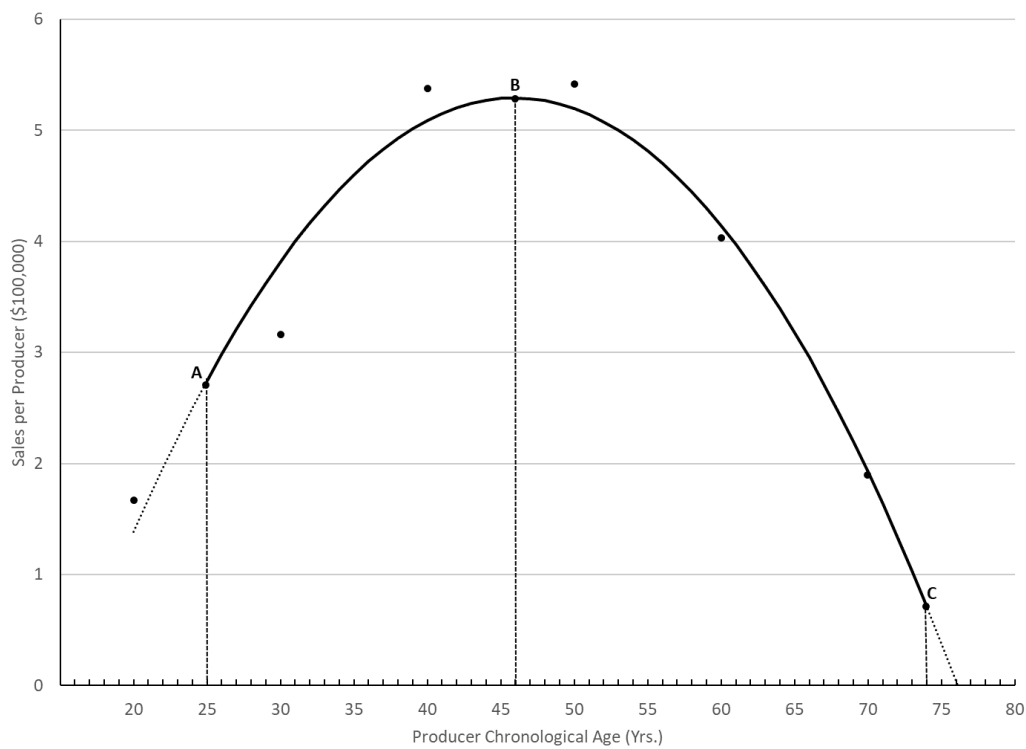


Figure 1. Age-sales relationship used in simulations

the regression. The solid portion of the curve, which extends from 25 to 74 chronological years of age (points A and C), represents the member's 50-year farming career. The greatest sales occur at 46 years of age (point B). Unlike the Barton and Schmidt (1988) and Kenkel (2020) analyses, the farming career used here does not include all years for which sales are nonnegative. Because this analysis is based on a typical member, the sales corresponding to the youngest and oldest producers in the census are excluded. Extending the farming career to include the oldest producers also would complicate the analysis of special plans for redeeming equity held by estates or based on member age.

Choices for the start and end of the member's farming career were not obvious given the broad definition of a farm used by USDA,¹⁰ the extent to which individuals retire to farming, and the complex set of factors that affect farmers' attitudes

of both shape and duration. Variations in those age-sales relationships and member ages help explain the different time paths taken by the equity held by the typical member and the total equity of the cooperative.

¹⁰ The census definition of a farm is "any place from which \$1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year" (USDA 2019).

about retirement and their decisions to retire (Kirkpatrick 2013). Although a 2006 survey of Iowa farm operators (Baker and Epley 2009) found that the average retirement age was 67 years, only 23 percent of respondents indicated they would retire. More than 30 percent indicated they would never retire, and that proportion was greater in four other states that were surveyed. A majority of Iowa respondents indicated they would semi-retire, i.e., they would continue to exercise some managerial control and/or provide some labor to the farm.

The retirement age used here was set to 74 years because data from the 2017 *Census of Agriculture* (USDA 2019) indicate that substantially more producers exit farming around 74 years of age than around 64 years of age. The typical member was assumed to begin farming at 25 years of age because census data show that only a relatively few producers are engaged in farming before that age.¹¹

Equation (6) was used to generate the member's patronage for each year of the farming career represented in figure 1. Simulation results are independent of scale. Thus, the cooperative's size relative to the member is unimportant, and it is convenient to normalize the member's patronage so it equals \$100,000 in the first year of the simulations. Patronage refunds received by the member in year i are πp_i where p_i is the member's patronage in year i . Cash and noncash patronage refunds are respectively $c\pi p_i$ and $(1-c)\pi p_i$.

The cooperative's net income is assumed to be returned to members as patronage refund distributions that qualify for exclusion from the cooperative's taxable income under Subchapter T of the Internal Revenue Code. Among the requirements for a qualified patronage refund distribution are that the refund must be paid from the net income of the cooperative according to a preexisting legal obligation, the cooperative must pay at least 20 percent of the refund in cash, and for tax purposes the member must consent to have the noncash portion treated as if it had been received in cash.

That definition includes small farms for which the principal operator is retired or is engaged in a primary occupation other than farming ("Farm Structure," U.S. Department of Agriculture, Economic Research Service, accessed January 17, 2022, <https://www.ers.usda.gov/topics/farm-economy/farm-structure-and-organization/farm-structure/>.)

¹¹ Only two of the seven age groups included fewer producers than the groups immediately preceding them. There were 197,418 fewer producers in the 65-to-74-years group than the 55-to-64-years group. There were 361,930 fewer producers in the 75-years-and-over group than the 65-to-74-years group. Only 1.5 percent of the nation's 3.4 million agricultural producers were under 25 years of age.

Simulation Models

Spreadsheet models are used to simulate the annual operation of the equity retirement plans. Equity is assumed to grow at the same rate in each of the models. Under that assumption, the systematic plans provide the cooperative identical levels of equity. In the model of the revolving fund plan, noncash patronage refunds received by the member are retained as allocated equity for one revolving cycle before they are redeemed in cash. The revolving period is set to 17 years according to the cooperative model.

In the model of the percentage plan, a fixed percentage of the member's allocated equity is retired each year. The retired equity is based on the member's equity balance at the beginning of the year. Retained patronage refunds added during the year are included in the beginning balance for the following year. Once the member quits farming, the equity balance asymptotically approaches zero as the fixed percentage is repeatedly applied to the declining equity base. This process continues indefinitely unless a special plan is used to close the member's equity account. The percentage of equity retired annually is set to 3.9 percent based on equation (3).

Under the base capital plan, the member is required to provide equity in proportion to use during the base period. Each year, the cooperative determines an equity adjustment intended to bring the member's equity balance to its required level. If the equity balance exceeds the equity requirement, the cooperative retires the equity needed to reduce the balance to the required level; if the balance is less than the equity requirement, the member must contribute additional equity in the form of direct cash investments, retained patronage refunds, or per-unit capital retains.¹² The base period is set to seven years, the average base period for U.S. cooperatives in 1991 as reported by Rathbone and Wissman (1993).

For the special plan based on age, the cooperative is assumed to redeem the member's equity at age 75, a year after the member quits farming. That age, which is close to the average age used by cooperatives,¹³ avoids a situation in which members continue to accumulate equity after their equity accounts are closed. In the

¹² Per-unit capital retains are investments members make in a cooperative based on the dollar value or physical volume of products marketed through it. The retains are withheld by the cooperative according to a bylaw provision or membership agreement that allows it to make specified deductions for capital purposes from proceeds due members or cash advances, and they are distinguished from deductions authorized to cover operating expenses. Per-unit capital retains are allocated to members and taxed in a manner similar to patronage refund allocations except they are not based on cooperative net income and Subchapter T of the Internal Revenue Code does not require a portion to be paid back to members in cash for them to be excluded from the cooperative's taxable income.

