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Some Alternatives to Conventional Farm Mortgage Loan Repayment Plans*

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SOME ALTERNATIVES TO CONVENTIONAL FARM MORTGAGE LOAN REPAYMENT PLANS

Most farm mortgage loans in Canada carry a fixed interest rate and call for a fixed level payment that amortizes the loan over a specified term. This type of loan is not ideal in all situations. This paper suggests four alternatives: flexible repayment mortgages, graduated mortgages, variable interest rate mortgages, and reverse mortgages.

INTRODUCTION

The typical farm mortgage loan contract offered by the Farm Credit Corporation (FCC) as well as most private lenders and provincial government agencies in Canada is the familiar level or fixed payment plan. Under these contracts, the loan is repaid in a series of equal annual, semi-annual, quarterly, or monthly payments that repay the loan, with interest, over the repayment period specified in the mortgage. Unlike residential mortgages, most farm mortgages also carry a fixed interest rate for the entire term of the loan.

The level payment mortgage has served its purpose well since it was originated during the depression of the 1930s. Borrowers know exactly how much must be paid on each payment due date and the lenders have a stable and predictable inflow of payments. Moreover, in inflationary times, the borrower's income and the value of the property that secures the loan may be rising. Thus, successive payments are more easily met and the borrower's equity steadily increases, giving borrowers a comforting sense of progress and lenders a safer security margin as the loan is repaid. Level payment mortgages are easily administered and well understood by both borrowers and lenders.

Despite its widespread success and acceptance, the level payment, fixed interest rate loan is not always ideal. This paper discusses four alternatives. *Flexible repayment mortgages* are suggested for borrowers whose incomes fluctuate widely from year to year. *Graduated mortgages* are offered as a partial remedy for the cash-flow problems that young, beginning farmers typically experience. *Variable interest rate mortgages* are designed to eliminate the risk of getting "locked in" to unusually low or unusually high interest rates over a long term. *Reverse mortgages* are suggested as one method of permitting retired farmers to use their equity to supplement retirement income without selling the farm. A $10,000 loan amortized over 20 years at 10 percent per annum compound interest on the unpaid balance is used throughout this paper to illustrate the alternative plans.

FLEXIBLE PAYMENT MORTGAGES

One problem with the conventional level payment plan is the fact that all payments *are* equal. Borrowers whose repayment ability is jeopardized by low yields or prices or large, unanticipated personal expenses sometimes have little choice but to go into arrears. Failure on the borrower's part to fully meet an installment, on or before the scheduled due date, generally involves some investigation by the lender. In cases where valid reasons for default exist, the account is usually carried in arrears for a reasonable time until the borrower can restore it to good standing. This procedure usually

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TABLE 1. TWENTY-YEAR AMORTIZATION SCHEDULE FOR A $10,000, 10-PERCENT LOAN, LEVEL PAYMENT PLAN

Year	Balance Before Payment	Total Payment	Interest	Principal	Balance After Payment
			dollars		
0	–	–	–	–	10,000.00
1	11,000.00	1,174.60	1,000.00	174.60	9,825.40
2	10,807.85	1,174.60	982.54	192.06	9,633.35
3	10,596.69	1,174.60	963.33	211.26	9,422.09
4	10,364.30	1,174.60	942.21	232.39	9,189.70
5	10,108.67	1,174.60	918.97	255.63	8,934.07
6	9,827.48	1,174.60	893.41	281.19	8,652.88
7	9,518.18	1,174.60	865.29	309.31	8,343.58
8	9,177.94	1,174.60	834.36	340.24	8,003.34
9	8,803.67	1,174.60	800.33	374.26	7,629.07
10	8,391.99	1,174.60	762.91	411.69	7,217.39
11	7,939.19	1,174.60	721.74	452.86	6,764.53
12	7,440.98	1,174.60	676.45	498.14	6,266.38
13	6,893.03	1,174.60	626.64	547.96	5,718.43
14	6,290.27	1,174.60	571.84	602.75	5,115.67
15	5,627.24	1,174.60	511.57	663.03	4,452.64
16	4,897.91	1,174.60	445.26	729.33	3,723.31
17	4,095.65	1,174.60	372.33	802.27	2,921.05
18	3,213.16	1,174.60	292.10	882.49	2,038.56
19	2,242.41	1,174.60	203.86	970.74	1,067.81
20	1,174.59	1,174.59*	106.78	1,067.81	–

