Agricultural Bank Efficiency and the Role of Managerial Risk Preferences

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Abstract

We investigate the objectives of agricultural bank managers and evaluate bank efficiency. If managers are concerned about risk, then their preferences should be considered when evaluating bank performance. We find risk-averse managerial behavior and efficiency gains due to bank size, market competition, risk-reduction, and less risk exposure of outputs.

Agricultural Bank Efficiency and the Role of Managerial Risk Preferences

The period from 1986 to 1996 has been noted as one of a decline in banking. Paré (1995) asserted in *Fortune* magazine that banks are going the way of the dinosaur and that most bankers are "clueless" when it comes to survival strategies. The common opinion is that banks are losing out to a wide range of nonbank competitors such as finance companies, mutual funds, and private pension funds that are offering traditional types of banking products more efficiently. Kohl (1989) noted that a sizeable portion of the lending market was being controlled by non-traditional credit sources.

Accompanying this decline was a wave of bank consolidations and mergers fueled by the lifting of restrictions on interstate banking and intrastate branching. In 1994, the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 was adopted by Congress. This legislation removed all barriers to interstate banking and branching.

Policy analysts and state legislators continue to debate the effects of these provisions on banks in their states. The Independent Bankers Association of America states that "interstate branching is bad public policy; it provides no benefits for community bankers; and it is little more than special interest legislation to allow our nation's biggest banks to consolidate their empires." Proponents of the Riegle-Neal Act advocate that removing interstate banking and branching restrictions would result in the entry of more efficient banks into local markets. Joe Brannen, president of the Georgia Bankers Association, said that "the Riegle-Neal gives our banks that are going to be operating across the country access to higher lending rates."

The main objective of this research is to evaluate efficiency in Georgia agricultural banks. The risk-preferences of bank managers will be investigated to accurately measure agricultural bank efficiency. The second objective is to estimate scale economies of agricultural banks. The research results will provide information about the optimal bank size and potential economic benefits of consolidation among agricultural banks. The third objective is to evaluate the effects of firm and market characteristics on agricultural bank efficiency. This information will provide insights regarding the influence of deregulation, mergers, and market structure on efficiency.

Agricultural Bank Risk and Risk Management

Agricultural financial contracts typically involve future cash flows. The inherently risky nature of future flows justifies the need to consider risk when evaluating agricultural bank efficiency. Industry professionals have identified the importance of risk management in the viability of a bank. Zaik *et al.* (1996) note that banks have invested heavily in risk-management systems since 1985 to assess risks their businesses face. Agricultural banks face three major sources of risk. First, default risk arises when borrowers cannot repay their loans and accrued interest. Second, liquidity risk derives from the uncertainty about banks' abilities to maintain enough funds to meet customers' loan demands. Third, interest rate risk is the hazard of banks refinancing their long-term loans at interest rates above the rates they receive.

These specific risks create variability in the cash flows of agricultural banks. Excessive risk taking coupled with adverse economic conditions may lead to bank failure.

Managers concerned about risk engage in hedging activities and maintain high levels of liquid assets in the form of financial capital to provide a cushion against any losses.

We focus on the use of financial capital by bank managers in controlling risk. Financial capital or equity is the dollar amount of capital provided by stockholders in the bank. The amount of equity held by a bank is vital in ascertaining the level of risk in a given loan portfolio. Bank capital levels provide a cushion for loan losses as protection from insolvency. The level of equity signals the level of the bank's riskiness to uninsured depositors. Financial capital indicates the extent to which the bank is protected from risk.

Economic Model

For managers concerned about risk, their utility functions contain elements that reflect their preferences for low risk and high profits. The aspects of managerial utility are the risk-free rate of return, $\mathbf{r}$, the amount of nonperforming loans $\mathbf{n}$, the vector of output prices $\mathbf{p}$, and $\mathbf{k}$, the level of financial capital. The inputs, $\mathbf{x}$ and outputs, $\mathbf{y}$ are introduced because some inputs and outputs may be riskier than others. If a bank's outputs are largely interest-bearing then it exposes the bank to severe levels of risk.

