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This paper assesses the ability of rural electric cooperatives to retire member equity under three strategies: (1) replacing equity with term debt to provide for an immediate one-time retirement of capital credits, (2) reducing the rate at which equity is accumulated and relying more on term debt to finance asset growth so margins can be used to accelerate the retirement of capital credits, and (3) adjusting the electric rate to generate additional margins for retiring capital credits. Analyses suggest that the average distribution cooperative could employ these strategies to expand capital credits retirement substantially without weakening its financial condition.

Keywords: Rural electric cooperatives, capital credits, equity financing, equity retirement, financial ratios, Goodwin formula

Introduction

Cooperatives are an important component of the U.S. electric utility industry. Electric cooperatives serve an estimated 42 million people by providing power to 18.5 million businesses, homes, schools, churches, farms, irrigation systems, and other customers. They deliver 11 percent of the electric power sold in the United States, operating in 47 states and 80 percent of all counties. Electric cooperatives serve their members through the generation, transmission, and distribution of electricity. Power supply cooperatives (also called generation and transmission or G&T cooperatives) are engaged in the generation or purchase of electricity and the transmission of wholesale electricity to distribution cooperatives. Distribution cooperatives carry electricity to retail customers. Power supply cooperatives are owned and financed by the distribution cooperatives they supply in the same manner distribution cooperatives are owned and financed by their customers. There are 840 distribution cooperatives and 65 power supply cooperatives in the United States, and they own combined assets of $140 billion.[1]

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The Rural Utilities Service (RUS) of the U.S. Department of Agriculture, the National Rural Utilities Cooperative Finance Corporation (CFC), and CoBank are important sources of borrowed funds for electric cooperatives. RUS provides financing for the construction of electric generation, transmission, and distribution facilities, including system improvements and replacement, necessary for providing and improving electric service in rural areas. It currently serves almost 700 borrowers and maintains a loan portfolio of approximately $46 billion. Through its guaranteed loan program, credit is provided by the Federal Financing Bank at interest rates set 12.5 basis points over U.S. Treasury rates and for terms of up to 35 years, depending on the useful life of the facilities that are financed.[2] CFC is a cooperatively organized corporation created by electric cooperatives to raise funds from capital markets. It has total loans outstanding of nearly $22 billion.[3] CoBank is a national cooperative bank and a member of the Farm Credit System. It makes loans to agribusinesses and providers of rural power, water, and communications and serves several hundred rural electric generation, transmission, and distribution cooperatives.[4] It has an average loan volume of about $83 billion.[5]

Equity capital is an essential part of the financial structure of any business because it provides a buffer against unexpected expenses or losses and reduces the risk that loans cannot be repaid. To raise equity capital, electric cooperatives must rely on net margins allocated to members in the form of capital credits. Capital credits are allocated to individual members based on their purchase of electricity from a cooperative. Those margins are retained for use by the cooperative until the credits are eventually replaced by new allocations and redeemed in cash. Capital credits are usually retired according to the first-in/first-out (FIFO) method.[6] Under the FIFO method, a cooperative retires, or rotates, capital credits in the order they were allocated as the oldest allocations are replaced by new ones. The rotation period or cycle refers to the length of time between when a capital credit is allocated and when it is retired.

During the early years of the U.S. rural electric program, cooperatives generally were unable to retire capital credits held by members because the continued accumulation of equity capital was required to serve member needs and build financial strength. Yet, as equity began to rise beyond necessary levels, many electric cooperatives continued to accumulate capital credits without establishing plans for retiring them. By the 1970s, the level of equity in the average distribution cooperative approached 35 percent of total assets. However, only 127 of 1,050 borrowers reported to the Rural Electrification Administration (now RUS) that they had retired capital credits (Capital Credits Task Force 2005). Without a systematic plan for retiring capital credits, a cooperative cannot ensure that members are financing the organization in proportion to the benefits they receive or that each generation of members is carrying its own weight.

Given the situation that existed in the 1970s, the National Rural Electric Cooperative Association (NRECA) and CFC appointed a committee of representatives from the nation's electric cooperatives to examine various issues related to member equity and make recommendations that could be used by cooperatives to expand their retirement of capital credits. In its 1976 report, the committee recommended that each distribution cooperative should develop long-range plans to achieve equity levels of at least 30 percent and rotate equity on a reasonable fixed-period basis. The committee suggested that distribution cooperatives should rotate equity according to a 10- to 20-year rotation period when possible and that the rotation periods for power cooperatives should be shorter, along the lines of 3 to 10 years. The committee also recommended that each distribution cooperative should adopt an approach for determining retail electric rates that took the costs of both debt and equity into account and enabled the generation of margins adequate for both building and retiring equity (Capital Credits Study Committee 1976).