*Final payment is adjusted to correct for minor rounding error.

works satisfactorily for lender and borrower; however, it might tend to be arbitrary and the borrower is never certain how long or to what extent he will be carried. Moreover, an extension of the due date may help little because it reduces the borrower's ability to meet the next scheduled installment on time. Obviously, failure to meet loan installments in full, on or before the due dates, is something that both borrowers and lenders should avoid. For lenders, arrears cases increase loan administration costs. Defaulting borrowers incur added costs, financial embarrassment, a weaker credit rating, and the increased possibility of foreclosure. Although most mortgage contracts allow borrowers to pay more than the scheduled installment in good years, thereby building reserves that can be drawn against in poor ones, prepayments generally tend only to reduce the term of the loan, leaving all subsequent installments unchanged. Also, some private lenders charge prepayment penalties to discourage early payments.

A flexible mortgage repayment plan would permit a borrower to increase or reduce the amount of the loan payment, within predefined limits, in response to changes in repayment ability. Many variations are possible but only a few are discussed here.

Table 1 illustrates the process by which a $10,000, 10-percent loan would be amortized over 20 years under the level payment amortization plan, assuming that all annual payments of $1,174.60 are made exactly as scheduled.[1] A flexible mortgage repayment plan would allow for changes in the amortization period, the scheduled unpaid balance, and the interest rate.

A provision for allowing the scheduled balance and amortization period to vary would permit the borrower to reborrow against accumulated equity in low income periods, and make repayments in good years. This privilege would be equivalent to moving backward or forward on the fixed payment amortization schedule such as the one in Table 1. Suppose that a borrower has made the first four payments of $1,174.60 exactly as scheduled but because of low income, cannot meet the full amount of the fifth installment. The scheduled balance after the fifth payment is $8,934.07. The borrower could reduce the payment to $918.97 by moving back to year four, to $686.58 by moving back to year three, etc. If the borrower moved all the way back to the beginning of the schedule, the accumulated equity, $1,065.93, would only be $108.67 short of covering the entire payment in year five. However, if the borrower used the entire equity reserve to meet the fifth payment, he would be starting all over again. Thus, the total amortization period would be extended from 20 to 25 years. Alternatively, the borrower may be able to pay more than $1,174.60 when the fifth payment is

[1]Readers not familiar with the mechanics of loan repayment plans are referred to Nelson, Aaron G., Lee, Warren F., and Murray, William G., *Agricultural Finance, 6th ed.*, Ames, Iowa State University Press, 1973, Chapter 11.

due. A prepayment of $281.19 would move the schedule ahead to the sixth year, a $590.49 prepayment to the seventh year, etc.

Most lenders would justifiably react unfavorably to the prospect of allowing borrowers to deviate this much from the original amortization schedule. This problem could be largely resolved by setting a maximum on the number of years that a borrower could move backward (or forward) on the amortization schedule. The loan contract could also specify a maximum amortization period. In the example shown in Table 1, the loan contract could specify that the borrower may move backward on the schedule no more than three years. A similar restriction could be placed on prepayments for lenders who wished to do so. In addition, the contract could specify that the maximum amount permitted to remain outstanding after any installment due date is the amount that the scheduled level payment will amortize by, for example, the end of the twenty-fifth year from the date the original loan was made. These, or similar restrictions, would ensure that the borrower didn't get hopelessly behind by setting limitations on the frequency and extent to which the flexible payment provisions could be used.

Under the "maximum three year" or "maximum 25 year" restrictions used in this example, a borrower who could not meet the full amount of the fifth annual installment of $1,174.60 could move back only as far as year two. In doing so, he would be obligated to reduce the after-payment loan balance to $9,633.35 instead of the scheduled balance of $8,934.07. Thus, the minimum payment would be $475.32.

If the borrower were to take full advantage of the "maximum three years" rule for the fifth installment, the equity reserves available for flexible payments would be almost depleted. Suppose that on the due date of the sixth installment, the borrower were still in financial difficulty and could not pay the scheduled installment of $1,174.60. Under the "maximum 25-year" rule, the maximum amount that could remain outstanding after the sixth payment is the amount that could be repaid in 19 equal, annual installments of $1,174.60. This amount is $9,825.43. The before-payment loan balance is $10,596.69; thus, the minimum payment that could be made on the due date of the sixth installment without going into arrears would be $10,596.69-$9,825.43 = $771.26. If the borrower paid only $771.26 for this sixth payment, the flexibility feature of the repayment plan would have been entirely used up and he would be committed to paying annual installments of at least $1,174.60 for the next 19 years.

