THE POTENTIAL FOR FIXED RATE LENDING ON FEDERAL LAND BANK LOANS

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Proceedings of a Seminar
Sponsored by North Central Regional Project NC-161
"Evaluating Financial Markets for Agriculture"

FINANCIAL MARKETS FOR AGRICULTURE: MACRO, INSTITUTIONAL, AND POLICY ISSUES

St. Louis, Missouri
October 31-November 1, 1984

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by

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INTRODUCTION

Since 1969, Federal Land Banks (FLBs) have offered, almost exclusively, variable interest rate mortgage loans. The switch from more traditional fixed rate mortgage loans was a consequence of a run up in interest rates that left the FLBs cost of funds higher than the rate they were earning on their loans. Variable rate loans were generally accepted by borrowers because rates changed very slowly. In addition, competitors who were still offering fixed rate farm loans had problems funding loans and charged rates well above the variable FLB rate. During the past few years, however, interest rates have been volatile and at times the FLB cost of funds has been significantly higher than their marginal cost of money. It is during these times that the farmer-borrower would like to obtain financing on a fixed rate basis. However, it is also in the times of high rate volatility that offering fixed rate loans becomes most difficult.

In order for Federal Land Banks to once again offer fixed rate loans, three major issues must be resolved. The first two, reinvestment and rollover risk, occur as the result of the funding process. Reinvestment risk arises from the need to invest, until it is due back to bondholders, funds repaid by borrowers. Reinvestment risk can be lessened by funding the loan with short term securities or a series of different length securities. Rollover risk occurs when the funds used to support a loan have to be repriced while the rate on the loan cannot

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change. The third issue to be resolved concerns what effects the fixed rate option will have on the continuing variable rate borrowers.

The purpose of this paper is to suggest several different methods by which the FLBs could reduce the risks discussed above and once again offer fixed rate loans.

CURRENT MORTGAGE LOAN PLANS

As discussed earlier, most FLB loans are currently written on a variable rate basis. Some of the FLBs have also begun to offer a fixed rate loan plan. An example of such a plan is the Farm Credit Services of St. Paul's fixed rate mortgage plan. Under the St. Paul plan, borrowers can fix the interest rate on their loans for five years. These fixed rate loans are matched and priced against a five year Farm Credit bond. By matching the life of the fixed interest rate with the life of the bond, rollover risk is shifted from the Bank to the borrower. These loans do require amortization of principal, and thus the FLBs do face reinvestment risk. During the first five year cycle this is minimal as a result of the small amount of principal which is actually repaid. During subsequent five year cycles, it is anticipated that enough new loans will be made so that the principal repaid on all the loans will not be a significant portion of the total bond pool.

The effects of offering fixed rate loans on the borrowers on a variable rate are reduced in the St. Paul plan by limiting, on a first come, first served basis, the volume of loans to be written on a fixed rate basis.

PROPOSED MORTGAGE LOAN PLANS

Four different ways to fund long term fixed rate loans will be presented. They will then be compared to the operation of the variable rate loan through the use of a cash flow simulation model. The mechanics of each loan are summarized in Table 1.

Plan A: Variable Rate Mortgage Program

This is the program now in use by FLBs. Interest rates charged borrowers are allowed to fluctuate monthly, in line with the average cost of the bond portfolio. Repaid principal can be

Table 1 Alternative Farm Mortgage Plans

	Rate Structure	Period Within Which Rate Cannot Change	Principal Repay	How Funded	Minimum Size if Public Funding[a]	Pricing	Prepayment Penalties
Plan A[b] Variable Rate	All Variable	1 Month	From: Scheduled Repayment To: Reduction of Portfolio	Current Operations	NO	Weighted Average cost of debt portfolio	NONE
Plan B[c] Fixed Rate-Risk Premium	All Fixed	Entire Length of Loan	From: Standard Amortization of Loan To: Reduction of Portfolio	Current Operations	NO	Current Rate on Variable Rate Loan plus a risk premium	NONE
Plan C Combination Fixed and Variable Rate	Yrs 1-20 Some Percentage fixed some variable Yrs 21-25 All variable	Fixed Portion - 5 Years Variable Portion 1 month	From: Standard Amortization all from Variable Rate To: Reduction of Portfolio	Set issuance of 5 year bullet bonds (4 times per year) for fixed portion current operations for variables	5 year bonds at least $300 million	Var. Rate Portion: Current Variable Rate Fixed Rate Portion: Matched Rate with 5 year bond	None on Variable Rate portion or at Refinancing time. Present value to next refinancing at other times
Plan D Fixed Rate-Bullet Bonds	All Fixed	Entire Length of Loan	From: Standard Amortization of Loan To: Invested until bullet bond matures	Series of bullet bonds issued 4 times per year	Each bullet $300 million	Cost of 25 year bond plus or minus some premium	Present value to make bank whole
Plan E Fixed Rate Bullet and Sinking Fund Bonds	All Fixed	Entire Length of Loan	From: Standard Amortization of Loan To: Yrs. 1-10 Invest until bullet bond matures Yrs. 11-25 satisfy sinking fund	Four times per year: Five and ten bullets, 25 year sinking fund	Each bullet $300 million, sinking fund $100 million	Cost of 25 year bond plus or minus some premium	Present value to make bank whole

[a]The use of private placements could possibly be used to lower the minimum size
[b]Currently in use by the Federal Land Banks
[c]Used by the Federal Land Banks until 1969

returned to bondholders by adjusting the amount of bonds sold monthly.

