FARM CREDIT ADMINISTRATION

12 CFR Part 650

RIN 3052–AB56

Federal Agricultural Mortgage Corporation; Risk-Based Capital Requirements

AGENCY: Farm Credit Administration.

ACTION: Proposed rule.

SUMMARY: This proposed rule amends Farm Credit Administration (FCA) regulations, through the Office of Secondary Market Oversight (OSMO), by establishing risk-based capital requirements for the Federal Agricultural Mortgage Corporation (Corporation or Farmer Mac). The proposed regulations: Set forth the risk-based capital rules for Farmer Mac, including definitions, methods, parameters and guidelines for developing and implementing the risk-based capital stress test; specify capital calculation, reporting, and compliance requirements; delineate our monitoring, examination, supervisory, and enforcement activities; and, prescribe certain policy requirements for business and capital planning.

DATES: Please send your comments to us by March 13, 2000.

ADDRESSES: You may mail or deliver written comments to Carl A. Clinefelter, Director, Office of Secondary Market Oversight, Farm Credit Administration, 1501 Farm Credit Drive, McLean, Virginia 22102–5090, or send them by facsimile transmission to (703) 734–5784. You may also send comments via electronic mail to ''reg-com@fca.gov'' or through the Pending Regulations section of our website at ''www.fca.gov.'' You may review copies of all comments we receive in the Office of Policy and Analysis, Farm Credit Administration.

FOR FURTHER INFORMATION CONTACT:

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or

Joy Strickland, Senior Attorney, Office of General Counsel, Farm Credit Administration, McLean, VA 22102–5090, (703) 883–4020, TDD (703) 883–4444.

SUPPLEMENTARY INFORMATION:

I. Objective

The purpose of this proposed regulation is to establish a risk-based capital stress test for the Corporation as required by section 8.32 of the Farm Credit Act of 1971, as amended (Pub. L. 92–181)(Act). Section 8.32 of the Act requires us to establish a risk-based capital stress test that will determine the level of regulatory capital [1] necessary for the Corporation to maintain positive capital during a 10-year period where stressful credit and interest rate conditions occur. The proposed rule contains specific information on the structure of the risk-based capital stress test, including guidelines for its implementation, monitoring, reporting and examination. The rule also includes requirements for business and capital planning. The guidelines and procedures for implementation of the stress test are available to the public through the proposed regulation, technical appendix to part 650, subpart B, and an electronic version of the risk-based capital stress test (spreadsheet-based) that is available on our website ''www.fca.gov'' or on written request. The technical appendix contains details on how to construct the risk-based capital stress test, including basic assumptions used in the test.

II. Farmer Mac Organization

Farmer Mac is a federally chartered instrumentality of the United States (U.S.) established on January 6, 1988 by the Agricultural Credit Act of 1987 (Pub. L. 100–233)(1987 Act), which amended the Act. The Corporation's status as a Government-sponsored enterprise (GSE) requires it to fulfill the public policy mission of providing a secondary market for agricultural real estate loans. The Corporation is charged with increasing liquidity to rural lenders, increasing available long-term credit to farmers and ranchers at stable interest rates, and enhancing the ability of individuals in rural communities to get financing for moderately priced homes. Congress established the Corporation as part of its efforts to resolve the agricultural crisis of the 1980s. Congress believed that a secondary market for agricultural mortgages would increase available mortgage credit to America's farmers, ranchers and rural homeowners. Farmer Mac serves this role mainly by buying and securitizing ''qualified loans'' [2] from lenders, thereby restoring the lenders' availability of funds to make new loans. Although created by Congress, Farmer Mac is privately owned with its common stock publicly traded on the New York Stock Exchange.

III. Corporation Authorities and Statutory Requirements for Risk-Based Capital

Farmer Mac's statutory authority, which was established under title VIII of the Act, has been substantively amended three times since its origination in 1988 (i.e., 1990, 1991, and 1996). The 1990 amendments authorized the Farmer Mac II program at the request of the United States Department of Agriculture (USDA). The 1991 amendments authorized the Farmer Mac linked portfolio program.[3] The 1991 amendments created OSMO and established the FCA, acting through OSMO, as the regulator of Farmer Mac. The 1991 amendments also set forth definitions for core capital [4] and regulatory capital. The 1991 amendments also established minimum

[1] ''Regulatory capital'' is defined in section 8.31(5) of the Act as core capital plus an allowance for losses and guarantee claims (in accordance with generally accepted accounting principles (GAAP)). For the purposes of this definition, regulatory capital includes any allowance or reserve accounts that Farmer Mac maintains for losses on loans that are held in portfolio and for losses on securities it has guaranteed, particularly, reserves required by section 8.10 of the Act.

[2] A qualified loan is a loan secured by a first lien, fee simple mortgage or a long-term leasehold mortgage on agricultural real estate or rural housing that is located in the U.S. Agricultural real estate is defined by Farmer Mac as a parcel or parcels of land, which may be improved by buildings or other structures permanently affixed to the parcel or parcels, that (1) Are used for the production of one or more agricultural commodities, and (2) consist of a minimum of five acres or are used in the production of agricultural receipts of at least $5,000. In accordance with the Act, the maximum principal amount of a qualified loan secured by agricultural real estate is indexed to inflation and currently is $3.49 million, unless the loan is secured by 1,000 acres or less, in which case the maximum loan size is set by Farmer Mac at $6.0 million.

[3] The linked portfolio authority allows Farmer Mac to purchase guaranteed securities that have been issued by Farmer Mac or another authorized issuer and hold the securities indefinitely in its portfolio.

[4] ''Core Capital'' is defined in section 8.31(2) of the Act as the sum (as determined in accordance with GAAP) of: (1) The par value of outstanding common stock; (2) the par value of outstanding preferred stock; (3) paid-in capital; and (4) retained earnings.

capital [5] and critical capital [6] levels and required us to establish risk-based capital requirements for Farmer Mac.

The 1996 amendments served to streamline Farmer Mac's operating structure to be more competitive. Specifically, and most importantly, Farmer Mac was allowed to buy loans directly from lenders and issue guaranteed securities representing 100 percent of the principal of the purchased loans. This amendment removed the previous requirement for poolers to hold at least a 10-percent subordinated interest against loan losses on pools of loans securitized by Farmer Mac.

The Food, Agriculture, Conservation, and Trade Act Amendments of 1991 (Pub. L. 102–237)(1991 Act) required us to develop and issue a risk-based capital stress test for the Corporation. The Farm Credit System Reform Act of 1996 (Pub. L. 104–105)(1996 Act) further amended the Act by prohibiting us from establishing a risk-based capital stress test prior to February 10, 1999, 3 years following the effective date of the 1996 Act. The risk-based capital stress test required by the 1991 Act determines the amount of capital necessary for the Corporation to preserve positive capital while undergoing stressful credit and interest rate risk conditions during a 10-year period. The 1991 Act also required an added amount of capital to cover management and operational risk.

Section 8.32 of the Act requires that the risk-based capital stress test subject the Corporation to credit losses on agricultural mortgages it owns or guarantees. The frequency of loan default and severity of losses must be reasonably related to a ''benchmark'' with the highest rate of default and severity of agricultural mortgage losses experienced during a historical period of at least 2 consecutive years. The credit losses also must be related to those experienced in contiguous areas of the U.S. containing at least 5 percent of the total U.S. population. The establishment of the benchmark loss experience is more fully discussed later in this preamble.

The 1991 Act also required us to incorporate in the risk-based capital stress test an interest rate risk stress scenario based on rising and falling interest rates on Treasury obligations of various terms. Under the interest rate stress scenario, current rates on Treasury obligations are instantaneously shocked up and down. For the first 12 months of the 10-year stress period, rates either increase or decrease by: (1) 50 percent of the average rates on various Treasury obligations during the 12-month period preceding the stress period, or (2) 600 basis point (bp), whichever is less. The rates must remain at the increased or decreased level for the remainder of the 10-year stress period.

In addition to the risk-based capital level required as a result of the credit loss and interest rate change components of the risk-based capital stress test, Farmer Mac is required to maintain additional capital to protect against management and operational risk. This additional capital level is specified in the Act to be 30 percent of the capital level required for the sum of the credit loss and interest rate change components of the risk-based capital stress test.

In developing the risk-based capital stress test, the Act permits us to take into account appropriate distinctions relative to various types of agricultural mortgage products, varying terms of Treasury obligations, and any other factors considered appropriate. We may also consider credit loss protection provided by retained subordinated participation interests, which were required for guaranteed securities under section 8.6(b)(2) of the Act prior to the enactment of the 1996 Act.[7] The 1991 Act does not require a specific adjustment for any of these factors, but allows us to determine how best to account for them. Unlike the risk-based capital stress tests applicable to other GSEs, the 1991 Act does not contain specific requirements for addressing new business and other corporate activities during the stress period, including growth, product types, and pricing.[8]

Our risk-based capital regulations must contain specific information on the requirements, definitions, methods and parameters used in implementing the risk-based capital stress test in order to enable others to apply the test in a similar manner. Finally, we must ultimately make available to the public any statistical model used to implement the risk-based capital stress test.

IV. Philosophy and Development of the Risk-Based Capital Stress Test

The principal objective of the risk-based capital standard is to ensure that Farmer Mac has sufficient capital to remain solvent in the face of extreme economic conditions. We believe that effective capital standards should also permit Farmer Mac to fulfill its public policy mission while pursuing prudent business practices and strategies.

Although the risk-based capital stress test can produce a single capital requirement, it effectively creates marginal capital requirements, that is, incremental requirements based on the riskiness of each additional dollar of business for every type of product that Farmer Mac guarantees or holds in its portfolio. Marginal capital requirements for mortgages held in portfolio will vary depending on the interest rate and credit risk associated with the mortgages as well as the Farmer Mac's funding strategy. These marginal capital requirements may have significant bearing on how Farmer Mac implements its business strategies.

We developed the risk-based capital stress test to closely reflect the risks inherent in Farmer Mac's various business activities. We incorporated, to the extent permitted by the Act, consistent relationships between the economic environment of the stress period and Farmer Mac's business activities. This required modeling Farmer Mac's assets, liabilities, and off-balance sheet positions at a sufficient level of detail to capture their various risk characteristics.

Our philosophy guiding the development of the risk-based capital stress test was that it should:

- Be consistent with the requirements of the statute, i.e., it should reflect worst-case credit conditions and interest rate movements, as defined in the Act;
- Reflect Farmer Mac's regulatory capital needs for credit and interest rate risks measured under stressful conditions;
- Be internally consistent;

[5] The Corporation's ''minimum capital'' requirements are described under section 8.33 of the Act. The minimum capital level for the Corporation is an amount of core capital equal to the sum of: (1) 2.75 percent of the aggregate on-balance sheet assets of the Corporation, as determined in accordance with GAAP; and (2) 0.75 percent of the aggregate off-balance sheet obligations of the Corporation which include: (a) The unpaid principal balance of outstanding securities that are guaranteed by the Corporation and backed by pools of qualified loans; (b) instruments that are issued or guaranteed by the Corporation and are substantially equivalent to (a); and (c) other off-balance sheet obligations. These minimum statutory capital standards will continue in effect after the risk-based capital rule becomes effective.

[6] The Corporation's ''critical capital level'' is described in section 8.34 of the Act. The critical capital level for the Corporation is an amount of core capital equal to 50 percent of the total minimum capital amount determined under section 8.33 of the Act.

[7] Section 8.32 of the Act states that we must also conform loan loss data to the geographic and commodity diversification standards that the Corporation loan pools had to meet based on provisions of the 1991 Act. Because the geographic and commodity diversification requirement was eliminated in the 1996 Act, this consideration is no longer applicable.

[8] *See* 12 U.S.C. 4611(a)(3).

- Not create inappropriate economic incentives;
- Aim for simplicity; and
- Reflect, to the extent practical and meaningful, Farmer Mac's current operating policies and practices.

In developing the risk-based capital regulations, we also compared our statutory requirements with the Basle Accord risk-based capital framework. Although the current Basle Accord and our risk-based capital framework significantly differ, both strive to equate risk with an appropriate capital requirement. We note that the proposed direction of the Basle Committee suggests an increasing reliance and acceptance of econometric and statistical models for measuring credit and market risk and allocating capital.[9] Additionally, we both advocate that proactive regulatory measures, such as our risk-based capital stress test, should be complemented by effective monitoring, supervision, and examination. For these reasons, we believe our risk-based capital framework is consistent with the current opinions of the Basle Committee.

In developing the risk-based capital stress test, we engaged in three distinct activities that vary in complexity and time horizons:

- Identification of the benchmark loss experience;
- Construction of the risk-based capital stress test; and
- Examination and oversight.

A. Identification of the Benchmark Loss Experience

Our first initiative was to identify the worst-case historical loss experience as required by the Act. We published our results for comment in the **Federal Register** on July 28, 1998 (63 FR 40282). This study entitled, ''Risk-based Capital Regulations for Farmer Mac: Loan Loss Estimation Procedures,'' is available through our website at (www.fca.gov/pubs/farmmac). The study was prepared by Barry & Associates,[10] consultants who also assisted us in all facets of development of the risk-based capital stress test. The following is a brief summary of our efforts to locate agricultural mortgage loan data and identify the worst-case loss rates to serve as a benchmark for the loss rates used in the risk-based capital stress test.

1. Available Loan Data

We were unable to use Farmer Mac loan data for establishing the benchmark loss experience because Farmer Mac is a relatively new enterprise and did not have historical data. Therefore, we searched for other possible data sources, including the Economic Research Service (ERS) of the USDA, commercial banks, life insurance companies, and System banks. After an exhaustive search, we identified the Farm Credit Bank of Texas (FCBT) and the former Farm Credit Bank of St. Paul (FCBSP) as the only data sources with available historic loan-level performance data on Farmer Mac-eligible loans that satisfied the statutory provisions.

After an extensive evaluation of the available data, we concluded that the FCBT had the most relevant data available for developing a benchmark loss experience for use in a risk-based capital stress test. Data from the FCBT is the most useful available for determining benchmark losses because losses were taken expeditiously as charge-offs and are thus clearly measurable. In contrast, although the FCBSP experienced substantial financial distress during the 1980s, charge-off rates were relatively low due to the FCBSP's strategy of forbearance and restructuring of problem loans. Thus, the FCBSP experienced most of its financial stress through reduced earnings on loans and increased servicing costs. This stress is more difficult to measure in the form of loan default rates and severity of defaults, which the statute requires us to measure. Also, we proposed to use only the FCBT loans that would have met the Farmer Mac underwriting standards that were in place at loan origination because non-conforming loans could present significantly different credit, market, and institutional risks.

2. Identification of Worst-Case Losses

According to the USDA, Texas ranked fourth among the 50 states in terms of farm financial stress in the 1980s. In addition, our experience with the System banks indicates that the FCBT did not experience the worst historical losses on agricultural real estate mortgages. Therefore, the only usable loan data we were able to identify, the FCBT data, did not represent the worst-case agricultural mortgage loss experience. We, thus, found it necessary to consider how Texas loss rates related to other states and regions for determining worst-case loss experience.

We employed a statistical procedure to expand the loan loss rates for the FCBT to estimate loss rates for other states and regions of the U.S. This procedure is explained in detail in the study published for public comment. Briefly, the preferred regression equation identified by Barry & Associates was based on the relationship between FCBT loss rates and the annual percentage change in Texas farmland values over the next 2 years. This regression equation was used to estimate historical loss rates for every state from 1976 to 1993. Then a ranking was compiled of 2-year loss rates for contiguous regions representing at least 5 percent of the 1990 U.S. population. Our study concluded that the worst-case region was found to contain Minnesota, Iowa and Illinois during the 1983–1984 time period with a 2-year loan loss rate of 4.18 percent. This region represents 7.5 percent of the U.S. population. Our experience in overseeing FCS institutions with severe credit problems and high default rates during this period also points to the upper mid-west as the focal point of agricultural stress.

3. Use of the Benchmark Losses

Following our identification of the worst-case benchmark loss rate, we began our development of the risk-based capital stress test. The Act requires that the risk-based capital stress test use losses that occur throughout the U.S. The identified losses are to be at a rate of default and severity ''reasonably related'' to the rate and severity that occurred for at least 2 years in contiguous areas of the U.S. containing not less than 5 percent of the U.S. population.

The published study used loss rates extrapolated from the FCBT data to identify the worst-case region. The primary variable used in the extrapolation was the change in farmland values. However, we are not proposing to use the benchmark loss rate in the risk-based capital stress test. The extrapolation method used in the study was an appropriate method for estimating aggregate loss rates on agricultural mortgages. The method proposed here allows us to incorporate the current risk characteristics of Farmer Mac's portfolio, including loan-level data, in addition to the farmland value changes for the worst-stress time period. These loan-level risk characteristics include loan size, loan-to-value ratio (LTV), debt service coverage ratio

[9] A New Capital Adequacy Framework is a consultative paper issued by the Basle Committee on Banking Supervision. A copy of this paper can be found at *www.bis.org.*

[10] Barry & Associates is a consulting group that conducts research and education projects in agricultural finance on behalf of industry, policy, and non-profit organizations. Projects have included analyses of capital regulations for financial institutions, insurance modeling, risk pricing of loans, community banks' access to agency market funds, and Farm Bill changes. Principal members of Barry & Associates are Peter Barry (Managing Partner), Bruce Sherrick, Paul Ellinger, and Del Banner. Each of these members is affiliated with the Center for Farm and Rural Business Finance at the University of Illinois, Urbana-Champaign.