The details of these calculations would vary according to when, how often, and the extent to which the borrower reduced the payment below the scheduled amount on any given installment due date. The calculations might appear complex; however, a carefully designed billing system should make the payment plan flexible and readily understandable. To illustrate, the billing statements for the fifth and sixth installments for this example could contain the information shown in Table 2.

TABLE 2. EXAMPLE OF BILLING STATEMENT INFORMATION FOR A FLEXIBLE LOAN REPAYMENT PLAN

Installment No. 5	
Original Loan	$10,000.00
Interest Rate	10 percent
Balance Before Scheduled Installment	$10,108.67
Scheduled Installment	$ 1,174.60
Balance After Scheduled Installment	$ 8,934.07
Minimum Payment[a]	$ 475.32

[a]Note: If you pay only the minimum amount due now, the minimum amount due next year will be $771.26.

Installment No. 6[b]	
Original Loan	$10,000.00
Interest Rate	10 percent
Balance Before Scheduled Installment	$10,596.69
Scheduled Installment	$ 1,174.60
Balance After Scheduled Installment	$ 9,422.09
Minimum Payment[c]	$ 771.26

[b]Assuming the borrower paid the minimum amount, $475.32, for the fifth installment.
[c]Note: If you pay only the minimum amount due now, the minimum payment for the next 19 installments will be $1,174.60.

As Table 2 illustrates, there is a constant incentive for the borrower to pay as much as possible on each installment due date so that equity reserves can be carried to future years. Depending upon the restrictions used, the lender retains enough control so that corrective action can be taken on serious default problems before loan losses occur. At the same time, the borrower has some latitude to vary the payment in response to changes in repayment ability without going into arrears.[2]

GRADUATED REPAYMENT PLANS

The fixed, level payment amortization plan is sometimes unsuitable for the young, beginning farmer who may be carrying a very high debt load. One solution is a loan amortization plan in which the payment increases during the life of the loan.

[2]Baker has described a plan under which the mortgage payment would be adjusted according to changes in the borrower's income and living costs. An insurance element would provide a constant payment to the lender. See Baker, C.B., "A Variable Amortization Plan to Manage Farm Mortgage Risks," *Agricultural Finance Review*, E.R.S., USDA, Vol. 36, April 1976, pp. 1-6.

One version is to require payment of "interest only" during the first few years and then convert to a level payment plan to amortize all or part of the principal balance. In our example, the borrower might be required to make interest payments of $1,000 for the first five years. The $10,000 balance could then be amortized over the remaining 15 in equal, annual payments of $1,314.74.

Several variations of the interest only concept are possible. One is to call for payments of interest only throughout the entire life of the loan contract, leaving a "balloon payment" for the entire principal. This balloon would have to be refinanced or paid off at maturity. Alternatively, the contract could ask for partial amortization, with a balloon payment for the balance. In our example, the contract might specify that $5,000 be amortized over 20 years with interest only on the remaining $5,000. For a 10-percent loan, the annual payment would be $587.30 on the $5,000 amortized portion plus $500 interest on the nonamortized portion, for a total annual payment of $1,087.30.

The interest only method is generally the best a lender can do because a payment of anything less than the interest would cause the after-payment loan balance to exceed the original amount of the loan. In most cases, some increase in the principal balance above the original amount of the loan is possible because rising land values tend to preserve the lender's security margin. Exceptions would be where the security consists largely of buildings and equipment, or where land values are static or declining.

Table 3 illustrates a loan amortization schedule in which the payment increases continuously over the life of the loan at the rate of 4 percent a year.[3] Since the first few payments do not cover interest on the unpaid balance, the after-payment loan balance increases slightly, to a peak of $10,277 at the end of year four. The before-payment loan balance also increases to a peak of $11,305 just before the due date of the fifth payment.

The effects of the interest rate, the term of the loan, and where applicable, the payment growth rate on loan payments are shown in Table 4. For any given loan interest rate and amortization period, an increase in the payment growth rate tends to lower payments in the early years and increase payments in the last few years. Higher payment growth rates also cause an increase in the amount by which the loan balance will go above the original amount of the loan before finally decreasing. These characteristics are illustrated in Figures 1 and 2 for a $10,000, 10-percent loan amortized over 20 years.