The bank manager has an ordering of preferences that reflects his or her taste. Assuming π is the real before-tax profit, the decision maker's preference for expected profit, conditional on the production plan is characterized by the utility function $\mathbf{U}(\pi, x; y, p, r, n, k)$. We assume that the utility function is quasi-concave and twice continuously differentiable. This formulation is general and adapts to various objectives besides profit maximization.

The manager's problem is to maximize utility with respect to the production plan and profit levels, conditional on the definition of profits, the technology that specifies the feasible production plan, and the preferred level of financial capital. Assume **l** is the total amount of loans made and **s** is the amount of securities purchased. The manager's problem is specified as

$$Max_{\pi,\ x}\ U(\pi,\ x;\ y,\ r,\ n,\ k)$$

$$s.t.\ \ py\ +\ m\ -\ wx\ -\ p_{\pi}\pi\ =\ 0$$

$$T(y,\ x,\ n,\ k)\ =\ 0$$

$$h(L\ +\ S)\ \leq\ k.$$

Here, **m** is the level of non-interest income, **w** is the input price vector, and $\mathbf{p}_{\pi}$ is the real value of before-tax profit.

The Generalized Almost Ideal Demand Model

We formulate a model based on bank managers' utility functions to evaluate their preferred production technologies and estimate agricultural bank efficiency. The econometric model builds on insights provided by Hughes *et al*. (1997) and generalizes the Almost Ideal Demand System (AIDS) to account for generalized managerial preferences.

The generalized AIDS model modifies the expenditure function **E** to incorporate additional elements that impact managerial utility. Let **U** be the desired level of managerial utility and the terms β, κ, ν, and μ represent parameters to be estimated. Then the generalized expenditure function **E** is

$$\ln E = \ln P + U \beta_0 [\Pi y_i^{\beta_i}] [\Pi w_j^{v_j}] P_\pi^\mu k^\Upsilon n^\xi r^\varphi.$$

We differentiate **E** using Shephard's lemma to obtain the input share and profit equations that constitute the Almost Ideal Demand System. The optimal solutions for inputs $\mathbf{x}^*$ and profit π^* define the preferred production plan used by the bank manager concerned about risk. The optimal demand for financial capital $\mathbf{k}^*$ is obtained by maximizing the manager's utility function with respect to **k**.

Testing Managerial Objectives

Three criteria are used in examining the risk-preferences of agricultural bank managers. These criteria are based on economic theory and directly impact the parameters to be estimated in generalized AIDS model. The first criterion evaluates the effects of the effective tax rate on the manager's choice of before-tax profit. For a bank manager who is indifferent to risk, a variation in the effective tax rate and in the real value of before-tax profit, $\mathbf{p}_\pi$ will not impact his or her choice of before-tax profit.

The second criterion assesses the impacts of the output price vector on the manager's cost minimizing plan. For a risk-neutral manager, the revenue and risk characteristics of production represented by the output price vector, $\mathbf{p}_i$ will not influence the cost minimizing production plan. Managers who are not concerned about risk base their decisions on cost minimization solely on input prices and the target output level. Their choices of technology ignore the possibility of failure accompanying risky outputs.

The third criterion evaluates the impacts of non-interest income, **m** on the optimal demands for the inputs $\mathbf{x}^*$, profit π^*, and financial capital, $\mathbf{k}^*$. For the risk-neutral manager, variations in income from sources other than those accounted for by output have no marginal significance for the optimal input demands, financial capital, and profit.

Deriving Scale Economies

Scale economies in production provide information about the technology that bank managers employ in managing resources to maximize utility. This information helps determine the optimal size of agricultural bank for efficiently providing credit.