¹³ When U.S. local cooperatives were grouped by total assets, the average age used in 2008 to redeem equity in special plans based on age ranged from 68 to 73 years (Eversull 2010).

special plan for retiring equity held by the member's estate, the cooperative is assumed to redeem the equity at 80 years of age, a value consistent with the 55.25-year U.S. life expectancy for a 25-year-old beginning farmer (Arias and Xu 2020).

Performance Indicators

Several variables are used to describe and compare the performance of the equity retirement plans: the cash flow the member receives from the cooperative; the length of the various stages of the cash flow relationship between the cooperative and member; a measure of the proportionality of the plan; the opportunity costs borne by the cooperative and member; and the amount of equity supplied by the member.

Member cash flow is reported on a before-tax basis. Because the systematic equity retirement plans are based on identical assumptions about the distribution of patronage refunds and the allocation of member equity, the choice of a plan is neutral in terms of its effect on cash flow. However, there are differences in the timing of cash flow, which are reflected in present value calculations. In addition, depending on the plan, there may be several years of low cash flow early in a member's farming career, and those should be considered when comparing plans. Although the proportion of patronage refunds paid in cash is usually sufficient for covering federal income tax, the combination of federal, state, and self-employment taxes can create negative after-tax cash flows.¹⁴ Negative cash flows also can result from the additional equity investments members must make to meet their equity requirements under the base capital plan.

The cash flow relationship between the cooperative and member can be partitioned into three stages that are useful in analyzing plan performance (Royer and Shihpar 1997). The stages are defined by whether there is active accumulation or retirement of member equity. During the investment stage, the member invests

¹⁴ Both cash and noncash patronage refunds a member receives as part of a qualified patronage refund distribution are subject to federal and state income taxes and self-employment tax, the latter of which consists of a Social Security component and a Medicare component. In 2021, the first \$142,800 of the net earnings of a self-employed individual were subject to Social Security tax at a 12.4 percent rate. All net earnings were subject to a 2.9 percent Medicare tax, and an additional Medicare tax of 0.9 percent was applied to net earnings in excess of \$200,000 for single taxpayers and \$250,000 for married taxpayers filing jointly. When both income taxes and self-employment tax are considered, it is not difficult to identify situations in which cooperative members may have faced combined marginal tax rates greater than 40 percent. For example, a single taxpayer in Nebraska would have been subject to a 44.14 percent combined tax rate for taxable income between \$40,525 and \$86,375 and a 46.14 percent rate for income between \$86,375 and \$142,800. The combined rate would have decreased at \$142,800 because earnings were no longer subject to Social Security tax. However, the rate would once again exceed 40 percent for incomes greater than \$164,925 due to the increasing federal income tax rate and the additional Medicare tax.

equity in the cooperative but has not participated in the cooperative's equity program long enough to receive cash redemptions. The investment stage occurs in the early years of the member's farming career and is often characterized by low cash flow. In the intermediate stage, the member continues to make equity investments but begins receiving cash redemptions. Cash flow is typically higher in this stage because of equity retirement and expanded patronage. The disinvestment stage begins when the member quits farming. Cash flow consists entirely of the redemption of equity allocated in earlier years.

The lengths of the stages can serve as meaningful indicators of the performance of a plan. In particular, a reduction in either the investment or disinvestment stage can be expected to benefit members. The earlier equity retirement associated with a shorter investment stage can increase cash flow early in members' farming careers when cash is necessary for establishing and expanding their farming operations. Likewise, a shorter disinvestment stage can improve the cash flow of members who have retired and are no longer receiving income from farming. Moreover, shorter disinvestment stages can reduce problems associated with estates.

The measure of proportionality considers the equity held by the cooperative both during the member's farming career and after the member quits farming. It is calculated as

$$\Pi = 1 - \frac{\sum_{i=1}^r |e_i - e_{i0}|}{2 \sum_{i=1}^q e_{i0}} \quad (7)$$

where e_i is the equity the member provides at the start of year i , q is the year the member quits farming, and r is the year the cooperative retires the last of the member's equity. The term e_{i0} represents the equity the member would provide under proportional financing, i.e., if equity were provided in proportion to patronage. It is calculated as $(p_i/P_i)E_i$ where p_i is the member's patronage, P_i is total patronage, and E_i is total equity at the start of the year. If equity is provided strictly in proportion to patronage during the member's entire farming career, $e_i = e_{i0}$ for all i so that $\Pi = 1$.

Proportional financing could require members to make substantial equity investments early in their farming careers when they have limited access to capital. On the other hand, members would receive immediate redemption of their remaining equity allocations when they quit farming. The financial demands proportional financing would impose on young members and the cooperative generally make it

impracticable. Nonetheless, it can serve as an ideal against which the relative performance of equity retirement plans can be measured.

The opportunity costs examined here are closely related to the proportionality concept because both are based on $e_i - e_{i0}$, the difference between the equity the member provides each year and the equity that would be provided under proportional financing. By focusing on these opportunity costs, it is possible to identify the separate impacts disproportionality has on the cooperative and the member and to assign economic values to those impacts. Two types of opportunities costs are examined: the costs incurred by the cooperative when members are underinvested relative to patronage, and those incurred by members when they are overinvested. The cooperative incurs opportunity costs when a member is underinvested because the member benefits from capital the cooperative could have put to other uses. A member incurs opportunity costs when overinvested because the cooperative benefits from capital the member could have put to other uses. Typically, members are underinvested early in their farming careers when the equity they have accumulated has not yet risen to levels proportionate to their use of the cooperative. They are usually overinvested late in their farming careers and after they have quit farming, when their equity accumulations are disproportionately large relative to use.

In calculating the opportunity cost for year i , the member is considered underinvested if $e_i < e_{i0}$ and overinvested if $e_i > e_{i0}$. If $e_i < e_{i0}$, the opportunity cost is $\delta_i = k_c (e_{i0} - e_i)$ where k_c is the cooperative's cost of equity, and δ_i is assigned to the cooperative. If $e_i > e_{i0}$, the opportunity cost is $\delta_i = k_c (e_i - e_{i0})$ and assigned to the member. Because an opportunity cost to one party is offset by an economic benefit to the other, the cooperative's cost of equity is used in calculating the opportunity costs for both the cooperative and member.

The cooperative's cost of equity used in calculating the opportunity costs and the discount rate used in the present value calculations is based on r_e , the rate of return on equity. Following Phillips (2001) and Royer (2019), r_e was chosen because of its role in determining the proportion of patronage refunds the cooperative can pay in cash and the rates at which it can grow and retire equity. It can be shown that r_e is equivalent to the cost of equity determined by the discounted cash flow method of valuation commonly applied to publicly traded corporations after key terms are replaced with their cooperative counterparts (Royer 2019).

For comparison purposes, all present values are calculated from the member's perspective. The discount rate was set to $r_e - g$, which differs from the cooperative's cost of equity in that it does not include cooperative growth; thus, it only represents opportunity costs at the member level. It is equivalent to the rate of

return members earn on their investments in the cooperative, which can be calculated by dividing the cash distributions members receive in a year by allocated equity (Snider and Koller 1971; Royer 2019). The 0.1260 discount rate based on $r_e - g$ is considerably higher than the 0.03 rate used by Kenkel (2020). Assumption of a lower discount rate would amplify the differences between equity retirement plans and increase the present value of cash flow that occurs late in the member's farming career or after retirement.