(DSCR), and debt-to-asset (D/A) ratio. The statistical method proposed makes it easier for Farmer Mac to implement and for us to examine the results.

Although we are not using the benchmark loss rate identified in the published study, we use the percentage changes in farmland values from the published study as a primary variable in estimating the loss rates used in the stress test. Using the farmland value changes from the published benchmark worst-case region of Minnesota, Iowa, and Illinois as input in the credit risk portion of the risk-based capital stress test is a direct linkage to the benchmark loss rate. The loss rates used in the risk-based capital stress test are closely related to the benchmark loss rate, because both are limited to changes in farmland values. The changes in farmland values identified in the published benchmark loss rate study are primary variables in the default equation used in the risk-based capital stress test. Changes in farmland values, as used in the risk-based capital stress test and the benchmark loss rate study, represent the combined effects of the level and growth rates of farm income, interest rates, and inflationary expectations. More detailed information on the procedure for calculating loss rates in the risk-based capital stress test is presented later in this supplementary information and in the technical appendix.

4. Comments on the Benchmark Loss Report

As noted earlier, in July 1998 we published a ''Notice of availability of study and request for comment'' on the loan loss study completed by Barry & Associates. (See 63 FR 40282, July 28, 1998.) Through the Notice, we made the results of the study available for public comment in expectation that it would lead to improved input for the credit risk component of the risk-based capital stress test. Due to the complexity of the study and the importance of the benchmark loss experience in the risk-based capital stress test, several parties requested that we extend the comment period on the Notice from September 15, 1998, to January 4, 1999, which we did.

We received five letters on the study from a variety of interested parties. The commenters were Farmer Mac (2 letters), AgFirst Farm Credit Bank, the American Bankers Association, and the Independent Bankers Association of America (now the Independent Community Bankers of America). We have considered these comments in the development of this proposed risk-based capital regulation. Many of the comments were related to the benchmark loss rates that were identified rather than the loan loss data we used as the starting point or the land value changes we identified. Because we are not using the benchmark loss rates as the loss rates in the risk-based capital stress test, we do not believe that a detailed response to each comment is relevant in this supplementary information. Thus, we are providing a summary of, and our response to, the primary comments relevant to this proposed rule.

First, the commenters stated that the statute does not permit extrapolation procedures in identifying the worst-case loss data. The commenters asserted that the statute required us to use as benchmark losses, the worst-case data that are available to us, *i.e.*, the losses from the FCBT portfolio. We disagree with this interpretation of the statute. The statute directs us to use the worst-case data, not the worst-case data ''that are available.'' Congress directed us to use loan loss rates in the risk-based capital stress test that are reasonably related to the area of the U.S. that experienced the ''highest rates of default and severity.'' Therefore, our first step was to determine the benchmark worst-case losses pursuant to this requirement.

Second, the commenters stated that the study failed to account for appropriate credit risk distinctions between the historical FCBT data and Farmer Mac's current portfolio. We believe it was appropriate to use only those agricultural mortgages that would have been Farmer Mac-eligible loans at the time the study was conducted so that the benchmark losses would reflect losses on relevant loans. We reviewed the process for selecting the screening criteria used in the study and found it to be appropriate given the underwriting data of Farmer Mac's portfolio, the statutory criteria for loan eligibility, and the limitations of the FCBT data set. We also reviewed the eligible loan set obtained from the FCBT data and determined that all variables were within the values found in Farmer Mac's current portfolio. Thus, we believe the data used for the benchmark study are appropriate. We also consider it appropriate to account for Farmer Mac's current portfolio risk factors in applying the loss rates in the risk-based capital stress test. Thus, we consider the current make-up of Farmer Mac's portfolio when we apply the loan loss default equation to determine the loss rates used in the risk-based capital stress test. Later discussions in this supplementary information and the technical appendix further explain how the risk characteristics of Farmer Mac's portfolio are incorporated in determining the loss rates used in the risk-based capital stress test.

B. Construction of the Statutory Stress Test

Our second major undertaking was to develop a financial model to represent Farmer Mac's assets, liabilities and off-balance sheet positions at a sufficient level of detail to capture important risk characteristics and project Farmer Mac's financial performance over a hypothetical period of stress lasting 10 years. The focus of our efforts was to determine the appropriate parameters and economic relationships necessary for the risk-based capital stress test to fulfill the statutory requirements. To accomplish this task, we worked in consultation with Barry & Associates. Additionally, Farmer Mac and PriceWaterhouseCoopers provided information relative to loan data, Farmer Mac's operations, and economic relationships and statistical methodologies for use in measuring various types and levels of risk.

A summary of the major components of the risk-based capital stress test is provided in a subsequent section of this preamble and the regulation. A more thorough discussion of all the technical aspects of the risk-based capital stress test can be found in the technical appendix to the proposed regulation. Due to the nature and complexity of the risk-based capital stress test, we are also making an electronic version of the risk-based capital stress test available to the public through our website at www.fca.gov.

The proposed rule specifies the basic structure and parameters of the risk-based capital stress test and allows Farmer Mac to implement the stress test internally using a model built according to our specifications to determine its risk-based capital level. During the 1-year period following adoption of the final risk-based capital regulation and on an ongoing basis thereafter, we will examine and verify Farmer Mac's implementation of the risk-based capital stress test to ensure compliance with the regulation, including the specifications identified in the technical appendix to the regulation. Furthermore, we are proposing that Farmer Mac have its implementation of the risk-based capital stress test verified and audited once every 3 years by an external independent party. The audit should ensure that the financial data used in the stress test are accurate and that stress test is implemented in accordance with our regulations and procedures. We note that because of the proprietary nature of specific, transaction level loan and financial data used in the risk-based

capital stress test, it is unlikely that results of the test will be fully reproducible by parties other than Farmer Mac and us. Other parties will, however, be able to approximate the test results on an aggregate basis using publicly available information.

C. Examination and Oversight

From a regulatory perspective, the ongoing nature of the risk-based capital stress test facilitates our understanding of how changes in Farmer Mac's business activities will affect its risk profile and resulting capital requirements. A risk-based capital stress test, because it is based on statistical relationships, is limited in a number of important ways that must be understood before it can be used as an effective regulatory tool. Foremost, the risk-based capital stress test uses econometric relationships based on historical data to estimate potential loss rates. Past historical data, even though required by the statute, may not be the best basis for projecting the performance of new agricultural mortgages originated using a different set of underwriting criteria and subject to a different set of economic conditions. As a result, we may need a significant period of time to collect and analyze new data to appropriately update the risk-based capital stress test procedures. Furthermore, the effectiveness of the risk-based capital stress test may be influenced by changes in Farmer Mac's operations, underwriting standards or products and services offered. Lastly, the risk-based capital stress test best measures identifiable and quantifiable risks.

Therefore, our ongoing monitoring and on-site examination will be integral in assessing Farmer Mac's capital adequacy. Our monitoring and examination program will help ensure that Farmer Mac appropriately implements the risk-based capital stress test and aid in identifying non-quantifiable risks that the risk-based capital stress test cannot measure. Together, the ongoing monitoring and examination by OSMO will enable us to provide effective regulatory oversight and ensure the adequacy of regulatory capital standard set by the risk-based capital stress test.

V. Risk-Based Capital Stress Test

The risk-based capital stress test is intended to be forward-looking and sensitive to fluctuations in the economy, as well as to changes in Farmer Mac's asset composition, funding strategies, and on- and off-balance sheet exposures. The risk-based capital level, unlike simple leverage ratios, is tailored to specific risks in Farmer Mac's book of business. In designing the risk-based capital stress test, we sought to identify and incorporate all significant credit and interest rate risks to which Farmer Mac is exposed.

Given the risk-based capital stress test's sensitivity to changing risk conditions, the risk-based capital requirement bears no direct relationship to the statutory minimum capital requirements. Based on a Farmer Mac condition of relatively low risk exposure, the risk-based capital stress test could produce a risk-based capital requirement below that of the statutory minimum standard. When this occurs, Farmer Mac must continue to meet its statutory minimum capital level.

Econometric models are used to project the effects of stressed conditions on Farmer Mac's assets, liabilities and off-balance sheet activities. The risk-based capital stress test will project credit losses from defaults on agricultural mortgages and loss severities comparable to the worst historical agricultural mortgage default loss experience in any region of the country.

The risk-based capital stress test is designed to capture Farmer Mac's specific exposure to credit and interest rate risks under stressed conditions. Economic conditions of the stress scenario affect Farmer Mac's agricultural mortgage performance, earnings and market values, and ultimately required capital. For example, movement in farmland values, which reflect changes in farm income and interest rates, influence mortgage credit loss rates, which in turn affect Farmer Mac's cashflows and capital accretion or depletion. By requiring the risk-based capital stress test to be conducted on a quarterly basis, we will strive to identify changes in capital needs before such economic events as declining farmland values can impact Farmer Mac's balance sheet to any significant degree. Thus, the risk-based capital stress test is more dynamic than simple leverage ratios because the entire business profile of Farmer Mac from assets and liabilities to off-balance sheet obligations is modeled.

The goal of the risk-based capital stress test is to align capital requirements with risk and avoid creating incentives for the Corporation to engage in inappropriately risky activities. The stress test approach also provides greater flexibility to meet regulatory requirements than is available in traditional capital requirements. For instance, the stress test approach recognizes risk-mitigating activities. As an example, Farmer Mac may meet its risk-based capital needs by reducing risk and/or increasing capital.

Proposed § 650.24 describes the main components of the risk-based capital stress test that Farmer Mac must apply to its current operations. The technical appendix to the regulation provides details on the specification and estimation of the statistical (econometric) model used to project Farmer Mac performance over the 10-year stress period. Additionally, the technical appendix discusses how the statistical model is applied in the proposed risk-based capital stress test. The key stress test components, include data requirements, specifications of credit risk, interest rate movements, the cashflow generator, and the capital calculation.

The following discussions provide a general overview of the risk-based capital stress test components and explanation of the concepts underlying the stress test.

A. Data Requirements

Historical loan data from the FCBT are used to determine appropriate relationships among mortgage-risk factors, rates of loan default and loss occurrence. Data on Farmer Mac's current book of business are used to establish Farmer Mac's initial balance sheet structure, financial position and risk profile for the start of the risk-based capital stress test. Current interest rate information as described in the technical appendix is needed for the interest rate component of the risk-based capital stress test.

Farmer Mac will be required to provide additional information in its quarterly financial reports to us. Specific details regarding the new requirements will be provided through modifications to our Call Report instructions. Although we are allowing Farmer Mac the flexibility to determine its risk-based capital level and report its results to us, we believe it is essential for FCA to retain the capability to also determine Farmer Mac's risk-based capital level. Therefore, we intend to modify the current Call Report instructions to accommodate our data and information needs.

B. Farmer Mac Programs and Risk Characteristics

Farmer Mac operates a variety of secondary market programs with varying amounts of risk to fulfill its mission. A brief description of these programs follows.

1. Farmer Mac I—Direct Loan Purchases

Farmer Mac purchases from approved lenders[11] qualified loans secured by a first mortgage on agricultural real estate, including part-time farms that meet specified credit standards. Farmer Mac provides liquidity to the agricultural mortgage market by: (1) Purchasing newly originated qualified loans directly from lenders on a continuing basis through its ''cash window''; (2) exchanging qualified loans for securities issued and guaranteed by Farmer Mac (Farmer Mac Guaranteed Securities) through ''swap'' transactions; and (3) purchasing portfolios of existing loans on a negotiated basis.[12] Qualified loans purchased by Farmer Mac are aggregated into pools that back Farmer Mac Guaranteed Securities, which are periodically issued and sold to investors in the capital markets. Farmer Mac also has the authority to purchase these securities and hold them in its portfolio. Farmer Mac receives income from guarantee fees on securities it guarantees. Farmer Mac also receives interest income on securities it holds.

2. Farmer Mac I—Long-term Standby Purchase Commitment

Under a standby purchase commitment agreement with the lender, Farmer Mac receives an annual fee in return for its commitment to purchase certain loans in the future. The lender services the loans and retains them on its books in a segregated pool. This program allows approved lenders to reduce credit risk and free capital to make additional loans.

3. Farmer Mac I—AgVantage Bond Sales

AgVantage bonds are highly collateralized corporate debt issued by approved lenders to Farmer Mac, which in turn guarantees the bonds. The approved lenders pledge qualified loans and other securities (Treasury securities) as collateral, which are retained by the lenders. This program provides approved lenders with another means to fund qualified loans and generates revenue for Farmer Mac. Farmer Mac receives revenue in the form of interest income on AgVantage bonds.

4. Farmer Mac II

Under Farmer Mac II, the Corporation purchases the portions of loans guaranteed by the USDA. The Food, Agriculture, Conservation, and Trade Act of 1990 (Pub. L. 101–624) (1990 Act) gives Farmer Mac the authority to operate a secondary market for certain USDA-guaranteed loans. The guaranteed portions of loans are pooled and securitized by Farmer Mac or other certified facilities. Farmer Mac then guarantees the repayment of the securities. Farmer Mac receives income from guarantee fees on securities it guarantees. Farmer Mac also receives interest income on securities it holds.

5. Farmer Mac—Rural Housing

Home mortgages from lenders in rural areas and small communities are eligible for sale to Farmer Mac for pooling and securitization. Rural housing is defined by Farmer Mac as a one-to-four family, owner-occupied principal residence that is a moderately priced dwelling located in a community having a population of 2,500 or fewer inhabitants; the dwelling (excluding the land to which it is affixed) cannot have a purchase price or current appraised value of more than $100,000 (adjusted annually for inflation). This figure is currently $133,000. In addition to the dwelling, a rural housing loan can be secured by land associated with the dwelling having an appraised value of no more than 50 percent of the total appraised value of the combined property. As of August 31, 1999, Farmer Mac had not issued any securities backed by rural home mortgages.

6. Risk Characteristics

Farmer Mac's primary exposure to credit risk is the risk of loss resulting from the inability of borrowers to repay their mortgages. Farmer Mac is exposed to credit risk on the loans it holds or guarantees against default, as well as securities it guarantees. Farmer Mac guarantees the timely payment of principal, including any balloon payments, and interest on securities. Loans held or guaranteed by Farmer Mac can be divided into three groups: (1) Pre-1996 Act Farmer Mac I loans; (2) post-1996 Act Farmer Mac I loans; and (3) Farmer Mac II loans. Within these general groupings, Farmer Mac, as previously discussed, operates other programs. Each of these programs carries different amounts of credit risk that must be appropriately reflected in the credit risk component of the risk-based capital stress test.

For pre-1996 Act loans, subordinated interests mitigate Farmer Mac's credit risk exposure. Before Farmer Mac incurs a credit loss, recourse must be taken against the subordinated interest. At December 31, 1998, the subordinated interest of each outstanding security on pre-1996 Act Farmer Mac I loans was equal to or greater than 10 percent. The 1996 Act eliminated the subordinated interest requirement. As a result, Farmer Mac assumes 100 percent of the credit risk exposure on the post-1996 Act Farmer Mac I loans. Farmer Mac mitigates the credit risk related to these loans through the application of its underwriting standards and by requiring collateral in the form of real estate. Farmer Mac's credit exposure on Farmer Mac II loans is covered by the ''full faith and credit'' of the U.S. Government by virtue of the USDA guarantee of the principal and interest on all guaranteed portions.

There is very limited, if any, credit risk exposure on the pre-1996 Act loans due to the subordinated interest, or on the Farmer Mac II loans because of the USDA guarantee. For this reason, we are not requiring Farmer Mac to project any credit losses on these programs during the stress period of the test. Farmer Mac's credit risk exposure on post-1996 Act Farmer Mac I loans is fully reflected in the risk-based capital stress test. Farmer Mac I rural home loans are subject to the same loss rates as agricultural mortgages. Rural home loan loss rates are not computed independently given the lack of data and the fact that there is no outstanding loan volume held on the balance sheet or guaranteed.

Farmer Mac is also exposed to institutional credit risk relating to: (1) Issuers of AgVantage bonds and other investments held by Farmer Mac; (2) sellers and servicers; and (3) interest-rate contract counterparties. We decided not to model these sources of institutional credit risk for several reasons. AgVantage bonds are general obligations of the AgVantage bond issuers and secured by collateral in an amount ranging from 120 percent to 150 percent of the bond amount. In addition to requiring collateral, Farmer Mac mitigates credit risk related to AgVantage bonds by evaluating and monitoring the financial condition of the AgVantage issuers. Farmer Mac manages institutional credit risk related to sellers and servicers by requiring such institutions to meet certain standards and by monitoring their financial condition and servicing performance. The credit risk inherent in the investment portfolio is mitigated by Farmer Mac's policy of investing in highly rated institutions and by establishing concentration limits, which reduce exposure to any one counterparty. Furthermore, the short-term nature of Farmer Mac's investment portfolio limits credit risk. Farmer Mac mitigates credit risk arising from interest-rate swaps by dealing only with counterparties with high credit ratings,

[11] Approved lenders are financial institutions that have met Farmer Mac's technical, financial and stock ownership requirements.

