# GEOGRAPHICAL LENDING DIVERSIFICATION: AN ANALYSIS OF REGIONAL AGRICULTURAL ASSET RETURNS AND RISK

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# GEOGRAPHICAL LENDING DIVERSIFICATION: AN ANALYSIS OF REGIONAL AGRICULTURAL ASSET RETURNS AND RISK

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Adjusted per acre net incomes for the 48 contiguous states were used to analyze geographic considerations related to the secondary farm real estate market and potential mergers of Farm Credit System (FCS) districts. A portfolio model was solved to determine efficient expected return--variance (EV) combinations of states restricted by market constraints. In addition, correlations of agricultural returns provide useful guidelines for merging FCS districts.

**Keywords:** diversification, Farm Credit System, risk, portfolio, secondary market

The Agricultural Credit Act of 1987 created the Federal Agricultural Mortgage Corporation (FAMC) in order to establish a secondary market for farm real estate loans. Under the terms of the Act, the FAMC will underwrite farm real estate loan pools, thereby guaranteeing timely principal and interest payments to pool investors. Pools will consist of farm real estate mortgage loans having loan-to-value ratios less than .80. Loan size will also be limited to $1 million or 1,000 acres, whichever is less, and borrowers must be engaged in agricultural production on the mortgaged properties. Pools must consist of at least 50 loans from geographically dispersed areas representing different types of agriculture.

The success of the secondary farm real estate market depends on many factors. Three of the more important are: (1) credit worthiness -- the credit worthiness of pools can be assured by having sound loan and pool underwriting criteria, (2) volume -- a significant volume of pools must exist so that the secondary market's liquidity is assured, and (3) information -- issuers of pool securities and investors must have adequate information to accurately price loan pools (Oliva). Meeting the credit worthiness condition will be aided by efficiently combining loans from geographically dispersed areas into efficient expected return--risk (EV) sets.

Geographic dispersion of loans is known to reduce lending risks (Barry and Barnard), and has been suggested as one means for insuring a sound agricultural lending system (Harl). In addition, loans from geographically dispersed areas likely will result in loans from differing types of agriculture, one requirement set forth for the secondary mortgage market in the Agricultural Credit Act of 1987. While the possibility of risk reduction is known, optimal compositions of loan pools are not known. Identifying EV efficient sets will aid in achieving the credit worthiness condition. Furthermore, knowledge of efficient sets should be of value to investors and issuers, thus aiding in meeting the information condition.

A secondary purpose of this article is to examine risk reduction possibilities resulting from combining Farm Credit System (FCS) districts. The Agricultural Credit Act of 1987 requires that the FCS consider district mergers. One consideration in proposed mergers is correlation of agricultural returns between districts. Capitalizing on low correlations may reduce risks associated with agriculture lending.

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The remainder of this article is divided into three sections. The first two deal with EV sets from geographical combinations of agricultural assets and describe methodology, data, and results. The third section examines potential FCS mergers.

## Methodology and Data

Mean--variance portfolio theory provides a framework for determining expected return--risk efficient sets preferred by risk averse individuals. Portfolio theory has weaknesses and criticisms, mainly revolving around assumptions concerning utility, perfect markets, and characterizations of distributions (see Anderson, Dillon, and Hardaker; Levy and Markowitz; Kroll, Levy, and Markowitz; and Meyer for discussions pertaining to violations of the normality assumption). Despite known limitations, portfolio analysis is used in this analysis of agricultural lending risks because of its solid underpinnings in financial theory and because, in many cases, violations of normality assumptions do not seem to bias results. To derive the efficient frontier, quadratic programming is used to minimize portfolio variance for differing return levels.

Adjusted per acre net income was used to determine returns, variances, and covariances for inclusion in the portfolio model. Per acre adjusted farm income was calculated from 1950 through 1986 for each of the contiguous 48 states. Per acre adjusted farm income was determined by adding farm mortgage interest paid and average capital gain in farmland value to average net farm income and dividing the result by total farm acres in each state (see Jones and Barnard and U.S.D.A. for data sources). Per acre adjusted net income was stated in terms of 1984 dollars using the gross national product--implicit price deflator.