By 2003, the average equity level of distribution cooperatives was over 40 percent, and 84 percent of those cooperatives with adequate levels of equity were retiring capital credits totaling more than $300 million annually. However, questions had arisen concerning the practices of some cooperatives that had continued to accumulate substantial amounts of equity without retiring capital credits. In response, NRECA and CFC established a second committee of electric cooperative representatives to reexamine issues related to capital credits. In 2005, that committee recommended that every electric cooperative should have a policy for retiring capital credits on an annual basis subject to the discretion of its board of directors and its financial condition. The committee also recommended that every cooperative should have an equity management plan that included setting electric rates to generate cash flows sufficient for retiring capital credits (Capital Credits Task Force 2005).

In recent years, the topic of capital credits retirement has gained the attention of at least one member of Congress. In a 2008 article highly critical of electric cooperatives, Jim Cooper, U.S. representative from Tennessee, complained that some cooperatives had held member capital credits for more than 20 years without retiring them. He argued that electric cooperatives were overcapitalized by 10 to 30 percent and had unused borrowing capacity that would allow them to retire $3 billion to $9 billion of capital credits on a one-time basis without threatening their financial stability (Cooper 2008).

Despite the importance of these issues to rural electric cooperatives and their members, little attention has been given to assessing the financial ability of electric cooperatives to adopt more aggressive equity retirement programs. While several studies, including Cobia et al. 1982, Royer 1983, and Royer 1993, have included quantitative analyses of the financial impact of various equity retirement programs on agricultural cooperatives, similar studies for rural electric cooperatives have not

been conducted. Research specific to electric cooperatives is needed because they differ from agricultural cooperatives in important ways.

For one, there are differences in the federal income tax treatment of agricultural and electric cooperatives, and those differences have implications for how cooperatives are financed and margins are returned to members. The tax treatment of agricultural cooperatives is defined by Subchapter T of the U.S. Internal Revenue Code, which consists of sections 1381–88 of the code. It applies to farmer cooperatives described in section 521 of the code as well as any corporations operating on a cooperative basis except mutual savings banks, insurance companies, cooperatives engaged in furnishing electricity or providing telephone service to rural areas, and organizations exempt from federal taxation. Electric cooperatives operating in either rural or urban areas may be exempt from federal taxation under section 501(c)(12) of the code. In most circumstances, Subchapter T requires cooperative members to include both cash and noncash patronage dividends in their taxable income. In turn, a cooperative can exclude patronage dividends from its taxable income as long as it pays at least 20 percent in cash. Most agricultural cooperatives pay a higher proportion of patronage dividends in cash to ensure members have cash adequate for paying tax on them. Electric cooperatives generally do not pay cash patronage dividends because they are not subject to Subchapter T.

There also are important functional differences between agricultural and electric cooperatives, and studies of U.S. agricultural cooperatives have shown that the financial structure of cooperatives varies substantially across principal product and function (Eversull 2011). In addition, agricultural cooperatives are subject to changes in market conditions to a greater extent than electric cooperatives, which are associated with comparatively stable rates and demand for electricity. For all these reasons, measures of financial structure and condition are likely to take on substantially different values when applied to electric cooperatives than when applied to agricultural cooperatives.

This paper seeks to address the need for additional knowledge on the ability of rural electric cooperatives to retire member capital credits by examining the financial impact on cooperatives of three equity retirement strategies:

1. *Replacing equity with term debt*—Acquiring additional long-term debt to replace equity capital so the cooperative can undertake an immediate one-time retirement of capital credits in the manner suggested by Cooper.

2. *Reducing the rate of equity accumulation*—Lowering the rate at which equity is accumulated and relying more on long-term debt to finance growth in assets so the cooperative's margins can be used to accelerate the retirement of capital credits.

3. *Adjusting the electric rate*—Raising the electric rate so the cooperative can generate additional margins for retiring capital credits and shift a greater share of financing to those members who currently benefit most from its use in a manner similar to that suggested in the NRECA-CFC reports.

The ability of rural electric cooperatives to retire capital credits under each of these strategies is analyzed in the next three sections. For each strategy, the ability of the average distribution cooperative to retire equity is assessed using a spreadsheet model and data on RUS electric borrowers to examine the effects of equity retirement on several important financial indicators such as interest coverage, the rate of return on equity, and the length of the rotation cycle. The following analyses suggest that rural electric cooperatives can on average employ one or more of these strategies to substantially expand or accelerate the retirement of capital credits.