A continuously graduated payment plan has two advantages over the level payment and interest only plans. Depending on the growth rate used, the first few

[3]The mechanics of computing payments for graduated payment plans are described in the appendix.

TABLE 3. AMORTIZATION OF A $10,000, 10-PERCENT LOAN IN 20 YEARS, 4-PERCENT PAYMENT GROWTH RATE

Year	Loan Balance Before Payment	Total Payment	Principal	Interest	Loan Balance After Payment
			dollars		
0	–	–	–	–	10,000.00
1	11,000.00	889.81	110.19	1,000.00	10,110.19
2	11,121.21	925.40	85.62	1,011.02	10,195.81
3	11,215.39	962.42	57.16	1,019.58	10,252.97
4	11,278.27	1,000.92	24.38	1,025.30	10,277.35
5	11,305.08	1,040.95	13.21	1,027.74	10,264.13
6	11,290.54	1,082.59	56.18	1,026.41	10,207.95
7	11,288.75	1,125.89	105.09	1,020.80	10,102.86
8	11,113.15	1,170.93	160.64	1,010.29	9,942.22
9	10,936.44	1,217.77	233.55	994.22	9,718.67
10	10,690.53	1,266.48	294.61	971.87	9,424.05
11	10,366.46	1,317.14	374.74	942.40	9,049.32
12	9,954.25	1,369.82	464.89	904.93	8,584.43
13	9,442.88	1,424.61	566.17	858.44	8,018.27
14	8,820.09	1,481.60	679.77	801.83	7,338.49
15	8,072.34	1,540.36	607.01	733.85	6,531.48
16	7,184.63	1,602.50	949.35	653.15	5,582.13
17	6,140.34	1,666.60	1,108.39	558.21	4,473.74
18	4,921.11	1,733.26	1,285.89	447.37	3,187.85
19	3,506.64	1,802.59	1,483.81	318.78	1,704.05
20	1,874.46	1,874.46[a]	1,704.05	170.41	—

[a]Last payment adjusted for minor rounding error.

TABLE 4. COMPARISON OF PAYMENT SCHEDULES FOR AMORTIZING A $10,000 LOAN UNDER LEVEL PAYMENT, INTEREST ONLY, AND GRADUATED REPAYMENT PLANS

			Interest Only First Five Years		Graduated Payments					
					2%		4%		8%	
Term	Interest Rate	Level Payment	Years 1 to 5	Years 6 to Maturity	First Payment	Final Payment	First Payment	Final Payment	First Payment	Final Payment
- Yr -	- % -	–	$	–	–		$			–
10	8	1,490.29	800	2,504.58	1,378.14	1,847.00	1,272.42	1,811.05	1,080.00	2,158.92
	10	1,627.45	1,000	2,837.97	1,509.38	1,803.83	1,397.62	1,989.25	1,193.03	2,384.86
	12	1,769.84	1,200	2,774.10	1,646.05	1,967.18	1,528.48	2,175.48	1,311.97	2,622.64
20	8	1,018.00	800	1,168.30	880.81	1,283.17	754.86	1,590.38	540.00	2,330.48
	10	1,174.60	1,000	1,314.74	1,026.80	1,495.85	889.81	1,874.46	651.09	2,809.90
	12	1,338.79	1,200	1,468.24	1,040.40	1,515.67	1,035.13	2,180.85	773.97	3,340.24
30	8	888.27	800	938.79	731.71	1,298.41	590.25	1,840.78	360.00	3,354.22
	10	1,060.79	1,000	1,101.68	892.66	1,585.23	736.99	2,298.41	472.45	4,401.86
	12	1,241.44	1,200	1,275.00	1,064.35	1,890.12	897.12	2,797.81	602.29	5,811.72

