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The Relationship between Risk, Capital and Efficiency:

Evidence from Japanese Cooperative Banks

Tara Deelchand
ICMA Centre, University of Reading

Carol Padgett
ICMA Centre, University of Reading

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ICMA Centre • University of Reading
Whiteknights • PO Box 242 • Reading RG6 6BA • UK
Tel: +44 (0)1183 787402 • Fax: +44 (0)1189 314741
Web: www.icmacentre.ac.uk
Director: Professor John Board, Chair in Finance
The ICMA Centre is supported by the International Capital Market Association

ABSTRACT

The risk-capital positions of Japanese banks have been under tension throughout the 1990s. However, existing theory on the determinants of bank risk-taking still remains limited and the evidence is conflicting. Most studies concentrate on US and European banks, while empirical evidence has remained scarce for Asian banks. Added to that, to our knowledge, there are almost no papers on this subject for cooperative banks in Japan. Thus, the main contribution of this study is to shed some light on the determinants of bank risk-taking and analyse its relationship with capital and efficiency in Japanese cooperative banking (namely shinkin and credit cooperatives banks). This paper focuses on Japanese cooperative banks as they constitute an important segment of the Japanese banking sector. We employ a simultaneous equation model in which the relationships between, risk, capital and cost inefficiency are modelled. Two stage least squares with fixed effects estimation procedure are applied to a panel data set of 263 Japanese cooperative banks over the period 2003 through 2006. The results confirm the belief that risk, capital and inefficiency are simultaneously determined. The empirical model shows a negative relationship between risk and the level of capital for Japanese cooperative banks. Inefficient Japanese cooperative banks appear to operate with larger capital and take on more risk. These arguments may reflect the moral hazard problem that exists in the banking system through exploitation of the benefits of deposit insurance. We also assess the size effects and find that larger cooperative banks holding less capital take on more risk and are less efficient.

Keywords: Risk; Capital; Efficiency; Japanese cooperative banks

JEL classifications: C23; D24; E44; E5; E52; G21; N25

Authors Details:
Dr. Carol Padgett
Lecturer in Finance
ICMA Centre, Henley Business School
University of Reading
Reading, RG6 6BA, UK.
Email: c.padgett@icmacentre.ac.uk

Tara Deelchand
PHD student, ICMA Centre, Henley Business School
University of Reading,
Reading, RG6 6BA, UK.
Email: t.deelchand@icmacentre.ac.uk

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1. Introduction

The successive banking crises that have occurred around the world reveal that banks often take excessive risks and these continuous crises have adverse snow-ball effects on the financial system and the real economy as well. The Japanese banking industry hasn't been spared and has indeed been hit by the banking crisis during the 1990s. Even some of the leading financial institutions failed to survive the financial turmoil. Burdened with bad loans and eroded capital positions, they had to withdraw from international markets and tried to solve their problems domestically. More specifically, the risk-capital positions of Japanese banks have been under tension throughout the 1990s. Pressure on banks to increase capital to asset ratios and reduce risk-taking activities has been referred to as an explanation for the reduction in aggregate lending in the 1990s.

Based on the drastic changes that have occurred over the last 20 years in Japan, the Japanese banking system represents an interesting sector to analyse. The Japanese banking structure is composed of a very small number of very large banking groups and a very large number of very small institutions but has undergone a sharp decline of the total number of institutions in recent years. In this paper, we will address an important subset of Japanese private depository institutions namely cooperative banks comprising Shinkin (also Known as credit associations) and credit cooperative banks[1]. They have played a critical role in the sustainable growth of regional economies and the SMEs that operate there. However, the cooperative banking sector has also been affected by the severe recession and economic slump during the 1990s and suffered more bankruptcies than the rest of the banking sector.

[1] *Shinkin banks* are cooperative financial institutions whose members are individuals and small/medium sized enterprises (SMEs). They operate in a similar way to commercial banks but in principle limit lending to members. On the other hand, credit cooperative banks accept deposits from members of the cooperative, government municipalities and non-profit organisation. Among the 176 bankrupted depository institutions during the period 1990-2001, Shinkin and credit cooperative banks together accounted for about 89% (Hanazaki, M., & A. Horiuchi, 2003). As part of the restructuring and consolidation procedure, between 31st March 1980-2008, the total number of Shinkin and credit cooperative banks was reduced by 40% and 66% to reach 280 and 164 respectively (Japanese Bankers Association).