[12] See Farmer Mac's 1998 Annual Report.

establishing and maintaining collateral requirements, and entering into netting agreements.

We are proposing to capture Farmer Mac's institutional credit risk exposure through the 30-percent management and operations risk add-on required by the statute. At this time, we believe modeling institutional credit risk presents many challenges that would unnecessarily complicate the risk-based capital stress test. However, if Farmer Mac significantly increases its credit risk exposure in these areas through modifications to its current operating policies, we will reconsider how to best reflect institutional credit risk exposure in the risk-based capital stress test.

Farmer Mac is also exposed to credit risk concentration in the mortgages it holds and guarantees. Farmer Mac's current policy is to limit its credit exposure in a particular geographic region or commodity to a percentage of total principal amount of all loans outstanding. Additionally, Farmer Mac employs more stringent underwriting criteria in regions with higher loan volume concentrations. Such underwriting criteria consider the credit quality of the loans in a particular geographic region or commodity based on the borrower's LTV, DSCR, equity-to-asset and working capital-to-current asset ratios. The effectiveness of Farmer Mac's underwriting standards is specifically measured in the risk-based capital stress test through our model of loan losses as described more thoroughly in the next section as well as in the technical appendix.

C. Credit Risk

A statistical methodology is used to model the stress conditions described in the statute. Econometric models are used to estimate the probability of mortgage defaults and the severity of loss under stressed conditions. Detailed instructions for measuring credit risk are provided in the technical appendix.

1. Estimation of Default.

A logistic model is used to estimate the frequency of defaults from historical FCBT loan data. Logistic models are widely accepted as an appropriate methodology for modeling loan-level mortgage defaults. There are several well-known predictors of mortgage default, including loan age, payment burden, LTV, and interest rates. Additionally, there are other variables that are specific to farm mortgages, such as farmland prices, net farm income, commodity prices and the D/A ratio. These variables, in addition to a host of others, were considered in the process of modeling defaults of FCBT loans. After extensive statistical analyses, the final equation for estimating the frequency of default includes the following variables:

- Maximum decline in farmland values
- LTV ratio
- DSCR
- Original loan balance in 1997 dollars
- D/A ratio

These variables have logical relationships to the incidence of loan default and loss.

a. *Farmland values.* Changes in farmland prices are an important factor in the model because they directly affect the likelihood of mortgage defaults and the magnitude of potential losses. In estimating the default frequency equation, the largest annual percentage decline in farmland values resulted in the strongest relationship between an economic variable and default frequency. For stress test purposes, we used the largest decline in farmland values from the benchmark loss experience as an input variable.

Because the lives of loans are unknown at origination and differ among loan observations, annual economic variables or annual changes throughout the life of the loan cannot be consistently applied across all loans. Economic variables need to be expressed in a form that can be applied to loans regardless of the life of the loan. For example, geometric average lifetime changes, minimum changes, or maximum changes could be considered. The maximum percentage decline in annual Texas farmland values resulted in the strongest relationship among economic variables considered in the estimated equation for default frequency.

b. *Loan-to-value Ratio.* Another important variable known to drive defaults is the LTV ratio. LTV is equal to the loan amount divided by the appraised value of the underlying property. This variable is one of the primary underwriting ratios that Farmer Mac uses in its loan purchasing decisions. LTV indicates the relative safety of collateralized debt. Large equity investments represent a substantial incentive for a borrower to continue making mortgage payments to safeguard their equity position in their property. Furthermore, if an income problem does arise, lower LTVs provide a significant cushion for the borrower to sell the underlying asset at a price that is sufficient to cover accrued interest and the remaining outstanding principal. Conversely, high LTV loans are more likely to default.

Ideally, an updated LTV could be calculated each year, which would take into account amortization and changes in property value. While we cannot obtain updates in the market value of the underlying collateral, the USDA Texas farmland value series could serve as a proxy for helping to update the denominator of the LTV. Since the amortization schedule of the FCBT data was not available, however, updating the numerator would require making payment assumptions as well. Rather than making additional assumptions, we opted to use LTV at origination.

c. *Debt Service Coverage Ratio.* A key factor in our assessment of potential frequency of default is the DSCR of a loan at origination. The numerator in the DSCR is net income plus depreciation, interest on capital debt, capital lease payments, and net off-farm income less living expenses and income taxes. The denominator is the sum of the total annual debt service requirements. Loans with low DSCRs have a higher expected frequency of default because borrowers cannot be expected to fund losses indefinitely. Conversely, loans with high DSCRs have a lower likelihood of default because they have an excess cashflow buffer, which would have to erode before the borrower would experience losses and consider defaulting. This variable would ideally be updated over the term of the loan. However, because of data limitations and the cyclical nature of agricultural receipts, DSCR at origination is used as the variable.

d. *Origination Loan Balance.* The beginning loan balance also proved to be a significant factor of default. We adjusted the origination loan balance for current constant dollars when we estimated the default equation and applied it to Farmer Mac's data. The base year we selected is 1997 and we adjusted the current dollars based on the consumer price index. It has been observed in the agricultural mortgage market that larger loans tend to have higher default rates. Liquidity constraints are the likely cause of this phenomenon. For a borrower who is experiencing financial difficulty, one of the alternatives is to sell the property and prepay the loan. Considering that there is relatively less demand for large farm properties, the owners of these properties may have difficulty in selling their properties in such an illiquid market. This inability to sell and then prepay eventually limits the farmers' alternatives to default.

e. *Debt-to-asset ratio.* The D/A ratio at origination is the last explanatory variable used in the default frequency estimation model. The D/A ratio

indicates the borrower's total amount of financial leverage. This is an important factor in agricultural lending because agricultural producers typically have significant amounts of debt from operations in addition to farm real estate debt. Borrowers with high D/A ratios experience higher default rates because they have limited capacity to withstand adverse conditions.

2. Loss Severity

Loss severity is a key element in the estimation of loan losses. Loss severity is defined as the total dollar amount of losses on a defaulted loan expressed as a percentage of origination loan balance. The loss severity rate is estimated with the same FCBT data employed in the estimation of defaults. To estimate loss severity, we searched for a significant statistical relationship between loss rate and various independent indicators in the FCBT loan-level data. We concluded, after extensive analysis, that the data set was insufficient to estimate an acceptable loss severity rate. As a result, the loss severity rate is calculated by taking the weighted average loss of defaulted loans. The resulting loss severity rate is 20.9 percent. When a more extensive data set becomes available, loss severity can be re-estimated.

3. Age Adjustment

Mortgage seasoning (aging) is widely accepted as an important determinant in default frequency. The probability of default is low in the early life of a loan and increases as the loan ages until it peaks in years 6 to 8. After this peak period, the borrower has developed greater equity in the property and the likelihood of default tapers off. Therefore, we adjust loan-level loss to reflect the differences in loss occurrence attributed to loan seasoning. We used FCBT data to estimate the distribution function for loan seasoning assuming that the loans have a 14-year average life.

4. Time Pattern of Loss Occurrence

The age-adjusted losses are then distributed through time on a deterministic path that is representative of a stressful scenario. The loss rates estimated in the credit risk component of the risk-based capital stress test are based on an origination year concept. Under this approach, all losses arising from loans originated in a particular year are expressed as a percent of that year's originated loan volume irrespective of when the losses actually occur. The stress test must adjust the origination loss rates to an exposure year concept, in which losses occurring in any 1 year are related to the total outstanding loan volume in that year. Because all loans held at any time are not all originated in that year (or, conversely, loan principal balances are reflected on more than 1 year's balance sheet), the origination year loss rates must be adjusted to exposure year rates. To adjust from origination to exposure year losses, we apply a deterministic time path for loss occurrence during the 10-year stress period. The deterministic time path for converting from origination year to exposure year was determined by calculating exposure year losses in the FCBT data and expressing such losses as proportions of total losses for each origination year. The maximum 1-, 2-, 3-, and 4-year commutative proportions of total origination loss observed in the FCBT data are used in the first four periods of the stress test. The remaining losses are equally allocated to years 5 through 10 of the stress test.

D. Interest Rate Risk

The statute requires the risk-based capital stress test to incorporate an interest rate risk component. Interest rate risk is the risk that interest rate changes could materially affect Farmer Mac's market value of equity and future earnings. Farmer Mac may be exposed to interest rate risk through any product or activity that is sensitive to changes in interest rates. Farmer Mac is exposed to three primary sources of interest rate risk: (1) Farmer Mac I and Farmer II securities; (2) other assets held for investment; and (3) loans held for securitization.

Farmer Mac's primary strategy to manage interest rate risk related to Farmer Mac I and II securities and other assets held for investment is to fund them with liabilities that have similar durations or average cashflow patterns over time.[13] To achieve the desired liability duration, Farmer Mac uses a mix of short-term discount notes and callable and non-callable medium term notes. By using a mix of liabilities that includes callable debt, the duration of the liabilities will tend to increase or decrease as interest rates change in a manner similar to the changes in the duration of assets. Farmer Mac also uses a variety of off-balance sheet derivative financial instruments to manage its interest rate risk exposure.

The Treasury yield curve represents the market's view of risk-free borrowing over a range of maturities. As such, it serves as a foundation for all other market rates. In the context of the risk-based capital stress test, the general level of interest rates will directly affect major components of Farmer Mac's business, including borrowing costs and earnings on mortgages and investments.

The statute specifically describes how Treasury rates must vary during the 10-year risk-based capital stress test period. While the Act provides a fairly specific description of how rates change in the stress scenario, it is silent on how we are to measure the financial effect of those rate changes. Accordingly, we are proposing the following procedures for implementing the statutory stress test and measuring Farmer Mac's exposure to interest rate risk.

Measurement of Farmer Mac's interest rate risk exposure requires the ability to estimate the sensitivity of the Corporation's assets and liabilities to interest rate risk. Vulnerability to interest rate risk is expressed through the degree of match between an institution's rate sensitive assets and liabilities, or between the durations of its assets and liabilities. More closely matched positions reduce the vulnerability to interest rate risk. By determining its duration gap, as measured by the difference between the duration of assets and liabilities under various parallel and instantaneous shifts in the yield curve, Farmer Mac can assess the potential effects of mismatches between the durations of its assets and liabilities. Farmer Mac derives its interest rate sensitivity measures using a commercially developed model, current market information, and other proprietary information.

We are proposing to use Farmer Mac's duration measures as inputs into the stress test to capture the cumulative effects of the Corporation's interest rate risk exposure under the interest rate shock scenarios required by the Act. We have two reasons for using this approach. One, we routinely assess Farmer Mac's interest rate risk measurement and management through our examination process. During this process, we closely evaluate the assumptions and inputs used in Farmer Mac's interest rate risk sensitivity measures. Therefore, we can validate the process and obtain the necessary confidence in the accuracy and integrity of the results to permit us to use them as inputs into the stress test. Our second reason for using Farmer Mac's internal duration measures is that it reduces the complexity of the stress test, thereby increasing the efficiency in implementing the model.

To estimate the effects of the interest rate shocks (up and down scenarios) on Farmer Mac's equity position, we compute effective duration over each

[13] See Farmer Mac's 1998 Annual Report.

interest rate shock scenario using information supplied by Farmer Mac. The duration measure is then used as a proxy for market value effects under each interest rate scenario. We consider Farmer Mac's assets and liabilities to be available for sale under GAAP. Thus, Farmer Mac must record changes in market values as increases or decreases to equity on its balance sheet. Finally, Farmer Mac must determine its risk-based capital level based on the rate movement (increase or decrease) that results in the highest level of required capital.

As noted, Farmer Mac is subject to interest rate risk on all assets held for investment because of the timing differences in the cashflows of the assets and related liabilities. This risk is primarily related to Farmer Mac I and II securities because of the ability of borrowers to repay their mortgages. Mortgage prepayments can cause fluctuations in the value of Farmer Mac securities to the extent they change cashflows of Farmer Mac's on- and off-balance sheet assets. Yield maintenance provisions associated with many of the loans underlying Farmer Mac securities significantly reduce, but do not eliminate, this risk.[14]

Although the effects of increasing and decreasing prepayments are captured in Farmer Mac's market value results, we are also proposing to use prepayment rates as input variables for generating balance sheet cashflows. We provide Farmer Mac the option to use their actual prepayment experience or assumed prepayment rates estimated from other data sources for the reasons explained below.

Prepayment rates often are estimated statistically by measuring relationships between prepayment and a set of independent variables that have been found to influence the prepayment rate. For several reasons, however, statistical relationships were not feasible to estimate in this case. During the historic time period in which the FCBT data were compiled, the FCBT priced its farm real estate loans with floating interest rates that adjusted annually in response to changes in the FCBT's average cost of funds. The resulting loan rates followed changes in market rates but with slower and lower rates of change. Because Farmer Mac does not engage in average cost pricing, estimating a prepayment function from the FCBT data would bear little, if any, relationship to prepayment rates experienced by Farmer Mac in the future. Moreover, an explicit or implicit prepayment measure was not available or obtainable from the FCBT data.[15]

Implementation of the interest rate shock requires several steps. The statutory interest rate shock is applied to the initial interest rate level, which is the preceding 3-month average of the 10-year Constant Maturity Treasury (CMT) rate. The 10-year CMT is frequently used for financial modeling of GSEs [16] since it is viewed as a good index for the cost of funds. Previous studies by Barry & Associates found the 10-year CMT to be a reliable index for System funding costs, and the 10-year CMT did not suffer random or unexplainable variations observed at shorter-term points on the yield curve. Thus, using a 3-month average avoids the possibility of unusual and extreme short-term movements in interest rates unduly influencing the results of the test and Farmer Mac's risk-based capital requirement. The interest rates resulting after the rate shock serve as the index needed to simulate mortgage and investment performance over the stress period and to calculate the risk-based capital level. Because many different interest rates affect Farmer Mac's business performance, we allow the use of other non-Treasury yield curves to simulate the financial effects of the interest rate shock on Farmer Mac's cashflows, income statement, and balance sheet.

Subject to our concurrence, Farmer Mac may use additional indexes, such as the London Interbank Offer Rates (LIBOR), in the risk-based capital test as long as the relationships between those indexes and the 10-year CMT are based on standard, widely used term structure modeling relationships. Farmer Mac may use these relationships to compute the cost of new debt, yields on investments, and coupon rates on mortgages purchased or guaranteed by Farmer Mac. The interest rate index and rate shock procedures described in the technical appendix are minimum guidelines, and although Farmer Mac can use additional indexes, the resulting risk-based capital level cannot be lower than it would be if only the 10-year CMT were used.

E. Cashflows

Our spreadsheet based model projects cashflows from all of Farmer Mac's assets, liabilities and off-balance sheet activities. Farmer Mac may use its own internal cashflow generator system and programming for this aspect of the risk-based capital stress test. However, Farmer Mac must first obtain our concurrence for any internal cashflow generator system and follow the procedures described in the technical appendix to this regulation.

There are numerous modeling constructs and assumptions used in the proposed cashflow component of the stress test. For the test, investments are aggregated into the following categories: (i) Cash and money market securities; (ii) commercial paper; (iii) certificates of deposit; (iv) Agency mortgage-backed securities and collateralized mortgage obligations; (v) and other investments. With our concurrence, Farmer Mac is permitted to more finely disaggregate these categories. Any new category deemed material to its operation in the future will also be required to be added as a separate account. The level of aggregation must appropriately reflect the contributions of revenues and expenses of major program activities. For each asset class, we must be able to discern the earnings rate and funding cost. Loan items requiring separate accounts include: (i) Farmer Mac I program assets, post-1996 Act; (ii) Farmer Mac I post-1996 Act swap balances; (iii) Farmer Mac I pre-1996 Act loans; (iv) Farmer Mac I AgVantage securities; (v) loans held for securitization; and (vi) Farmer Mac II loans.

During the stress test, the balance sheet remains a constant size over the 10-year period. This reflects a steady state scenario, meaning that when on-balance sheet assets and liabilities and off-balance sheet obligations amortize or pay-down, they are replaced with similar assets, liabilities, and obligations. However, as discontinued loan programs (*e.g.*, pre-1996 Act Farmer Mac I program) amortize, they are assumed to be replaced by current loan programs to more appropriately reflect Farmer Mac's current operations.

We use effective years to maturity to simulate the amortization of financial instruments, such as loans and other investments. A constant prepayment rate (CPR) is used for all assets that have embedded prepayment options. Together, the effective years to maturity and the CPR are used to establish a roll-off rate and generate cashflows reflecting a steady state over the stress

[14] Yield maintenance provisions require borrowers to make an additional payment to Farmer Mac when they repay their loans.

[15] The FCBT data set has a ''status'' variable that indicates whether the loan was active, foreclosed, re-amortized, paid in full or merged with a new loan.