The amount of equity the member supplies the cooperative is measured in equity units, defined as one dollar of equity held for one year. Total equity supplied

under a plan is $\sum_{i=1}^r e_i$. The monetary value of that equity is $\sum_{i=1}^r k_e e_i$, determined by

multiplying equity units by the cooperative's cost of equity. The equity units the member supplies vary from one plan to another depending on how long the cooperative holds the equity before retiring it. This has important implications for member opportunity costs and the ability of the cooperative to add a special equity retirement plan to an existing systematic plan. The equity supplied is related to proportionality because the cooperative typically holds onto the member's equity longer under plans characterized by low proportionality.

Comparison of Systematic Plans

The revolving fund, percentage, and base capital plans are compared in this section. The comparisons focus on member cash flow, proportionality, and opportunity costs. The equity units the typical member supplies the cooperative are discussed in the context of proportionality.

Member Cash Flow

Figure 2 shows the cash flow the member would receive under each of the three plans. The figure extends only until the last of the member's equity is retired under the revolving fund plan. The equity remaining to be retired under the percentage plan is not shown. Table 3 reports several numerical indicators of the performance of the plans.

Initially, member cash flow associated with the revolving fund plan consists entirely of cash patronage refunds, which increase at first and then decrease as they follow the age-sales relationship in figure 1. After one revolving cycle, there is a large jump in cash flow as the member begins receiving the redemption of retained patronage refunds allocated earlier. At the end of the member's farming career, there is a large decline in cash flow as it no longer includes cash patronage refunds

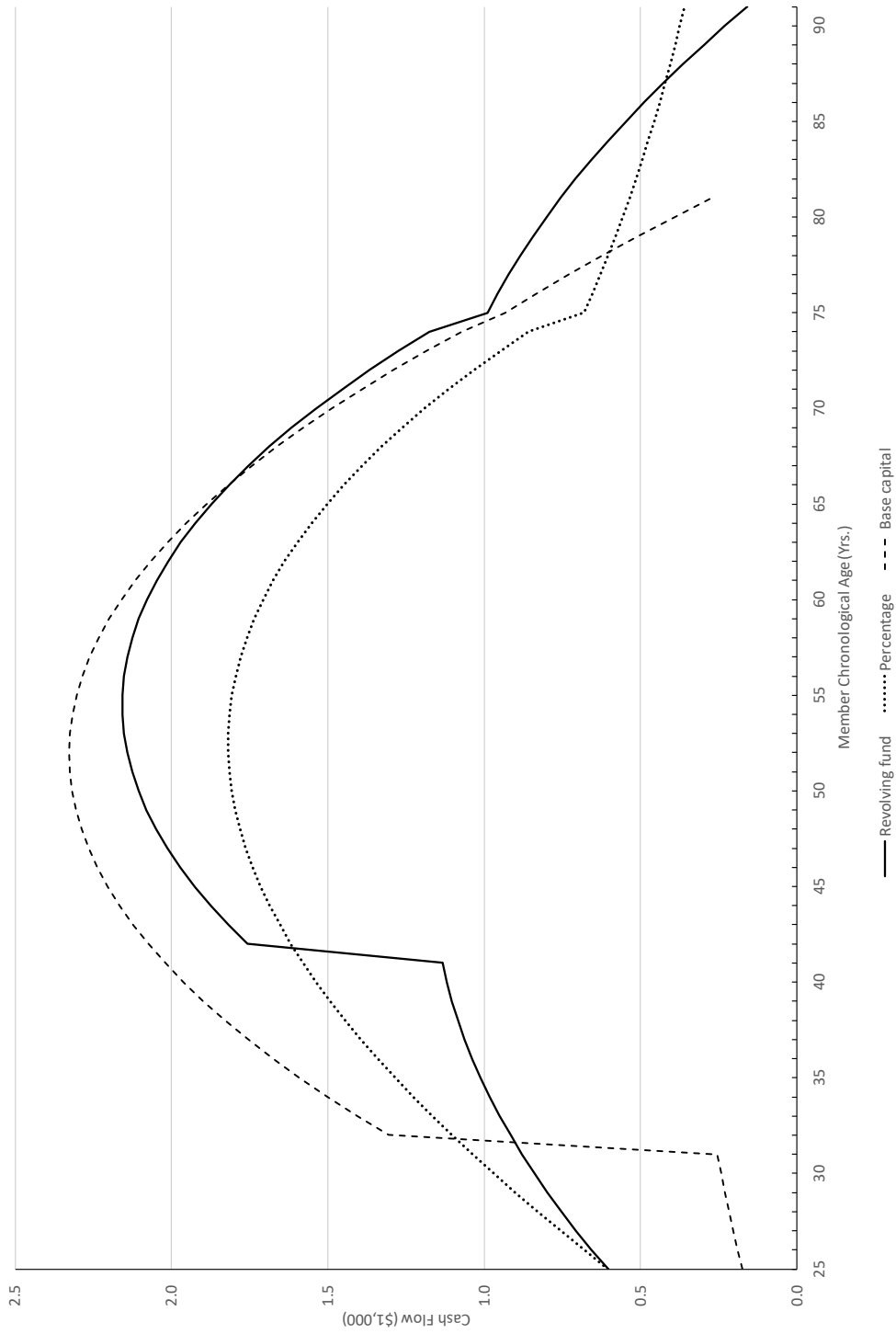


Figure 2. Member cash flow under systematic equity retirement plans

Table 3. Performance of systematic equity retirement plans

| | Revolving fund | Percentage | Base capital |
|--------------------|-----------------------|-------------------|---------------------|
| Proportionality | 0.6425 | 0.2430 | 0.8947 |
| | <i>Dollars</i> | | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 8,716 | 9,521 | 7,988 |
| Opportunity costs: | | | |
| Cooperative | 13,426 | 16,986 | 9,799 |
| Present value | 7,843 | 8,652 | 5,924 |
| Member | 53,116 | 123,912 | 9,799 |
| Present value | 990 | 681 | 83 |
| Total | 66,542 | 140,898 | 19,598 |
| | <i>Years</i> | | |
| Cash flow stages: | | | |
| Investment | 17 | 1 | 7 |
| Intermediate | 33 | 49 | 43 |
| Disinvestment | 17 | ∞ | 7 |

and consists entirely of the redemption of retained patronage refunds in the revolving fund. The redemption of retained patronage refunds continues for one more revolving cycle, after which the balance of the member's equity account is zero.

Under the percentage plan, the member begins receiving redemption of retained patronage refunds in the second year. Because redemption starts almost immediately, there is not a large jump in cash flow as with the revolving fund plan. Instead, cash flow gradually increases and then decreases as it follows the age-sales relationship. There is a substantial drop in cash flow at the end of the member's farming career when cash patronage refunds cease and cash flow consists entirely of equity retirement. From that point, the member's equity balance gradually declines as a fixed percentage of the equity is redeemed annually. Without a special plan to close out the member's equity account, the cash flow from redemption will continue indefinitely.

In the case of the base capital plan, the member's cash flow is low in the first years when members are required to make additional equity investments to meet

their equity requirements under the plan. Once a member's equity balance is proportionate to use, cash flow jumps, after which it follows the age-patronage relationship. There is a slight inflection when the member's farming career ends and patronage ceases.

Overall, the base capital plan provides the member the greatest cash flow during the middle years of the simulations whereas the percentage plan results in the least. In the early years, the cash flow from the percentage plan is greatest because the redemption of retained patronage refunds begins almost immediately. The base capital plan results in the least cash flow during the early years because of the additional investments underinvested members are required to make. At the end of the member's farming career, the revolving fund plan produces the largest member cash flow, but only because much of the member's equity has already been redeemed in the case of the base capital plan. In fact, under the base capital plan, all of the member's equity has been redeemed well before the last equity has been redeemed under the revolving fund plan. Even after the revolving fund plan has retired the last of the member's equity, a substantial amount of equity remains to be retired under the percentage plan.

Although total member cash flow is the same for all three equity retirement plans, the present value of member cash flow varies from one plan to another. The present value is highest for the percentage plan because of the higher cash flow early in the member's farming year. The present value is least for the base capital plan because of the low cash flow in early years due to the additional equity investments underinvested members must make.