Following repeated worldwide banking crises, numerous bank regulators and researchers have expressed an interest in understanding and analysing the determinants of bank-risk taking and its relationship with bank capital. However, knowledge about the banks' risk-capital behaviour is still very limited and mixed. Current research implies that banks tend to be hit by a number of factors namely moral hazard provided by mispriced deposit insurance, agency problems, ownership structure and managerial incentive among others.

On theoretical grounds, some authors argue that capital characterises the degree of loss faced by a bank in the event of a bankruptcy. Thus, if a bank has a higher level of capital, it will incur lower risks. A negative relationship between risk and capital also occurs when all deposits are insured with a flat premium rate, i.e., in the absence of 'market discipline'. Thus, the marginal cost of increasing bank risk and/or lowering the level of capital is zero as the insurance premium remains constant with risk or capital. Some also state that risk-taking activities are reduced at commercial banks when capital adequacy requirements are introduced (Repullo, 2004; Konishi & Yasuda, 2004; and Furlong & Keeley, 1989). In contrast, others argue that higher capital requirements might lead to excessive risk-taking by banks as this would lower the bank's charter value[2] thereby restricting bank's drive to behave cautiously (Besanko and Kanatas, 1996; Hellman, Murdock and Stiglitz, 2000).

On the other hand, if capital is regarded as very costly, banks will bear more risks to generate a higher return on equity, the higher the level of capital. Banks also have incentives to take higher risks with regard to moral hazard by exploiting deposit insurance schemes. Moral hazard occurs when central banks, governments, or supervisory agencies lead economic agents to believe that they will get involved to protect an institution and its creditors in case of any failure. The moral hazard hypothesis could also be developed when analysing agency problems between managers

[2] The charter value of a bank represents the present value of the expected stream profits that a bank is expected to obtain on a going concern. This is usually measured as the difference between the market value of a bank's equity and the value of equity invested by the bank's shareholders.

and shareholders. In an unhealthy banking industry, managers will be less inclined to take on more risk. Added to that, well informed managers may employ an expansionary strategy which may end up being very risky. While it may be a desirable explanation, moral hazard is an incomplete justification of the relationship between bank capital and risk-taking. Under the ‘‘too-big-to fail’’ argument, large banks may rely too much on a public bailout in case of financial difficulties as they are conscious of their importance in the financial system. Some banks may also choose to bear more risk as they assume that they will be bailed out if they fail at the same time as other banks.

An increasing area of the theoretical literature attempts to assess the effects of minimum capital requirements on capital and banks' risk. According to the Basel Accord I (risk-based capital standard), agreed upon in 1988 among G-10 countries, banks are compelled to sustain a certain level of capital for risk-weighted assets[3]. Since then, banks are expected to hold a minimum regulatory capital ratio of 8% of all risk-weighted assets. Similarly in Japan, international banks are required to maintain a capital to risk-weighted asset ratio of at least 8%. This ratio is also referred to as the ‘‘BIS’’ (Bank of International Settlements) ratio. However, domestic banks in Japan are subject to a more lenient requirement of a 4% Ministry of Finance (MOF) ratio.

Basel II[4] (Basel Committee, 2004), the extended version and second of the Basel Accords was published in June 2004 to ensure that banks assess and measure other types of risk, including operating risks and make adequate provision of capital to guard against the risks they face. It was scheduled for implementation by end of 2006/beginning of 2007, but given resource and other constraints in some countries, the implementation process continues to move forward around the globe. It is important to note that the regulatory framework, including the recent amendments, is

[3] Risk Weighted Assets (RWA) is calculated as a weighted sum of assets held by the bank.

[4] Basel II went into effect in Japan in fiscal 2006 (end of March 2007) and required banks to abide to its three pillars. Pillar I is a new method for calculating bank capital adequacy ratios by introducing a risk sensitive, computational formula. Pillar II represents the financial institution's internal capital adequacy assessment process, followed by supervisory review and evaluation process. Pillar III is appropriate disclosure regarding capital adequacy to be evaluated fairly by the market. (Rixtel, Alexopoulou & Harada,2003)

planned with commercial banks in mind and thus ignores the nature of activities of cooperative banks[5].

In line with the capital buffer theory, banks aim at holding more capital than required (i.e., maintaining regulatory capital above the regulatory minimum) as insurance against breach of the regulatory minimum capital requirement. More capital tends to absorb adverse shocks and thus reduces the likelihood of failure. Consequently, portfolio risk and regulatory capital are assumed to be positively related. Banks raise capital when portfolio risk goes up in order to keep up their capital buffer. Indeed, evidence from the US banking sector by Shrieves and Dahl, 1992; Jacques and Nigro, 1997; and Aggarwal and Jacques, 1998 as well as by Rime, 2001 from Switzerland and Heid, Porath, and Stolz, 2003 seems to confirm this positive relationship. As a matter of fact, Shrieves and Dahl, 1992 and Jacques and Nigro, 1997 emphasize that changes in risk and capital outlook by bank management are simultaneously determined.