[16] The Office of Federal Housing Enterprise Oversight also used the 10-year CMT as a component of their previously published proposed risk-based capital rule. (*See* 64 FR 18083, April 13, 1999.)

period. All cashflows and losses are computed on an annual basis.

To construct pro forma income statements for each period of the stress test, it is necessary to establish rules and relationships for deriving future income and expense items. Information from the first period balance sheet is used in conjunction with the earnings and cost-spread relationships from Farmer Mac supplied data to generate the first period's income statement. In our spreadsheet model, each investment account, loan item, and liability account can be specified as either: (i) A fixed rate investment; or (ii) an instrument with a fixed spread to Treasury with initial rates determined by actual data. The specific spreads (weighted average yield less initial 10-year CMT) by category are calculated directly in the stress test from the weighted average yield data supplied by Farmer Mac in accordance with the data requirements described in the technical appendix.

For non-interest income items, we follow certain decision rules for generating earnings over time. For example, gains on agricultural mortgage-backed security (AMBS) sales are a function of the amount of new AMBS being issued. We based the relationship on historical financial information. Expense items, such as fixed cost and variable cost, are measured using a regression equation where operating expenses is the dependent variable and the sum of investments and Farmer Mac program assets held on-balance sheet is the independent variable. We use the historical relationship of reserves to loan assets (that are subject to reserves, post-1996 Act Farmer Mac I loan items, on- and off-balance sheet) to simulate the loan reserves over time. The corporate tax rate is estimated from actual Farmer Mac financial data. Guarantee fee rates are obtained from actual guarantee fees charged by Farmer Mac on its loan programs.

F. Financial Reports

Pro forma financial statements showing the resulting capital levels for each period of the stress test are developed. Annual pro forma balance sheets and income statements are generated for the stress period using Farmer Mac's starting position, the stress conditions, resulting cashflow outputs, and current operating strategies and policies, as well as other assumptions. The proposed regulation provides Farmer Mac with the option to use its own financial software to produce the projected financial statements using the risk-based capital stress test specifications and parameters described in the technical appendix to this regulation. Projected financial statements must comply, to the extent practical, with GAAP.

G. Capital Calculation

The risk-based capital stress test determines the amount of starting capital Farmer Mac must hold to maintain a positive amount of capital throughout the stress period using an iterative methodology. Also, Farmer Mac must add on an additional 30 percent to this amount to account for management and operational risk. Section 8.31(5) of the Act defines regulatory capital as core capital (the par value of outstanding common and preferred stock, paid-in capital, and retained earnings), plus the allowance for losses and guarantee claims, as determined in accordance with GAAP.

More specifically, to calculate the risk-based capital, our model includes a section to solve for the minimum initial capital amount that results in at least zero capital at the end of each period of the 10-year stress test. In solving for initial capital, it is assumed that reductions or additions to the initial capital accounts are made in the retained earnings accounts and are balanced in the debt accounts at levels proportionate to initial balances (same relative proportion of long- and short-term debt as existing initial proportions). Because the initial capital position affects the earnings, and hence capital positions and appropriate discount rates through time, the initial and future capital are simultaneously determined and must be solved using an iterative process.

H. Future Changes to the Stress Test

Farmer Mac's performance over the stress period reflects its current operating policies and other assumptions about its operations to make the model functional. Due to significant data limitations relating to a variety of issues, we were required to make a number of simplifying assumptions. We recognize this may require us to revisit a number of issues, particularly as more data become available from Farmer Mac's own operations. Therefore, we will continually monitor the risk-based capital stress test results and consider whether modifications to the risk-based capital stress test are warranted. In particular, we anticipate that as more data from agricultural mortgage losses, especially those loans currently securitized by the Corporation become available, changes may be required in the risk-based capital stress test through amendment of this subpart.

Through our ongoing evaluations of the risk-based capital stress test, we also may find it necessary to make technical modifications to the risk-based capital stress test procedures. If we modify the procedures for implementing the risk-based capital stress test, we will notify Farmer Mac and provide them with written instructions to implement the changes. We will make these modifications available to the public on a quarterly basis on our web site.

VI. Statistical Properties of the Default Equation

This section provides further details about the credit risk component, including the underlying theory, analytical methods, data, model specifications, econometric estimation results, and conformance with the worst-case conditions specified in the statute. This section is intended for readers who desire further information on the measurement of credit risk and the statistical properties of the default estimation equation.

A. Estimation Methods

Historic time series on the frequency and severity of losses on farm mortgage loans are compiled from available loan-level data.[17] The measures of frequency and severity are related to selected loan-level characteristics and macroeconomic conditions through appropriately specified regression equations in order to account explicitly for the collective effects of these characteristics on frequency and severity of loss. The resulting regression equations are applied to estimate Farmer Mac's future credit risk position by substituting the respective values of their loan level characteristics and macroeconomic (farmland value changes) measures into the estimated regression equations, calculating the results, and determining the performance implications.

Several estimation approaches are possible, although the ultimate choice depends on the degree of conformance between the characteristics of the data and the properties of the respective regression methods. In the case of frequency of default and loan loss occurrence, the loan outcome is a qualitative, binary variable—default and loss either occur or do not occur. Therefore, the appropriate regression procedure must also accommodate qualitative characteristics (e.g., loan default and loss is coded with a value of 1, while successful loan performance is coded with a value of 0).

[17] As previously discussed, the historic loan data was obtained from FCBT.

Regression approaches with qualitative dependent variables include the linear probability model, logit, and probit. The linear probability model has a number of shortcomings and is rarely used. Under the linear probability model, estimates can occur outside the 0–1 interval resulting in nonsense probabilities and negative variances. Logit and probit are the most commonly used approaches. The primary difference between the two approaches is the assumed underlying probability distribution. The probit model assumes a normal distribution while the logit model uses the logistic distribution. Logit is used more frequently in modeling loan defaults, and is utilized in the credit risk component of the stress test.

In the case of severity of loss, the resulting magnitude of loan loss does not have a qualitative characteristic. Rather, magnitude of loss occurs in a continuous form, bounded at zero, thus requiring a different modeling approach.

The two equations for frequency and severity could be estimated independently. If they are estimated independently, but are in fact related, inconsistent estimates result. A method to accommodate possible dependence is to use a Heckman two-step approach that first assesses the probability of default then subsequently estimates the level of loss based on similar or different covariates. Accordingly, Heckman's two-step or ''Heckit'' estimation method was also explored. The Heckman two-step approach is estimated using method of moments techniques that results in consistent estimates.[18] Basically, it is a discrete model estimated on the basis of sample selection criteria. Then, a linear regression is performed in the second step. Examples of the two-step estimation procedure include Miller, Barry, Ellinger, and Lajili and Nakosteen and Zimmer.[19] The method utilizes an asymptotic covariance for the two-step estimation and results in a consistent estimator for variance (Σ_e^2). The system specification is appropriate in this case because of the relationship between the two equations. That is, severity of loss only occurs on defaulted loans. Default is required in order for loss to occur. While we explored this approach, the two-step procedure did not yield significant results for estimating a loss severity equation. Severity was not found to vary systematically and considered constant across the tested loan characteristics and lending conditions. Therefore, the simple weighted average by loss volume of 20.9 percent is used in the stress test.

Due to Farmer Mac's relatively short history, its own loan-level data are insufficiently developed for use in estimating default frequency and loss severity equations. In the future, however, expansions in both the scope and historic length of Farmer Mac's lending operations likely will warrant use of its data in estimating the regression equations.

B. Model Specifications

Agricultural credit and residential mortgage literature suggest several independent financial variables to consider in modeling loan default. These include the D/A ratio, LTV ratio, DSCR, age of the loan, payment burden, interest rate changes, land price changes, net farm income and changes in commodity prices. These variables were each considered in modeling the default experiences of FCBT loans. Standard goodness-of-fit measures and the credibility of outcomes were used to select the final equation used to estimate the loss probabilities.

The FCBT farm real estate loans were included in the estimating data if they satisfied at least three of four underwriting standards currently utilized by Farmer Mac. The four standards specify that: (1) The D/A ratio must be less than or equal to 0.50, (2) the LTV ratio must be less than or equal to 0.70,(3) the DSCR must exceed 1.25, (4) and the current ratio must exceed 1.0. Farmer Mac may waive complete compliance with these standards if a loan is judged to have appropriate offsetting strengths. Accordingly, the approach employed in the 1998 study requires that loans satisfy at least three of the four specified standards.

Furthermore, the D/A and LTV ratios were restricted to be less than or equal to 0.85. It is unlikely that Farmer Mac would waive these standards if the ratios exceeded these values. Inspection of a portion of Farmer Mac's loan portfolio indicated several instances where the D/A and LTV ratios exceed .50 and .70, respectively, with values of both ratios rarely exceeding 0.85. In the Farmer Mac data, 3.3 percent of the loans and 3.1 percent of the current outstanding loan balances have LTV ratios exceeding 0.70. The use of the maximum values for LTV and D/A and the three-out-of-four standards requirement for passing standards is intended to emulate Farmer Mac's underwriting standards, and includes the practice of waiving selected standards.

Several limitations in the FCBT loan-level data affect construction of the default function. The data contained loans that were originated between 1979 and 1992, but there were virtually no losses during the early parts of the sample period. As a result, losses attributable to specific loans are only available from 1986 through 1992. In addition, no prepayment information was available in the data.

The data set used for estimation also includes loans that were re-amortized, paid in full, or merged with a new loan as performing loans. Including these loans may lead to an underestimation of defaults, if some of the re-amortized, paid, or merged loans default and incur losses. In contrast, when the loans that are re-amortized, paid in full or merged are excluded from the analysis, the default rates are overestimated if a higher proportion of loans that are re-amortized, paid in full, or combined (merged) into a new loan are non-default loans compared to live loans. Excluding loans with defaults, 11,527 loans were active and 7,515 loans were paid in full, re-amortized or merged as of 1992. Application of a t-test[20] for differences in the means for these two groups indicated that active loans had significantly higher D/A and LTV ratios, and lower current ratios than other loans. These results indicate that, on average, active loans have potentially higher risk than loans that were re-amortized, paid in full, or merged.

C. Estimation Results

From a statistical perspective, models utilizing information based on origination information and subsequent economic information were consistently more reliable than models using loans that are transformed into multiple observations.

The structure of the historical FCBT data supports estimation of defaults based on origination information and economic conditions. Under an origination year approach each observation is used only once in estimating loan default. The underwriting variables at origination and economic factors that occur over the life of the loan are used to estimate loan default.

The final estimated equation for loss frequency is:

[18] Greene, W. A. *Economic Analysis*, 3rd ed., Prentice Hall, 1997.

[19] Miller, L.P.N. Ellinger, P.J. Barry, and K. Lajili. ''Price and Non-Price Management of Agricultural Credit Risk,'' *Agricultural Finance Review*, 53 (1993): 28–41. Nakosteen, R. and M. Zimmer. ''Migration and Income: The Question of Self-Selection,'' *Southern Economic Journal*, 7 (1980): 840–851.

[20] The t-test used evaluates the hypothesis that the means from the two loan groups are statistically different. The t-test uses a statistic derived from the student distribution.

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

where p is the probability that a loan defaults and has positive losses (Pr(Y=1|x)); B_0 to B_5 are the estimated coefficients for the intercept and variables X_1 to X_5; X_1 is the LTV ratio at loan origination raised to the power 5.38027;[21] X_2 is the largest annual percentage decline in FCBT farmland values during the life of the loan discounted by 4.8 percent per year;[22] X_3 is the DSCR at loan origination; X_4 is the original loan balance in 1997 dollars; and X_5 is the D/A ratio at loan origination. It is commonly accepted that farmland values at any point in time reflect the discounted present value of expected returns to the land.[23] Thus, changes in land values, as expressed in the default equation, represent the combined effects of the level and growth rates of farm income, interest rates, and inflationary expectations—each of which is accounted for in the discounted, present value process.

These variables have logical relationships to the incidence of loan default and loss, as evidenced by the findings of numerous credit scoring studies in agricultural finance.[24] Each of these anticipated directions of relationship signifies greater risk for the borrower, and thus greater credit risk and incidence of loan loss for the lender. The frequency of loan default was found to differ significantly across all of the loan characteristics and lending conditions, as indicated by the results of the logit equation. The estimated logit coefficients and p-values are:

	Coefficients	p-value
Intercept	−9.7267	0.0001
X_1: LTV	2.7337	0.0001
X_2: Max farmland value decline	−0.3138	0.0001
X_3: DSCR	−0.1822	0.0003
X_4: Loan size ..	8.222E–7	0.0001
X_5: D/A ratio	2.3229	0.0001

The low p-values on each coefficient indicate a highly significant relationship between loan default and the respective independent variables. Other goodness-of-fit indicators are:

Hosmer and Lemeshow goodness-of-fit p-value—0.2232
Max-rescaled R^2—0.1204
Concordant—79.4%
Disconcordant—16.5%
Tied—4.1%

Explanations of these indicators follow:

1. *Hosmer and Lemeshow Goodness-of-Fit Test* divides subjects into deciles based on predicted probabilities, then computes a chi-square test statistic from observed and expected frequencies. A probability (p) value is computed from the chi-square distribution with 8 degrees of freedom to test the fit of the logistic model. If the Hosmer and Lemeshow goodness-of-fit test statistic is .05 or less, the null hypothesis that there is no difference between the observed and predicted values of the dependent is rejected. If it is greater, the null hypothesis of no difference is not rejected, implying that the model's estimates fit that data at an acceptable level. This result does not, however, indicate that the model necessarily explains much of the variance in the dependent variable. Because the p-value of 0.22 is greater than 0.05, the null hypothesis of no difference between the observed and predicted values cannot be rejected. No other information about the default equation's goodness-of-fit is provided by this statistic.

2. *Max-rescaled R-squared.* Several measures often are used to develop R-squared measures with logistic regression. The logistic measures do not specifically measure the degree of variation explained by the model. However, the measures often are scaled from 0 to 1.0 to provide a relative index of degree of fit. The one reported here is a modification of the Cox and Snell coefficient that compares the likelihood function with the intercept only with the likelihood function with all the variables. Nagelkerke proposed normalizing the value between 0 and 1 by dividing by the likelihood function with intercepts only. The specific formula is:

$$R^2 = 1 - \left(\frac{L(0)}{L(\beta)}\right)^{\frac{n}{2}}$$

where L(0) is the likelihood of the intercept-only model, L((β) is the likelihood of the specified model and n is the sample size. The quantity R^2 achieves a maximum of less than 1 for discrete models, where the maximum is given by:

$$R^2_{max} = 1 - (L(0))^{\frac{2}{n}}$$

The Nagelkerke adjustment to normalize the value between 0 and 1 is:

$$R^2_{max\ rescaled} = \frac{R^2}{R^2_{max}}$$

While the default equation has strong statistical significance, the Max-rescaled R-squared value of 0.1204 indicates that other variables and factors not included in the default equation may also influence default rates. Limitations on availability and quality of data, however, restrict the access to, and use of, other variables.

Other statistical measures that are indicative of a model's performance for correctly estimating the probability of loan default, include concordant, disconcordant, and ties. Generally, model performance is superior when the concordant measure is high and the other two measures are low. Each measure is discussed below.

3. *Concordant.* The predicted values for each possible pair of non-defaulted and defaulted loans are compared. The number of possible pairs is equal to the number of non-default loans times the number of defaulted loans. The percent of pairs that have defaulted loans with higher predicted default rates than predicted default rates for non-defaulted loans are included in the concordant category. Given all possible non-default/default pairwise combinations, the concordant percentage is the proportion that has defaulted loans with a higher predicted percentage than non-default loans. The concordant value for the default equation of 79.4 percent

[21] Loss probability is likely to be more sensitive to changes in LTV at higher values of LTV. To test and implement this non-linearity, the model was first estimated with 8 dummy variables at LTV intervals of 0 to 0.399, 0.400 to 0.499, 0.500 to 0.599, 0.650 to 0.699, 0.700 to 0.749, 0.750 to 0.799 and 0.800 to 0.850. A power functional form for the LTV variable was fit to replace the individual dummy variables. The result using generalized least squares (GLS) was LTV $^{5.38027}$. The default equation is re-estimated with the power function. The power function increases the degrees of freedom for the model and provides a continuous relationship between LTV and defaults.

[22] Discounting reflects the declining effect that the maximum land value decline has on the probability of default when it occurs later in a loan's life. The value of 4.8 percent was determined by iteratively solving the default equation with the default equation dummy variable ranging from 0 percent to 10 percent. The 4.8 percent rate yielded the highest goodness-of-fit values.

[23] Barry, P. J., P. N. Ellinger, J. A. Hopkin, and C. B. Baker. *Financial Management in Agriculture*, 5th ed., Interstate Publishers, 1995.

[24] Splett, N.S., P. J. Barry, B. Dixon, and P. Ellinger. ''A Joint Experience and Statistical Approach to Credit Scoring,'' *Agricultural Finance Review*, 54 (1994):39–54.

indicates a relatively high incidence of correct rankings for the possible pairs of defaulted and non-defaulted loans, when the estimated coefficients of the default equation are used to estimate default rates.