Proportionality

Proportionality is greatest for the base capital plan and least for the percentage plan. Indeed, the proportionality of the percentage plan is only a fraction of that of the base capital plan. The proportionality of the revolving fund plan is substantially higher than the percentage plan but considerably lower than the base capital plan.

Figure 3 compares the equity the member supplies under each plan to the amount that would be supplied by proportional financing. For any age i , the distance between the curve for a particular plan and the curve for proportional financing represents the difference in the equity provided under the plan (e_i) and proportional financing (e_{i0}). Those differences serve as the basis for the calculation of proportionality in equation (7).

All three plans lag proportional financing in both the accumulation and retirement of equity. The lags are least pronounced for the base capital plan, which follows the profile for proportional financing more closely than either the revolving fund or percentage plans. The percentage plan exhibits the largest lags of the three

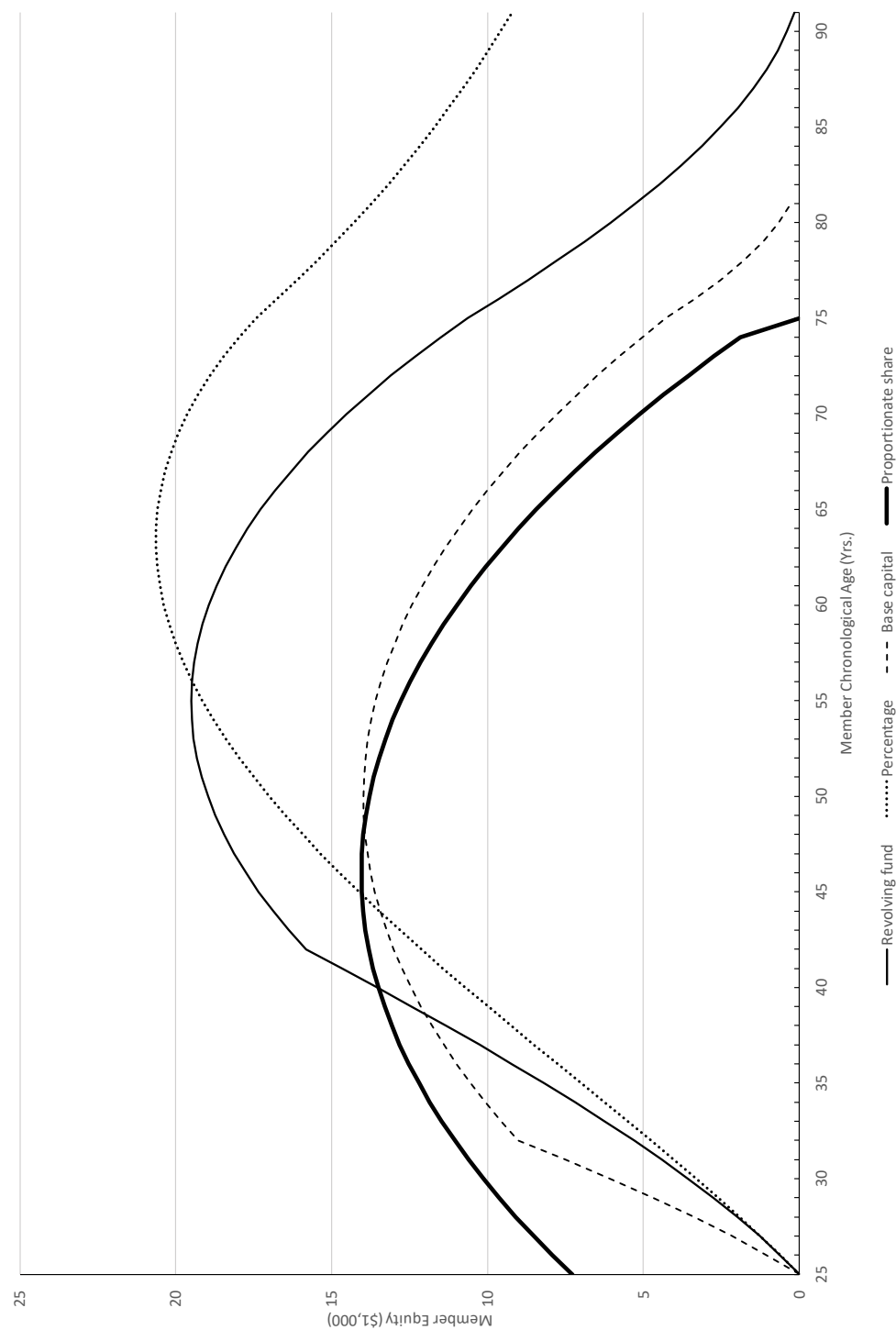


Figure 3. Member equity balances under systematic plans and proportional financing

Table 4. Equity supplied by member under systematic and special plans

| | Revolving fund | Percentage | Base capital |
|----------------------------|-----------------------|-------------------|---------------------|
| Systematic plan only | | | |
| Equity units | 758,689 | 1,142,938 | 531,863 |
| Value (dollars) | 132,756 | 199,992 | 93,066 |
| With special plan (age) | | | |
| Equity units | 694,735 | 714,075 | 522,092 |
| Value (dollars) | 121,565 | 124,949 | 91,356 |
| With special plan (estate) | | | |
| Equity units | 733,795 | 791,517 | 531,593 |
| Value (dollars) | 128,400 | 138,500 | 93,019 |
| | <i>Net change</i> | | |
| With special plan (age) | | | |
| Equity units | -63,954 | -428,863 | -9,772 |
| Value (dollars) | -11,191 | -75,043 | -1,710 |
| With special plan (estate) | | | |
| Equity units | -24,893 | -351,422 | -270 |
| Value (dollars) | -4,356 | -61,492 | -47 |

plans. These observations are consistent with the values for the proportionality measure presented in table 3.

The area under each curve represents the total equity units the member would supply the cooperative under that plan. Those areas correspond to the numerical values presented in the first row of table 4. The equity units supplied under the base capital plan are identical to the units that would be supplied by proportional financing. The principal difference between the base capital plan and proportional financing is the lags in equity accumulation and retirement that occur under the plan. The cooperative holds substantially more equity units under the revolving fund and percentage plans than under the base capital plan; it holds the most equity units under the percentage plan. Although the three plans are equivalent in terms of the overall equity they provide the cooperative, they differ in their impacts on individual members. Because the cooperative holds the typical member's equity longer under the revolving fund and percentage plans, member opportunity costs are greater under those plans.

Opportunity Costs

Figure 4 illustrates cooperative and member opportunity costs for the plans. Under all three plans, the cooperative incurs opportunity costs early in the member's farming career when the member is underinvested relative to patronage. As the member accumulates equity, the cooperative's opportunity costs diminish until the member is eventually fully invested. With additional equity accumulation, the member becomes overinvested and begins incurring opportunity costs.

The pattern of opportunity costs differs from one plan to another, depending on how equity is accumulated and retired. In the figure, the point at which cooperative opportunity costs are replaced by member opportunity costs is labeled A for the revolving fund plan, B for the percentage plan, and C for the base capital plan. The greatest opportunity costs are usually associated with the percentage plan. Generally, both cooperative and member opportunity costs are larger for the percentage plan than the other plans with the exception of a period in the middle of the member's farming career when member opportunity costs are larger for the revolving fund plan. Both cooperative and member opportunity costs are usually lowest under the base capital plan.