On the other hand, Konishi and Yasuda (2004) analysing the factors determining risk taking at Japanese commercial banks, highlight that risk taking activities are reduced at commercial banks when capital adequacy requirements are introduced, indicating that the results for Japan differ to some extent. A negative relationship between capital and risk is also obtained in UK banks and building societies according to Alfon et al (2004). They argue that the possible explanations for keeping substantially high capital position are: distance from minimum capital requirement, internal risk assessments by bank managers and their skills in managing risk, the level deemed appropriate by rating agencies and depositors and the costs of raising extra capital.

[5] For example, Fonteyne (2007) argues that ‘‘the third pillar of the New Basel Capital Accord (Basel II)—which relies on extensive disclosure to ensure that banks are subject to market discipline—has significantly reduced effectiveness in the case of cooperative banks’’. He also states that ‘‘Cooperatives’ disclosure practices and requirements are substantially below those of commercial banks, especially listed ones’’.

While the aforementioned studies focussed mainly on the relationship between risk and capital, there is not much evidence on their relationship with efficiency. Hughes and Moon (1995) and Hughes and Mester (1998) thus stress the importance of analysing the impact of efficiency on risk and capital. They observe a positive relationship between risk and the level of capital (and liquidity), perhaps signalling regulators' preference for capital as a means of restricting risk-taking activities but a negative relationship between inefficiency and bank risk-taking. The relationship between capital, risk and efficiency for a large sample of European banks between 1992 and 2000 was also examined by Altunbas et al (2007). They note that inefficient European banks seem to hold more capital and undertake less risk. However, they obtain a positive relationship between risks and the level of capital for commercial banks. On the other hand, in the case of cooperative banks, they find that capital levels are inversely related to risks and that inefficient banks hold lower levels of capital.

While theory does not provide a clear picture, the empirical evidence on the relationship between banks' risk and capital remains also inconclusive. So far, to the best of our knowledge, empirical evidence on the risk-capital relationship in Japanese cooperative banking is not available because previous studies focussed on commercial banks. This explains why no reference is made to any review of literature for Japanese cooperative banks. We believe that this is a relevant issue given that the cooperative banks have experienced substantial asset quality problems and low levels of capitalisation since the early 1990s.

This paper thus attempts to fill the void by addressing the following question: How does a cooperative bank's risk-taking behaviour depends on its capital position (i.e., how does the behaviour of an undercapitalized bank differ from the behaviour of a well-capitalized bank)? We thus aim to shed some light on the determinants of bank risk-taking and analyse its relationship with capital and efficiency in Japanese cooperative banking. A panel data set of 263 Japanese Shinkin and credit cooperatives banks over the period 2003 to 2006 is being tested. Thus, an important contribution of our study is that we are focussing on Japanese cooperative banks which haven't been explored so far to our knowledge in this area of research.

Our results reveal an inverse relationship between risk and the level of capital for Japanese cooperative banks, which is similar to results reported for European cooperative banks. However, inefficient Japanese cooperative banks hold more capital and take on more risk, contrasting with evidence from Europe (Altunbas et al, 2007). We also observe that larger banks hold lower capital, are engaged in more risky activities and are inefficient.

This paper is structured as follows. Section 2 outlines issues to be addressed in this area in terms of definitions and measurement. Section 3 presents data and methodology. Section 4 highlights the empirical results and finally section 5 draws the conclusion.

2. Definition and Measurement: Risk, Capital and Inefficiency

2.1 Risk

In the most basic sense, risk is the probability of financial loss and also refers to the variability of returns associated with a given asset. The Shinkin Central Bank organises ‘‘risk’’ into two categories – risk that must be controlled and risk that must be minimized. The types of risk that must be controlled are credit risk, market risk, and. liquidity risk. On the other hand, operational risk is the type of risk that needs to be minimized (Shinkin Central Bank Annual Report, 2008). We shall now examine the definition and types of banking risk as follows:-

Risk that must be controlled

- *Credit risks:* the risk of loss when customers fail to comply fully with the terms of a loan or contract. However credit risk is not only limited to the risk that borrowers are unable to pay; it also accounts for risk of delayed payments which can also be problematic for the bank.
- *Market risks* - the risk of loss arising from adverse fluctuations in assets or liabilities values. These fluctuations may be due to changes in interest rates, equity prices, foreign exchange rates or commodity prices.