Bank managers concerned about risk pursue activities that present several input combinations for utility maximizing levels of output. The *most preferred cost*, $\hat{\mathbf{c}}$ incorporates the cost of producing outputs accounting for the expenses incurred in reducing risk. Risk-reduction yields a measure of scale economies that encompasses generalized managerial preferences. The generalized scale economy measure, **GSE** incorporates the level of financial capital **k** and additional expenses incurred by managers who are concerned about risk. The **GSE** shows how variations in bank output levels impact the cost of production and may be defined as

$$GSE = \frac{\hat{c}}{\sum_{i=1}^{n} y_i \left(\frac{\partial \hat{c}}{\partial y} + \frac{\partial \hat{c}}{\partial k} \frac{\partial k}{\partial y} \right)}.$$

Measuring Bank Efficiency With Risk Expected-Return Tradeoff

We estimate a best-practice risk-expected return frontier to assess the efficiency of Georgia agricultural banks. Efficiency is measured at a given level of risk. The deviation

of observed profit from the potential profit that can be achieved at that stipulated level of risk gives an index of agricultural bank inefficiency.

Expected return is the predicted profit obtained from the production model. Risk is the absolute value of the standard deviation of predicted profit. We posit that expected return is a function of the absolute standard deviation of expected return and the variance of expected return. A composite term is included to account for the interaction between the absolute standard deviation and variance.

Let **ER** represent an agricultural bank's expected return and **RK** be the level of risk associated with that expected return. Assume ν is independently and identically distributed as a random variable with zero mean and variance σ_ν^2. Suppose μ accounts for technical inefficiency in production, is independent of ν, non-negative, independently and identically distributed with mean, **q** and variance, σ_μ^2, and is truncated at 0. Let the δ_i s be parameters to be estimated. Then for a sample of i agricultural banks over t periods, the stochastic efficient production frontier is

$$ER_{it} = \delta_0 + \delta_1 * RS_{it} + \delta_2 * RS_{it}^2 + \delta_3 * RS_{it}^3 + \nu_{it} - \mu_{it},$$

for all i and t.

The variance and interaction terms capture the shape of the manager's utility function. The shape of the utility function depends on the manager's attitude toward risk at various levels of expected return. The utility function may be linear, concave, or convex depending on the manager's risk-preference.

Size, Market, and Firm Efficiency Effects

We employ factors perceived as partly exogenous and beyond the immediate control of the manager to explain differences in inefficiency across banks. This evaluation will demonstrate how the characteristics of the Georgia banking market impact agricultural bank efficiency. Technical inefficiency effects **μ** are assumed to be defined by

$$\mu_{it} = \lambda_0 + \lambda_1 * TA + \lambda_2 * LS + \lambda_3 * DS + \lambda_4 * SDROA + \lambda_5 * \frac{TL}{TA} + \lambda_6 * \frac{TD}{TL}.$$

The λ_i s are parameters to be evaluated. The value of total bank assets, **TA** is a proxy for bank size. The relationship with bank efficiency reflects the impacts of bank expansion on performance. The loan shares, **LS** and deposit shares, **DS** of the agricultural bank serve as proxies for the bank's market share and characterize the competitive conditions of the banks' localities. The standard deviation of the bank's return on assets, **SDROA** is included as a direct measure of bank risk that is realized in bank earnings. The loan to asset ratio, **LA** and deposit to loan ratio **DL** are firm-specific characteristics that influence bank inefficiency.

Data and Estimation

This research uses data from 1990 to 1995 from Sheshunoff: The Banks of Georgia. This annual publication is provided by the Sheshunoff Information Services, a Texas based company which compiles data obtained from the Consolidated Reports of Condition and Income. The 1139 banks included in the sample are Georgia banks that provided loans to agricultural production over the 1990-1995 sample period.

Production technology parameters are measured using the iterative three-stage least squares program in the **LIMDEP** computer program. Agricultural bank efficiencies

are computed using maximum likelihood techniques in the **FRONTIER, Version 4.1** (Coelli, 1994) computer program.

Results and Conclusions

The likelihood ratio test of managerial risk-preferences yields statistics which indicate that managers of Georgia agricultural banks are concerned about risk. They maximize satisfaction by substituting high profit levels with reduced risk.