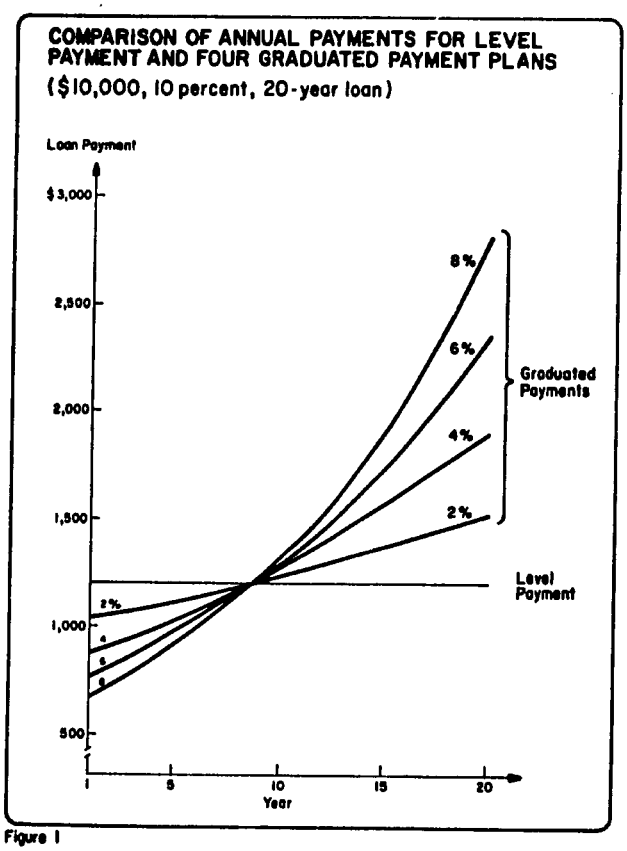

Figure 1

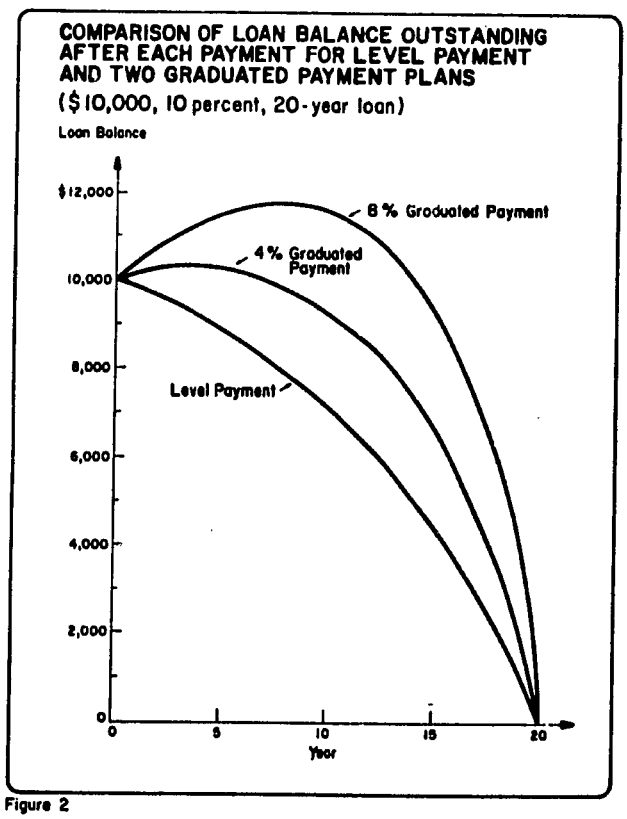

Figure 2

payments will be somewhat less than the interest only and level payment amounts. Compared with the level payment plan, a 4-percent payment growth rate plan throughout the entire term of the loan reduces the first payment on a $10,000, 10-percent, 20-year loan from $1,174.60 to $889.81. On a $100,000 loan, the absolute reduction in the first annual payment would be about $2,848. Thus, a graduated payment plan would give beginning farmers a better chance of keeping their loan accounts in good standing during the typically difficult early years in farming. Under a steadily increasing payment plan the sudden increase from the interest only amount to a level payment is eliminated. Of course the interest only and graduated payment plans could be combined. For example, the mortgage contract could call for interest only payments of $1,000 for the first five years, followed by a 4-percent graduated payment schedule over the next 15. Under this plan, the sixth payment would be $1,054.73 and it would gradually increase to $1,826.45 for the final twentieth installment.

Graduated payment plans do not have to involve a

continuous increase in the payment throughout the entire amortization period. The borrower could be required, or given the option to switch to a level payment plan on specified loan anniversary dates. The $10,000, 10-percent, 20-year loan could be written so that the first 10 payments increased at a rate of 5 percent a year and the last 10 be equal. In this case, the first payment would be $885.06, the tenth $1,373.02, and payments 11 through 20 would be $1,441.67.