- *Liquidity risks* - Depository institutions generally use short-term liabilities to finance long-term assets and thereby rely on additional deposits to satisfy withdrawal requests. However, liquidity risks may arise when there are insufficient new deposits to cater withdrawal requests, i.e., the institution is unable to generate sufficient cash inflow to meet required cash outflows. Thus it represents the inability of the bank to meet its liabilities when they fall due.

Risk that must be minimized

- *Operational risk* – the risk of unforeseen loss due to resulting from shortcomings in operational processes; breaches in internal controls, employee actions, or computer systems, as well as risk of loss arising from external events.

It is important to note that there is no ideal single measure of risk, and as a matter of fact, there are a number of measures. They are classified as accounting–based and market-based approaches. The accounting measures employ balance sheet ratios that represent traditional indicators of riskiness. They are namely the ratio of loan-loss reserves to total assets or loan-loss provisions as a fraction of either total assets or gross loans to reflect credit risk. On the other hand, market-based measures are captured by the standard deviation of daily stock returns. Shrieves and Dahl, 1992 and Jacques and Nigro, 1997, use the ratio of risk-weighted assets to total assets to measure risk.

2.2 Capital

The capital of a financial institution comprises mainly retained earnings and funds from issuing stock. It is important to understand that capital is not synonymous with liquidity. A firm can be highly capitalized, that is, can have more assets than liabilities, but may at the same time experience liquidity problems if the assets cannot be sold quickly for cash or any other sources of liquidity to meet other needs. There are three concepts of capital; actual, regulatory and economic as follows:-

- *Actual capital* refers to the physical capital which is represented within the

balance sheet as equity and long-term debt. It is usually measured as the ratio of equity to total assets, also known as the capital ratio.

- *Regulatory capital* relates to risk-based capital which the bank maintains in line with supervisory determined rules and is measured as the ratio of capital to risk-weighted assets (also referred as risk-based capital ratio).
- Finally, *economic capital* represents the maximum amount of capital that a bank requires to operate its business effectively based on its business strategies.

2.3 Inefficiency

Studies of X-efficiency estimate a best practice cost function which denotes the forecasted cost function of banks that are X-efficient and then measure the degree of inefficiency in the sample relative to this best practice. In other words, a bank is considered as inefficient if its costs are higher than those predicted for an efficient bank producing the same input/output configuration and the difference cannot be explained by statistical noise (Altunbas et al, 2001). Efficiency can be measured in two ways; nonparametric programming (Charnes et al, 1978) and parametric stochastic frontier technique (Aigner et al, 1977). The major difference between the techniques is that the parametric frontier (production, cost or profit frontier) assumes that maximising behaviour exists. Another difference is that while parametric techniques measure allocative efficiencies, the non-parametric ones measure technical efficiencies.

The most widely used nonparametric technique is labelled as Data Envelopment Analysis (DEA) and the most widely used parametric technique is called Stochastic Frontier Analysis (SFA). Both techniques have their advantages and disadvantages, but the choice depends on the situation. DEA measures bank's efficiency by the ratio of its own cost to the cost of the 'best practice' bank that faces the same input prices and produces the same output bundle. One benefit of DEA is that it does not dictate a particular functional form. However, one drawback of DEA analysis is that it does not allow for any error in the data, thus stating that all the error term is accredited to inefficiency.

Detailed information about nonparametric methods can be found in Styrin (2005), and Hsien-Chang Kuo et al. (2008).

On the other hand, in the SFA analysis, a bank is labelled as inefficient if its costs are higher than the costs predicted for an efficient bank producing the same output/input price combination and the difference cannot be explained by statistical noise. In other words, it breaks down the error term into the expected value of inefficiency and random variation (measurement error). The random error takes either a positive or negative value. In cost functions, the inefficiency term is always positive as it raises costs. Since some studies argue that this approach may lead to biased results, Battese and Coelli (1995) extend and improve on SFA by estimating the impact of the determinants of inefficiency simultaneously with the efficient frontier by applying iterative maximum likelihood procedure. This method has been gaining ground in bank efficiency literature.

3. Data and methodology

3.1 Data and sample

We use a panel data set of individual Japanese Shinkin and credit cooperative banks for the period 2003 to 2006. Data were collected from banks' balance sheets and income statements obtained from the Fitch IBCA Bankscope database to construct standard accounting measures of risk activity. The sample comprises a large set of panel data of 263 banks over the four years under consideration. Shinkin banks dominate the sample, comprising 74% of the total. The number of banks is limited by data availability. All variables in this study are measured in YEN (billions).