Modifications of the Base Capital Plan

The base capital plan performs well with respect to proportionality and other performance indicators. However, the need for young members to make additional equity investments to meet their equity requirements can place a substantial financial burden on them and make it harder for cooperatives to attract new members. In this section, several modifications of the base capital plan are examined to determine whether they can improve the cash flow of young members without unduly compromising the plan's performance. The modifications include changing the length of the base period used to calculate equity requirements, relaxing the equity requirements for underinvested members so additional investments are unnecessary, and operating a variable cash patronage refund program in conjunction with the plan. In a variable cash patronage refund program, underinvested members receive less of their patronage refunds in cash than other members. Such a plan can be used to accelerate the investments of underinvested members by increasing the noncash portions of their patronage refund allocations.

Plans with five-year and ten-year base periods, a plan in which the equity requirements for underinvested members are relaxed, and a plan with a variable cash patronage refunds program are compared to a basic plan with a seven-year base period. Under the plan with relaxed equity requirements, it is assumed that underinvested members receive both cash and noncash patronage refunds but do not participate in equity retirement. In the variable cash patronage refund program, the

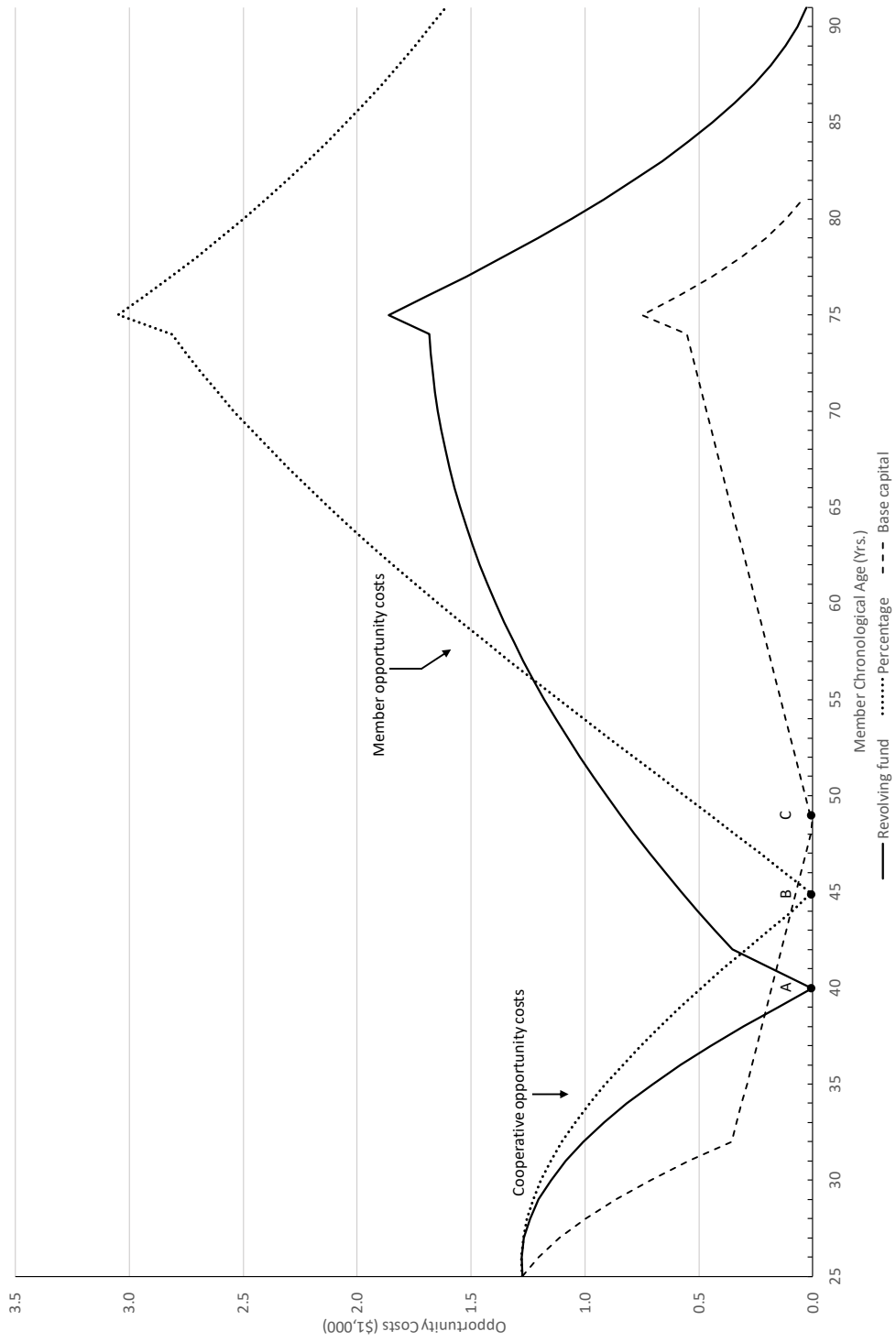


Figure 4. Cooperative and member opportunity costs under systematic plans

proportion of patronage refunds a member receives in cash is assumed to follow this schedule:

| Proportion equity requirement met (ϖ) | Proportion cash patronage refunds (c) |
|--|---|
| $\varpi < 0.25$ | 0.20 |
| $0.25 \leq \varpi < 0.50$ | 0.25 |
| $0.50 \leq \varpi < 0.75$ | 0.30 |
| $0.75 \leq \varpi < 1.00$ | 0.40 |
| $1.00 \leq \varpi$ | 0.50 |

Results from varying the base period are displayed in table 5, which includes information on the additional equity investments the typical member must make to meet the equity requirements of the plan; the results are presented graphically in figure 5. A plan in which the equity requirements for underinvested members are relaxed and a plan combined with variable cash patronage refunds are compared to the basic plan in table 6 and figure 6.

As shown in table 5, reducing the base period shortens the investment and disinvestment stages and lengthens the intermediate stage. Reducing the base period also increases proportionality and decreases both cooperative and member opportunity costs. On the other hand, it lowers the present value of member cash flow. This is due primarily to the additional equity investments members must make during the shorter base period. As a result of those investments, cash flow during the investment stage is lowest for the plan with the five-year base period, as illustrated in figure 5. Cash flow during the disinvestment stage is also lowest for the five-year base period. However, cash flow during the intermediate stage is higher for the five-year base period than the others.

A major drawback of the shorter base period is the greater financial pressure it places on members early in their farming careers. Reducing the base period increases the additional investments members must make during the investment stage, and those investments reduce cash flow substantially. Indeed, for the plan with a five-year base period, member before-tax cash flow is negative during the investment stage.

Of course, lengthening the base period produces results opposite those from reducing the base period. An important effect of a longer base period is that it provides members more time to meet their equity requirements. Consequently, the

Table 5. Effects of varying base period

| | 5-yr. base | 7-yr. base | 10-yr. base |
|-------------------------|----------------|------------|-------------|
| Proportionality | 0.9209 | 0.8947 | 0.8557 |
| | <i>Dollars</i> | | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 7,163 | 7,988 | 9,019 |
| Opportunity costs: | | | |
| Cooperative | 7,361 | 9,799 | 13,429 |
| Present value | 4,764 | 5,924 | 7,375 |
| Member | 7,361 | 9,799 | 13,429 |
| Present value | 67 | 83 | 101 |
| Total | 66,542 | 140,898 | 19,598 |
| Additional investments: | | | |
| Total | 4,927 | 3,724 | 1,570 |
| Average | 985 | 532 | 157 |
| | <i>Years</i> | | |
| Cash flow stages: | | | |
| Investment | 5 | 7 | 10 |
| Intermediate | 45 | 43 | 40 |
| Disinvestment | 5 | 7 | 10 |

cash flow received by the typical member is higher during the first few years when the member is building equity to bring it into line with use.