Graduated payment plans could also incorporate the provisions of a flexible payment plan, allowing limited movements backward or forward on the payment schedule. The degree of flexibility would be less with a graduated payment plan because the borrower's equity increases at a much lower rate.

Lenders have two main objections to loan repayment plans which call for lower payments in the loan's early years. The security margin is lower than it otherwise would be under the level payment plan, and there is the added risk that the borrower's repayment capacity may not increase fast enough to handle the higher payments in the later stages of the amortization period. These objections can be partially overcome by choosing realistic payment growth rates, tailored to the anticipated inflation rate in the value of the security and the expected growth rate in the borrower's income.

VARIABLE INTEREST RATES

Most farm mortgage loans in Canada carry a fixed interest rate for the entire term of the loan. In the Canadian residential housing mortgage market, the typical loan contract calls for renewal of the loan every five years at a new interest rate determined by prevailing market rates. In the United States, the Production Credit Association and the Federal Land Banks (the largest suppliers of farm credit) have been making variable interest rate farm loans since about 1970.

At first glance, variable interest rate loans appear to benefit only lenders. Variable rate loans allow lenders to pass to borrowers the risk of getting locked into a long-term loan with a low, fixed rate of return. Borrowers, however, also assume considerable risk when they borrow over long terms at fixed interest rates. The general interest rate level tends to rise and fall in largely unpredictable cycles so some borrowers become locked into comparatively high rates over long terms. From the lender's standpoint, interest earnings on loans to borrowers who are locked into cyclically high rates tend to offset low rates of return on loans made when interest rates were low. Borrowers, however, do not have an effective means of dealing with the risks of interest rate changes.

Variable rate farm mortgages could benefit both lenders and borrowers. Consider a borrower who obtained a $10,000 FCC loan on December 1, 1968 at the interest rate of 8 percent a year. For convenience, it was assumed that the loan is to be repaid over 20 years in annual installments due the first of every December, and that the interest rate could be adjusted only once a year on each payment due date. Since the interest rates on FCC loans are subject to change every April 1 and October 1, the variable rates on this loan would be as shown in columns 2 and 3 of Table 5. The new rate each year is the rate in effect after each October 1 rate adjustment.

The payments on this variable rate plan would be as shown in column 5 of Table 5. In any given year, the payment is the amount needed to amortize the after-payment loan balance over the remaining years to maturity at the new interest rate. The first payment, $1,018.52, would amortize a $10,000, 8-percent loan in 20 years. The second payment, $1,074.10, would amortize a $9,781.48, 8.75 percent-loan in 19 years, and the fifth payment (December 1, 1973) $956.02, would amortize a $9,031.15, 7-percent loan in 16 years, etc.

TABLE 5. FIRST NINE PAYMENTS ON A $10,000 VARIABLE INTEREST RATE LOAN AMORTIZED IN 20 YEARS

Payment Due Date	Interest Rate: Preceeding 12 Months	Interest Rate: Next 12 Months	Years To Maturity	Payment	Loan Balance: Before Payment	Loan Balance: After Payment
	-- %	–		–	$	–
Dec. 1, 1969	8.00	8.75	19	1,018.52	10,800.00	9,781.48
Dec. 1, 1970	8.75	8.50	18	1,074.10	10,637.36	9,563.26
Dec. 1, 1971	8.50	7.50	17	1,056.07	10,376.14	9,320.07
Dec. 1, 1972	7.50	7.00	16	987.93	10,019.08	9,031.15
Dec. 1, 1973	7.00	7.00	15	956.02	9,663.33	8,707.31
Dec. 1, 1974	7.00	9.25	14	956.02	9,316.82	8,360.81
Dec. 1, 1975	9.25	9.00	13	1,088.95	9,134.18	8,045.23
Dec. 1, 1976	9.00	10.00	12	1,074.57	8,769.30	7,694.73
Dec. 1, 1977	10.00	–	11	1,129.30	8,464.20	7,334.90

Source: Interest rate data in columns 1, 2 and 3 are from the Farm Credit Corporation, *Statistics 1977: Federal Farm Credit*, p. 28.