3.2 Methodology

We adopt the approach suggested by Shrieves and Dahl (1992), Jacques and Nigro (1997), Kwan and Eisenbeis (1996), Hughes and Mester (1998) and Rime (2001) to estimate the relationship between risk, capital and efficiency. They underline that capital and risk decisions are made simultaneously and are interrelated. This endogeneity can make OLS estimators inconsistent and thus calls for the use of a simultaneous equation specification and estimation methodology.

However, like Altunbas et al (2007), we modify the approach by using the level rather than changes of data as we are limited by the length of data period. To allow for simultaneity between banks' risk, capital and efficiency, a system of equations is being used and estimated using two-stage least squares (2SLS) approach through panel data techniques as follows: -

$$RISK_{i,t} = \alpha_0 + \alpha_1 CAP_{i,t} + \alpha_2 INEFF + \alpha_3 SIZE_{i,t} + \alpha_4 NLTA_{i,t} + e_1 \ldots\ldots\ldots (1)$$

$$CAP_{i,t} = \beta_0 + \beta_1 RISK_{i,t} + \beta_2 INEFF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 ROA_{i,t} + e_2 \ldots\ldots\ldots (2)$$

$$INEFF_{i,t} = \gamma_0 + \gamma_1 CAP_{i,t} + \gamma_2 RISK_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 OBSTA_{i,t} + e_3 \ldots\ldots\ldots (3)$$

Banking sector risk is represented by equation (1), bank capital by equation (2) and determinants of bank inefficiency by equation (3). Based on the different definitions of risk described in the previous section, this paper focuses on accounting measures of risk proxied by credit risk. It is worth noting that measuring banks' risk can be difficult for those institutions that do not have regular traded securities (Shrieves and Dahl, 1992, Rime, 2001). Since the Japanese cooperative banks do not have public traded securities, we resort to the use of accounting measures of banking risk. However, one limitation of the accounting measure is that managers may have some influence over these measures and can thus exercise cautious in a way to minimize regulatory costs. Equation 1 uses loan-loss reserves as a fraction to total assets ($RISK_{i,t}$) to capture banking risk. Higher levels of loans loss reserves signal higher banking risk. In our study, capital is proxied by the ratio of equity to total assets ($CAP_{i,t}$), which align with the definition used by Shrieves and Dahl (1992). We could not use risk-based capital ratio as the data was not available.

We use the concept of X-efficiency to compute bank cost inefficiency. X-inefficiencies are usually the combination of technical and allocative inefficiencies (Leibenstein, 1996). Technical efficiency

represents the ability of the firm to produce maximum output from a given sets of inputs, while allocative efficiency refers to the ability of a firm to use the inputs in optimal proportions given their respective prices and technology. A combination of both provides a measure of cost efficiency when cost is observed instead of production. Individual bank cost inefficiency ($INEFF_{i,t}$) is obtained as the distance of a firm's observed operating costs to the minimum or 'best-practice' efficient cost frontier and is derived using the stochastic efficient cost-frontier methodology of Aigner et al.(1977)[6].

[6] We base our discussion on the stochastic efficient frontier production methodology developed by Aigner et al 1977) to measure the X-inefficiency of each banking firm. From this formulation, the stochastic cost function model was developed. For more illustration, see Schmidt and Lovell (1979) and Kwan & Eisenbeis (1996). In this method, a banks' observed cost is formulated to deviate from cost-efficient frontier due to random noise and inefficiency.

For the *n* th Firm,

$$\ln TC_n = f(\ln Q_i, \ln P_j) + \varepsilon_n \text{.....(4)}$$

Where TC_n is the total operating costs (including interest costs), outputs Q_i (loans and other Earning assets), input prices P_j (wages, interest costs and other operating costs).

In equation (4), ε_n measures the distance of banks' actual total costs to the cost-efficient frontier and includes the following two-component disturbance term of the form:-

$$\varepsilon_n = U_n + V_n \text{.....(5)}$$

Where V_n represents the random term and assumed to be independent and identically distributed (i.i.d.)