Plan B: Fixed Rate Loan with Risk Premium

Under this plan the FLBs would operate their fixed rate program in the same way they did in the 1960s. The entire loan made to the borrower would have a fixed rate for the entire length of the loan. Since the loan would be made on a fixed rate basis, repayment would be made according to a standard amortization plan. The principal would be used to satisfy current maturity obligations or to lend to other borrowers. This plan would use the same funding methods by the Federal Farm Credit Banks Funding Corporation (FFCBFC) that are currently in use with the variable rate program. The interest rate charged borrowers would be the average cost of the bond portfolio plus some risk premium to cover the possibility of an increase in the Bank's cost of funds. As was the case with the current variable rate plan, there would be no FCS committment tied to a specific loan and thus no repayment penalty would be charged.

There are few advantages to the bank in making this type of loan. If it could be priced competitively it might be well accepted by borrowers. However, in order to protect the bank from unexpected increases in interest rates, the risk premium may be so large as to make the cost of the loan prohibitive.

Under this plan the borrower has the benefit of a known interest rate, and thus a known total payment for the entire life of the loan. The borrower may, however, be committing to an interest rate that is higher than it would have been under the variable rate scenario.

Plan C: Combination Fixed and Variable Rate

This plan combines the features of both fixed and variable rate loans by charging the borrower a fixed rate loan on part of the loan balance and a variable rate on the remainder. The fixed portion of the loan would remain at a constant rate for some set period of time, while the variable portion would carry an interest rate equal to that charged those borrowers who remained in the standard variable rate pool. The length of the fixed rate portion is flexible. Five years is used as the length of the fixed portion in this study since it is a common maturity on bond issuances by the FCS. It also has been

demonstrated in a study by the St. Paul Farm Credit Services that a five year bond can be effectively hedged on the futures market. This could aid the FLBs in a quoting loan rates to borrowers.

Under this plan, repayment of principal is all applied to paying down the variable rate portion of the loan. A principal payment amount is set up at the time the loan is made. This principal payment is set equal to the principal which would have been repaid if a standard amortization plan had been in effect. The rate used to amortize the loan is independent of any interest rate charged, since, in effect, its purpose will be to set the amount of fixed and variable rate funds. By fixing the principal payment, the loan will pay off at original maturity since the bank avoids the negative amortization problem. The borrower's yearly payment would thus equal the interest on the fixed rate portion plus required principal repayment (both known amounts) plus the interest on the outstanding variable rate balance (an unknown amount). The variable rate portion is reduced each year in accordance with the principal amount repayment.

The amount in each of the fixed and variable rate components is flexible. The bank may want to set some minimum and maximum amount which can be put into the fixed rate component, for example at least 50% but no more than 75% of the outstanding balance. The maximum amount which could be placed in the fixed rate component is that amount which would leave enough of a balance in the variable rate component to make the required principal payments. Table 2 gives an example of how these two alternatives would operate in the first five years.

Using a $100,000, 25 year loan that is to be amortized at a 12.5% rate, Table 2 shows that under either method the amount of principal repaid in each year will be the same, and that amount will be equal to the amount repaid on a standard amortizing fixed rate loan. At the end of year five, the fixed rate components would be refinanced. For method 1, the entire fixed rate balance of $50,000 could again be put on a fixed rate basis while the variable rate balance would be left at $45,545. Under method 2, at least $8,028, the amount which would be repaid during the next five year period, would have to be shifted from the fixed rate to the variable rate pool. This type of shift would occur again after years 10 and 15. After year 20 the entire balance would be placed in the variable rate pool under

Table 2 Combination Fixed and Variable Rate Alternatives

Method 1 50% Allowed to be Fixed

Year	Fixed Balance	Variable Balance	Principal Payment	Loan Balance
0	$50,000	$50,000	0	$100,000
1	$50,000	$49,306	694	$ 99,306
2	$50,000	$48,525	781	$ 98,525
3	$50,000	$47,646	879	$ 97,646
4	$50,000	$46,657	989	$ 96,657
5	$50,000	$45,545	1,112	$ 95,545

Method 2 Maximum Amount Fixed

Year	Fixed Balance	Variable Balance	Principal Payment	Loan Balance
0	$95,545	$4,455	0	$100,000
1	$95,545	$3,761	694	$ 99,306
2	$95,545	$2,980	781	$ 98,525
3	$95,545	$2,101	879	$ 97,646
4	$95,545	$1,112	989	$ 96,657
5	$95,545	0	1,112	$ 95,545

Method 3 Standard Fixed Rate Loan

Year	Fixed Balance	Variable Balance	Principal Payment	Loan Balance
0	$100,000	0	0	$100,000
1	$99,306	0	694	$ 99,306
2	$98,525	0	781	$ 98,525
3	$97,646	0	879	$ 97,646
4	$96,657	0	989	$ 96,657
5	$95,545	0	1,112	$ 95,545

method 2. For method 1, the timing of the shifts from the fixed to the variable rate pool would depend on an agreement between the bank and the borrower, but the variable rate pool would always contain enough funds to cover principal repayment. For purposes of this study, method 2, the maximum amount of fixed rate possible, will be used.

This type of loan package would be funded through the use of 5 year bullet maturity bonds and the current variable rate loan funds procedure. The only change the FFCBFC would have to make is to issue the 5 year bullet bonds at least 4 times per year. These issues would have to be about $300 million in size in order to be most advantageously priced, but part of these funds could go into the variable rate pool.