Replacing Equity with Term Debt

To assess the ability of rural electric cooperatives to retire capital credits by replacing equity capital with long-term debt, a spreadsheet model of the average distribution cooperative was constructed from RUS data for the 2006–11 period during which data are available (Rural Utilities Service 2013, and earlier). Selected balance sheet and operating statement data for the average distribution cooperative during the 2006–11 period are presented in table 1. On average, 581 distribution cooperatives were included in the RUS data.

Table 1. Selected data for average distribution cooperative, 2006–11

Balance sheet		Operating statement	
Net utility plant	$64,080,460	Electric sales (kWh)	466,342,400
Total assets	$85,071,404	Operating revenue	$43,576,771
		Operating expenses	−40,084,707
RUS long-term debt	$29,317,341		
Other long-term debt	9,374,272	Operating income	$3,492,064
Total long-term debt	$38,691,613	Nonoperating income	$313,319
Total equity	$34,443,849	Interest expense	$1,919,838
Total capital	$73,135,462	Net income	$2,603,439

The ability of the average distribution cooperative to retire equity was evaluated by incrementally replacing equity with long-term debt in the spreadsheet model and recalculating the balance sheet and operating statement values. In addition to affecting the levels of equity capital and long-term debt on the balance sheet, the replacement of equity affects the operating statement by increasing interest expense and decreasing net income.

Although RUS provides financing only for construction of facilities, other lenders have indicated a willingness to make unsecured loans for the retirement of capital credits. The interest rate used here to calculate the increase in interest expense due to new long-term debt was set at 5.34 percent, the average rate rural electric cooperatives might have been expected to pay for unsecured term debt during the 2006–11 period. This rate was determined by adding 200 basis points to the average seven-year U.S. Department of the Treasury yield curve rate for the period.[7]

In particular, this analysis tracked the values of seven variables related to the cooperative's financial structure and condition. Those variables are the ratio of equity to total assets, the ratio of equity to total capital, the average interest rate, the times-interest-earned ratio, the rate of return on equity, the weighted average cost of capital, and the length of the rotation cycle.

The *equity/total assets* ratio is equivalent to the proportion of total assets financed by equity capital. The 2005 NRECA-CFC report recommended that distribution cooperatives maintain an equity level of 30 to 50 percent, what would be appropriate for an investment grade rating according to Fitch Ratings, one of the three nationally recognized statistical rating organizations designated by the U.S. Securities and Exchange Commission. The *equity/total capital* ratio measures equity as a proportion of total capital, i.e., the sum of long-term debt and equity capital. This ratio provides a convenient metric for the replacement of equity by debt. The *average interest rate* represents the average cost of term debt after the cost of new debt used to replace equity is taken into account. It will increase with additional long-term borrowing if the interest rate on new debt is greater than the average interest rate on existing loans.

The *times-interest-earned ratio* (TIER) is a measure of interest coverage or the ability of a cooperative to cover principal and interest payments. It is calculated by dividing the sum of net income and total interest expense by total interest expense. Provisions in RUS loan agreements require a minimum TIER of 1.25 for distribution cooperatives. However, financial experts have cautioned that TIERs at that level cannot be counted on to provide the margins necessary for electric cooperatives to meet their needs in private capital markets and retire capital credits on a systematic and reasonable basis. Fitch Ratings recommends that distribution cooperatives maintain a TIER of 1.5 to 2.0 or higher (Capital Credits Task Force 2005,

62). In an equity management model based on TIER values, Phillips (2001) suggested that most electric cooperatives need to maintain a TIER between 1.5 and 3.0 to generate the margins and cash flows necessary to achieve their financial goals.

The *rate of return on equity* (ROE) determines how quickly a cooperative can accumulate equity or retire capital credits. The rate of return on equity required for a cooperative to maintain a constant equity share for a given growth rate and rotation cycle can be calculated from the Goodwin formula (also called the modified Goodwin formula). In simplified form, the formula can be expressed as

$$r_e = \frac{g}{1-(1+g)^{-T}} \text{ for } g > 0 \tag{1}$$

where r_e is the rate of return on equity, g is the growth rate, and T is the length of the rotation cycle (Royer 2015, 276). An alternative interpretation of the rate of return in equation (1) is that it represents the cost to the cooperative of maintaining a particular growth rate and rotation cycle. As such, it has been used to represent the cost of equity in various applications related to electric cooperatives, including discount calculations (Capital Credits Task Force 2005, 48–50) and Phillips's equity management model. Because the rate of return on capital before interest expense is assumed constant in the spreadsheet model used here, the rate of return on equity increases as equity/total capital is reduced. The relationship between the rate of return on equity and the share of total capital provided by equity can be expressed

$$r_e = \frac{r_{kb} - i(1-p)}{p} \tag{2}$$

where r_{kb} is the rate of return on capital before interest expense, i is the average interest rate, and p is equity/total capital (Royer 2015, 273–75). For given values of r_{kb} and i, it is clear that $dr_e/dp < 0$ if $i < r_{kb}$.