4. *Disconcordant.* The disconcordant value is the proportion of pairwise estimates that have higher predicted default rates for non-default loans than defaulted loans. The discordant value of 16.5 percent indicates a relatively low incidence of incorrect rankings of default and non-default loans.

5. *Ties.* The proportion of pairwise estimated probabilities that are equal between non-default and default is 4.1 percent, which is relatively low.

D. Comparison of Actual to Predicted Losses

We compared the actual and predicted loss rates based on origination date and the 20.9 percent severity rate applied to all FCBT loans for the years 1979 to 1992. The largest discrepancies between the series occur on loans originated in 1984 and 1987. A problem associated with errors on specific loans is the application of an average severity value. Using an average severity rate underestimates losses on specific loans that have actual severity rates exceeding 20.9 percent. Using the average severity rate restricts the maximum estimated loss on any loan in the portfolio to 20.9 percent of the origination loan balance.

Application of the estimated loss equations to the FCBT data results in total estimated loss over the entire sample period equal to $9,417,704. Actual losses incurred total $9,805,472. The average of the predicted loss rates is 0.48 percent while the average of the actual default rates during 1979–92 is 0.50 percent. The maximum 1- and 2-year loss rates are 1.54 percent and 2.17 percent in 1985 and 1984–85, respectively. The maximum 1- and 2-year loss rates estimated by the model are 1.20 percent in 1984 and 1.85 percent in 1984–85.

VII. Sensitivity of Risk-Based Capital Requirement

The stress test is responsive to changes in the risk profile inherent in Farmer Mac's financial positions. The stress test requires higher levels of risk-based capital when Farmer Mac's risk levels increase and a lower requirement when risk levels decrease. Risk increases or decreases when Farmer Mac modifies its loan underwriting standards and/or interest rate risk exposure through various funding and hedging strategies. In addition, the mix and volume of assets and liabilities, both on- and off-balance sheet, affect risk levels as does the initial market interest rate used in the stress test. Some assets such as high quality investments, Farmer Mac II program mortgages, AgVantage, and Farmer Mac I pre-1996 Act mortgages present little or no loss exposure (lower credit risk exposure assets), while other assets such as Farmer Mac I post-1996 Act mortgages present greater levels of credit risk (higher credit risk exposure assets).

We evaluated the sensitivity of the stress test using two different initial financial positions. Financial position one is consistent with Farmer Mac's current business activities and risk profile. Financial position two is a hypothetical portrayal of Farmer Mac as a more mature business. For this scenario, we increased Farmer Mac's size, business activities, and risk profile. We specifically designed financial position two to evaluate the sensitivity of the stress test assuming additional growth in Farmer Mac program I assets. The characteristics of financial position one and two are as follows.

TABLE 1. Financial Positions Used in Performing the Sensitivity Analysis

Financial Component (in millions)	Financial Position 1	Financial Position 2
Assets	$2,566	$3,206
Liabilities	2,481	3,095
Capital	84	111
Off-Balance Sheet Assets.		
Overall Portfolio Characteristics	828	3,187
Lower Credit Risk Exposure Assets	1,931	2,133
Higher Credit Risk Exposure Assets	1,459	4,260

We used these two hypothetical financial positions as our initial starting positions. For each initial position, we calculated a ''base'' case risk-based capital requirement. We then increased or decreased Farmer Mac's risk levels by varying:

- Mortgage factors that influence loss performance (D/A ratio, LTV ratio, DSCR, loan size, and loan age);
- Interest rate risk exposure as measured by Farmer Mac in a market value framework;
- The initial interest rate environment;
- Spread relationships of interest earning assets to interest rate index used in the stress test; and
- Guarantee fee charged by Farmer Mac.

We then recalculated the risk-based capital requirement for each varied condition and compared the results to the ''base'' case. The results of this analysis follow.

A. Sensitivity to Changes in Mortgage Risk Factors

The stress test calculates increases in the risk-based capital requirement when the risk increases in Farmer Mac's mortgage portfolio of held and guaranteed loans. We found that, if Farmer Mac increases risk by loosening origination loan underwriting standards, the stress test calculates a higher capital requirement. Conversely, if Farmer Mac tightens its underwriting standards, the stress test calculates a lower capital level. As shown in the following table, the stress test consistently produces these results when mortgage characteristics are changed individually or on a combined basis.

TABLE 2.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR CHANGES IN MORTGAGE CHARACTERISTICS

Sensitivity Cases (in millions)	Risk-Based Capital Requirement	
	Financial Position 1	Financial Position 2
1. Base Case	$29.5	$43.2
2. Origination D/A Ratios Increase	38.3	65.8
3. Origination LTV Ratios Increase	37.2	63.1
4. Origination DSCR Decrease	30.3	45.3
5. Origination Loan Size Increases	65.2	141.6

TABLE 2.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR CHANGES IN MORTGAGE CHARACTERISTICS—Continued

Sensitivity Cases (in millions)	Risk-Based Capital Requirement	
	Financial Position 1	Financial Position 2
6. Increases Stated 2 to 5 Above Occur Simultaneously	109.5	266.9

The mortgage factors were increased from the base case on a loan-by-loan basis to increase risk levels in Farmer Mac's current portfolio. In each case, the increase in a mortgage factor was limited to the maximum permitted under Farmer Mac's underwriting standards or the unadjusted existing loan origination value, whichever was greater. We used the existing origination values in Farmer Mac's current portfolio as our starting point and then increased and decreased individual loan underwriting ratios to perform our sensitivity testing. The sensitivity tests are:

1. Base case;

2. D/A ratio for individual loans was increased 50 percent resulting in an increase in the portfolio-weighted average ratio to 56 percent from 37 percent;

3. LTV ratio for individual loans was increased 25 percent resulting in an increase in the portfolio-weighted average ratio to 70 percent from 56 percent with the maximum individual loan increase capped at 85 percent;

4. DSCR for individual loans was decreased 25 percent resulting in a decrease in the portfolio-weighted average ratio to 1.26 from 1.71;

5. Origination size for each loan in Farmer Mac's current portfolio was doubled resulting in an increase in the portfolio average to $956 thousand from $478 thousand with the maximum individual increase capped at $3.49 million; and

6. All increases stated in tests 2 to 5 occurring simultaneously.

Loan age affects the level of risk-based capital required by the stress test. Older loans represent lower credit risk and, therefore, reduce the risk-based capital requirement while the opposite is true for new loans. We evaluated how the capital requirement changes for an increase in loan age of 1 year. The results show a reduced risk-based capital requirement from the base case as follows:

TABLE 3.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR CHANGES IN LOAN AGE

Sensitivity Cases (in millions)	Risk-Based Capital Requirement	
	Financial Position 1	Financial Position 2
1. Base Case	$29.5	$43.2
2. Loan Age Increases by 1 year	26.9	35.8

B. Sensitivity to Changes in Interest Rate Risk Exposure and the Initial Rate Environment

The stress test requires Farmer Mac to hold more capital as it increases its interest rate risk exposure and less capital as it decreases exposure. The stress test uses Farmer Mac's market value measurement of interest rate risk to quantify the effects that changes in interest rates have on risk-based capital. Farmer Mac can change its market value exposure by varying its funding, asset holdings, and hedging strategies. We evaluated the effect on the risk-based capital requirement if Farmer Mac pursues strategies that either increase or decrease its interest risk exposure as measured by the market value methodology. For the increase in interest rate risk scenario, we assume Farmer Mac doubles its interest rate risk exposure. In this scenario, a 277 bp movement in interest rates caused the loss to capital to increase by $25.1 million compared to the base case. We also evaluated the situation where Farmer Mac's interest rate risk exposure declines 50 percent from the base case. The results of our sensitivity tests are summarized below.

TABLE 4.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR CHANGES IN INTEREST RATE RISK EXPOSURE

Sensitivity Cases (in millions)	Risk-Based Capital Requirement	
	Financial Position 1	Financial Position 2
1. Base Case	$29.5	$43.2
2. IRR Exposure Increases	54.7	74.9
3. IRR Exposure Decreases	16.9	27.3

The interest rate environment affects stress test results. When interest rates are low, the rate change used in the stress test is relatively small compared to when interest rates are high. Clearly, interest rates can change by a greater degree when they are high compared to when they are low. In addition, the large changes in interest rates expose Farmer Mac to greater risk. The stress test, therefore, requires higher risk-based capital in rate environments where interest rates are high relative to low rate environments as indicated in the following table:

Table 5.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR DIFFERENT INITIAL RATES

Sensitivity Cases (in millions)	Initial Rate (percent)	Risk-Based Capital Requirement	
		Financial Position 1	Financial Position 2
1. Base Case	5.54	$29.5	$43.2
2. Higher Initial Rate	11.08	62.6	75.8

C. Sensitivity to Changes in Spread Relationships and Guarantee Fees

The stress test requires higher risk-based capital when earnings are under pressure from a tightening in spreads on interest earning assets or a reduction in guarantee fees charged by Farmer Mac. On the other hand, the risk-based capital requirement would be lower when yield spreads widen or Farmer Mac increases its guarantee fees. The stress test incorporates earnings when calculating risk-based capital. We evaluated the sensitivity of the stress test for decreases in spreads on interest earning assets of 5 bp and 10 bp. The stress test uses current spreads (i.e., the difference in current yields and the interest rate index used in the model) to determine asset yields when interest rates are changed. Therefore, a tightening in spreads will reduce asset yields used to generate earnings. We also evaluated stress test results assuming Farmer Mac reduced guarantee fees currently charged by half. The stress test calculated a higher risk-based capital requirement under diminished earnings capacity as follows:

TABLE 6.—CHANGES IN RISK-BASED CAPITAL REQUIREMENTS FOR CHANGES IN EARNING SPREADS AND GUARANTEE FEES

Sensitivity Cases (in millions)	Risk-Based Capital Requirement	
	Financial Position 1	Financial Position 2
1. Base Case	$29.5	$43.2
2. Spread Tighten by 5 bp	31.0	44.2
3. Spread Tighten by 10 bp	33.8	45.2
4. Guarantee Fee Decrease	38.4	59.6

VIII. Impact of the Risk-Based Capital Stress Test on Farmer Mac

The impact of the stress test depends on Farmer Mac's risk profile and starting capital position. High-risk assets and unhedged interest rate risk will result in larger risk-based capital requirements. Conversely, if Farmer Mac maintains a low risk profile, the stress test will produce a low capital requirement. Given Farmer Mac's current financial position and risk profile, the proposed stress test would not require Farmer Mac to increase its capital. The risk-based capital requirement for Farmer Mac produced by the proposed stress test is below the statutory minimum and critical capital standards. Furthermore, Farmer Mac's current capital level exceeds both the statutory minimum and critical capital standards. We emphasize that this result is only based on Farmer Mac's current financial position and risk profile. If Farmer Mac accepts more risk as it grows into a mature business, the risk-based capital requirement could exceed the statutory minimum and critical capital standards as well as current capital level. In such a situation there are several options available to Farmer Mac, including:

- Issue additional stock,
- Increase guarantee fees to build earnings and capital,
- Reduce credit risk through modifications to loan underwriting standards or obtain credit enhancements,
- Mitigate interest rate risk through funding and hedging strategies.

IX. Reporting Requirements

Proposed §§ 650.25 and 650.26 outline Farmer Mac's basic responsibilities for determining its risk-based capital level and reporting the results to us. Farmer Mac must determine its risk-based capital level in accordance with the procedures in § 650.24 and the technical appendix of the subpart. Farmer Mac must at all times maintain compliance with the risk-based capital levels established by the risk-based capital stress test and must be able to determine its risk-based capital level at any time. If, at any time, the risk-based capital level computed using the risk-based capital stress test procedures is less than the minimum capital requirements set forth in section 8.33 of the Act, Farmer Mac must maintain the statutory minimum capital level.

Proposed § 650.26 requires Farmer Mac to determine its risk-based capital level at least quarterly. However, changing circumstances that may have a significant effect on capital may necessitate that Farmer Mac determine its risk-based capital level more frequently than quarterly. For example, we may require the Corporation to determine its risk-based capital level and report the results to us more frequently than quarterly if:

1. The Corporation is receiving special supervisory attention;
2. The Corporation has, or is expected to have, losses resulting in capital depletion;
3. The Corporation has significant exposure due to operational risk, the risks from concentrations of credit, certain risks arising from other products, services, or related activities, or management's overall inability to monitor and control financial risks;
4. The Corporation is exposed to a high volume of, or particularly severe, problem loans;
5. The Corporation is growing rapidly;
6. The Corporation may be adversely affected by the activities or the condition of other institutions with which it has significant business relationships or in which it has significant investments; or
7. The Corporation has significant exposure to declines in net income or in the market value of its capital due to a change in interest rates and/or the exercise of embedded or explicit options.

In addition, if Farmer Mac anticipates entering into any new business activity that could have a significant effect on capital, it must determine a pro forma risk-based capital level that includes the new business activity. Farmer Mac must provide the pro forma determination to us 10 days prior to implementation of the new business program. Proposed §§ 650.27 and 650.28 provide further instructions on how and when to report the risk-based capital level.

X. Business and Capital Plans

Well-conceived strategic and operational business and capital plans promote safety and soundness and are essential ingredients in meeting institutional objectives. The process of identifying, measuring and controlling

an institution's risks and the resulting capital requirements starts with the development of the institution's goals and objectives. Such goals and objectives should identify the direction in which an institution wants to proceed, its stated mission, business structure, and how it intends to achieve its stated goals.

We expect that any strategic and operational business and capital plans will address the long-term purpose and mission of the business. In addition, we believe that such plans should include quantifiable goals and objectives, and recognize and discuss internal and external factors that are likely to influence the future operations of the business. We also expect that the strategic planning process will include an appropriate capital adequacy plan.

Proposed § 650.22 sets forth the responsibilities of the Corporation's board to ensure that the Corporation maintains its capital at a level that is sufficient to sustain continued financial viability and provide for growth. The Board must take appropriate measures so that the Corporation's capital is not only adequate to meet formal regulatory standards, but is also sufficient to support the Corporation's business objectives and strategies. This requires the Board to set explicit goals for capitalization with respect to risk and return objectives. The capital adequacy target levels should be part of the Corporation's internal process for evaluating capital adequacy. The Board should annually review and approve the Corporation's capital adequacy target and composition of capital.

Proposed § 650.22(b) requires the Board to adopt a 3-year strategic and operational business plan. The plan must contain the elements of both a basic strategic and operational business plan as well as a capital adequacy plan. Among other items listed in proposed § 650.22(b), the capital adequacy plan must include any projected dividends, equity retirements, or other action that may decrease the Corporation's capital. The Board should also consider other relevant factors that may affect Farmer Mac's capital adequacy, such as the capability of management to measure, manage, and control risk, the development of new lines of business or Farmer Mac's continued ability to access the market at favorable rates.

XI. Supervision and Notification

Section 8.35(a) of the Act describes the various levels (I–IV) of enforcement under which the Corporation will be classified by the OSMO Director. Proposed § 650.29 establishes the regulatory procedure for the OSMO Director to notify Farmer Mac of a determination that it is not meeting the risk-based capital level calculated by the Corporation as required by § 650.23 or the minimum or critical capital requirements specified by sections 8.33 and 8.34 of the Act. Proposed § 650.29 provides for the submission of a capital restoration plan, as appropriate, when it has been determined that the Corporation is not meeting the required capital levels.

List of Subjects in 12 CFR Part 650

Agriculture, Banks, banking, Conflicts of interest, Rural areas.

For the reasons stated in the preamble, part 650 of chapter VI, title 12 of the Code of Federal Regulations is proposed to be amended to read as follows:

PART 650—FEDERAL AGRICULTURAL MORTGAGE CORPORATION

1. The authority citation for part 650 is revised to read as follows:

Authority: Secs. 4.12, 5.9, 5.17, 8.11, 8.31, 8.32, 8.33, 8.34, 8.35, 8.36, 8.37, 8.41 of the Farm Credit Act (12 U.S.C. 2183, 2243, 2252, 2279aa–11, 2279bb, 2279bb–1, 2279bb–2, 2279bb–3, 2279bb–4, 2279bb–5, 2279bb–6, 2279cc); sec. 514 of Pub. L. 102–552, 106 Stat. 4102; sec. 118 of Pub. L. 104–105, 110 Stat. 168.

2. Subpart B is added to read as follows:

Subpart B—Risk-Based Capital Requirements

Sec.

650.20 Definitions.
650.21 General.
650.22 Corporation board of directors guidelines.
650.23 Risk-based capital stress test.
650.24 Risk-based capital level.
650.25 Your responsibility for determining the risk-based capital level.
650.26 When you must determine the risk-based capital level.
650.27 When to report the risk-based capital level.
650.28 How to report your risk-based capital determination.
650.29 Failure to meet capital requirements.
650.30 Effective date for compliance with regulation.
650.31 Audit of the risk-based capital stress test.
Appendix A to Subpart B. of Part 650—Risk-Based Capital Stress Tests.

§ 650.20 Definitions.

For purposes of this subpart, the following definitions will apply:

(a) *Farmer Mac, Corporation, you, and your* means the Federal Agricultural Mortgage Corporation and its affiliates as defined in subpart A of this part.