There would be two interest rates charged borrowers under this plan. The rate applied to the fixed rate pool would be equal to the rate on the matched 5 year bullet bond plus the normal operating markup. The variable rate portion would be charged the rate at which standard variable rate loans were being made.

The prepayment penalties for this option are at two different levels. Paying early on the variable rate balance would carry no prepayment penalty, since the principal could be passed on through the variable rate pool as it is now. Extra payments could be made on the fixed rate balance at refunding time, but a penalty would likely have to be assessed if the extra principal payment came during a fixed rate period. The amount of the prepayment penalty would have to equal the amount needed to invest at current rates by the bank in order to satisfy the obligation set up in making the loan. As an example, assume the fixed rate portion of a loan is $80,000 and carries a 12.5% interest rate. Further, assume that it will be two years before the fixed balance is refinanced, and the best two year investment available to the bank at the time of prepayment is yielding 10%. The bank would have to invest $83,471 to satisfy its obligations. The prepayment penalty would thus be $3,471

Since all the principal collected would be applied to the variable rate portion of the loan, the bank would experience reinvestment risk to the extent that it does under the current variable rate program--which is very little. Also, since the fixed portion is match funded, there is no rollover risk experienced by the bank.

Under this plan borrowers do not get the 25 year fixed rate that they would under the other options. However, they do get a fixed rate on some part of their debt and, depending on how the terms are set up, it could be a substantial part of the loan.

The borrower also does not have the advantage of a fixed total annual payment under this plan. Since only part of the loan is assessed the variable rate, the variance on the total payment may be less than that experience under a straight variable rate loan. The variation in payment amount is a function of the size of the variable rate component and the change in the 5 year bond rate when the fixed rate portion is rolled over. Although the bank has no rollover risk, the borrower does. The borrower must refinance part of the loan after five years. This problem could be mitigated by allowing the borrower to switch over entirely to the variable rate at the end of a five year interval, or by allowing the borrower to delay the repricing decision through the use of discount notes. The futures market might also be used to lock in an interest rate in the months preceeding the refinancing of the loan.

Plan D: Fixed Rate Funded with Bullet Bonds

Under this plan the entire loan amount would carry a fixed rate for the duration of the loan life. The loan would be repaid using the standard amortization procedure. The bank would have to invest repaid principal until a bullet bond matures.

This option would be funded by a series of four or five bullet maturity bond issues. This would allow principal to be returned to investors three or four times before the 25 year loan life is completed. The number and length of bond maturities can be set in either of two ways. First, it may be stipulated that the bank will not hold any principal for more than 5 years, thus necessitating 5 bullet isues (a 5, 10, 15, 20 and 25 year issue) to fund the fixed rate loan. The other alternative is to issue 4 bonds in such a way that the bank would never hold more than 25% of the original principal at any time. In the case of a 12.5% loan, this would require bullet issues with maturities of 14, 19, 22, and 25 years. An 8.5% loan would be funded by 12, 18, 21 and 25 year issues. The second alternative will be examined in this study.

In order to effectively issue bullet bonds in the national financial market, each bond issue must be approximately $300 million in size. Thus if the second alternative, requiring 4 bullets to fund the loans is used, each fixed rate loan program would have to be in excess of $1 billion.

Pricing this type of loan arrangement would likely be done by using the cost of the 25 year bond, plus or minus some premium.

Since the bank has committments outstanding they would most likely assess prepayment penalties for early payments in order to reduce their risk exposure. Once again, the penalty could be based on the present value concept.

Under this alternative the bank would not experience any rollover risk since the funds to support the loan are set at a fixed cost for the life of the loan when the loan is made. However, since the bank would be required to hold principal for some amount of time before it could be returned to investors, they would have reinvestment risk. The reinvestment risk would be less than would be the case if the loan was funded by a single 25 year bond issue since the principal would not have to be held for as long a period. This alternative may also lead to lower cost loans in a positive yield curve environment since the earlier maturing issues would be priced at a lower rate than the 25 year issue.

In addition to the size issue discussed previously, there are also other issues involving the funding of this alternative which may hamper its implementation. Although the alternative requires no new types of debt instruments, it may require the issuing of maturity lengths that are not common, and thus hard to sell, in the money market. The maturities that would be required under the second funding alternatives, i.e., 14, 19, and 22 year bonds, would fall into this area. In addition, there may be a major funding problem in that at times the market will not accept 25 year fixed rate securities.

This plan would allow the borrower to have a fixed interest rate for the life of the loan. The loan would use a standard amortization plan and thus total payment amounts would be equal and known with certainty, and the loan would be paid off on a predetermined date. As with any all fixed rate

option, the borrower would have to accept the risk that he may be paying a rate of interest that is higher than current market rates at some time during the life of the loan.

Plan E: Fixed Rate Funded with Sinking Fund and Bullet Bonds

As with Plan D, this plan puts the entire loan on a fixed rate for the entire length of the loan. The loan would carry a fixed payment and be amortized using a standard amortization schedule. Principal would be returned in year 5 upon the maturity of a 5 year bullet bond, and year 10 when a 10 year bullet bond matures. The remainder would be returned as it was collected via a sinking fund provision on a 25 year bond.