The *weighted average cost of capital* (WACC) represents the cost of capital in present value calculations used in capital budgeting decisions. It is determined by weighting the average interest rate and the cost of equity by the respective amounts of long-term debt and equity:

$$k = r_e \cdot p + i(1-p). \tag{3}$$

In this analysis, the rate of return on equity is used to represent the cost of equity capital. It is important for a cooperative to assign an appropriate cost to equity.

Otherwise, it may rely too much on equity and underestimate overall capital costs, resulting in an overinvestment in assets and actual capital costs that are unnecessarily high. If the cooperative does not assign an appropriate cost to equity, it also is less likely to retire capital credits in a timely manner. Because the rate of return on capital before interest expense is assumed constant in the spreadsheet model, the weighted average cost of capital is invariant with respect to changes in equity/total capital. This can be shown quite easily by substituting r_e from equation (2) into equation (3). That change results in $k = r_{kb}$ irrespective of the values of *p* and *i*.

The length of the *rotation cycle* a cooperative can maintain is used to represent the ability of the cooperative to retire capital credits. The rotation cycle depends on the cooperative's rate of return on equity and growth rate. Derived from equation (1), the following expression can be used to calculate its length:

$$T = -\frac{\log\left(1-\frac{g}{r_e}\right)}{\log(1+g)} \text{ for } r_e > g,\ g > 0. \tag{4}$$

For a given growth rate, the rotation cycle will decrease as the rate of return increases. Based on the recommendations in the 1976 NRECA-CFC report, a 10- to 20-year rotation cycle is used here as a benchmark.

Results

The effects the replacement of equity with term debt would have had on the average distribution cooperative are represented in table 2. In that table, the baseline column represents the values that would have existed without changes in the equity level. Those columns to the right of that indicate the values that would have accompanied reductions in the equity level, as measured by the proportion of equity retired, according to the spreadsheet calculations. Without a reduction in equity, the average cooperative could have maintained a rotation cycle of 28.2 years, much longer than the 10- to 20-year benchmark. On the other hand, the average equity share and TIER value are respectively 40.5 percent and 2.36, considerably greater than their benchmark values, suggesting that the average cooperative would have had a substantial capacity to lower its equity level by taking on additional debt.

A 5 percent reduction in equity only would have reduced the equity share to 38.5 percent and the TIER value to 2.25 but would have allowed the cooperative to shorten its rotation cycle by about a year. As the proportion of equity replaced by term debt is increased, both equity/total assets and equity/total capital decline as expected. Up to 25 percent of equity can be replaced by debt before equity/total

Table 2. Retiring capital credits by replacing equity with term debt (2006–11 average interest rate)

	Baseline	Proportion of equity retired							
		0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
					Thousand dollars				
Long-term debt	38,692	40,414	42,136	43,858	45,580	47,303	49,025	50,747	52,469
Equity	34,444	32,722	30,999	29,277	27,555	25,833	24,111	22,389	20,666
Total capital	73,135	73,135	73,135	73,135	73,135	73,135	73,135	73,135	73,135
Capital credits retired		1,722	3,444	5,167	6,889	8,611	10,333	12,055	13,778
Income before interest expense	4,523	4,523	4,523	4,523	4,523	4,523	4,523	4,523	4,523
Interest expense	1,920	2,012	2,104	2,196	2,288	2,380	2,471	2,563	2,655
Net income	2,603	2,511	2,420	2,328	2,236	2,144	2,052	1,960	1,868
					Rates				
Equity/total assets	0.4053	0.3850	0.3648	0.3445	0.3242	0.3040	0.2837	0.2634	0.2432
Equity/total capital	0.4710	0.4474	0.4239	0.4003	0.3768	0.3532	0.3297	0.3061	0.2826
TIER	2.36	2.25	2.15	2.06	1.98	1.90	1.83	1.76	1.70
Average interest rate	0.0496	0.0498	0.0499	0.0501	0.0502	0.0503	0.0504	0.0505	0.0506
Rate of return on equity	0.0756	0.0768	0.0781	0.0795	0.0811	0.0830	0.0851	0.0875	0.0904
Weighted average cost of capital	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618
					Years				
Rotation cycle	28.2	27.1	26.0	24.9	23.8	22.7	21.5	20.3	19.1

assets drops to below the 30 to 50 percent range recommended in the 2005 NRECA-CFC report. As the equity level declines, the TIER value also falls. However, even with a 25 percent reduction in equity, the TIER is 1.90, still considerably greater than the 1.25 minimum required by RUS loan agreements or the 1.5 level recommended by both Fitch Ratings and Phillips.