Elasticity estimates from the demand for financial capital equation provide insight into the utility-maximizing behaviors of agricultural bank managers. The weighted average input price elasticity of demand for financial capital is -0.09. The negative relationship means that financial capital serves as a complement to labor, physical capital, other borrowed money, insured and uninsured deposits. Risk-averse managers seek higher levels of equity to reduce liquidity risk as they acquire more of the cheaper input.

A positive relationship exists between the demand for equity and the weighted average price of outputs with an estimated elasticity is 0.06. Bank levels of financial capital are positively related to the levels of the outputs. As output prices and levels rise, the expected returns increase. When managers increase their banks' stocks financial capital with an increase in expected revenues, they tradeoff higher levels of profit for lower risk.

The demand for financial capital is positively linked with the level of nonperforming loans. Bank managers who are concerned about risk demand higher levels of financial capital as a cushion against the risk associated with delinquent borrowers. The demand for equity rises as the real value of before-tax profit increases. A similar

relationship exists with non-interest income. These relationships demonstrate that Georgia agricultural bank managers are concerned with risk and substitute higher profits with low levels of risk. They employ higher levels of financial capital expected returns increase.

Over the entire asset range, agricultural banks are operating with increasing returns to scale technologies. The **GSE** measure significantly exceeds one so bank costs increase at a less than proportionate rate than a scaled expansion in outputs. Banks with assets below $1 billion are operating at increasing returns to scale while banks with over $1 billion in assets operate at constant returns to scale. Georgia agricultural banks with assets less than $1 billion that merge with other banks will experience a more than proportionate expansion in outputs. Mergers that result in banks with over $1 billion in assets do not accrue any scale economies. Since the largest asset category includes banks with assets up to $17.5 billion we conclude that the optimal bank size for the efficient provision of agricultural credit lies between $1 billion and $17.5 billion.

The estimates presented in table 1 show that the banks with assets under $500 million operate with similar technologies. Banks in the larger asset categories also use similar production techniques different from those of their smaller bank counterparts.

The signs of the parameters of the expected return-risk frontier obtained illustrate a concave efficiency frontier. A one percent increase in risk leads to a 0.01 percent increase in expected return. This rate of substitution falls by 0.12 percent per unit increase in risk. The concavity of the frontier is consistent with the behavior of a risk-averse manager whose satisfaction increases at a less-than-proportional rate as income increases.

When risk is low, managers who are disinclined toward risk will accept higher levels of risk for greater expected returns. As risk increases, they become less inclined to assume the higher risk accompanying larger expected returns. Every additional unit of profit carries a more-than-proportionate level of risk. The decreasing rate of substitution between high expected returns and low risk yields a concave efficient frontier.

The efficiency estimate for the entire 1990-1995 sample period is 0.89. From 1990 to 1995, efficiency declined at an annual rate of 0.1 percent. The efficient risk-expected return frontier is determined by best practice banks so managers of inefficient Georgia agricultural banks were lagging behind the best practice technologies. Bank efficiency improved with size, market competition levels, and reduced risk. Exposing bank outputs to lower levels of risk also improved bank efficiency.

Banks are exposed to various sources of risk in their businesses. To control risk, risk-averse managers engage in activities that deviate from profit maximization. Considering the risk-preferences of managers is important when evaluating bank performance. Models that ignore risk are wrongly specified and lead to wrong conclusions about bank performance.

Table 1. Scale Economy Estimates Distributed Across the Different Bank Sizes

Asset Categories ($ million)	Mean	Standard Error	Number of Banks
Under $25	1.0686*	0.0296	173
$25 to $50	1.0675*	0.0495	392
$50 to $100	1.0618*#	0.0254	302
$100 to $500	1.0670*	0.0304	236
$500 to $1000	1.114*#	0.0450	6
Over $1000	1.1840#	0.1689	30
Whole Sample	1.0693*	0.0497	1139

* Significantly different from 1 at the 90 percent confidence interval.
# Significantly different from other category means at 90 percent confidence interval.

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