Variable interest rate loans clearly introduce some uncertainty for farm borrowers. Under a fixed rate loan, the borrower in the example in Table 5 would have paid $1,018.52 every year. The variable rate loan causes the payment to go above this amount, as shown in column 5 of Table 5. The problem of payment fluctuations caused by interest rate changes can be at least partially resolved by allowing limited changes in the amortization period described earlier for flexible loan repayment schedules. For example, the variable rate contract could specify that the borrower could maintain the same payment as long as the amortization schedule is not increased more than three years from the original schedule. In this case, the "maximum three year" rule would almost completely eliminate payment fluctuations caused by the interest rate changes.

This example demonstrates that if there is no rate differential between fixed and variable rate loans, the borrower would have been better off with an 8-percent fixed rate loan taken out in 1968. Although the absolute differences are not large, the total payments made, the remaining loan balance, and the total interest paid over the first nine years are all lower with the fixed interest rate loan. Lenders, however, will likely be able to offer lower interest rates on variable rate loans because the risk of losses on loans made when interest rates were at a cyclical low is less. In a previous article, the risk premium for interest rate fluctuations in Canada for 1969-76 was estimated to be 0.83 percent.[4] Thus, lenders could offer a lower initial interest rate as an incentive to borrowers willing to accept variable rate loans.

REVERSE MORTGAGES

A reverse mortgage is the opposite of a conventional mortgage loan. The lender makes regular payments to the borrower and at the end of the term, the borrower owes the lender a lump sum. Reverse mortgages have been proposed to help older homeowners use their home equity to supplement their retirement incomes without selling property. The same concept applies equally well to retiring farmers.

The same $10,000, 10-percent, 20-year example described previously can also be used to illustrate the mechanics of a reverse mortgage. Consider a 65-year-old farmer planning to retire who would like to keep his farm, continue to live in the house, and rent the land out to a younger neighbor. He has determined, however, that his rental income and pension benefits would be insufficient to cover the retirement living costs. Depending upon the amount of equity in the farm, a reverse mortgage might solve the problem. Suppose that a reverse mortgage contract is designed so that this farmer would owe the lender $10,000 at the end of 20 years. With an interest rate of 10 percent a year, the lender could pay the retired farmer $174.60 a year for 20 years (the reader can verify that the accumulated principal and interest on 20 annual payments of $174.60 would be $10,000 after 20 years).

Reverse mortgages have some potential problems. One obvious one, though not very likely in this example, is that if the retiree outlives the term of the mortgage, he would have no way of paying off the loan. Also, if the retiree dies before the end of the term, the lender would have to collect the loan balance due at that point from the estate.

Collecting the loan from the estate poses only a minor administrative problem for the lender (as long as the security's value has not decreased substantially – an unlikely occurrence given the recent trends in values). The problem of the retiree (and spouse) outliving the term of the mortgage could also be resolved by tailoring loan terms to life expectancy, just as insurance companies do with annuities. Furthermore, with rising land values, retirees who do outlive the term of a reverse mortgage would probably have accumulated sufficient additional equity to extend the term of the loan.

As with the plans described earlier, there are many possible variations of the reverse mortgage concept. For example, the payments could be graduated so that the retiree's income would keep pace with inflation. With minor adjustments, variable interest rates could also be used.

SUMMARY

Most farm mortgage loans made in Canada carry a fixed interest rate and call for a fixed, level payment that amortizes the loan over a specified term. For some borrowers, this type of loan contract may not be suitable. Year-to-year variations in farm incomes might result in periodic arrears, even though the average income over time is adequate to cover scheduled installments. Highly indebted, beginning farmers may find it difficult to meet payments in the early years. The fixed interest rate exposes both lenders and borrowers to the risk of becoming locked into unusually low or high rates for the duration of a long-term contract. Finally, many retiring farmers are forced to sell their farms to use their equities as a source of retirement income.

[4]See Lee, Warren F., "Problems in Financing Canadian Agriculture," *Canadian Journal of Agricultural Economics*, July 1976, pp. 32-45.

Many of these problems can be partially resolved by using one or a combination from four variations of the typical farm mortgage loan contract: 1. a provision for limited variations in loan payments in response to changes in repayment ability. 2. a graduated payment plan in which the loan is amortized by payments that increase over time, 3. variable interest rate loans which call for periodic adjustment in the interest rate in response to changing market rates, and 4, reverse mortgages in which the lender would pay the borrower regular payments over the term of the loan.