Given the 5.34 percent interest rate assumed for new debt is greater than the 4.96 percent average interest rate on existing debt, the average interest rate increases with additional debt. However, the increase is fairly small; the average rate associated with a 25 percent reduction in equity is only 5.03 percent. Meanwhile, the rate of return on equity rises rather substantially because of the increased financial leverage. As a result of the higher rate of return, the cooperative could have reduced its rotation cycle 5.5 years by lowering equity 25 percent. Thus, in addition to the immediate benefit from the one-time retirement of capital credits, the replacement of equity capital with debt provides an important secondary benefit by reducing the rotation cycle so remaining capital credits can be retired more rapidly. Consistent with the discussion of equation (3), the weighted average cost of capital is invariant with respect to reductions in equity. Therefore, capital budgeting decisions would not have been affected.

Because neither the equity level nor TIER value are reduced to below their benchmark values, it appears that the average distribution cooperative would have been financially capable of undertaking a one-time retirement of up to 25 percent of its equity.[8] However, it is unlikely that lenders would have been willing to provide unsecured loans sufficient for replacing that much equity. Instead, it seems reasonable to expect that the average cooperative only would have been able to obtain financing to replace between 5 and 15 percent of its equity under this strategy. Individual cooperatives would have differed in their ability to acquire financing based on the collateral value of existing hard assets and expected cash flows. In general, the ability of a particular cooperative to employ this strategy also would have depended on its capital requirements, financial performance, and competitive situation.[9]

Effects of Lower Interest Rates

The results of this analysis are sensitive to the interest rate used to calculate the interest expense on new debt. The interest rate affects net income, the TIER value, and the rate of return on equity among other variables. In turn, the TIER value plays an important role in determining how much equity can be replaced, and the rate of return determines the rotation cycle that can be maintained. The sensitivity of the results in table 2 is of relevance given interest rates fell substantially between 2006 and 2011. The average seven-year Treasury yield curve rate for 2011 was 2.16 percent, which represented a 55 percent decline from the 2006 rate of 4.76 percent.

Table 3 reports the results of replicating the analysis in table 2 while assuming that the interest rate on new debt was 4.16 percent, 200 basis points over the average 2011 Treasury rate. Net income and the TIER value both decline as the proportion of equity replaced increases but less rapidly than in table 2. Because the interest rate for new debt is less than that for existing debt, the average interest rate declines as more equity is replaced. In addition, the rate of return on equity rises more quickly and the rotation cycle falls more quickly. At 25 percent equity replacement, the TIER value is almost 5 percent greater than in table 2. The rate of return on equity is only slightly higher, but it is associated with a two-year reduction in the rotation cycle.

Interest rates continued to decline after 2011. The average seven-year Treasury rate for 2012–15 was 1.75 percent, 19 percent lower than in 2011. With even lower interest rates, the ability of the average distribution cooperative to replace equity with term debt would have been further enhanced.

Reducing the Rate of Equity Accumulation

An alternative strategy for a cooperative is to reduce the rate at which it accumulates equity so a larger share of new assets is financed with borrowed capital. In this way, more of current earnings can be used to retire capital credits while the cooperative's equity share is gradually reduced. An advantage of this method is that as long as increases in hard assets exceed new debt, new assets may provide a source of collateral for new loans, thus providing the cooperative greater access to financing and at lower interest rates than it would face with unsecured debt.

Table 4 illustrates this strategy applied to the average distribution cooperative based on a second spreadsheet model. Both assets and equity capital of the average cooperative grew at about 6.1 percent per annum during the 2006–11 period. Most balance sheet items shown in the table, including total assets and total capital, are assumed to grow at a 6.1 percent rate. However, it is assumed that the cooperative has chosen to reduce the rate at which it accumulates equity to 3 percent as a means of accelerating the retirement of capital credits. As a consequence, the cooperative must rely on borrowed capital to finance a greater share of the growth in assets.

In this analysis, increases in net utility plant (assets employed for electric generation, transmission, or distribution, less accumulated depreciation) are considered a source of collateral. The interest rate used to calculate the increase in interest expense due to new long-term debt was set at 4.49 percent, the average rate RUS would have charged during the 2006–11 period on loans for electric facilities, including system improvements and replacement. This rate was determined by adding 12.5 basis points to the average 30-year Treasury yield curve rate for 2006–11.