Adjusted per acre net income is a limited measure of risk, accounting only for variability of asset returns. It does not consider other factors affecting the abilities of farmers to meet mortgage payments such as non-farm income, liquidity, leverage, and security. Therefore, adjusted per acre net income does not totally reflect risks to agricultural lending. Data accounting for the above factors are not available. This study, however, does provide useful insights into risk relationships among states and regions.

Deflated adjusted per acre net income exhibits auto-regressive time patterns which can lead to incorrect estimates of variances and covariances causing portfolio model results to be suspect. To correct for time patterns, it was assumed that the state adjusted net income series exhibited a similar auto-regressive pattern to that of the aggregate U.S. data series. The state data series were transformed by subtracting each observation in the U.S. data set from the observations for corresponding years in each group data set. Auto-regressive time patterns were then checked for by regressing lagged transformed per acre net income on transformed per acre net income. Time patterns were not found, as indicated by insignificant F values. Also, the Bruesch-Pagen test was used to check for heteroscedasticity related to return level and time. In each case, tests supported null hypotheses of homoscedasticity.

Expected returns, variances, and covariances then were calculated using the transformed data. Expected values were found by adding the expected value of the transformed data sets and the U.S. aggregate data set. Using the transformed data slightly changes the interpretation of portfolio results. The portfolio model minimizes variance around an autoregressive time pattern. Therefore, the general time trend cannot be diversified away. One can view this process as reducing unsystematic risk -- around the time pattern -- while still being subject to systematic risk -- the time pattern.

These data were used to analyze potential risk efficiency gains from pooling loans from across the U.S. The 48 states were combined into 25 regions. The ten states with the largest cash receipts from commodity sales in 1986 were not combined with other states, but the remaining 38 states were combined into 15 contiguous groups based on similarities in type and size of agricultural production.

Expected returns, standard deviations, and coefficients of variation (CVs) for the state groups are presented in Table 1. When calculating statistics for state groups, averages of the state returns within the groups were calculated. The range of CVs for state groups varies from 1.91 for the Montana group to 0.30 for Texas.

## Results of the Portfolio Model

The analysis was first conducted without any market restrictions on portfolio composition. While the unrestricted portfolios were "efficient", ten of the state groups, including Minnesota and Florida which have significant agricultural production, were not included in any of the portfolios. Moreover, some states entered the unrestricted solution at unrealistically high percentages. To examine the characteristics of farm loan pools more likely to occur in the market place, a restricted portfolio analysis was conducted.

In this analysis, the state group percentages were required to be within 5 percent of the share of total U.S. farm mortgage debt as of year-end 1987. In 1987, for example, 9 percent of U.S. farmland debt outstanding was in California. Therefore, the fraction of the total portfolio represented by California was allowed to vary between 4 percent and 14 percent. In addition, each state group had to represent at least 1 percent of the portfolio. Resulting lower and upper bounds on the portfolios are shown in the columns labeled "lower limit" and "upper limit" as shown in Table 2.

Selected resulting portfolio compositions for the restricted state group analysis are presented in table 2. The portfolios range in expected return from $30.90 to $110, and range in standard deviation from $12.00 to $42.20. As expected, most of the state groups not entering the unrestricted portfolios at a particular return level, enter into the partially restricted portfolios at the lowest levels allowed. Sometimes, however, these groups enter into the partially restricted portfolios at the maximum levels allowed. At relatively higher expected return and standard deviation levels, the portfolios include significant percentages in important agricultural states such as California, Iowa, Texas, Wisconsin, Florida, and the New York, Pennsylvania, and New Jersey state groups.