Relaxing the equity requirements for underinvested members also provides them more time to increase their equity investments, while resulting in only a modest diminution in performance relative to the other systematic plans. Although there is an increase in cooperative opportunity costs, the present value of member cash flow increases, and there is only a slight decrease in proportionality. Relaxing the equity requirements improves cash flow in early years, but it extends the investment stage. As figure 6 shows, cash flow is lower than under the basic plan toward the end of the extended investment stage. By allowing members more time to build their equity investments, the cooperative takes on a greater financial burden, which is reflected by its increased opportunity costs. Because the effects of relaxing the

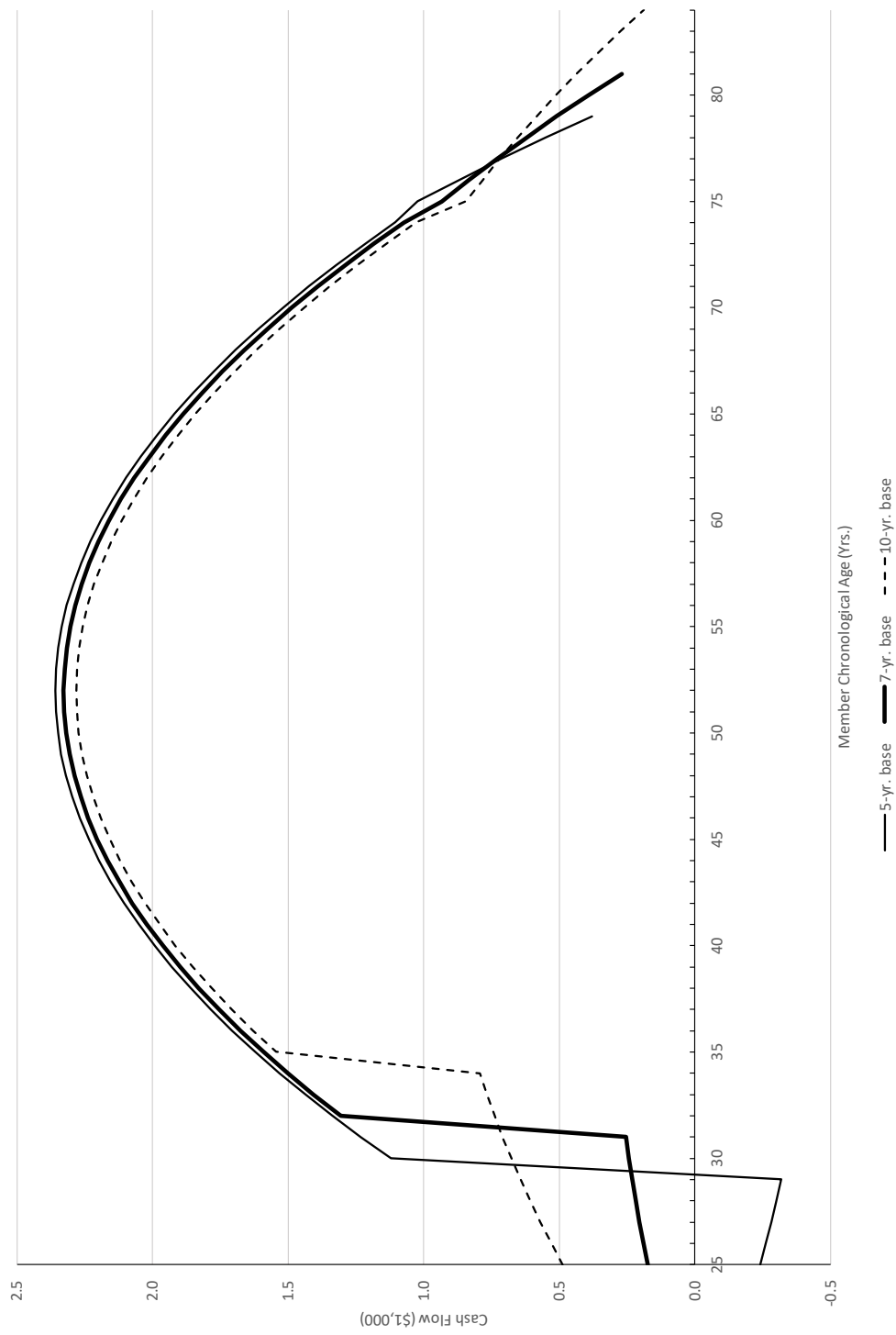


Figure 5. Effects of varying base period on member cash flow

Table 6. Effects of relaxed equity requirements and variable cash patronage refunds

| | Basic plan | Relaxed equity requirements | Variable cash patronage refunds |
|--------------------|-------------------|------------------------------------|--|
| Proportionality | 0.8947 | 0.8703 | 0.8890 |
| | | <i>Dollars</i> | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 7,988 | 9,456 | 8,378 |
| Opportunity costs: | | | |
| Cooperative | 9,799 | 14,338 | 10,864 |
| Present value | 5,924 | 7,963 | 6,467 |
| Member | 9,799 | 9,799 | 9,799 |
| Present value | 83 | 83 | 83 |
| Total | 19,598 | 24,137 | 20,663 |
| | | <i>Years</i> | |
| Cash flow stages: | | | |
| Investment | 7 | 13 | 9 |
| Intermediate | 43 | 37 | 41 |
| Disinvestment | 7 | 7 | 7 |

equity requirements occur early in the member's farming career, member opportunity costs are unaffected. An important advantage of relaxed equity requirements is that they avoid subjecting members to negative after-tax cash flows early in their farming careers.

The effects of a variable cash patronage refunds are similar. However, the investment stage is shorter because members do not need as much time to bring their equity balances into line with patronage. Therefore, proportionality is greater than when the equity requirements are relaxed although it is still less than in the basic plan. The present value of member cash flow is lower than when the equity requirements are relaxed, but so are the cooperative's opportunity costs. Both values are larger than in the basic plan. One disadvantage of the variable cash patronage refund program is that members may still experience negative after-tax cash flows