During the 10-year period represented in table 4, both long-term debt and equity increase. However, debt must rise at an average annual rate of 8.3 percent if asset

Table 3. Retiring capital credits by replacing equity with term debt (2011 average interest rate)

	Baseline	Proportion of equity retired							
		0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
					Thousand dollars				
Long-term debt	38,692	40,414	42,136	43,858	45,580	47,303	49,025	50,747	52,469
Equity	34,444	32,722	30,999	29,277	27,555	25,833	24,111	22,389	20,666
Total capital	73,135	73,135	73,135	73,135	73,135	73,135	73,135	73,135	73,135
Capital credits retired		1,722	3,444	5,167	6,889	8,611	10,333	12,055	13,778
Income before interest expense	4,523	4,523	4,523	4,523	4,523	4,523	4,523	4,523	4,523
Interest expense	1,920	1,991	2,063	2,135	2,206	2,278	2,349	2,421	2,493
Net income	2,603	2,532	2,460	2,389	2,317	2,245	2,174	2,102	2,031
					Rates				
Equity/total assets	0.4053	0.3850	0.3648	0.3445	0.3242	0.3040	0.2837	0.2634	0.2432
Equity/total capital	0.4710	0.4474	0.4239	0.4003	0.3768	0.3532	0.3297	0.3061	0.2826
TIER	2.36	2.27	2.19	2.12	2.05	1.99	1.93	1.87	1.81
Average interest rate	0.0496	0.0493	0.0490	0.0487	0.0484	0.0482	0.0479	0.0477	0.0475
Rate of return on equity	0.0756	0.0774	0.0794	0.0816	0.0841	0.0869	0.0902	0.0939	0.0983
Weighted average cost of capital	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618	0.0618
					Years				
Rotation cycle	28.2	26.6	25.0	23.5	22.0	20.6	19.2	17.8	16.5

Table 4. Accelerating capital credits retirement by reducing the rate of equity accumulation

	Baseline	Year							
		1	2	3	4	5	6	7	10
					Thousand dollars				
Long-term debt	38,692	42,085	45,715	49,597	53,748	58,184	62,924	67,988	85,334
Equity	34,444	35,477	36,541	37,638	38,767	39,930	41,128	42,362	46,290
Total capital	73,135	77,562	82,256	87,235	92,515	98,114	104,052	110,350	131,623
Increase in net utility plant		3,878	4,113	4,362	4,626	4,906	5,203	5,518	6,582
New long-term debt		3,393	3,630	3,882	4,151	4,436	4,740	5,064	6,164
Capital credits allocated		2,603	2,725	2,852	2,985	3,125	3,272	3,427	3,937
Capital credits retired		1,570	1,660	1,756	1,856	1,962	2,074	2,193	2,589
Increase in capital credits		1,033	1,064	1,096	1,129	1,163	1,198	1,234	1,348
Income before interest expense	4,523	4,797	5,087	5,395	5,722	6,068	6,435	6,825	8,141
Interest expense	1,920	2,072	2,235	2,410	2,596	2,796	3,009	3,236	4,016
Net income	2,603	2,725	2,852	2,985	3,125	3,272	3,427	3,589	4,125
					Rates				
Equity/total assets	0.4053	0.3936	0.3823	0.3713	0.3606	0.3502	0.3401	0.3304	0.3026
Equity/total capital	0.4710	0.4574	0.4442	0.4315	0.4190	0.4070	0.3953	0.3839	0.3517
TIER	2.36	2.31	2.28	2.24	2.20	2.17	2.14	2.11	2.03
Average interest rate	0.0496	0.0492	0.0489	0.0486	0.0483	0.0481	0.0478	0.0476	0.0471
Rate of return on equity	0.0756	0.0768	0.0780	0.0793	0.0806	0.0820	0.0833	0.0847	0.0891
					Years				
Rotation cycle	28.2	16.8	16.4	16.1	15.7	15.4	15.1	14.8	13.9

growth is to remain at 6.1 percent while equity growth is restricted to 3 percent. As a result, equity/total assets declines throughout the period. By the tenth year, it is quickly approaching the 30 percent recommended minimum. New long-term debt continues to increase throughout the period, but by the tenth year, the increase in net utility plant still exceeds new debt. Thus, increases in net utility plant provide a steady source of collateral for new debt. Both capital credits allocated and retired increase, resulting in a net increase in capital credits over time. Similarly, income before interest expense, interest expense, and net income all rise. As interest expense increases relative to net income, the TIER value gradually declines, but it still exceeds 2.0 in the tenth year.