N $(0, \sigma_v^2)$

U_n accounts for cost inefficiency in production and assumed to be distributed independently of V_n and a half-normal distribution i.e. the absolute value of a variable that is i.i.d. N (0, σ_u^2)

To specify the cost function in equation (4), we employ the following multiproduct translog cost function using intermediation approach (Sealey and Lindley, 1977):-

$$\ln TC = \lambda_0 + \sum_i \lambda_i \ln Q_i + \sum_j \beta_j \ln P_j + 1/2 \sum_i \sum_k \gamma_{ik} \ln Q_i \ln Q_k + 1/2 \sum_j \sum_h \zeta_{jh} \ln P_j \ln P_h + \sum_i \sum_j \omega_{ij} \ln Q_i \ln P_j + \varepsilon \text{.....(6)}$$

The Cost-inefficiency of firm *n*, defined as C_n, is expressed as the expected value of U_n conditional on ε_n (Jondrow, Lovell, Materov, and Schmidt, 1982):

The bank-specific variables consist of net loans to total assets ($NLTA_{i,t}$); loan growth may increase risk and have an unfavourable impact on capital and bank efficiency. The variable logarithm of total assets ($SIZE_{i,t}$) is also incorporated to account for the effect of size in the bank´s capital position. Large banks are expected to have a greater degree of leverage (Demsetz and Strahan, 1997). On the other hand, Hughes, Mester and Moon (2001) suggest that big banks usually hold less capital as compared to smaller ones as they benefit from diversification and other size advantages.

In addition to risk and inefficiency, the capital level of cooperative banks is also likely to be linked to earnings ($ROA_{i,t}$), as retained earnings represent the main basis for banks to improve their capital position. The level of capital is expected to be positively related to the profitability of the banking firm, as earnings will be ploughed back into reserves. For example, earlier studies by Berger (1995) observe that profits and capital are positively related in US banking. Finally, the ratio of off-balance-sheet items to total assets ($OBSTA_{i,t}$) is also included to capture off-balance sheet (OBS) activities (loan commitments, standby letters of credit and commercial papers). OBS activities help banks to increase their sources of revenue without adjusting their capital structure. The moral hazard hypothesis states that OBS activities increase bank risk and thus leads to inefficiency.

$$C_n = E\ U_n / \varepsilon_n\ = [\sigma\lambda / (1+\lambda^2)][\varphi(\varepsilon_n\lambda / \sigma) / \phi(\varepsilon_n\lambda / \sigma) + \varepsilon_n\lambda / \sigma].....(7)$$

Where:-

λ : Ratio of the standard deviation of U_n to standard deviation of V_n (i.e., σ_u / σ_v); $\sigma^2 = \sigma_u^2 + \sigma_v^2$

φ : Cumulative standard normal density function, and ϕ : Standard normal density function

Estimates of C_n are obtained by evaluating equation (3) at the estimates of σ_u^2 and σ_v^2.

We computed the estimates of C_n for each bank in the sample period using a program called Frontier Version 4.1 devised by Coelli (1996) for Stochastic Frontier Production and Cost function estimation by the method of maximum likelihood. We are grateful to Prof. T.Coelli for responding to questions on the calculations of firm efficiency level in the FRONTIER programme.

4. Empirical Results

This section presents results derived from the simultaneous model described above where risk, capital and cost inefficiency are the endogenous variables. Two stage least squares with fixed effects[7] estimation has been used and the results for each equation are disclosed separately for ease of explanation. We have adopted the 'balanced panel' approach, whereby each bank is always represented in each time period. A challenge in modelling a panel with long-time dimension is that variables are likely to be non-stationary. However, our sample has only four years time dimension. We thus investigate the nature of stationarity of our data by conducting unit root tests (Maddala and Wu, 1999). The test statistics reject the null hypothesis that the variables are non-stationary. This may be due to the short time dimension of our panel data set. A White test (1980) was also carried out to investigate cross-sectional heteroscedasticity and the hypothesis of homoscedasticity is not rejected at the 5% level of significance. We also conduct a Hausman test for the endogeneity of risk, capital and inefficiency variables and the null hypothesis that they are endogeneous is not rejected at 5% significance level. First, we report our findings on the determinants of bank risk, followed by that of capital and inefficiency equations. Bank and time heterogeneity are captured by the use of fixed effects estimation procedure.

4.1 Determinants of banking risk

Table 1 summarizes the regression results for the estimation of the risk equation derived from the simultaneous estimation. An accounting measure of bank risk (loan-loss reserves as a proportion of total assets, RISK) is used as the dependent variable. The ratio of equity to total assets (CAP) is significantly and negatively related to risk. In other words, Japanese cooperative banks with lower capital take on more risk. The results are similar to those obtained for European cooperative banks as discussed in the introduction of the paper. This may reflect the moral hazard problem whereby

[7] Generally, the estimation procedure is intended for consistency (Baltagi, 2001). Fixed effects and instrumental variables are used to sort out any possible endogeneity between errors and regressors. Hausman Test was also conducted and the rejection of the null hypothesis shows that fixed effects is preferred in this case against random effects (GLS).

banks exploit the benefits of deposit insurance. Previous studies show evidence that cooperative banks engage in less risky activities. Some authors observe that cooperative banks are more stable than commercial banks. For instance, the Swiss Raiffeisen banks resisted the real estate crisis of the early 1990s and French cooperative banks were less hit than commercial banks during times of banking stress in the 1980s and 1990s. Italian cooperatives also suffered lower loan losses in recent years (Cihak and Hesse, 2007).