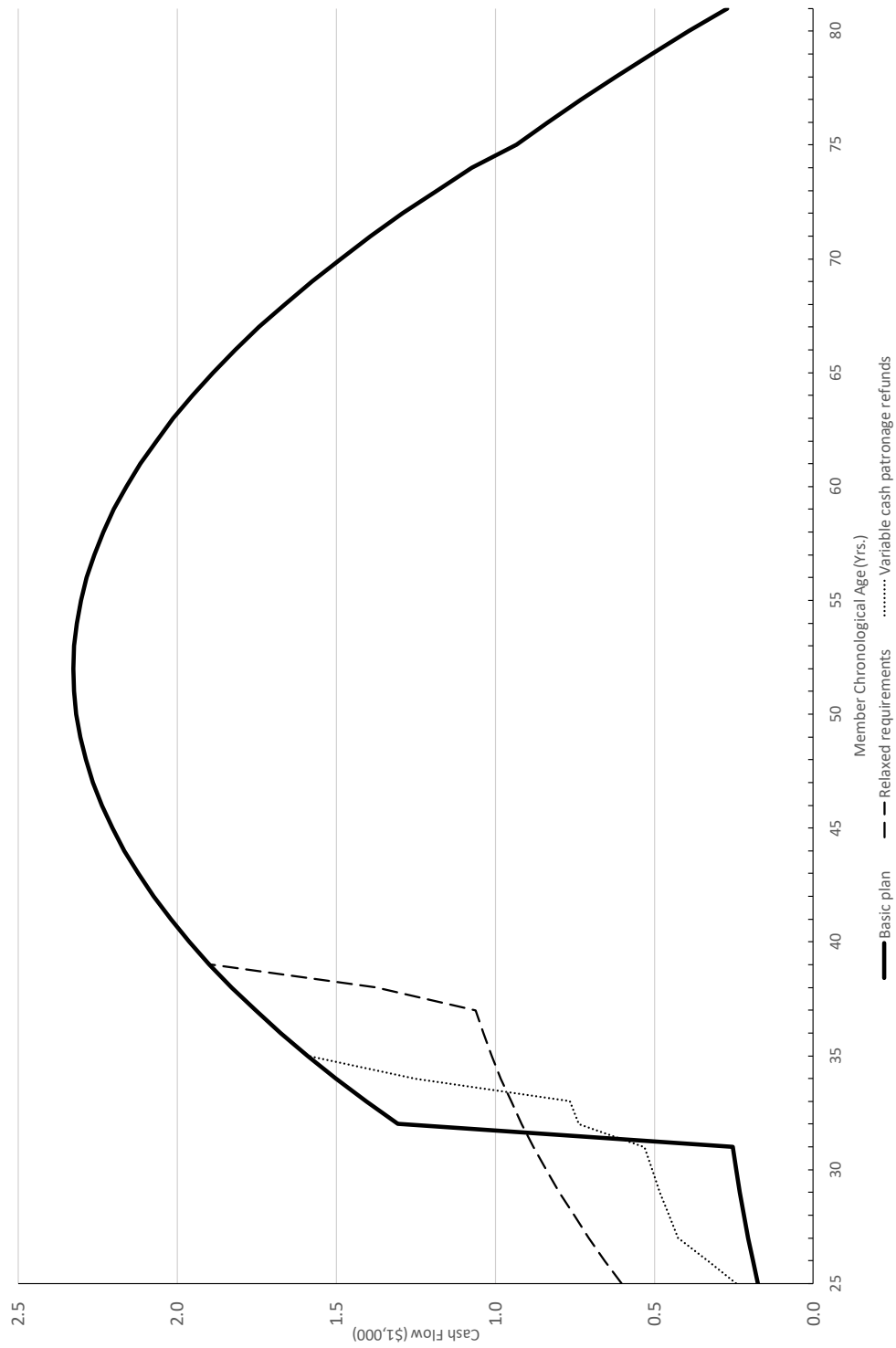


Figure 6. Effects of relaxed equity requirements and variable cash refunds on member cash flow

Table 7. Revolving fund plan in combination with special plans

| | Revolving fund plan only | Revolving fund plan with special plan | |
|---------------------|-----------------------------|--|------------------------|
| | | Age (at 75 yrs.) | Estate (at 80 yrs.) |
| Proportionality | 0.6425 | 0.7026 | 0.6659 |
| | | <i>Dollars</i> | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 8,716 | 8,728 | 8,719 |
| Disinvestment stage | 10,644 | 10,644 | 10,644 |
| Present value | 5,237 | 9,453 | 6,263 |
| Opportunity costs: | | | |
| Cooperative | 13,426 | 13,426 | 13,426 |
| Present value | 7,843 | 6,729 | 7,843 |
| Member | 53,116 | 41,925 | 48,760 |
| Present value | 990 | 972 | 985 |
| Total | 66,542 | 53,352 | 62,186 |
| | | <i>Years</i> | |
| Cash flow stages: | | | |
| Investment | 17 | 17 | 17 |
| Intermediate | 33 | 33 | 33 |
| Disinvestment | 17 | 1 | 6 |

if their marginal tax rates exceed the proportion of patronage refunds they receive in cash.

Effects of Special Plans

This section reports on analyses of how the addition of a special plan affects the performance of the systematic plans. Two special plans are considered: a plan that redeems the member's equity based on age (at 75 years of age) and a plan that redeems the equity held by the member's estate (at 80 years of age). The results of those analyses are presented in tables 7–9. Because the special plans redeem equity

Table 8. Percentage plan in combination with special plans

| | Percentage plan only | Percentage plan with special plan | |
|---------------------|-------------------------|--------------------------------------|------------------------|
| | | Age (at 75 yrs.) | Estate (at 80 yrs.) |
| Proportionality | 0.2430 | 0.6462 | 0.5734 |
| <i>Dollars</i> | | | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 9,521 | 9,555 | 9,537 |
| Disinvestment stage | 17,426 | 17,426 | 17,426 |
| Present value | 4,123 | 15,476 | 9,262 |
| Opportunity costs: | | | |
| Cooperative | 16,986 | 16,986 | 16,986 |
| Present value | 8,652 | 8,652 | 8,652 |
| Member | 123,912 | 48,869 | 62.42 |
| Present value | 681 | 634 | 659 |
| Total | 140,898 | 65,855 | 79,406 |
| <i>Years</i> | | | |
| Cash flow stages: | | | |
| Investment | 1 | 1 | 1 |
| Intermediate | 49 | 49 | 49 |
| Disinvestment | ∞ | 1 | 6 |

several decades after the member's farming career begins, their effects on the present value of member cash flow are not easily discerned when present values are calculated at 25 years of age. To bring those effects into sharper focus, the tables include the member cash flow during the disinvestment stage (i.e., after the member retires); the corresponding present values are calculated at 75 years of age. The special plans do not affect the level or timing of the cooperative's opportunity costs because all opportunity costs are borne by the member at the time the plans are implemented.

Table 9. Base capital plan in combination with special plans

| | Base capital plan only | Base capital plan with special plan | |
|---------------------|---------------------------|--|------------------------|
| | | Age (at 75 yrs.) | Estate (at 80 yrs.) |
| Proportionality | 0.8947 | 0.9039 | 0.8950 |
| | | <i>Dollars</i> | |
| Member cash flow: | | | |
| All stages | 88,721 | 88,721 | 88,721 |
| Present value | 7,988 | 7,990 | 7,988 |
| Disinvestment stage | 4,289 | 4,289 | 4,289 |
| Present value | 2,975 | 3,809 | 2,990 |
| Opportunity costs: | | | |
| Cooperative | 9,799 | 9,799 | 9,799 |
| Present value | 5,924 | 5,924 | 5,924 |
| Member | 9,799 | 8,089 | 9,752 |
| Present value | 83 | 79 | 83 |
| Total | 19,598 | 17,888 | 19,551 |
| | | <i>Years</i> | |
| Cash flow stages: | | | |
| Investment | 7 | 7 | 7 |
| Intermediate | 43 | 43 | 43 |
| Disinvestment | 7 | 1 | 6 |

As reported in table 7, the special plan based on age improves the performance of the revolving fund plan by shortening the disinvestment stage and reducing member opportunity costs. The plan also increases the present value of member cash flow after retirement and improves proportionality. The effects of the plan for redeeming the equity held by the member's estate are similar, but they are weaker because of the five-year difference in timing.

The special plans produce their greatest effects when used in conjunction with the percentage plan. As shown in table 8, the special plan based on age results in a substantial reduction in the disinvestment stage and a severalfold increase in the present value of member cash flow after retirement. Member opportunity costs are

cut by more than one-half, and proportionality more than doubles. Although not as large, the improvements brought by the plan for redeeming the equity held by the member's estate are still substantial. In general terms, the proportionality of the percentage plan is still considerably less than the revolving fund and base capital plans when those plans are combined with special plans. Nonetheless, adding a special plan to the percentage plan results in a level of proportionality comparable to the revolving fund plan without a special plan.

Because the disinvestment stage corresponding to the base capital plan is already fairly short, the effects of the special plans on performance are relatively small. As shown in table 9, the special plan based on age reduces the disinvestment stage by six years, but the associated effects on the present value of member post-retirement cash flow, member opportunity costs, and proportionality are modest. Because the plan for the member's estate reduces the disinvestment stage by only one year, its effects are negligible.

Table 4 reports the equity units the member supplies the cooperative when the special plans are operated in conjunction with a systematic plan. As the table demonstrates, the addition of a special plan to an existing systematic plan results in a reduction in equity units. In general, the reduction due to a special plan is inversely related to the performance of the systematic plan (table 3) and directly related to the benefits associated with the special plan (tables 7–9). The addition of special plans to the percentage plan results in the greatest reductions in equity units. The addition of special plans to the base capital plan results in comparatively minor reductions in equity because the special plans produce only modest improvements in performance.