Due to the increased leverage resulting from the reduced growth in equity, the rate of return on equity rises throughout the period. Given the greater rate of return, the rotation cycle the cooperative can maintain is reduced. In the first year, an immediate and substantial reduction in the rotation cycle occurs because the cooperative can accelerate equity retirement simply by reducing the rate of equity growth from 6.1 percent to 3 percent (see equation (4)). However, the rotation cycle decreases further as the rate of return on equity continues to climb.

Adjusting the Electric Rate

Cooperatives often may have flexibility in determining the rates they charge members for electricity.[10] A third strategy for accelerating the retirement of capital credits is for a cooperative to generate additional margins by raising its electric rate. In this analysis, we assess the ability of the average distribution cooperative to shorten its rotation cycle by applying this strategy. Using the RUS data for the 2006–11 period and a model described in Royer (2015), we calculate the electric rates that would be required for the cooperative to maintain several target rotation cycles and examine the effects of rate changes on net income, various rates of return, and the TIER value.

Let T^* represent the target rotation cycle. From equation (1), the rate of return on equity required to rotate equity according to T^* is

$$r_e^* = \frac{g}{1-(1+g)^{-T^*}} \tag{5}$$

for a given growth rate and constant equity/total capital ratio. The required rate of return on capital can be determined from the required rate of return on equity:

$$r_k^* = pr_e^* \tag{6}$$

where p is once again equity/total capital.

In general, the rate of return on capital can be calculated from the ratio of net income to total capital, which can be expressed as

$$r_k = \frac{ES \times ER + OI}{K} \tag{7}$$

where *ES* represents electric sales, *ER* represents the electric rate, and *K* represents total capital. The product $ES \times ER$ is operating revenue. The *OI* term consists of the sum of several other components of net income, including operating expenses (−), nonoperating income (+), and interest expense (−). Setting equation (7) equal to r_k^* and solving for *ER* yields the electric rate necessary to rotate equity according to the target rotation cycle T^*:

$$ER^* = \frac{r_k^* K - OI}{ES}. \tag{8}$$

The average distribution cooperative could have maintained a 28.2-year rotation cycle given the baseline electric rate of 9.34 ct./kWh. Table 5 shows that the cooperative could have reduced its rotation cycle to 25 years by raising the electric rate by only 0.03 ct./kWh or 0.30 percent. Shorter rotation cycles would have required greater rate increases, but the cooperative could have shortened its rotation cycle substantially with less than a 5 percent rate increase. With a 4.84 percent increase, the cooperative could have maintained a 10-year rotation cycle, well within the range recommended in the 1976 NRECA-CFC report.

Raising the electric rate also would have increased the rates of return and TIER value. By raising the electric rate by 4.84 percent, the rate of return on equity would have risen to 0.1369, which is considerably greater than the baseline value. With any increase in the rate of return on equity, there would have been a corresponding increase in the cost of equity capital relative to debt. That increase in the relative cost of equity would have encouraged the cooperative to retire additional capital credits in an effort to reduce its equity share. The corresponding increase in the rate of return on capital would have implied that higher returns would be required for decisions to invest in new capital projects.[11]

Conclusions

During the 2006–11 period, the average distribution cooperative would have been capable of replacing up to 25 percent of its equity with term debt without reducing its equity share or TIER value below recommended levels. In addition to the one-time benefit members would have received from the retirement of capital

Table 5. Accelerating capital credits retirement by adjusting the electric rate

	Baseline	Target rotation cycle (years)				
		25	20	15	10	5
Electric rate (ct./kWh)	9.34	9.37	9.44	9.55	9.80	10.55
Increase (percent)		0.30	1.00	2.25	4.84	12.87
			Thousand dollars			
Operating revenue	43,577	43,708	44,015	44,556	45,688	49,185
Operating income	3,492	3,693	3,930	4,471	5,603	9,100
Net income	2,603	2,735	3,041	3,583	4,715	8,212
			Rates			
Rate of return on equity	0.0756	0.0794	0.0883	0.1040	0.1369	0.2384
Rate of return on capital	0.0356	0.0374	0.0416	0.0490	0.0645	0.1123
Rate of return on assets	0.0306	0.0321	0.0357	0.0421	0.0554	0.0965
TIER	2.36	2.42	2.58	2.87	3.46	5.28

credits, the reduction of equity would have created an important secondary benefit by raising the rate of return on equity due to increased financial leverage. That higher rate of return would have improved the cooperative's ability to retire additional equity in a timely manner. In general, by taking steps to accelerate the retirement of capital credits, a rural electric cooperative can help ensure that its members are financing the organization in proportion to the benefits they receive and that each generation of members carries its own weight.