The plans illustrated here are only a few examples of how such loan repayment plans might work. The details can be varied considerably to suit each borrower's or lender's situation. Because these plans are new, little is known about the administrative costs, possible legal obstacles, and other problems. With computerized billing systems and some imagination, however, an innovative lending agency could probably overcome most of the major obstacles and offer better service to a wider range of borrowers.

APPENDIX

The computer and the comparatively recent development of moderately priced electronic calculators have made it possible to expand the range of available options for repaying loans. From a computational standpoint, almost any repayment plan that is agreeable to both lender and borrower is possible. The purpose of this appendix is to elaborate on the mechanics of computing the first loan payment for graduated loan repayment plans.

In any loan repayment plan, the present value of the stream of payments is equal to the initial amount of the loan. The following notation is used:

B = beginning loan balance,
r = rate of interest on loan,
g = payment growth rate for graduated payment loans, and
n = the term of the loan.
$PVA_{i,t}$ = the present value of an annuity of 1 for t periods with an interest rate of i percent per period compounded.
$PV_{i,t}$ = the present value of 1, t periods at i percent per period compounded.
I_i = loan payment in year i.
$GLA_{g,n,r}$ = graduated payment loan amortization factor to compute the first payment for a payment growth rate of g percent, n loan payments, r-percent interest rate on loan.

For a loan of B to be repaid over n periods at an interest rate of r percent in equal payments, the amount of each payment is:

$$I = \frac{B}{PVA_{r,n}} \qquad (1)$$

To determine the first payment for a payment stream that increases at a compound rate of g per period over the entire term of the loan, define a new interest rate, r*, where:

$$r^* = \frac{1+r}{1+g} - 1, (r > g) \qquad (2)$$

For a 10-percent loan, a 20-year term, and a 4-percent payment growth rate:

$$r^* = \frac{1+.10}{1+.04} - 1 = .0576923$$

Next, compute the present value of an annuity for n periods (the term of the loan) with an interest rate of r* percent per period. (A computer or financial calculator is needed.) For our example,

$$PVA_{r^*,n} = PVA_{5.76923,\ 20} = 11.687928$$

Next, compute a graduated loan amortization factor:

$$GLA_{g,n,r} = \frac{1+g}{PVA_{r^*,n}} \qquad (3)$$

For our example,

$$GLA_{4,20,10} = \frac{1+.04}{11.687928} = .088981$$

Finally, multiply the graduated loan amortization factor by the amount of the loan to compute the first payment:

$$I_1 = GLA_{g,n,r} \times B \qquad (4)$$

For our example,

$$I_1 = GLA_{4,20,10} \times B = .088981 \times \$10{,}000 = \$889.81$$

The payment increases 4 percent each year and the loan is amortized as illustrated in Table 3.

If the mortgage contract calls for a graduated payment in the early years followed by a series of level payments, first determine the present value of the level payments. For a loan with a total term of n years with

payments graduated at rate g in the first s years this would be:

$$PVA_{n-s,r} \times PV_{s,r} \times I_1 (1 + g)^s \qquad (5)$$

For a 20-year loan with graduated payments for years 1 through 10 and level payments for years 11 through 20, the present value of the level payment portion is:

$$\begin{aligned} &PVA_{20-10,10} \times PV_{10,10} \times I_1 (1 + .05)^{10} \\ &= 6.144567 \times .385543 \times 1.628895\, I_1 \\ &= 3.858843\, I_1 \end{aligned}$$

Next, subtract the present value of the level payment portion from the amount of the loan, i.e., $B - (PVA_{n-s,r})\,(PV_{s,r})\,(I_1)(1 + g)^s)$, to obtain the amount that the first s graduated payments must amortize. For our example, the first 10 graduated payments must amortize a loan of $10,000-3.858843 I_1.

From this point, the procedure described in equations (2) through (4) is used for s years.

$$r^* = \frac{1 + .10}{1 + .05} - 1 = .047619$$

$$PVA_{r^*,s} = PVA_{.047619,10} = 7.811805$$

$$GLA_{.05,10,10} = \frac{1 + .05}{7.811805} = 0.134412$$

Now, solve for I_1:

$$\begin{aligned} I_1 &= (10{,}000 - 3.858843\, I_1)\, .134412 \\ I_1 &= \$885.06 \end{aligned}$$

As described in the foregoing text, payments for years 1-10 would increase 5 percent a year from $885.06 in year 1 to $1441.67 for years 11 through 20.