Although implementation of a special plan generally improves the performance of the cooperative's equity retirement program, there is a cost to the cooperative because the redeemed equity can no longer be put to its current uses. For example, consider a cooperative that operates a revolving fund plan. If the cooperative were to add a special plan for redeeming the equity of members at 75 years of age, the equity supplied by the typical member would be reduced by 63,954 equity units. Unless the cooperative replaces that reduction with equity from other sources, it must lengthen its revolving period, reduce its growth, or lower the proportion of patronage refunds it pays in cash. The loss to the cooperative and its members due to those effects represents an opportunity cost equal to the economic value of the equity units no longer available, \$11,191 in this example. The total opportunity costs associated with a special plan would consider the equity of other members also retired under the plan.

Discussion

The relative performance of the systematic equity retirement plans is apparent from the results displayed in table 3. By almost all indicators of performance, the base capital plan performs better than the other two plans. Similarly, the percentage plan exhibits poorer performance than the other plans. The base capital plan is associated with the greatest proportionality while the percentage plan is associated with the least. Both cooperative and member opportunity costs are lowest with the base capital plan; they are highest with the percentage plan.

Only in terms of the present value of member cash flow does the percentage plan yield the best results. The superior performance of the percentage plan in terms of present value can be attributed to the higher cash flow in the early years of the member's farming career when equity retirement begins almost immediately under the plan. During that period, member cash flow is low under the base capital plan because of the additional equity investments the member must make to meet the equity requirements of the plan.

The present value comparisons do not represent a strong argument against the base capital plan's overall superiority for two reasons. First, the ranking of plans relative to the present value of member cash flow is sensitive to changes in the discount rate. The discount rate used in calculating the present values in table 3 is relatively high, and the base capital plan yields the greatest present value at lower discount rates.¹⁵ Second, when the cash flow of the cooperative's entire membership is considered, the present value of member cash flow is identical for the three systematic plans. From equation (2), it is clear that the cash flow available for equity retirement in any particular year is fixed given the proportion of patronage refunds paid in cash and the equity growth rate. Thus, the cash flow members receive from the cooperative and the present value of that cash flow are independent of the equity retirement plan in place. So from an aggregate perspective, no plan can be preferred over another on the basis of the present value of the cash flow members receive.

Notwithstanding the greater present value for the typical member under the percentage plan, the base capital plan is clearly the best-performing plan with respect to achieving proportionality and reducing both cooperative and member opportunity costs. Yet despite its performance, only a small proportion of U.S. agricultural cooperatives use the plan for the accumulation and retirement of member equity. The best explanation for the low use of the base capital plan is the financial burden it places on members early in their farming careers when they must make

¹⁵ Recall that the discount rate used to calculate the present values in table 3 is 0.1260. For positive discount rates of 0.0699 or less, the present value associated with the base capital plan exceeds those for the percentage and revolving fund plans.

additional equity investments in the form of direct cash investments, retained patronage refunds, or per-unit capital retains to meet their equity requirements. As a result of those investments, member after-tax cash flow can be negative. In fact, if the base period used to calculate the equity requirements is short enough, the typical member's cash flow can be negative even before taxes.¹⁶

Two modifications of the base capital plan offer means for mitigating the problem of the low cash flow received by members early in their farming careers. Relaxing the equity requirements for underinvested members provides them more time to increase their equity investments while resulting in only a modest diminution in performance relative to the other systematic plans. There is only a slight decrease in proportionality, and younger members are not subjected to negative after-tax cash flows. Extending the base period from seven years to ten years has similar effects. Although proportionality declines more than when the equity requirements are relaxed, it still exceeds the proportionality under the revolving fund and percentage plans. With the longer base period, the cash flow of younger members is increased but not as much as when the equity requirements are relaxed. The variable cash patronage refund program offers the greatest proportionality of the three modifications of the base capital plan, but it does not entirely eliminate the problem of low cash flow for younger members. The cash flow received by young members is still low, and the after-tax cash flow can indeed be negative if their marginal tax rates exceed the proportion of patronage refunds they receive in cash.

The percentage plan performs poorly relative to the other two systematic plans. Proportionality is extremely low for the plan, and opportunity costs, especially member opportunity costs, are substantially greater than in the other plans. Early redemption provides members higher cash flow early in their farming careers, and that cash flow may improve the cooperative's ability to attract new members. Otherwise, there is little to recommend the plan for use in local or centralized cooperatives. The plan probably works best for federalized regional cooperatives that maintain relatively stable long-term relationships with their cooperative members.

Although special plans for redeeming equity held by estates or based on member age provide a way to improve the performance of systematic plans, two factors may limit their use. In some cases, the loss in equity and the concomitant opportunity costs attributable to a special plan may discourage its adoption. This may contribute to explaining the low incidence of special plans used in conjunction with

¹⁶ A cooperative can avoid negative member cash flow by issuing patronage refund or per-unit capital retain allocations in nonqualified form. Use of nonqualified allocations shifts the tax burden from members to the cooperative until the allocations are eventually redeemed in cash. The redemptions are then included in the members' taxable income and deducted from the cooperative's taxable income. Thus, the cooperative can avoid imposing a tax burden on members early in their farming careers when cash flow may be low. Instead, the tax is deferred until later when it can be offset by cash redemptions.

the percentage plan, for which the loss of equity and the associated opportunity costs are quite large relative to the other systematic plans. In other cases, special plans may do little to improve the performance of a systematic plan that already performs well. This applies in particular to the base capital plan, which performs better than the other systematic plans even without the help of a special plan. By their nature, special plans address problems associated with the equity held by members after they have retired from farming. Special plans do nothing to eliminate the problems of low cash flow associated with the base capital plan, which typically occur early in a member's farming career. In general, special plans may offer the greatest advantages to cooperatives that operate revolving fund plans. Cooperatives with revolving fund plans may experience a balance of potential benefits and opportunity costs that encourages the adoption of a special plan. These observations suggest an explanation for the low incidence of special plans among cooperatives that employ percentage and base capital plans relative to revolving fund plans.¹⁷

A cooperative's decision to replace its existing equity retirement plan with another plan can be complicated by the differential impacts the transition is expected to have on members. Consider the decision of whether to replace a revolving fund plan with a base capital plan. Older, overinvested members might benefit from the change because their equity allocations would be retired more quickly. However, younger, underinvested members could be disadvantaged because of the additional equity investments they would need to make. A decision to adopt a new plan will depend on resolving the conflicting interests of various member groups.¹⁸ The difficulty of reconciling those interests may make it harder for a cooperative to change plans because the complexity of the decision tends to favor the status quo (Hessami and Resnjanskij 2019).

¹⁷ According to Eversull (2010), 18.6 percent of U.S. local cooperatives that operated revolving fund plans in 2008 used special plans to redeem equity according to member age, and 47.5 percent used special plans to redeem equity held by estates. In contrast, of those cooperatives that operated percentage plans, 14.1 percent redeemed equity according to age, and only 13.7 percent redeemed equity held by estates. Because the addition of a special plan is expected to improve the performance of the percentage plan the most, the relatively low use of special plans in conjunction with percentage plans can likely be attributed to the associated opportunity costs. Of the cooperatives that maintained base capital plans, 2.9 percent redeemed equity based on age, and 4.6 percent redeemed equity held by estates. The low frequency of use among cooperatives with base capital plans can be explained by the strong performance of the base capital plan in the absence of special plans.

¹⁸ An approach similar to that of Royer and Shihipar (1997) might be taken to analyze the decision to change equity retirement plans. That paper examined how an individual member's preferences regarding patronage refunds and equity revolvment are affected by age and other factors. Using an estimated member distribution and a collective choice model based on the preferences of the median voter, the paper predicted which patronage refund and equity revolvment practices would dominate under selected member and cooperative characteristics.

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