The most common sinking fund issues carry a provision that there will be no sinking fund payments until year 11. Once the sinking fund begins to operate, principal that is collected on loans can be returned to investors and reinvestment risk is alleviated. By using the 5 and 10 year bullet issue, the reinvestment risk encountered in the first 10 years is minimized. The size of the five year bullet will be equal to the amount of principal collected in the first five years. In the case of a 12.5% loan, this would be 4.46% of the original principal. The ten year bullet would be 8.02% of the principal, with the remaining 87.52% being issued by the use of the 25 year sinking fund bond.

The amount of retirement involved with meeting the sinking fund provision can be as much as 150% of the stated retirement rate in any given year. The required sinking fund payment in year 11 is thus set to be just less than the expected principal repayment, and is changed whenever the expected rate of principal repayment exceeds 1.5 times the stated rate. Table 3 gives the contract sinking fund payment and the expected repayment, in percentages, for a 12.5% loan. The percentages correspond to the sinking fund bond only, not the total (bullets plus sinking fund) loan amount. The bonds needed to satisfy the sinking fund requirement could either be purchased in the open market or called at par.

There are two issues that involve the FFCBFC that must be considered with this option. The first is that the plan would require the issuance of a type of bond that has never been offered by the Farm Credit System before, the sinking fund bond.

Table 3 Contract versus Expected Sinking Fund Payment for a 12.5% Loan

Year	Contract Sinking Fund Rate	Expected Sinking Fund Rate
11	2.5	2.58
12	2.5	2.90
13	2.5	3.26
14	2.5	3.67
15	4.0	4.13
16	4.0	4.64
17	4.0	5.22
18	4.0	5.88
19	6.0	6.61
20	6.0	7.44
21	6.0	8.37
22	9.0	9.41
23	9.0	10.59
24	9.0	11.91
25	9.0	13.40

Secondly, size may present a problem. Although there would most likely be enough fixed rate loan fund demand to float the sinking fund bond, the question is whether the 5 and 10 year issues would be large enough for a competitive public offering. If this did indeed prove to be a problem it could be remedied in three ways. The two bullets could be combined into a single, 10 year issue. This would expose the bank to greater reinvestment risk. Secondly, the bullets supporting the fixed rate program could be sold by private placement, thus lowering the minimum size required. Finally, the bullet issues could be combined with regular funding needs to form an issue of adequate size. The alternative would be priced by using the cost of the 25 year sinking fund bond, plus or minus some premium.

Some early payments could be handled through the use of the sinking fund provision with no prepayment penalties. However, since it is possible that there would be prepayment in excess of the amount which could be handled in this manner, prepayment penalties may have to be enforced and would once again be determined by a present value method.

This plan would be attractive to the FLBs since reinvestment risk is encountered only in early years when the amount of principal held is low. Also, there is no rollover risk since all the loan funds are priced when the loan is made. Once again there may be a problem encountered due to the need to issue a 25 year sinking fund bond on a regular basis. The sinking fund may bring new buyers into the Farm Credit market and thus somewhat lessen this problem. Borrowers face the same advantages and disadvantages as they did under the other full fixed rate plans, Plan B and Plan D.

Cash Flow Model Development

In order to examine the operation of the various loan plans, a cash flow model was developed that would provide a projected repayment and use of repaid funds schedule for each loan plan. The program was used to analyze only the funds flow needed to meet bond obligations and not the markup charged borrowers. Therefore the rate charged borrowers will be set equal to the cost of the bonds supporting the loan.

The interest rates used to run the model can be classified into two groups. The first is the funds rate, which is the average cost of the bond portfolio held by the FLB in each year.

It is this rate at which the bank is assumed to be able to invest excess funds or to borrower to cover a shortfall in funds.

Most of the plans require not only the current portfolio cost but also the cost of bonds in future years. Therefore a yield curve must be estimated for each period in which long term bonds are to be issued. A baseline yield curve was thus estimated and shifted up or down in accordance with the portfolio cost at the time the long term bonds were to be issued. Data was collected on FLB securities in January of 1977 and FCS securities in January of 1983. Using least squares regressions, yield curves were estimated for the two periods. The two estimated equations were:

$$1) \quad y = 4.7852 + \underset{(26.912)}{.93099(\ln Yr)} \qquad R^2 = .9904$$

$$2) \quad y = 9.1900 + \underset{(6.586)}{.83579(\ln Yr)} \qquad R^2 = .8785$$

where y is the bond's yield to maturity, ln is natural log and Yr is years to maturity. The number in parenthesis below the estimated beta coefficients are t-statistics. Taking an average of the constant and beta values gives the baseline yield curve equation, equation 3.

$$3) \quad y = 6.9876 + .88339 \ln Yr$$

The constant in equation 3 was adjusted to reflect current portfolio costs. The average cost of the FLB portfolio was assumed to be equal to a two year Farm Credit bond. Therefore, the yield on a two year bond was calculated from equation 3. The difference between this calculated value and the portfolio cost at the time long term bonds were to be used was used as the shift parameter and therefore was added back into the constant. For example, suppose the portfolio cost in year one is 10.69%. Using equations 3, a two year bond would yield 7.5999%. Subtracting 10.69 - 7.5999 equals 3.09. The constant is thus increased by 3.09 to 10.7768, and the equation for the yield curve becomes:

$$4) \quad y = 10.07768 + .88339 \ln Yr$$

Using equation 4 it can be calculated that a 5 year bond would carry a 11.499% interest rate while a 25 year bond would yield 12.921%

Interest Rate Scenarios

The cash flow model was used to test the performance of the loan plans over four different interest rate scenarios. The yearly funds rate is given for all four scenarios in Table 4. Scenarios 1 and 2 allow rates to rise and fall during the life of the loan. For both scenarios the mean rate was set at 10%. The standard deviation for the end of the year weighted average net cost to FLBs of bonds outstanding was calculated for 1965-1981. For scenario 1, moderate variation, the rate was allowed to vary up to two times the standard deviation from the mean. This resulted in possible rates between 6.23% and 13.77%. For scenario 2, high variation, movement up to four times the calculated standard deviation was permitted. Rates could thus move between a high of 17.54% and a low of 2.46%

Since the funds rate represents the average cost of the FLB portfolio, which has an average life of approximately 2 years, the year to year changes in the funds rate must be kept less than the total variance allowed during the scenario. In order to limit year to year variation, a random number table was first used to determine the rate in year 1 and every third year after that. Once these points were determined, the random number table was once again employed to determine rates within these two points.