## Mergers of Farm Credit System Districts

The Agricultural Credit Act of 1987 requires the 12 FCS districts to consider merging into no fewer than six FCS districts. In this section, a heuristic approach is used to examine potential mergers based on correlations of adjusted per acre net income (Table 3). This approach does not necessarily yield an optimum; however, it does provide guidelines based on income correlations. Merging districts with low correlations should result in less risk emanating from agricultural lending. Two merger possibilities are presented: (1) mergers of existing FCS districts (2) mergers without regard to current FCS district boundaries.

### Mergers of Existing FCS Districts

Combining districts that have low or negative correlations provides the greatest gains in risk reduction. Such districts, however, generally lie in different regions of the country as can be seen in Table 3. From an operational standpoint, having contiguous districts is highly desirable. Unfortunately, under such a constraint, gains in risk reduction are diminished. Nevertheless, some gains are still possible.

To illustrate, the Spokane district can be merged with either the Sacramento, St. Paul, or Omaha districts. The Spokane district has a positive correlation with the Sacramento district of 0.44, a low correlation of 0.12 with the St. Paul district, and a negative correlation of -0.13 with the Omaha district. Therefore, merging the Spokane and Omaha districts should achieve the most risk reduction.

A similar procedure was used to determine risk reducing merger possibilities for the other nine districts. Figure 1A shows the resulting FCS districts. This analysis does not consider the present financial condition or loan volumes of the FCS districts. Only correlation coefficients and geographic constraints are considered.

## Mergers without Regard For Current District Boundaries

Allowing present FCS districts to be split and realigned into new districts, as opposed to merging existing districts, allows more opportunities to reduce lending risks. Six FCS districts are formed using a heuristic approach based on correlations among state groups, with the stipulation that the districts must consist of contiguous states. Six districts are formed because the Agricultural Credit Act of 1987 stipulates that no fewer than six FCS districts will be allowed. The first step in the heuristic process is to note which state groups are highly correlated. Second, low or negative correlations among groups are noted. Considering the total geographic size of each district, and stipulating contiguous state groups, the six new FCS districts presented in figure 1B are formed.

The South Central district serves as an example of the process in determining these new districts. Iowa, Illinois, and Indiana are all highly correlated and exhibit high standard deviations of adjusted income, so, these states should not be in the same district. For Illinois, this leaves alignment with Wisconsin or the Missouri group as possibilities. Wisconsin and Illinois have a low correlation, 0.05. The correlation for Illinois and the Missouri group is 0.23. The Missouri group is more highly correlated with Kansas, 0.42, but less correlated with Texas, 0.17. Further, Illinois and Texas are negatively correlated, -0.50. Therefore, Texas, Illinois, and the Missouri group form the South Central district. A similar process is followed in forming the remaining five districts in Figure 1B.

This arrangement of districts shows how the states may be aligned to form FCS districts. These results do not consider other factors relevant to forming FCS districts, such as the resulting size of district loan portfolios, or current district financial conditions, nor does this analysis necessarily yield an optimum. Nonetheless, the analysis does provide useful insights into what may be appropriate FCS district mergers.

## Summary and Conclusions

Risk efficiencies emanating from agricultural asset returns can be gained by combining loans from different regions of the country. When forming farm real estate loan pools, having loans from the Far-West (e.g. California), Southwest (e.g. Texas), and Midwest (e.g. Iowa) appears crucial in gaining risk efficiency. For higher rates of return, pools should consist of more loans from the Far-West, Midwest, and the Great Lakes states.

One consideration when merging Farm Credit System districts should be correlations of agricultural returns. Analyzes suggest that correlations can be considered while still having contiguous districts. While combining states in this manner will not guarantee the success of new Farm Credit System districts, it should place the resulting districts on a more solid financial footing.