(b) *Our, us or we* means the Farm Credit Administration.

(c) *Regulatory capital* means the sum of the following as determined in accordance with generally accepted accounting principles:

(1) The par value of outstanding common stock;

(2) The par value of outstanding preferred stock;

(3) Paid-in capital, which is the amount of owner investment in the Corporation in excess of the par value of stock;

(4) Retained earnings; and

(5) Any allowances for losses on loans and guaranteed securities.

(d) *Risk-based capital* means the amount of regulatory capital sufficient for the Corporation to maintain positive capital during a 10-year period of stressful conditions as determined by the risk-based capital stress test described in § 650.23.

§ 650.21 General.

You must hold risk-based capital in an amount determined in accordance with this subpart.

§ 650.22 Corporation board of directors guidelines.

(a) Your board of directors is responsible for ensuring that you maintain total capital at a level that is sufficient to ensure continued financial viability and provide for growth. In addition, your capital must be sufficient to meet statutory and regulatory requirements.

(b) No later than 30 days after the beginning of each calendar year, your board of directors must adopt an operational and strategic business plan for at least the next 3 years. The plan must include:

(1) A mission statement;

(2) A review of the internal and external factors that are likely to affect you during the planning period;

(3) Measurable goals and objectives;

(4) Pro forma financial statements for each year of the plan;

(5) A detailed operating budget for the first year of the plan; and,

(6) A capital adequacy plan.

(c) The capital adequacy plan must include capital targets necessary to achieve the minimum, critical and risk-based capital standards specified by the Act and this subpart as well as your capital adequacy goals. The plan must address any projected dividends, equity retirements, or other action that may decrease your capital or its components for which minimum amounts are required by this subpart. You must specify in your plan the circumstances in which stock or equities may be retired. In addition to factors that must be considered in meeting the statutory

and regulatory capital standards, your board of directors must also consider at least the following factors in developing the capital adequacy plan:

(1) Capability of management;

(2) Strategies and objectives in your business plan;

(3) Quality of operating policies, procedures, and internal controls;

(4) Quality and quantity of earnings;

(5) Asset quality and the adequacy of the allowance for losses to absorb potential losses in your retained mortgage portfolio, securities guaranteed as to principal and interest, commitments to purchase mortgages or securities, and other program assets or obligations;

(6) Sufficiency of liquidity and the quality of investments; and

(7) Any other risk-oriented activities, such as funding and interest rate risks, contingent and off-balance sheet liabilities, or other conditions warranting additional capital.

§ 650.23 Risk-based capital stress test.

You will perform the risk-based capital stress test as described in summary form below and as described in detail in appendix A to this subpart. The risk-based capital stress test spreadsheet is also available electronically at www.fca.gov. The risk-based capital stress test has five components:

(a) *Data requirements.* You will use the following data to implement the risk-based capital stress test.

(1) You will use Corporation loan-level data to estimate the credit risk component of the risk-based capital stress test.

(2) You will use Call Report data as the basis for Corporation data over the 10-year stress period supplemented with your interest rate risk measurements and tax data.

(3) You will use other data, including the 10-year Constant Maturity Treasury (CMT) and the applicable Internal Revenue Service corporate income tax schedule, as further described in the technical appendix.

(b) *Credit risk.* The credit risk part estimates loan losses during a period of sustained economic stress.

(1) For each loan in the Farmer Mac I portfolio, you will determine a default probability by using the logit functions specified in appendix A to this subpart with each of the following variables:

(i) Borrower's debt-to-asset ratio at loan origination;

(ii) Loan-to-value ratio at origination, which is the loan amount divided by the value of the property;

(iii) Debt-service-coverage ratio at origination, which is the borrower's net income (on- and off-farm) plus depreciation, capital lease payments, and interest, less living expenses and income taxes, divided by the total term debt payments;

(iv) The origination loan balance stated in 1997 dollars based on the consumer price index; and

(v) The worst-case percentage change in farmland values (23.52 percent).

(2) You will then calculate the loss rate by multiplying the default probability for each loan by the estimated loss severity rate, which is the average loss of the defaulted loans in the data set (20.9 percent).

(3) You will calculate losses by multiplying the loss rate by the origination loan balances stated in 1997 dollars.

(4) You will adjust the losses for loan seasoning, based on the number of years since loan origination, according to the functions in appendix A to this subpart.

(5) The losses must be applied in the risk-based capital stress test as specified in appendix A to this subpart.

(c) *Interest rate risk.* (1) During the first year of the stress period, you will adjust interest rates for two scenarios, an increase in rates and a decrease in rates. You must determine your risk-based capital level based on whichever scenario would require more capital.

(2) You will calculate the interest rate stress based on changes to the quarterly average of the 10-year CMT. The starting rate is the 3-month average of the most recent CMT monthly rate series. To calculate the change in the starting rate, determine the average yield of the preceding 12 monthly 10-year CMT rates. Then increase and decrease the starting rate by:

(i) 50 percent of the 12-month average if the average rate is less than 12 percent; or

(ii) 600 bp if the 12-month average rate is equal to or higher than 12 percent.

(3) Following the first year of the stress period, interest rates remain at the new level for the remainder of the stress period.

(4) You will apply the interest rate changes scenario as indicated in appendix A to this subpart.

(5) You may use other interest rate indices in addition to the 10-year CMT subject to our concurrence, but in no event can your risk-based capital level be less than that determined by using only the 10-year CMT.

(d) *Cashflow generator.* (1) You must adjust your financial statements based on the credit risk inputs and interest rate risk inputs described above to generate pro forma financial statements for each year of the 10-year stress test. The cashflow generator produces these financial statements. You may use the cashflow generator spreadsheet that is described in the technical appendix to this subpart and available electronically at www.fca.gov. You may also use any reliable program that can develop or produce *pro forma* financial statements using generally accepted accounting principles and widely recognized financial modeling methods, subject to our concurrence. You may disaggregate financial data to any greater degree than that specified in appendix A to this subpart, subject to our concurrence.

(2) You must use model assumptions to generate financial statements over the 10-year stress period. The major assumption is that cashflows generated by the risk-based capital stress test are based on a steady state scenario. To implement a steady state scenario, when on- and off-balance sheet assets and liabilities amortize or are paid down, you must replace them with similar assets and liabilities. Replace amortized assets from discontinued loan programs with current loan programs. In general, keep assets with small balances in constant proportions to key program assets.

(3) You must simulate annual pro forma balance sheets and income statements in the risk-based capital stress test using the Corporation's starting position, the credit risk and interest rate risk components, resulting cashflow outputs, current operating strategies and policies, and other inputs as shown in appendix A to this subpart and the electronic spreadsheet available at www.fca.gov.

(e) *Calculation of capital requirement.* The calculations that you must use to solve for the starting regulatory capital amount are shown in appendix A to this subpart and in the electronic spreadsheet available at www.fca.gov.

§ 650.24 Risk-based capital level.

The risk-based capital level is the sum of the following amounts:

(a) *Credit and interest rate risk.* The amount of risk-based capital determined by the risk-based capital test under § 650.23.

(b) *Management and operations risk.* Thirty (30) percent of the amount of risk-based capital determined by the risk-based capital test in § 650.23.

§ 650.25 Your responsibility for determining the risk-based capital level.

(a) You must determine your risk-based capital level using the procedures in this subpart, appendix A to this subpart, and any other supplemental instructions provided by us. You will report your determination to us as

prescribed in § 650.28. At any time, however, we may determine your risk-based capital level using the procedures in § 650.23 and appendix A to this subpart, and you must hold risk-based capital in the amount we determine is appropriate.

(b) You must at all times comply with the risk-based capital levels established by the risk-based capital stress test and must be able to determine your risk-based capital level at any time.

(c) If at any time, the risk-based capital level you determine is less than the minimum capital requirements set forth in section 8.33 of the Act, you must maintain the statutory minimum capital level.

§ 650.26 When you must determine the risk-based capital level.

(a) You must determine your risk-based capital level at least quarterly or whenever changing circumstances occur that have a significant effect on capital, such as exposure to a high volume of or particularly severe, problem loans or a period of rapid growth.

(b) In addition to the requirements of paragraph (a) of this section, we may require you to determine your risk-based capital level at any time.

(c) If you anticipate entering into any new business activity that could have a significant effect on capital, you must determine a pro forma risk-based capital level, which must include the new business activity, and report this pro forma determination to the Director, Office of Secondary Market Oversight, at least 10 business days prior to implementation of the new business program.

§ 650.27 When to report the risk-based capital level.

(a) You must file a risk-based capital report with us each time you determine your risk-based capital level as required by § 650.26.

(b) You must also report to us at once if you identify in the interim between quarterly or more frequent reports to us that you are not in compliance with the risk-based capital level required by § 650.24.

(c) If you make any changes to the data used to calculate your risk-based capital requirement that causes a material adjustment to the risk-based capital level you reported to us, you must file an amended risk-based capital report with us within 5 business days after the date of such changes;

(d) You must submit your quarterly risk-based capital report for the last day of the preceding quarter not later than the last business day of April, July, October, and January of each year.

§ 650.28 How to report your risk-based capital determination.

(a) Your risk-based capital report must contain at least the following information:

(1) All data integral for determining the risk-based capital level, including any business policy decisions or other assumptions made in implementing the risk-based capital test;

(2) Other information necessary to determine compliance with the procedures for determining risk-based capital as specified in appendix A to this subpart; and,

(3) Any other information we may require in written instructions to you.

(b) You must submit each risk-based capital report in such format or media as we require.

§ 650.29 Failure to meet capital requirements.

(a) *Determination and notice.* At any time, we may determine that you are not meeting your risk-based capital level calculated according to § 650.23, your minimum capital requirements specified in section 8.33 of the Act or your critical capital requirements specified in section 8.34 of the Act. We will notify you in writing of this fact and the date by which you should be in compliance (if applicable).

(b) *Submission of capital restoration plan.* Our determination that you are not meeting your required capital levels may require you to develop and submit to us, within a specified time period, an acceptable plan to reach the appropriate capital level(s) by the date required.

§ 650.30 Effective date for compliance with regulation.

For the 12-month period beginning on the effective date of this regulation, you must determine a risk-based capital level by implementing the risk-based capital stress test as described in § 650.23 and appendix A to this subpart, and must report the results to us as described in § 650.28. During this 12-month period, you will not be required to maintain capital at the risk-based capital level, but you must maintain your minimum capital level as prescribed in section 8.33 of the Act. Beginning on the day following the 12-month period, you must comply with all provisions of this subpart.

§ 650.31 Audit of the risk-based capital stress test.

You must have a qualified, independent external auditor review your implementation of the risk-based capital stress test every 3 years and submit a copy of the auditor's opinion to us.

Appendix A to Subpart B of Part 650—Risk-Based Capital Stress Tests

1.0 Introduction.
2.0 Credit Risk.
2.1 Loss Frequency and Severity Models.
2.2 Loan Seasoning Adjustment.
2.3 Example Calculation of Dollar Loss on One Loan.
2.4 Treatment of Long-term Standby Purchase Commitments.
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3.0 Interest Rate Risk.
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4.0 Elements Used in Generating Cashflows.
4.1 Data Inputs.
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4.4 Loan and Cashflow Accounts.
4.5 Income Statements.
4.6 Balance Sheets.
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5.0 Capital Calculations.
5.1 Method of Calculation.

1.0 Introduction

a. This technical appendix provides details about the risk-based capital stress test (stress test) for Farmer Mac. The stress test is a deterministic portrayal of Farmer Mac's annual capital needs for 10 years. The stress test calculates the risk-based capital level required by statute under stipulated conditions of credit risk and interest rate risk. The stress test uses loan-level data from Farmer Mac's agricultural mortgage portfolio, as well as quarterly Call Report and related information to generate pro forma financial statements and calculate a risk-based capital requirement. The stress test also uses historic agricultural real estate mortgage performance data, relevant economic variables, and other inputs in its calculations.

b. The key components of the stress test include the specifications of credit risk, interest rate risk, the cashflow generator, and the capital calculation. Linkages among the components ensure that the measures of credit and interest rate risk pass into the cashflow generator. The linkages also transfer cashflows through the financial statements to represent values of assets, liabilities, and equity capital. We designed the 10-year projection to reflect a steady state in the scope and composition of Farmer Mac's assets. This technical appendix provides details about the credit risk, interest rate risk, cashflow generator, and capital components of the stress test.

2.0 Credit Risk

Computing credit risk requires loan loss rates. We determined loan loss rates by applying loss frequency and severity equations to Farmer Mac loan-level data. From these equations, we calculated loan losses under stressful economic conditions and loss rates assuming Farmer Mac's portfolio remains at a ''steady state.'' Steady state assumes the underlying characteristics and, therefore, risks of Farmer Mac's

portfolio remain constant over the 10 years of the stress test. From estimated dollar losses, we computed loss rates for use in the stress test. The loan volume subject to loss throughout the stress test is then multiplied by the loss rate. Lastly, the stress test allocates losses to each of the 10 years assuming a time pattern for loss occurrence as discussed in section 4.3 of this appendix entitled *Risk Measures.*

2.1 Loss Frequency and Severity Models

a. We modeled credit risk using historical time series loan-level data to measure the frequency and severity of losses on agricultural mortgage loans. The model relates frequency and severity to loan-level characteristics and economic conditions through appropriately specified regression equations in order to account explicitly for the collective effects of these characteristics on loan losses. We can then estimate loan losses for Farmer Mac with the resulting regression equations by substituting the respective values of Farmer Mac's loan-level data and using a stressful economic input.

b. The loss frequency and severity equations were estimated from historical agricultural real estate mortgage loan data from the Farm Credit Bank of Texas (FCBT). To estimate the equations, the data used included FCBT loans if they satisfied at least three of four underwriting standards Farmer Mac currently uses (estimation data). The final estimated equation for loss frequency is:

$$\log\left(\frac{p}{1-p}\right) = -9.7267 + 2.7337\ X_1 - 0.3138\ X_2 - 0.1822\ X_3 + 0.0000008222\ X_4 + 2.3229\ X_5$$

Where:

- p is the probability that a loan defaults and has positive losses (Pr (Y=1|x)),
- X_1 is the loan-to-value ratio (LTV) at loan origination raised to the power 5.38027,[1]
- X_2 is the annual percentage decline in farmland values during the life of the loan discounted by 4.8 percent per year, [2]
- X_3 is the DSCR at loan origination,
- X_4 is the origination loan balance stated in 1997 dollars based on the consumer price index, and
- X_5 is the debt-to-asset ratio (D/A) at loan origination.

c. When applying the equation to Farmer Mac's portfolio, you must get the input values for X_1, X_3, X_4, and X_5 for each loan on the stress test run date. For the variable X_2, the stressful input value from the benchmark loss experience is −23.52 percent. You must apply this input to all Farmer Mac loans subject to loss to calculate loss frequency under stressful economic conditions.[3] The maximum land value decline stressed input from the benchmark loss experience is the simple average of annual land value changes for Iowa, Illinois, and Minnesota for the years 1984 and 1985.

d. The loss frequency (default) equation is non-linear and, therefore, using inputs outside the estimation data requires special treatment to implement the non-linear nature of the equation. While the estimation data embody Farmer Mac values for various loan characteristics, the maximum farmland price decline experienced in Texas was 16.69 percent, far below the benchmark experience of 23.52 percent. Applying the more severe benchmark loss experience to the increasing non-linear loss frequency equation could result in unreasonably large loss rates. The rates could get too large if the actual relationship between loss rates and land value declines is lower than calculated from the estimation data. To account for this effect you must apply a procedure that restricts the slope of all the independent variables to that observed at the maximum land value decline observed in the estimation data. Essentially, you must approximate the slope of each variable and use the measurement to adjust the probability of loan default and loss occurrence to reflect the more severe benchmark land value change. The adjustment procedure is shown in step 4 of section 2.3 of this appendix entitled *Example Calculation of Dollar Loss on One Loan.*

e. Loss severity is a weighted average rate of 20.9 percent where the weight is loss volume.[4] You must multiply loss severity with the probability estimate computed from the loss frequency equation to determine the origination loss rate for a loan.

f. Using origination data results in estimated probabilities of loss frequency over the life of a loan. To account for loan seasoning, you must apply the loan seasoning distribution and subtract the cumulative distribution of loss exposure already experienced by each loan as discussed in section 2.3 of this appendix entitled *Loan Seasoning Adjustment.* This subtraction is based on loan age and reduces the loss estimated by the loss frequency and severity equations. The result is an age-adjusted dollar loss that can be used in subsequent calculations of loss rates as discussed in section 2.5 of this appendix entitled *Calculation of Loss Rates for Use in the Stress Test.*

2.2 Loan Seasoning Adjustment

a. You must use the seasoning distribution to adjust each Farmer Mac loan for the cumulative loss exposure already experienced based on age. The estimated seasoning distribution for a 14-year average loan life and estimated values of p = 5.0875 and q = 13.6376 is: [5]

Year	Proportion of loss (percent)
1	0.58
2	8.30
3	21.98
4	27.56
5	21.99
6	12.45
7	5.18
8	1.57
9	0.33
10	0.05
11	0.00
12	0.00
13	0.00
14	0.00

b. How you must use the loan seasoning distribution is shown in step 7 of section 2.3 of this appendix entitled *Example Calculation of Dollar Loss on One Loan.*

2.3 Example Calculation of Dollar Loss on One Loan

Following is an example of how to calculate the loss for an individual loan that has the following independent characteristics and input values: [6]

Loan Origination Year	1996
Loan Origination Balance	$1,250,000
LTV at Origination	0.5
D/A at Origination	0.5
DSCR at Origination	1.3984
Maximum Percentage Land Price Decline (MAX	−23.52

Step 1: Convert 1996 Origination Value to 1997 dollar value (LOAN) based on the consumer price index as follows: $1,278,750 = $1,250,000 • 1.023

[1] To test and implement the non-linear relationship between loss probability and LTV, the model was first estimated with 8 dummy variables at LTV intervals of 0 to 0.399, 0.400 to 0.499, 0.500 to 0.599, 0.650 to 0.699, 0.700 to 0.749, 0.750 to 0.799 and 0.800 to 0.850. Using generalized least squares, a power function of LTV 5.38027 was fit to replace the individual dummy variables, and the equation was re-estimated. The power function increases the degrees of freedom for the model and provides a continuous relationship between LTV and defaults.