Scenario 3 represents increasing rates over time. Year 1 was set equal to approximately the lower end of the moderate variation range, and year 25 set at approximately the upper end. Year 12 was set equal to the mean. The random number table was used to select the rates between these set points. Scenario 4, representing falling interest rates, is the same as scenario 3 but in reverse order.

Table 5 gives the yield for various maturities on bullet bonds that may be issued at the beginning of each of the four interest rate scenarios. Line 1 gives the beginning funds rate, taken from Table 4. Line 2 is the adjusted constant, as was discussed earlier. Line 3 gives the slope or beta coefficient. The yield in any given year can then be calculated according to the equation:

Table 4 Yearly Cost of Funds

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1	10.69%	11.37%	6.00%	14.00%
2	11.53%	13.05%	7.43%	10.79%
3	12.44%	14.89%	8.55%	11.27%
4	12.80%	15.60%	6.82%	11.75%
5	12.76%	15.52%	8.62%	10.12%
6	12.65%	15.31%	9.38%	10.39%
7	12.55%	15.10%	6.33%	12.76%
8	9.37%	8.73%	7.26%	13.22%
9	12.23%	14.55%	6.36%	12.81%
10	9.28%	8.55%	9.07%	10.13%
11	9.83%	9.66%	8.64%	11.01%
12	9.77%	9.53%	10.00%	12.85%
13	9.94%	9.88%	10.86%	10.86%
14	8.81%	7.62%	12.85%	10.00%
15	9.54%	9.09%	11.01%	8.64%
16	8.66%	7.32%	10.13%	9.07%
17	9.64%	7.28%	12.81%	6.36%
18	7.05%	4.10%	13.22%	7.26%
19	6.35%	2.70%	12.76%	6.33%
20	7.42%	4.83%	10.39%	9.38%
21	7.93%	5.86%	10.12%	8.26%
22	10.45%	10.90%	11.75%	6.82%
23	9.19%	8.40%	11.27%	8.55%
24	9.56%	9.14%	10.79%	7.43%
25	8.67%	7.36%	14.00%	6.00%

Table 5 First Period Yields

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Funds Rate	10.69	11.37	6.00	14.00
constant	10.0776807	10.7576807	5.3876807	13.3876807
beta	0.088339	0.88339	0.88339	0.88339
yr				
1	10.078	10.758	5.388	13.388
2	10.690	11.370	6.000	14.000
3	11.048	11.728	6.358	14.358
4	11.302	11.982	6.612	14.612
5	11.499	12.179	6.809	14.809
6	11.661	12.341	6.971	14.971
7	11.797	12.477	7.107	15.107
8	11.915	12.595	7.225	15.225
9	12.019	12.699	7.329	15.329
10	12.112	12.792	7.422	15.422
11	12.196	12.876	7.506	15.506
12	12.273	12.953	7.583	15.583
13	12.344	13.024	7.654	15.654
14	12.409	13.089	7.719	15.719
15	12.470	13.150	7.780	15.780
16	12.527	13.207	7.837	15.837
17	12.581	13.261	7.891	15.891
18	12.631	13.311	7.941	15.941
19	12.679	13.359	7.989	15.989
20	12.724	13.404	8.034	16.034
21	12.767	13.447	8.077	16.077
22	12.808	13.488	8.118	16.118
23	12.848	13.528	8.158	16.158
24	12.885	13.565	8.195	16.195
25	12.921	13.601	8.231	16.231

yield = constant + beta (ln year)

Pricing Strategies

The interest rate charged borrowers compared to the cost of funds is an important consideration in making fixed rate loans. In order to attract as much volume as possible, the rate has to be set as low as possible. If it is set too low, however, the bank will experience losses. Therefore more than one pricing strategy will be tested for each scenario.

For Plan B, three pricing strategies will be tested. The risk premium will be set at 50, 100 and 150 basis points above the funds rate at the time the loan is made. This will give some idea of the minimum risk premium needed. If the bank is in a negative funds position under all three pricing strategies for a particular analysis, the risk premium will continue to increase at 50 basis point intervals until the negative position is eliminated.

The amortization rate selected for use in establishing the repayment schedule under option C will affect how much of the loan is made on a fixed or variable rate basis. Therefore two strategies for selecting this amortization rate will be used. The first is to select an amortization rate equal to the current variable rate, while the second will be the current variable rate minus 50 basis points.