In the case of the inefficiency (INEFF) variable, the positive effect of inefficiency on risk-taking supports the view that inefficient banks are more vulnerable to risk-taking than high more efficient ones. Larger cooperative banks come out to be more risky than their smaller counterparts as shown by the positive sign of SIZE. Net lending (NLTA) is inversely related to risk, thereby indicating that loan growth is linked to loan-loss reserves level.

Table 1: Bank risks ($RISK_{i,t}$ as the dependent variable)

Estimates from the risk equation derived from the simultaneous equations using 2 SLS approach with fixed effects estimation are described using loan-loss reserves to total assets ($RISK_{i,t}$) as the dependent bank risk variable. The table reports the results obtained for Japanese Shinkin and credit cooperatives banks over the years 2003 to 2006. Independent variables include bank-specific indicators (denoted by subscripts *i*) at period (subscript *t*). The bank-specific indicators include: equity to assets ratios for bank *i* at period *t* ($CAP_{i,t}$); cost inefficiency estimates derived from stochatic cost frontier estimation ($INEFF_{i,t}$) for each bank; size of each bank proxied by the natural log of total assets ($SIZE_{i,t}$) and the net loans to total assets ratio ($NLTA_{i,t}$) for each bank.

Variable	Coefficient	Standard error	T-value
Constant	-0.3307*	0.0178	-18.5598
$CAP_{i,t}$	-0.4963*	0.0882	-5.6293
$INEFF_{i,t}$	0.3300*	0.0164	20.076
$SIZE_{i,t}$	0.0078*	0.0021	3.7000
$NLTA_{i,t}$	-0.0230*	0.0089	-2.5713
Note: * denotes significance at the 5 per cent level			
Number of banks	263		
Observations	1052		
R^2	0.94		

4.2 Capital Equation

Table 2 reports the results for equation (2) where capital is used as the dependent variable. Cooperative banks with higher risk hold a smaller amount of capital as reflected by the negative and

significant sign of RISK. This may suggest that there is lack of intervention by regulators in forcing riskier cooperative banks to hold more capital. There is also evidence of moral hazard incentives as more inefficient cooperative banks run with larger amounts of capital as captured by the positive coefficient of INEFF. As per expectations, we obtain a positive relationship between return on assets (ROA) and capital, such that banks with higher earnings also tend to operate with high capital. This could be explained by the fact that cooperative banks usually depend on retained earnings as they have fewer alternatives to increase their capital ratios as compared to other banks. Added to that, cooperative banks usually require considerable investment in retail infrastructure and human resources, and these in turn allow them to achieve high returns on assets. The negative relationship between size and capital may be attributed to the fact that larger banks will aim at a lower capital ratio as they have easier access to capital and can raise capital more easily due to lower transaction costs.

Table 2: Bank Capital ($CAP_{i,t}$ as the dependent variable)

Estimates from the capital equation derived from the simultaneous equations using 2 SLS approach with fixed effects estimation are described using equity to assets ratios for bank *i* at period *t* ($CAP_{i,t}$) as the dependent bank capital variable. The table reports the results obtained for Japanese Shinkin and credit cooperatives banks over the years 2003 to 2006. Independent variables include bank-specific indicators (denoted by subscripts *i*) at period (subscript t). The bank-specific indicators include:loan-loss reserves to total assets ($RISK_{i,t}$); cost inefficiency estimates derived from stochatic cost frontier estimation ($INEFF_{i,t}$) for each bank; size of each bank proxied by the natural log of total assets ($SIZE_{i,t}$) and the return-on-assets ($ROA_{i,t}$) for each bank.