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Table 1. Expected Returns, Standard Deviations, and Coefficients of Variation of Adjusted Per Acre Net Income for the State Groups and the U.S., 1950 to 1986.

| State Group | Expected Return | Standard Deviation | Coefficient of Variation |
|---|---|---|---|
| CA | $298.55 | $141.93 | 0.48 |
| IA | 200.32 | 174.76 | 0.87 |
| TX | 193.16 | 57.35 | 0.30 |
| NE | 102.34 | 65.56 | 0.64 |
| IL | 172.45 | 187.38 | 1.09 |
| MN | 139.76 | 105.62 | 0.76 |
| KS | 96.29 | 58.98 | 0.61 |
| WI | 117.16 | 64.35 | 0.55 |
| FL | 133.30 | 73.29 | 0.55 |
| IN | 104.11 | 148.79 | 1.43 |
| WA,OR | 59.61 | 35.89 | 0.60 |
| MT,ID | 42.72 | 31.88 | 0.75 |
| NV,UT | 11.51 | 22.01 | 1.91 |
| AZ,NM | 28.07 | 15.90 | 0.57 |
| WY,CO | 30.44 | 18.45 | 0.61 |
| ND,SD | 63.87 | 44.96 | 0.70 |
| MO,AR,OK | 82.31 | 55.33 | 0.67 |
| LA,MS | 64.11 | 73.33 | 1.14 |
| KY,TN | 75.91 | 34.97 | 0.46 |
| MI,OH | 82.13 | 85.03 | 1.04 |
| AL,GA | 74.65 | 36.89 | 0.49 |
| NC,SC | 85.14 | 82.01 | 0.96 |
| WV,VA,MD,DE | 38.20 | 53.49 | 1.40 |
| NY,PA,NJ | 81.83 | 60.27 | 0.74 |
| ME,VT,NH,MA,CT,RI | 41.20 | 46.42 | 1.13 |
| U.S | 47.99 | 41.58 | 0.87 |

Table 2. Composition of Portfolios From the Partially Restricted State Group Analysis.

| State Group | Lower Limit[1] | ----------Selected Portfolios---------- | | | | | Upper Limit[2] |
|---|---|---|---|---|---|---|---|
| | ----------Percent---------- | | | | | | |
| CA | 4 | 4.0 | 5.8 | 11.4 | 14.0 | 14.0 | 14 |
| IA | 3 | 3.0 | 4.4 | 6.8 | 13.0 | 13.0 | 13 |
| TX | 2 | 3.9 | 12.0 | 12.0 | 12.0 | 12.0 | 12 |
| NE | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9 |
| IL | 1 | 1.0 | 1.0 | 1.0 | 3.1 | 8.8 | 11 |
| MN | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 9.0 | 10 |
| KS | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 8 |
| WI | 1 | 1.0 | 6.1 | 7.2 | 8.0 | 8.0 | 8 |
| FL | 1 | 1.0 | 1.0 | 1.0 | 8.0 | 8.0 | 8 |
| IN | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9 |
| WA,OR | 1 | 6.4 | 2.3 | 1.0 | 1.0 | 1.0 | 9 |
| MT,ID | 1 | 9.0 | 9.0 | 1.0 | 1.0 | 1.0 | 9 |
| NV,UT | 1 | 6.0 | 1.0 | 1.0 | 1.0 | 1.0 | 6 |
| AZ,NM | 1 | 7.0 | 2.9 | 1.0 | 1.0 | 1.0 | 7 |
| WY,CO | 1 | 8.0 | 1.0 | 1.0 | 1.0 | 1.0 | 8 |
| ND,SD | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 9 |
| MO,AR,OK | 3 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 13 |
| LA,MS | 1 | 8.0 | 8.0 | 5.4 | 1.0 | 1.0 | 8 |
| KY,TN | 1 | 8.0 | 8.0 | 8.0 | 8.0 | 1.0 | 8 |
| MI,OH | 1 | 10.0 | 10.0 | 8.3 | 1.0 | 1.0 | 10 |
| AL,GA | 1 | 1.0 | 2.7 | 8.0 | 1.0 | 1.0 | 8 |
| NC,SC | 1 | 3.6 | 6.9 | 8.0 | 7.9 | 1.2 | 8 |
| WV,VA,MD,DE | 1 | 7.0 | 1.0 | 1.0 | 1.0 | 1.0 | 7 |
| NY,PA,NJ | 1 | 3.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8 |
| ME,VT,NH,MA,CT,RI | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 6 |
| Portfolio: | | | | | | | |
| Standard deviation ($) | | 12.00 | 16.80 | 23.40 | 32.70 | 42.20 | |
| Return ($) | | 30.90 | 60.00 | 80.00 | 100.00 | 110.00 | |
| Coefficient of Variation | | .39 | .28 | .29 | .33 | .38 | |