Plans D and E are funded by a combination of long term bonds. Three pricing strategies will be analyzed for each. The highest cost funding instrument for both options is a 25 year bond. For Plan D this is a bullet bond, for Plan E a sinking fund bond. One strategy will be to price the loan at the same rate as the 25 year bond. There are two factors that influence whether this rate is effective. Since some of the funding will come at a lower cost (during normal yield curve situation), it may be possible to price the loan below the cost of the 25 year bond. Therefore one strategy will be to price the loan 50 basis points below the cost of the 25 year security. Acting in the opposite direction is the banks need to contend with reinvestment risk. The third strategy, then, will be to price at 50 basis points above the 25 year security. Since the sinking fund bond is assumed to cost 15 basis points more to issue, Plan E will always be priced slightly above Plan D.

Criterion to Evaluate Options

The five mortgage loan options identified in Table 1 will be evaluated from both the FLBs' and the borrowers' perspectives. There are four criteria by which the alternatives will be judged from the lenders' perspective. They are: 1) Number of periods in which borrower repayments do not meet the required payment on the funding mechanism; 2) The amount of funds paid by the borrower in excess of what is needed to meet bond obligations; 3) The relative impact on the rate charged variable rate borrowers; and 4) Changes in the funding procedure that would be needed to implement the option. Three areas will be examined to assess the options from the borrowers' viewpoint. They are: 1) Total interest paid over the life of the loan; 2) Average payment on the loan; and 3) The standard deviation of the loan payments.

Model Results

Tables 6 through 9 present a summary of the results of the model runs under the different interest rate scenarios and pricing strategies.

Interest Rate Scenario 1

The moderate variation of interest rate scenario is summarized in Table 6. The risk premium plan gives negative funds periods when prices are set at plus 50 and 100 basis points, but by the end of the loan period all obligations have been met. Plans D and E, priced at 50 basis points below the 25 year bond cost, show 12 and 20 negative periods, respectively, and both fall more than 30% short of repaying the bonds. Plan D, priced right at the cost of the 25 year bond, has a very slim excess funds amount, .14%.

The potential effect on the variable rate portfolio varies from none for Plans A and B to plus or minus 31 basis points for Plans D and E. Plan C would result in a change of 28 basis points in the variable rate, either up or down.

As for funding changes, Plans A and B will result in no funding changes. Plan C would call for no new funding instruments, but would require the regular issuance of 5 year bullet bonds. Option D would be funded by four bullet bonds,

Table 6 Scenario 1--Moderate Variance

	Plan A Variable Rate	Plan B Risk Premium			Plan C Combination Fixed and Variable	
FLB Criterion		RP=50 bp	RP=100 bp	RP=150bp	Amort. @ Cost	Amort. @ Cost-.5
Periods of Negative Funds	0	16	7	0	0	0
Excess Funds as a % of Loan Amount	0	8.80%	47.69%	86.96%	0	0
Effect on Variable Rate Portfolio	None	None	None	None	+/-28 bp	+/-28 bp
Funding Changes	None	None	None	None	Regular 5 Year Bullets	Regular 5 Year Bullets
Borrower Criterion						
Total Interest Paid	1,837,366	2,009,770	2,119,142	2,229,593	1,983,976	1,065,297
Average Payment	113,495	120,390	124,765	129,183	119,359	118,612
Std Deviation of Payments	11,647	0	0	0	12,063	12,778

Table 6 Scenario 1--Moderate Variance (Cont.)

	Plan D Bullet Bonds			Plan E Sinking Fund		
FLB Criterion	25 yr. - 50bp	25 year	25 yr. + 50 bp	25 yr.sf - 50 bp	25 yr sf	25 yr.sf + 50 bp
Periods of Negative Funds	12	0	0	20	0	0
Excess Funds as a % of Loan Amount	-38.59%	.14%	39.22%	-33.01%	5.35%	44.08%
Effect on Variable Rate Portfolio	+/-31 bp	+/-31 bp	+/-31 bp	+/-31 bp	+/-31 bp	+/-31 bp
Funding Changes	14,19,22 and 25 Yr Bullets	14,19,22 and 25 Yr Bullets	14,19,22 and 25 Yr Bullets	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker
Borrower Criterion						
Total Interest Paid	2,280,968	2,392,880	2,505,717	2,314,441	2,426,637	2,539,739
Average Payment	131,239	135,715	140,229	132,578	137,065	141,590
Std Deviation of Payments	0	0	0	0	0	0

and implementation of this option would require the regular issuance of these bullet bonds. Plan E would require regular issuance of 5 and 10 year bullets, and a new type of bond, a 25 year sinking fund. Since the necessary funding changes do not change with difference interest rate scenarios, they will not be discussed in each section.

From the borrowers viewpoint, the variable rate option gives the lowest total interest paid and average payment. It also has a lower variance than Plan C, and thus can be said to dominate Plan C. Of the all fixed rate plans, all pricing strategies for the risk premium plan give lower average payments and total interest paid.

The higher standard deviation of payments under Plan C as compared to Plan A is a result of the variance of the rates paid on the 5 year bonds used to fund Plan C. If the portfolio cost returned to approximately the same rate in years 6, 11 and 16 as it was in year 1, causing the 5 year bond prices to be very close, variance would be lower under Plan C. As an example, interest rate scenario 1 was modified so that the funds rate was 10.69 in years 1, 6, 11 and 16. Average payment for Plan A was now computed at $113,583, with a standard deviation of payments of $10,726. For Plan C, average payment was $119,168, but standard deviation was only $5092. The result of this is that Plan C, will not, as expected, always provide lower payment variances. Whether it will or not is dependent on the rate on the 5 year bonds.