[2] We determined the 4.8 percent by iteratively solving the default equation using dummy variables ranging from 0 percent to 10 percent. The 4.8-percent rate yielded the highest goodness-of-fit values.

[3] On- and off-balance sheet Farmer Mac I agricultural mortgage program assets booked after the 1996 amendments are subject to the loss calculation.

[4] We calculated the weighted average severity from the estimation data.

[5] We estimated the loan seasoning distribution from portfolio aggregate charge-off rates from the estimation data. To do so, we arrayed all defaulting loans where loss occurred according to the time from origination to default. Then, a beta distribution, β(p, q), was fit to the estimation data scaled to the maximum time a loan survived (14 years).

[6] In the example calculations, we rounded numbers. However, the stress test does not use rounded numbers.

Step 2: Calculate the default probabilities using −16.69 percent and −16.79 percent land value declines as follows:[7]

Where,

$$Z_1 = -9.7267 + 2.7337 \cdot LTV^{5.38027} - 0.3138 \cdot -16.69 - 0.1822 \cdot DSCR + 8.222e-7 \cdot LOAN + 2.3229 \cdot DA = -2.466$$

$$\text{Default probability @–16.69\%} = \frac{1}{1+\exp^{-(-2.466)}} = 0.078276$$

And

$$Z_2 = -9.7267 + 2.7337 \cdot LTV^{5.38027} - 0.3138 \cdot -16.79 - \text{Default probability @–16.79\%} = \frac{1}{1+\exp^{-(-2.434)}} = 0.080616$$

$$0.1822 \cdot DSCR + 8.222e-7 \cdot LOAN + 2.3229 \cdot DA = -2.434$$

Step 3: Calculate the slope adjustment. You must calculate slope by subtracting the difference between ''Default Probability @ −16.69 percent'' and ''Default Probability @ −16.79 percent'' and dividing by −0.1 (the difference between −16.69 percent and −16.79 percent) as follows:

$$0.02340 = \frac{0.078276 - 0.080616}{-0.1}$$

Step 4: Make the linear adjustment. You make the adjustment by increasing the ''default probability @ −16.69 percent'' computed in Step 2 to reflect the stressed farmland value input, appropriately discounted. As discussed previously, the stressed land value input is discounted to reflect the declining effect that the maximum land value decline has on the probability of default when it occurs later in a loan's life.[8] The linear adjustment is the difference between the −16.69 percent land value decline and the adjusted stressed maximum land value decline input of −23.52 multiplied by the slope estimated in Step 3 as follows:

Discounted Maximum Land Price Decline = −19.50 = (−23.52)(1.048)−[4]

Slope Adjustment = 0.06575 = 0.02340 ÷(−16.69—−19.50)

Loan Default Probability = 0.144026 = 0.078276 + 0.06575

Step 5: Multiply loan default probability times the average severity of 0.209 as follows:

0.03010 = 0.144026 ÷ 0.209

Step 6: Multiply the loss rate times the origination loan balance as follows:

$37,625=$1,250,000×0.03010

Step 7: Adjust the dollar losses for 4 years of loan seasoning as follows:

$15,644=$37,625−($37,625×0.584215)

b. The loan seasoning adjustment factor is obtained from the beta distribution, previously discussed, for the age of the loan, where age is determined from loan origination to the run date of the test.

2.4 Treatment of Long-term Standby Purchase Commitments.

a. The default equation cannot directly compute the loss exposure on loans covered by a long-term standby purchase commitment (standbys) because complete origination underwriting standards for these loans are unavailable. Instead, the loss rate applied to each standby loan is the respective state-level loss rate unadjusted for loan seasoning. You must calculate state-level loss rates from non-standby loans as total dollar loan losses before the loan seasoning adjustment divided by total origination loan balances. Then you must multiply the origination loan balance of each standby loan by the appropriate loss rate to calculate estimated dollar losses. You must now adjust the resulting standby loan-level dollar losses adjusted for loan seasoning as was done for non-standby loans. For example, consider a $1,000,000 standby loan originated in Idaho in 1990. And, suppose the unadjusted loss rate for Idaho is 3 percent. The loss for this loan is:

($1,000,000 × 0.03) = $30,000.

The loan is 7 years old, thus the estimated age-adjusted loss rate is:

Estimated standby loan loss=$30,000*(0.02)=$600. As previously noted, the loan seasoning adjustment factor is obtained from the beta distribution for the age of the loan, where age is determined from loan origination to the run date of the test.

c. This treatment may not be used for loans that exhibit risk characteristics that, at the time Farmer Mac makes the commitment, disqualify the loan from being placed in the lowest risk category of the internal credit classification systems of both guarantor and guarantee. In the credit component of the stress test, such loans must be treated in the same manner as a new loan in any standard Farmer Mac I program. Thus, the risk characteristics of the loan at the time Farmer Mac enters into the standby commitment are treated as loan origination characteristics for calculating credit losses.

2.5 Calculation of Loss Rates for Use in the Stress Test.

a. You must compute loss rates by state (based on Farmer Mac's loan portfolio distribution) after you calculate dollar loan losses for each loan subject to loss in Farmer Mac's portfolio. The estimated origination year lifetime losses adjusted for loan seasoning for non-standby loans are computed as total dollar loan losses divided by total origination loan balances for each state. Similarly, you must calculate the estimated origination year lifetime losses adjusted for loan seasoning for standby loans. This calculation is total dollar loan losses divided by total scheduled current loan balances for each state. You must then blend the resulting state-level loss rates for non-standby and standby loans by calculating the weighted average loss rate for each state. For instance, the state-level loss rates you would calculate on Farmer Mac's current loan portfolio are:

[7] This process facilitates the approximation of slope needed to adjust the loss probabilities for land value declines greater than observed in the estimation data.

[8] The discount period is the number of years from the beginning of the origination year to the current year (*i.e.*, January 1, 1996 to January 1, 2000, is 4 years).

	Non-standby loans (percent)	Standby loans (percent)	Blended rate for stress test use (percent)
All States	3.24	0.14	2.42
Alaska	3.24	0.00	0.00
Alabama	4.58	0.14	4.58
Arkansas	1.97	0.14	1.97
Arizona	2.32	0.14	1.68
California	3.89	0.33	3.83
Colorado	2.78	0.14	2.78
Connecticut	3.24	0.14	2.42
Delaware	1.90	0.14	1.90
Florida	1.46	0.00	1.42
Georgia	3.78	0.14	3.78
Hawaii	3.24	0.44	0.44
Iowa	3.81	0.14	3.81
Idaho	2.88	0.12	1.57
Illinois	3.95	0.31	3.86
Indiana	3.31	0.14	3.31
Kansas	1.92	0.00	1.92
Kentucky	1.46	0.14	1.46
Louisiana	2.06	0.14	2.06
Massachusetts	3.24	0.14	2.42
Maryland	1.40	0.14	1.40
Maine	3.24	0.00	0.00
Michigan	2.42	0.00	2.41
Minnesota	2.46	0.00	2.46
Missouri	2.96	0.14	2.96
Mississippi	3.62	0.14	3.62
Montana	2.09	0.10	0.82
North Carolina	2.31	0.00	2.12
North Dakota	2.04	0.14	2.04
Nebraska	1.89	0.14	1.89
New Hampshire	3.24	0.14	2.42
New Jersey	3.24	0.81	0.81
New Mexico	3.79	0.00	3.73
Nevada	4.74	0.00	4.62
New York	1.17	0.33	1.06
Ohio	2.05	0.14	2.05
Oklahoma	2.13	0.14	2.13
Oregon	2.84	0.15	1.13
Pennsylvania	3.24	0.14	2.42
Rhode Island	3.24	0.14	2.42
South Carolina	3.24	0.14	2.42
South Dakota	1.49	0.14	1.49
Tennessee	1.25	0.14	1.25
Texas	4.53	0.71	4.51
Utah	2.39	0.39	2.29
Virginia	3.55	0.29	2.40
Vermont	3.24	0.14	2.42
Washington	2.93	0.13	1.65
Wisconsin	6.72	0.14	6.72
West Virginia	3.24	0.14	2.42
Wyoming	2.61	0.00	2.48

b. How the stress test uses the blended loss rates is discussed in section 4.3 of this appendix entitled *Risk Measures.*

3.0 Interest Rate Risk.

The stress test explicitly accounts for Farmer Mac's vulnerability to interest rate risk from the movement in interest rates specified in the statute. The stress test considers Farmer Mac's interest rate risk position through the current structure of its balance sheet, reported interest rate risk shock-test results,[9] and other financial activities. The stress test calculates the effect of interest rate risk exposure through market value changes of interest-bearing assets and liabilities, and thus equity capital. The stress test also captures this exposure through the cashflows on rate-sensitive assets and liabilities. We discuss how to calculate the dollar impact of interest rate risk in section 4.0 of this appendix entitled *Elements Used in Generating Cashflows.*

3.1 Process for Calculating the Interest Rate Movement.

a. The stress test uses the 10-year Constant Maturity Treasury (10-year CMT) released by the Federal Reserve in their publication HR. 15 *Selected Interest Rates,* which is available on their website at www.frb.gov. The stress test uses the 10-year CMT to generate earnings yields on assets, expense rates on liabilities, and changes in the market value of assets and liabilities. For stress test purposes, the starting rate for the 10-year CMT is the 3-month average of the most recent monthly rate series published by the Federal Reserve and available through their website. The 3-month average is calculated by summing the monthly series of the 10-year CMT and dividing by 3. For instance, you would calculate the initial rate on June 30, 1999, as:

Month end	10-year CMT monthly series
04/1999	5.18

[9] See paragraph c of section 4.1 of this appendix entitled *Data Inputs* for a description of the IRR shock-reporting requirement.

Month end	10-year CMT monthly series
05/1999	5.54
06/1999	5.90
Average	5.54

b. The amount by which the stress test shocks the initial rate up and down is determined by calculating the 12-month average of the 10-year CMT monthly series. If the resulting average is less than 12 percent, the stress test shocks the initial rate by an amount determined by multiplying the 12-month average rate by 50 percent. However, if the average is greater than or equal to 12 percent, the stress test shocks the initial rate by 600 bp. For example, you would determine the amount by which to increase and decrease the initial rate for June 30, 1999 as:

Month End	10-year CMT Monthly Series
07/1998	5.46
08/1998	5.34
09/1998	4.81
10/1998	4.53
11/1998	4.83
12/1998	4.65
01/1999	4.72
02/1999	5.00
03/1999	5.23
04/1999	5.18
05/1999	5.54
06/1999	5.90
12-Month Average	5.10

Calculation of Shock Amount:

12-month Average Less than 12%: Yes
12-month Average: 5.10
Multiply the 12-month Average by: 50%
Shock in bp Equals 255

c. You must run the stress test for two separate changes in interest rates, an immediate increase in the initial rate by the shock amount and an immediate decrease in the initial rate by the shock amount. The stress test holds the changed interest rate constant for the entire 10-year stress period. For example, at June 30, 1999, you would run the stress test for an immediate and sustained (for 10 years) upward movement in interest rates to 8.09 percent (5.54 percent plus 255 bp). You would also run the stress test for an immediate and sustained (for 10 years) downward movement in interest rates to 2.99 percent (5.54 percent minus 255 bp). The movement in interest rates that results in the greatest need for capital is used to determine Farmer Mac's risk-based capital requirement.

4.0 Elements Used in Generating Cashflows.

a. This section describes the elements that are required for implementation of the stress test and assessment of Farmer Mac capital performance through time. An Excel spreadsheet named FAMC RBCST, available at www.fca.gov contains the stress test, including the cashflow generator. The spreadsheet contains the following seven worksheets:

(1) Data Input;
(2) Assumptions and Relationships;
(3) Risk Measures (credit risk and interest rate risk);
(4) Loan and Cashflow Accounts;
(5) Income Statements;
(6) Balance Sheets; and
(7) Capital.

b. Each of the components is described in further detail below with references where appropriate to the specific worksheets within the Excel spreadsheet. The stress test may be generally described as a set of linked financial statements that evolve over a period of 10 years using generally accepted accounting conventions and specified sets of stressed inputs. The stress test uses the initial financial condition of Farmer Mac, including earnings and funding relationships, and the credit and interest rate stress inputs to calculate Farmer Mac capital performance through time. The stress test then subjects these to the first period set of stresses, generates cashflows by asset and liability category, performs necessary accounting postings into relevant accounts, and then generates an income statement associated with the first interval of time. The stress test then uses the income statement to update the balance sheet for the end of period 1 (beginning of period 2). All necessary capital calculations for that point in time are then performed.

c. The beginning of the period 2 balance sheet then serves as the departure point for the second income cycle. The second period's cashflows and resulting income statement are generated in similar fashion as the first period's except all inputs (i.e., the periodic loan losses, portfolio balance by category, and liability balances) are updated appropriately to reflect conditions at that point in time. The process evolves forward for a period of 10 years with each pair of balance sheets linked by an intervening set of cashflow and income statements. In this and the following sections, additional details are provided about the specification of the income-generating model to be used by Farmer Mac in calculating the risk-based capital requirement.

4.1 Data Inputs.

The stress test requires the initial financial statement conditions and income-generating relationships for Farmer Mac. The worksheet named ''Data Inputs'' contains the complete data inputs and the sample data form used in the stress test. The stress test uses these data and various assumptions to calculate pro forma financial statements. For stress test purposes, Farmer Mac is required to supply:

a. *Call Report Schedules RC: Balance Sheet and RI: Income Statement.* These schedules form the starting financial position for the stress test. In addition, the stress test calculates basic financial relationships and assumptions used in generating pro forma annual financial statements over the 10-year stress period. Financial relationships and assumptions are in section 4.2 of this appendix entitled Assumptions and Relationships.

b. *Cashflow data for asset and liability account categories.* The necessary cashflow data for the spreadsheet-based stress test are book value, weighted average yield, weighted average maturity, conditional prepayment rate, weighted average amortization, and weighted average guarantee fees. The spreadsheet uses this cashflow information to generate starting and ending account balances, interest earnings, guarantee fees, and interest expense. Each asset and liability account category identified in this data requirement is discussed in section 4.2 of this appendix entitled *Assumptions and Relationships.*

c. *Interest rate risk measurement results.* The stress test uses the results from Farmer Mac's interest rate risk model to represent changes in the market value of assets, liabilities, and equity for upward and downward instantaneous movement in interest rates of 300, 250, 200, 150, and 100, bp. The stress test uses the estimated effective duration to calculate the market value effects from a change in interest rates. The stress test uses the duration information to construct a linear interpolated schedule relating a change in interest rates to a change in the market value of assets and liabilities. This calculation is described in section 4.4 of this appendix entitled Loan and Cashflow Accounts.

d. *Loan-level data for all Farmer Mac I program assets.* (1) The stress test requires loan-level data for all Farmer Mac I program assets to determine age-adjusted origination year loss rates. The specific loan data fields required for running the credit risk component are:

All other Farmer Mac I program loans	Long-term standby commitments
Loan Number	Loan Number.
Ending Scheduled Balance	Current Month Actual Balance.
Group	Group.
Pre/Post Act	Pre/Post Act.
Property State	Property State.
Product Type	Product Type.
Origination Date	Note Date.
Origination Loan Balance	Origination Loan Balance.
Origination Scheduled P&I	Cutoff Scheduled P&I.

All other Farmer Mac I program loans	Long-term standby commitments
Origination Appraised Value	Most Recent Appraised Value.
Loan-to-Value Ratio	Loan-To-Value Ratio.
Current Assets	Current Assets.
Current Liabilities	Current Liabilities.
Total Assets	Total Assets.
Total Liabilities	Total Liabilities.
Gross Farm Revenue	Gross Farm Revenue.
Net Farm Income	Net Farm Income.
Depreciation	Depreciation.
Interest on Capital Debt	Interest On Capital Debt.
Capital Lease Payments	Capital Lease Payments.
Living Expenses	Living Expenses.
Income & FICA Taxes	Income & FICA Taxes.
Net Off-Farm Income	Net Off-Farm Income.
Total Debt Service	Total Debt Service.
Guarantee Fee	Commitment Fee Rate.
Seasoned Loan	Seasoned Loan.