[1] Gives the lower percent restriction on the asset's composition of the portfolio.
[2] Gives the upper percent restriction on the asset's composition of the portfolio.

Table 3. Correlation Matrix of Adjusted Per Acre Net Incomes for Farm Credit System Districts, 1950 to 1986

| FCS District | Spring. | Balt. | Col. | Louis. | St. Lo. | St. Pa. | Omaha | Wich. | Texas | Sacra. | Spokane |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Springfield | 1.00 | | | | | | | | | | |
| Baltimore | 0.44 | 1.00 | | | | | | | | | |
| Columbia | 0.24 | 0.32 | 1.00 | | | | | | | | |
| Louisville | -0.33 | 0.33 | 0.07 | 1.00 | | | | | | | |
| St. Louis | -0.47 | 0.15 | 0.00 | 0.87 | 1.00 | | | | | | |
| St. Paul | -0.25 | 0.01 | -0.01 | 0.13 | 0.43 | 1.00 | | | | | |
| Omaha | -0.10 | 0.20 | -0.04 | 0.44 | 0.66 | 0.60 | 1.00 | | | | |
| Wichita | 0.57 | 0.12 | 0.20 | -0.58 | -0.50 | 0.04 | 0.10 | 1.00 | | | |
| Texas | -0.20 | -0.21 | 0.17 | -0.13 | -0.06 | 0.15 | -0.19 | 0.19 | 1.00 | | |
| Sacramento | 0.18 | -0.25 | 0.21 | -0.42 | -0.31 | 0.18 | 0.13 | 0.44 | 0.25 | 1.00 | |
| Spokane | 0.37 | -0.23 | 0.05 | -0.59 | -0.54 | 0.12 | -0.13 | 0.68 | 0.09 | 0.60 | 1.00 |