Interest Rate Scenario 2

The results of the high variation in interest rates scenario are summarized in Table 7. All risk premium pricing strategies give some negative funds periods, but only the 50 basis point strategy falls short of meeting funding obligations. Plan D must be priced at 50 basis points above the 25 year bond cost in order to avoid a final negative funds position. Plan E could be priced at cost of the 25 year sinking fund or above. Plan C would result in a 57 basis point shift in the rate charged variable rate borrowers, under the assumptions discussed earlier, while Plans D and E would cause a 63 basis points swing.

Table 7 Scenario 2--High Variance

	Plan A Variable Rate	Plan B Risk Premium			Plan C Combination Fixed and Variable	
FLB Criterion		RP=50 bp	RP=100 bp	RP=150bp	Amort. @ Cost	Amort. @ Cost-.5
Periods of Negative Funds	0	24	16	11	0	0
Excess Funds as a % of Loan Amount	0	-18.96%	16.63%	52.54%	0	0
Effect on Variable Rate Portfolio	None	None	None	None	+/-57 bp	+/-57 bp
Funding Changes	None	None	None	None	Regular 5 Year Bullets	Regular 5 Year Bullets
Borrower Criterion						
Total Interest Paid	1,914,781	2,158,784	2,269,607	2,381,422	2,095,179	2,077,673
Average Payment	116,596	126,351	130,784	135,257	123,807	123,107
Std Deviation of Payments	24,065	0	0	0	22,821	23,298

Table 7 Scenario 2--High Variance (Cont.)

FLB Criterion	Plan D Bullet Bonds			Plan E Sinking Fund		
	25 yr. - 50bp	25 year	25 yr. + 50 bp	25 yr.sf - 50 bp	25 yr sf	25 yr.sf + 50 bp
Periods of Negative Funds	12	3	0	21	0	0
Excess Funds as a % of Loan Amount	-38.08%	-3.20%	30.49%	-29.38%	5.35%	40.40%
Effect on Variable Rate Portfolio	+/-63 bp	+/-63 bp	+/-63 bp	+/-63 bp	+/-63 bp	+/-63 bp
Funding Changes	14,19,22 and 25 Yr Bullets	14,19,22 and 25 Yr Bullets	14,19,22 and 25 Yr Bullets	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker
Borrower Criterion						
Total Interest Paid	2,433,398	2,546,553	2,660,554	2,467,252	2,580,667	2,694,911
Average Payment	137,336	141,862	146,422	138,690	143,227	147,796
Std Deviation of Payments	0	0	0	0	0	0

As was the case for scenario 1, the variable interest rate plan gives the lowest total interest paid and average payment. However, when one standard deviation is added to the average payment, the variable rate plan payment does get above many of the fixed rate payments. Plan C, although requiring a higher average payment than Plan A, does have a lower variance.

Interest Rate Scenario 3

Table 8 gives the results of interest rate scenario 3, generally increasing interest rates. As could be expected, it is in this scenario that the benefits for the borrower of having a fixed rate loan are the greatest. The full term, fixed rate plan (B, D, E) have the lowest average payment and total interest paid, with the exception of Plan E priced at 50 basis points above the cost of the sinking fund bond. The variable rate plan results in the highest total interest, average payment and standard deviation of payments. Since rates are increasing, the rate in year zero is assumed to be below the rate in year 1. Therefore, the effect on variable rate borrowers is estimated at -44 basis points under Plan C, -49 basis points under Plans D and E.

Although the borrower would benefit from having a fixed rate during this period of time, the bank would be in serious trouble if that loan was priced according to the Plan B procedure. The bank does not experience problems, with Plans D and E, priced at the 25 year bond or sinking fund Further analysis was done for Plan B under this scenario. The risk premium was increased in 50 basis point intervals until the excess funds figure became positive. The risk premium had to be set at 250 basis points before the bank could meet all bond obligations from borrower payments. At 250 basis points, the borrower payment would have to be set at $97,711 and total interest paid on the loan would be $1,442,792. Excess funds generated under this pricing strategy were 16.67% of the loan amount.

Interest Rate Scenario 4

The most disadvantageous time for borrowers to hold fixed rate loans, during times of falling interest rates, is summarized in Table 9. Under this scenario, the bank would collect a large amount (from 2.5 to 3 times the original loan amount) of excess funds if the risk premium plan was used.

Table 8 Scenario 3--Increasing Rates

	Plan A Variable Rate	Plan B Risk Premium			Plan C Combination Fixed and Variable	
FLB Criterion		RP=50 bp	RP=100 bp	RP=150bp	Amort. @ Cost	Amort. @ Cost-.5
Periods of Negative Funds	0	24	23	16	0	0
Excess Funds as a % of Loan Amount	0	-153.38%	-111.98%	-69.82%	0	0
Effect on Variable Rate Portfolio	None	None	None	None	-44 bp	-44 bp
Funding Changes	None	None	None	None	Regular 5 Year Bullets	Regular 5 Year Bullets
Borrower Criterion						
Total Interest Paid	1,562,234	1,049,537	1,145,263	1,242,767	1,464,799	1,441,669
Average Payment	102,489	89,981	85,810	89,711	98,592	97,667
Std Deviation of Payments	12,289	0	0	0	9,918	10,172

Table 8 Scenario 3--Increasing Rates (Cont.)