(2) From the loan-level data, you must identify the geographic distribution by state of Farmer Mac's loan portfolio and enter the current loan balance for each state in the ''Data Inputs'' worksheet. We discussed previously how to calculate age-adjusted origination year loss rates in section 2.0 of this appendix entitled *Credit Risk.* The age-adjusted origination year loss rates, blended across standby and non-standby program assets are entered in the ''Risk Measures'' worksheet of the stress test. In addition, we discuss how the stress test applies loss rates in section 4.3 of this appendix entitled *Risk Measures.*

e. *Other data requirements.* Other data elements are taxes paid over the previous 2 years, the corporate tax schedule, and 10-year CMT information as discussed in section 3.1 of this appendix entitled *Process for Calculating the Interest Rate Movement.* The stress test uses the corporate tax schedule and previous taxes paid to determine the appropriate amount of taxes, including loss carry-backs and loss carry-forwards.

4.2 Assumptions and Relationships.

a. The stress test assumptions are summarized on the worksheet called ''Assumptions and Relationships.'' Some of the entries on this page are direct user entries. Other entries are relationships generated from data supplied by Farmer Mac or other sources as discussed in section 4.1 of this appendix entitled Data Inputs. After current financial data are entered, the user selects the date for running the stress test. This action causes the stress test to identify and select the appropriate data from the ''Data Input'' worksheet. The next section highlights the degree of disaggregation needed to maintain reasonably representative characterizations of Farmer Mac in the stress test. Several specific assumptions are established about the future relationships of account balances, how they evolve, and at what magnitude.

b. From the data and assumptions, the stress test computes pro forma financial statements for 10 years. The stress test will be run as a ''steady state'' with regard to program balances, and where possible, will use information gleaned from recent financial statement and other data supplied by Farmer Mac to establish earnings and cost relationships on major program assets that are applied forward in time. As documented in the stress test, entries of ''1'' imply no growth and/or no change in account balances or proportions relative to initial conditions. The interest rate risk and credit loss components are applied to the stress test through time. The individual sections of that worksheet are:

(1) *Elements related to cashflows, earnings rates, and disposition of discontinued program assets.* (A) The stress test accounts for earnings rates by asset class and cost rates on funding. The level of detail is such that it should be easy to understand the contributions of costs and revenues by the major program activities of Farmer Mac. The stress test aggregates investments into the categories of: Cash and money market securities; commercial paper; certificates of deposit; agency mortgage-backed securities and collateralized mortgage obligations; and other investments. With our concurrence, Farmer Mac is permitted to further disaggregate these categories. Similarly, we may require new categories for future activities. Loan items requiring separate accounts include the following:

(i) Farmer Mac I program assets post-1996 Act;

(ii) Farmer Mac I program assets post-1996 Act Swap balances;

(iii) Farmer Mac I program assets pre-1996 Act;

(iv) Farmer Mac I AgVantage securities;

(v) Loans held for securitization; and

(vi) Farmer Mac II program assets.

(B) The stress test also uses data elements related to amortization and prepayment experience to calculate and process the implied rates at which asset and liability balances terminate or ''roll off'' through time. Further, for each category, the stress test has the capacity to track account balances that are expected to change through time for each of the above categories. For purposes of the stress test, all assets are assumed to maintain a ''steady state'' with the implication that any principal balances retired or prepaid are replaced with new balances. The exceptions are that expiring pre-1996 Act program assets are replaced with post-1996 Act assets.

(2) *Elements related to other balance sheet assumptions through time.* As well as interest earning assets, the other categories of the balance sheet that are modeled through time include interest receivable, guarantee fees receivable, prepaid expenses, accrued interest payable, accounts payable, accrued expenses, reserves for losses (loans held and guaranteed securities), and other off-balance sheet obligations. The stress test is consistent with Farmer Mac's existing reporting categories and practices. If reporting practices change substantially, the above list would be adjusted accordingly. The stress test has the capacity to have the balances in each of these accounts determined based on existing relationships to other earning accounts, to keep their balances either in constant proportions of loan or security accounts, or to evolve according to a user-selected rule. For purposes of the stress test, these accounts are to remain constant relative to the proportions of their associated balance sheet accounts that generated the accrued balances.

(3) *Elements related to income and expense assumptions.* Several other parameters that are required to generate pro forma financial statements may not be easily captured from historic data or may have characteristics that suggest that they be individually supplied. These parameters are the gain on agricultural mortgage-backed securities (AMBS) sales, miscellaneous income, operating expenses, reserve requirement, and guarantee fees. The stress test assumes a 75 bp gain rate on sale of AMBS securities, recognizing that this parameter, while reasonably related to recent performance, may change with changes in market conditions. Miscellaneous income as a percentage of total assets contributes 2 bp to income. Fixed costs and variable costs are determined from historical financial data by running a linear regression (ordinary least squares) of operating expenses, excluding provision expense and taxes, to on-balance sheet investments and Farmer Mac program assets. The regression equation is:

$$Y = \alpha + \beta X$$

(A) Where Y is annualized operating expenses excluding provision and tax expenses, and X is investments and Farmer Mac program assets held on-balance sheet.

(B) The regression provides estimates of fixed costs (α) and a variable cost rate

coefficient (β). To run the stress test, the operating expense regression equation must be re-estimated by using data from Farmer Mac inception to the most recent quarterly financial information. For example, at June 30, 1999, fixed costs were estimated at $2,092 thousand per year and variable costs at 0.004330 of investments and Farmer Mac program assets held on-balance sheet.

(C) The reserve requirement as a fraction of loan assets is also specified, currently at 45 bp, and the corporate income tax is supplied as an input. However, the stress test is run with the reserve requirement set to zero. Setting the parameter to zero causes the stress test to calculate a risk-based capital level that is comparable to regulatory capital, which includes reserves. Thus, the risk-based capital requirement contains the regulatory capital required, including reserves. The amount of total capital that is allocated to the reserve account is determined by GAAP. The guarantee rates applied in the stress test are: Post-1996 Act Farmer Mac I assets (50 bp); pre-1996 Act Farmer Mac I assets (25 bp); and Farmer Mac II assets (25 bp).

(4) *Elements related to earnings rates and funding costs.* (A) The stress test can accommodate numerous specifications of earnings and funding costs. In general, both relationships are tied to the 10-year CMT interest rate. Specifically, each investment account, each loan item, and each liability account can be specified as fixed rate, or fixed spread to the 10-year CMT with initial rates determined by actual data. The stress test calculates specific spreads (weighted average yield less initial 10-year CMT) by category from the weighted average yield data supplied by Farmer Mac as described earlier. For example, the fixed spread for Farmer Mac I program post-1996 Act mortgages is calculated as follows:

Fixed Spread = Weighted Average Yield less 10-year CMT

0.014 = 0.0694—0.0554

(B) The resulting fixed spread of 1.40 percent is then added to the 10-year CMT when it is shocked to determine the new yield. For instance, if the 10-year CMT is shocked upward by 300 bp, the yield on Farmer Mac I Program post-1996 Act loans would change as follows:

Yield=Fixed Spread+10-year CMT

.0994=.014+.0854

(C) The adjusted yield is then used for income calculations when generating pro forma financial statements. All fixed spread asset and liability classes are computed in an identical manner using starting yields provided as data input from Farmer Mac. The fixed yield option holds the starting yield data constant for the entire 10-year stress test period. You must run the stress test using the fixed spread option for all accounts except for discontinued program activities, such as Farmer Mac I Program loans made before the 1996 Act. For discontinued loans, the fixed rate specification must be used if the loans are primarily fixed rate mortgages.

(5) *Elements related to interest rate shock test.* As described earlier, the interest rate shock test is implemented as a single set of forward interest rates. The stress test applies the up-rate scenario and down-rate scenario separately. The stress test also uses the results of Farmer Mac's shock test, as described in paragraph (3) of section 4.1 of this appendix entitled *Data Inputs,* to calculate the estimated effective duration of assets and liabilities at a given interest rate change. The stress test uses estimated effective duration information to construct a linearly interpolated schedule that relates a change in interest rates to a change in the market value of assets and liabilities. For instance, if interest rates are shocked upward by 262 bp, the linearly interpolated effective estimated duration is −1.389 years given Farmer Mac's interest rate measurement results at 250 and 300 bp of −1.395 and −1.373 years, respectively. The stress test uses the linearly interpolated estimated effective duration for assets to calculate the market value change by multiplying duration with the total value of on-balance sheet assets and with the change in interest rates. An identical procedure must be followed for computing the market value change in liabilities for a change in interest rates.

4.3 Risk Measures.

a. This section describes the elements of the stress test in the worksheet named ''Risk Measures'' that reflect the interest rate shock and credit loss requirements of the stress test.

b. As described in section 3.1 of this appendix, the stress test applies the statutory interest rate shock to the initial 10-year CMT rate. It then generates a series of fixed annual interest rates for the 10-year stress period that serve as an index for earnings yields and cost of funds rates used in the stress test. See the ''Risk Measures'' worksheet for the resulting interest rate series used in the stress test.

c. The blended loss rates by state, as described in section 2.5 of this appendix entitled *Calculation of Loss Rates for Use in the Stress Test,* are entered into the ''Risk Measures'' worksheet and applied to the loan balances that exist in each state as reported in the initial loan portfolio of Farmer Mac. The initial distribution of loan balances by state is used to allocate new loans that replace loan products that roll off the balance sheet through time. The loss rates are applied both to the initial volume and to new loan volume that replaces expiring loans. The total life of loan losses that are expected at origination are then allocated through time based on a set of user entries describing the time-path of losses.

d. The loss rates estimated in the credit risk component of the stress test are based on an origination year concept, adjusted for loan seasoning. All losses arising from loans originated in a particular year are expressed as a percent of that year's originated loan volume irrespective of when the losses actually occur. The allocations of the origination year loss rates that must be used are 43 percent to year 1, 17 percent to year 2, 16 percent to year 3, and 3.4 percent for the remaining years. The total allocated losses in any year are expressed as a percent of loan volume in that year to reflect the conversion to exposure year.

4.4 Loan and Cashflow Accounts.

The worksheet called ''Loan and Cashflow Data'' contains the categorized loan data and cashflow accounting that is used in the stress test in generating the projections of Farmer Mac's performance and condition. As can be seen in the worksheet, the steady-state formulation results in account balances that remain constant except for the effects of discontinued programs. For assets with maturity under 1 year, the results are reported for convenience as though they matured only one time per year with the additional convention that the earnings/cost rates are annualized. For the pre-1996 Act assets, maturing balances are added back to post-1996 Act account balances. The liability accounts are used to satisfy the accounting identity. In addition to the replacement of maturities under a steady-state, liabilities are increased to reflect net losses or decreased to reflect resulting net gains. Adjustments must be made to the long-and short-term debt accounts to maintain the same relative proportions as existed at the beginning period from which the stress test is run. The primary receivable and payable accounts are also maintained on this worksheet, as is a summary balance of the volume of loans subject to credit losses.

4.5 Income Statements.

a. Information related to income performance through time is contained in the worksheet called ''Income Statements.'' Information from the first period balance sheets is used in conjunction with the earnings and cost-spread relationships from Farmer Mac supplied data to generate the first period's income statement. The same set of accounts is maintained in this worksheet as ''Loan and Cashflow Accounts'' for consistency in reporting each annual period of the 10-year stress period of the test. The income from each interest-bearing account is calculated, as are costs of interest-bearing liabilities. In each case, these entries are the associated interest rate for that period multiplied by the account balances.

b. The credit losses described in section 2.0 of this appendix, entitled *Credit Risk,* are transmitted through the provision account as is any change needed to re-establish the target reserve balance. For determining risk-based capital, the reserve target is set to zero as described in section 4.2 of this appendix entitled *Assumptions and Relationships.* Under the income tax section, you must first determine whether it is appropriate to carry forward tax losses or recapture tax credits. The tax section then establishes the appropriate income tax liability that permits the calculation of final net income (loss) which is credited (debited) to the retained earnings and the paid-in capital account.

4.6 Balance Sheets.

a. The worksheet named ''Balance Sheets'' is used to construct pro forma balance sheets from which the capital calculations can be performed. As can be seen in the Excel spreadsheet, the worksheet is organized to correspond to Farmer Mac's normal reporting practices. Asset accounts are built from the initial financial statement conditions, and loan and cashflow accounts. Liability accounts including the reserve account are likewise built from the previous period's results to balance the asset and equity

positions. The equity section uses initial conditions and standard accounts to monitor equity through time. The equity section maintains separate categories for increments to paid-in-capital and retained earnings and for mark-to-market effects of changes in account values. The process described below in the ''Capital'' worksheet uses the initial retained earnings and paid-in-capital account to test for the change in initial capital that permits conformance to the statutory requirements. Therefore, these accounts must be maintained separately for test solution purposes.

b. The market valuation changes due to interest rate movements must be computed utilizing the linearly interpolated schedule of estimated effective duration information contained in the ''Assumptions and Relationships'' worksheet. The stress test calculates the change in the market value of assets by multiplying total assets, the linearly interpolated estimated effective duration assets, and the change in interest rate. The changes in the market values of liabilities are calculated in a similar manner using total liabilities, the effective estimated duration of liabilities, and the change in interest rate. The changes in market value of assets and liabilities are then netted to Farmer Mac's capital position. This approach ensures that the value of capital reflects the economic loss or gain in value of Farmer Mac's capital position from a change in interest rates.

c. The stress test considers Farmer Mac's balance sheet as consisting primarily of available-for-sale assets. Therefore, Farmer Mac's capital position should reflect mark-to-market changes in the value of assets and liabilities. This approach ensures that the stress test captures interest rate risk in a meaningful way by addressing explicitly the loss or gain in value resulting from the change in interest rates required by the statute.

d. After one cycle of income has been calculated, the balance sheet as of the end of the income period is then generated. The ''Balance Sheet'' worksheet shows the periodic pro forma balance sheets in a format convenient to track capital shifts through time.

4.7 Capital.

The ''Capital'' worksheet contains the results of the required capital calculations as described below, and provides a method to calculate the level of initial capital that would permit Farmer Mac to maintain positive capital throughout the 10-year stress test period.

5.0 Capital Calculations.

a. The stress test computes regulatory capital as the sum of the following:

(1) The par value of outstanding common stock;

(2) The par value of outstanding preferred stock;

(3) Paid-in capital;

(4) Retained earnings; and

(5) Reserve for loan and guarantee losses.

b. Inclusion of the reserve account in regulatory capital is an important difference compared to minimum capital as defined by the statute. Therefore, the calculation of reserves in the stress test is also important because reserves are reduced by loan and guarantee losses. The reserve account is linked to the income statement through the provision for loan loss expense (provision). Provision expense reflects the amount of current income necessary to rebuild the reserve account to acceptable levels after loan losses reduce the account or as a result of increases in the level of risky mortgage positions, both off-and on-balance sheet. Provision reversals represent reductions in the reserve levels due to reduced risk of loan losses or loan volume of risky mortgage positions. When calculating the stress test, the reserve is maintained at zero to result in a risk-based capital requirement that includes reserves, thereby making the requirement comparable to the statutory definition of regulatory capital. By setting the reserve requirement to zero, the capital position includes all financial resources Farmer Mac has at its disposal to withstand risk.

5.1 Method of Calculation.

a. Risk-based capital is calculated in the stress test as the minimum initial capital that would permit Farmer Mac to remain solvent for the following 10 years. To this amount, an additional 30 percent is added to account for managerial and operational risks not reflected in the specific components of the stress test.

b. The relationship between the solvency constraint (i.e., future capital position not less than zero) and risk-based capital requirement reflects the appropriate earnings and funding cost rates that may vary through time based on initial conditions. Therefore, the minimum capital at a future point in time cannot be directly used to determine the risk-based capital requirement. To calculate the risk-based capital requirement, the stress test includes a section to solve for the minimum initial capital value that results in a minimum capital level over the 10 years of zero at the point in time that it would actually occur. In solving for initial capital, you must assume that reductions or additions to the initial capital accounts are made in the retained earnings accounts, and are balanced in the debt accounts at terms proportionate to initial balances (same relative proportion of long- and short-term debt at existing initial rates). Because the initial capital position affects the earnings, and hence capital positions and appropriate discount rates through time, the initial and future capital are simultaneously determined and must be solved iteratively. To implement this calculation, you can either find the reduction/increase in initial capital needed that results in a zero excess minimum capital balance or utilize the ''solver'' utility of Excel to more efficiently locate the solution. The resulting minimum initial capital from the stress test is then reported on the ''Capital'' worksheet of the stress test. The ''Capital'' worksheet includes an element that uses Excel's ''solver'' capability to calculate the minimum initial capital that, when added (subtracted) from initial capital and replaced with debt results in a minimum capital balance over the following 10 years of zero.

Dated: November 3, 1999.

Vivian L. Portis,

Secretary, Farm Credit Administration Board.

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