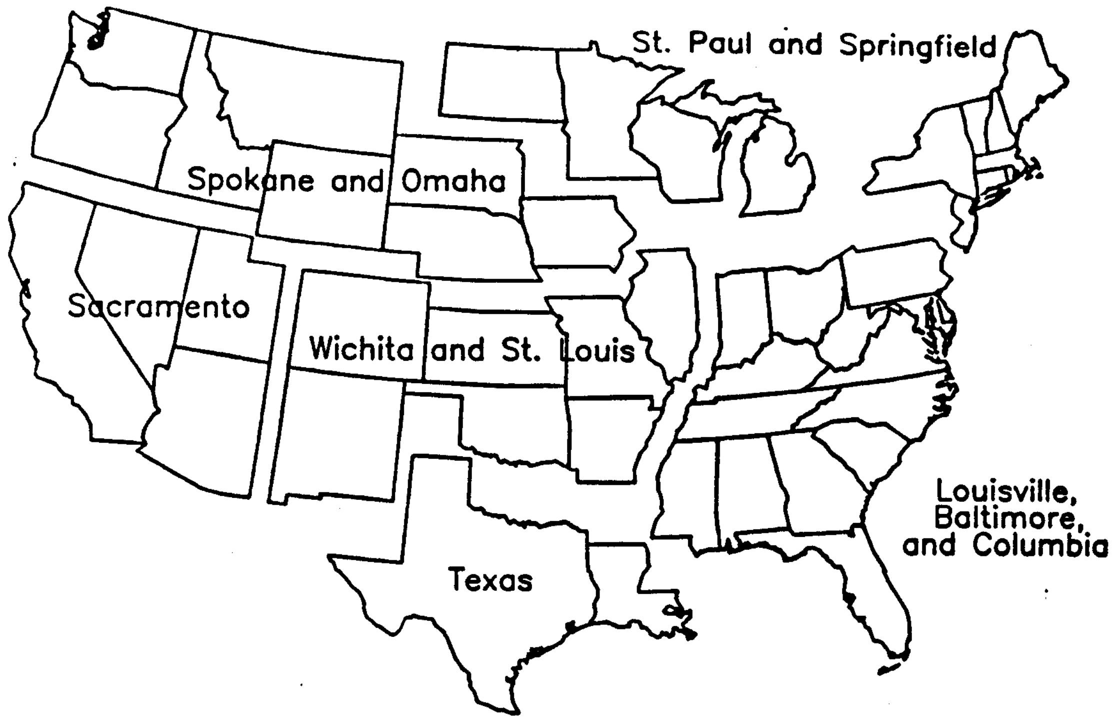


Figure 1A. Proposed Mergers of FCS Districts without State Realignment

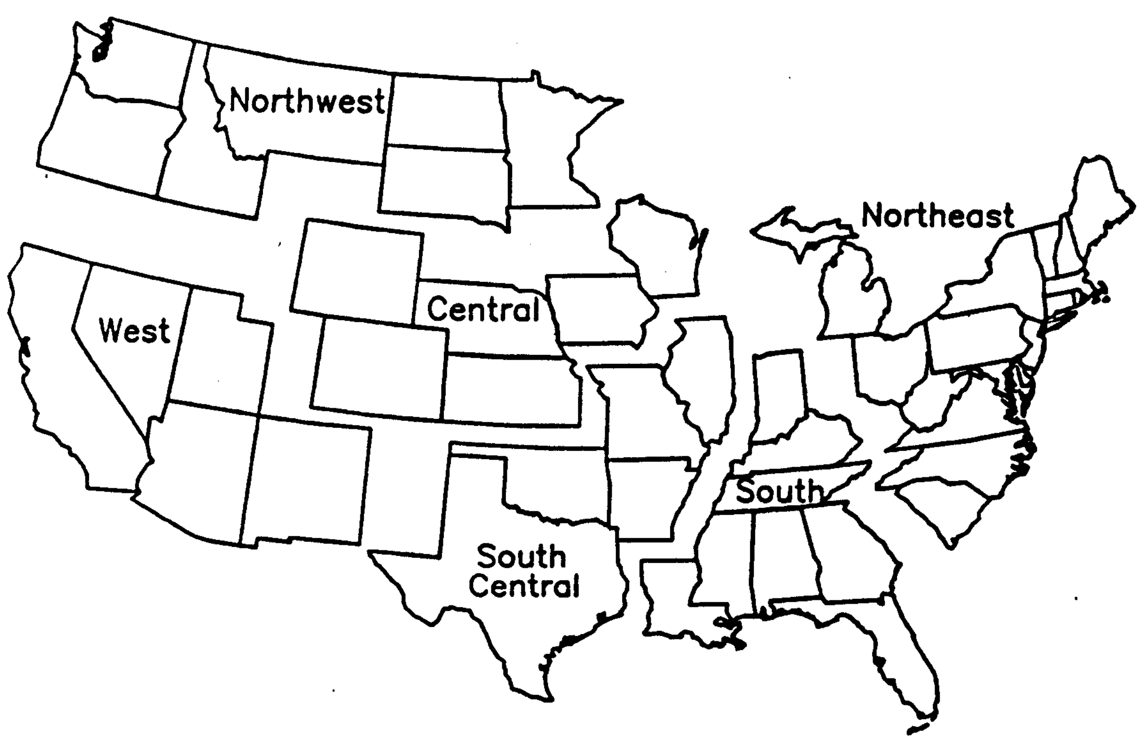


Figure 1B. Proposed Mergers of FCS Districts with State Realignment