	Plan D Bullet Bonds			Plan E Sinking Fund		
FLB Criterion	25 yr. - 50bp	25 year	25 yr. + 50 bp	25 yr.sf - 50 bp	25 yr sf	25 yr.sf + 50 bp
Periods of Negative Funds	7	0	0	17	0	0
Excess Funds as a % of Loan Amount	-13.91%	29.81%	75.45%	-32.33%	11.42%	55.86%
Effect on Variable Rate Portfolio	-49 bp	-49 bp	-49 bp	-49 bp	-49 bp	-49 bp
Funding Changes	11,17,21 and 25 Yr Bullets	11,17,21 and 25 Yr Bullets	12,18,22 and 25 Yr Bullets	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker
Borrower Criterion						
Total Interest Paid	1,288,392	1,388,353	1,489,987	1,318,209	1,418,654	1,520,658
Average Payment	91,536	95,534	99,596	92,728	96,746	100,826
Std Deviation of Payments	0	0	0	0	0	0

Table 9 Scenario 4--Decreasing Rates

	Plan A Variable Rate	Plan B Risk Premium			Plan C Combination Fixed and Variable	
FLB Criterion		RP=50 bp	RP=100 bp	RP=150bp	Amort. @ Cost	Amort. @ Cost-.5
Periods of Negative Funds	0	0	0	0	0	0
Excess Funds as a % of Loan Amount	0	248.81%	288.43%	328.29%	0	0
Effect on Variable Rate Portfolio	None	None	None	None	+44 bp	+44 bp
Funding Changes	None	None	None	None	Regular 5 Year Bullets	Regular 5 Year Bullets
Borrower Criterion						
Total Interest Paid	1,876,885	2,752,097	2,867,485	2,893,573	2,188,308	2,173,363
Average Payment	115,075	150,084	154,699	159,343	127,532	126,935
Std Deviation of Payments	12,815	0	0	0	13,957	14,251

Table 9 Scenario 4--Decreasing Rates (Cont.)

	Plan D Bullet Bonds			Plan E Sinking Fund		
FLB Criterion	25 yr. - 50bp	25 year	25 yr. + 50 bp	25 yr.sf - 50 bp	25 yr sf	25 yr.sf + 50 bp
Periods of Negative Funds	7	4	0	21	0	0
Excess Funds as a % of Loan Amount	-51.31%	-12.24%	27.06%	-36.95%	1.45%	40.04%
Effect on Variable Rate Portfolio	+ 49 bp	+ 49 bp	+ 49 bp	+ 49 bp	+ 49 bp	+ 49 bp
Funding Changes	16,20,23 and 25 Yr Bullets	16,20,23 and 25 Yr Bullets	16,20,23 and 25 Yr Bullets	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker	5,10 Yr Bullets 25 Year Sinker
Borrower Criterion						
Total Interest Paid	3,037,430	3,154,459	3,272,077	3,072,474	3,189,684	3,307,472
Average Payment	161,497	166,178	170,883	162,899	167,587	172,299
Std Deviation of Payments	0	0	0	0	0	0

Due to falling reinvestment rates the returns on loan Plans D under the first two pricing arrangements are negative.

For the borrower, total interest charges range from $300,000 to $1,830,000 more under the fixed rate loan plans than under the variable rate option. The variable rate average payment, plus one standard deviation is below the fixed payment of the all fixed rate plans, while approximately equal to the average payment of Plan C.

Summary

The cash flow model in this paper has demonstrated that Federal Land Banks could make long term, fixed rate loans without exposing themselves to a great amount of risk in any interest rate environment. By match funding the long term loan with a series of bullet bonds, and adding 50 basis points to the cost of the longest maturity of those issued, the bank does not end up in a negative funds position under any of the interest rate scenarios tested. Using a 25 year sinking fund allows pricing at the cost of the bond without incurring negative total funds position. However, use of either of these types of funding procedures poses some important questions. First, there is some doubt that a series of 4 bullet bonds, all with maturities between 10 and 25 years, could be issued on a regular basis. The same is true for the 25 year sinking fund bond. Second, these two procedures will cause the greatest impact on the remaining variable rate borrowers. Finally, by pricing off a 25 year security, the rate quoted on a fixed rate loan, during periods of a normal yield curve, will be substantially above that charged on variable rate loans. This can be seen by the fact that total interest paid using these fixed rate plans was well above that for the variable rate plan in three of the four interest rate scenarios.

Making fixed rate loans by charging a 100 to 150 basis point margin above the current portfolio cost worked well in all but the increasing rate scenario. This plan brings with it the advantages of requiring no changes in funding procedures and no effect on variable rate borrowers, but the risk incurred and bad past experience will probably prohibit a return to this type of fixed rate lending.

The final type of plan discussed was combination of fixed and variable rate loan. By having at least part of the loan on a fixed rate basis, the borrower can sometimes decrease the variability of loan payments and also protect against increases in interest rates. Since all scheduled principal repayments come from the variable rate portion of the loan, the bank does not have to contend with problems associated with returned principal. By refunding the fixed portion at five year intervals, the bank has some opportunity to pass on changes in operating costs. Five year bullet bonds are quite common to the system and regular issuance would pose few problems. By keeping part of the funds in the variable rate pool, the effect on variable rate borrowers is dampened.

Perhaps the most interesting observation that can be drawn from the cash flow tests is how much less interest would have been paid by a borrower on a variable rate than one on a fixed rate. The only scenario where this did not hold true was when rates were trending upward. It is true, however, that the variance on the variable rate loan was greater than for the full term, fixed rate options. What is interesting is that the average payment on the variable rate loan, plus one standard deviation, is generally below the payment on the fixed rate options.