Despite the advantages, a cooperative that seeks to use this strategy to accelerate the retirement of capital credits may face limitations on its ability to acquire necessary financing. Because RUS provides financing only for constructing facilities, a cooperative employing this strategy would need to acquire unsecured loans from other lenders at higher interest rates. In addition, lenders may restrict equity replacement to within the range of 5 to 15 percent. Individual cooperatives will differ in their ability to acquire financing based on the collateral value of existing hard assets and expected cash flows. In general, the ability of a particular cooperative to employ this strategy also will depend on its capital requirements, financial performance, and competitive situation.

An alternative strategy for a cooperative is to reduce the rate at which it accumulates equity so a larger share of new assets is financed with borrowed capital. In this way, more of current earnings can be used to retire capital credits while the cooperative's equity share is gradually reduced. An advantage of this strategy is that as long as increases in hard assets exceed new debt, new assets may provide a source of collateral for new loans, thus providing the cooperative greater access to financing and at lower interest rates than it would face with unsecured debt. Simply by lowering the rate at which it accumulates equity, a cooperative will be able to shorten the length of its rotation cycle. In addition, as the equity share declines over time, the rate of return on equity will rise, further reducing the rotation cycle. Analysis presented here demonstrates that the average distribution cooperative could have substantially reduced its rotation cycle by halving its rate of equity growth.

Cooperatives also may benefit from exploring higher electric rates as a means of expanding the retirement of capital credits. A third analysis shows that the average distribution cooperative could have reduced its rotation cycle to 25 years with only a minimal increase in its electric rate. Shorter rotation cycles would have required greater rate increases, but the cooperative could have shortened its rotation cycle substantially with less than a 5 percent increase. Raising the electric rate also would have increased the rates of return and the TIER value.

Notes

1. "Co-op Facts & Figures," National Rural Electric Cooperative Association, accessed July 25, 2016, http://www.nreca.coop/about-electric-cooperatives/co-op-facts-figures/.

2. "Electric Programs," U.S. Department of Agriculture, Rural Development, accessed July 25, 2016, http://www.rd.usda.gov/programs-services/all-programs/electric-programs.

3. "Overview," National Rural Utilities Cooperative Finance Corporation, accessed July 25, 2016, https://www.nrucfc.coop/content/cfc/about_cfc/overview.html.

4. "About CoBank," CoBank, accessed July 25, 2016, http://www.cobank.com/About-CoBank.aspx.

5. "CoBank Reports Full Year Financial Results for 2015," CoBank, accessed July 25, 2016, http://www.cobank.com/Newsroom-Financials/CoBank-News-Feed-2/2016/March/CoBank-Reports-Full-Year-Financial-Results-For-2015.aspx.

6. A 2003 survey of distribution cooperatives indicated that 43 percent used the FIFO method exclusively and an additional 36 percent used FIFO in combination with another method (Capital Credits Task Force 2005, 41).

7. "Daily Treasury Yield Curve Rates," U.S. Department of the Treasury, accessed July 25, 2016, https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield. The interest rate on new debt is assumed constant over the relevant range. At some point, when leverage increases (i.e., equity/total assets decreases), the interest rate charged on new loans may begin to rise as the risk to lenders grows because of the probability of bankruptcy or default.

8. The ability of the average distribution cooperative to replace 25 percent of its equity is consistent with the range of 10 to 30 percent by which Cooper maintained cooperatives were overcapitalized based on 2005 and 2006 data (Cooper 2008, 364–65). However, he did not take into account limitations on the ability of cooperatives to acquire necessary financing.

9. An analysis of the average power supply cooperative indicated that it would not have been able to rotate equity during the 2006–11 period. Although its TIER value was 1.58, higher than the 1.25 minimum recommended by Fitch Ratings, the equity level was 14.5 percent, well below the 20 percent usually expected for an A rating (Capital Credits Task Force 2005, 62). Consequently, it appears that power supply cooperatives on average were not in a good position to replace equity with term debt.

10. According to the Capital Credits Task Force report (2005, 61), electric cooperatives in 24 states are subject to some statutory authority over rates. However, Cooper (2008, 342) contended that cooperative electric rates are regulated in only 13 states and cooperative rates are regulated in a manner similar to those of investor-owned utilities in only 7 of those states.

11. RUS data on the electric sales and operating revenue of power supply cooperatives necessary for this type of analysis are not available. A similar analysis of a mid-size power supply cooperative with a record of not recently retiring capital credits showed that the cooperative could maintain a

rotation cycle of 25 years with a 1.41 percent rate increase and a rotation cycle of 10 years with a 3.84 percent rate increase (Royer 2015, 275–77).

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