Variable	Coefficient	Standard error	T-value
Constant	-0.2247*	0.0448	-5.0158
$RISK_{i,t}$	-0.7703*	0.1132	-6.8035
$INEFF_{i,t}$	0.2619*	0.0355	7.3803
$SIZE_{i,t}$	-0.0007	0.0040	-0.1748
$ROA_{i,t}$	0.0919*	0.0286	3.2132
Note: * denotes significance at the 5 per cent level			
Number of banks	263		
Observations	1052		
R^2	0.99		

4.3 Inefficiency equation

Table 3 shows that bank capital (CAP) has a significant and positive coefficient implying that better capitalised firms operate less efficiently than undercapitalised ones. This contrasts with the results

in most of the literature analysing the determinants of bank efficiency (Kwan and Eisenbeis, 1997; Berger and Young, 1997) that well capitalised banks are better run. As regard to the effects of risk on efficiency, the results are in line with those in the risk equation. The accounting measure of credit risk (RISK) is positively and significantly related to inefficiency. It suggests that operating inefficiency may be the result of managing a larger amount of loans. Contrary to expectations, off-balance sheet items to total assets (OBSTA) appears to be negatively related to inefficiency suggesting that banks who are more actively involved in OBS activities operate more efficiently.

Table 3: Cost Inefficiency ($INEFF_{i,t}$ as the dependent variable)

Estimates from the capital equation (model 3) derived from the simultaneous equations using 2 SLS approach with fixed effects estimation are described using cost inefficiency estimates derived from stochatic cost frontier estimation ($INEFF_{i,t}$) for each bank as the dependent bank capital variable. The table reports the results obtained for Japanese Shinkin and credit cooperatives banks over the years 2003 to 2006. Independent variables include bank-specific indicators (denoted by subscripts *i*) at period (subscript *t*). The bank-specific indicators include:loan-loss reserves to total assets ($RISK_{i,t}$);equity to assets ratios for bank i at period t ($CAP_{i,t}$); size of each bank proxied by the natural log of total assets ($SIZE_{i,t}$) and the ratio of off-balance-sheet items to total assets ($OBSTA_{i,t}$) for each bank.

Variable	Coefficient	Standard error	T-value
Constant	0.8740*	0.1243	7.0331
$CAP_{i,t}$	2.4727*	0.9807	2.5214
$RISK_{i,t}$	4.4625*	1.3232	3.3726
$SIZE_{i,t}$	0.0171	0.0329	0.5212
$OBSTA_{i,t}$	-0.5857	0.5583	-1.0491
Note: * denotes significance at the 5 per cent level			
Number of banks	263		
Observations	1052		
R^2	0.58		

5. Conclusion

This paper reports the relationship between risk, capital and efficiency for a large sample of Japanese cooperative banks between 2003 and 2006. We adopt a simultaneous equation model in which risk, capital and cost inefficiency are modelled as dependent variables. The results confirm the belief that risk, capital and inefficiency are simultaneously determined. Empirical evidence reveals an inverse relationship between risks on the level of capital but we find that inefficient cooperative banks take on more risk and hold a higher level of capital. This somehow supports the moral hazard behaviour whereby inefficient banks are more prone to engage in more risk-taking activities. Banking capital has a negative influence on efficiency of Japanese cooperatives banks

suggesting that better capitalised banks tend to operate less efficiency. As regards to size, larger cooperative banks holding less capital, take on more risk and are less efficient. Overall our results suggest that regulators should monitor closely bank loan expansion, efficiency and capital adequacy requirement on risk-taking activities so as to ensure a safer operating environment for cooperative banks in Japan.

However, one limitation of this study is that we have focussed our analysis on levels rather than changes. In other words, we examine whether the level of risk is related to the level of capital and efficiency. This is mostly due to the small sample period based on data availability. It may be more convenient to look at changes; given some of the previous studies have emphasized on risk changes and capital augmentation (e.g. Shrieves and Dahl, 1992).

Further studies could compare our findings with that of Japanese commercial banks so as to get more insight of risk-bank behaviour. As discussed earlier, Basel II went into effect in Japan in fiscal year 2006 (end of March 2007). It will be interesting to compare our findings with the post-Basel II period to observe the effects of Basel II on the risk-capital relationship.

Cooperative banks are also involved in risk-taking activities but to a lesser extent than commercial banks. This is because they are less driven by the need to maximize profits for investors and bonuses for managers. For instance, under the present financial crisis marked by the massive public bail-out of private investor-owned banks worldwide, hardly any cooperative banks have asked for government help (Birchall and Ketilson, ILO, 2009). By focusing on the needs of their members, most cooperatives banks worldwide have escaped the excessive risk-taking that hit many large global financial institutions. Thus they continue to play an even more important role as consumers and businesses face a credit crunch by supplying funds to their clients. We thus believe that cooperatives banks may not be the solution to the world's problems but they are certainly part of the solution.

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