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# Micro and macro determinants of bank fragility in North Cyprus economy

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**The main purpose of this paper is to empirically investigate the determinants of bank fragility in the North Cyprus Economy from 1984 to 2008, using a multivariate logit model. A panel data set containing bank level data for 24 commercial banks together with variables related to the macroeconomic environment. The empirical methodology employed in the article allows for the determination of the factors that influence the probability of bank failure. The model links the probability of banking problems to a set of bank-specific factors and macro-environment that may have exacerbated the internal troubles of the financial institutions. The empirical findings suggested that, capital inadequacy, lower income, lower bank size, high inflation rate, lower growth rate, adverse terms of trade shocks and market pressure in Turkey are important determinants of banking sector distress in North Cyprus.**

**Key words:** North Cyprus, determinants of bank failure, logit model, market pressure index.

## INTRODUCTION

The North Cyprus economy experienced severe economic and financial problems between the years 2000 to 2008. In 1999, there were a total of 37 authorised commercial banks operating in North Cyprus. However, towards the end of 2008 thirteen of these banks were revoked from operation and five were taken over by other banks. The understanding of what caused the banking system failure in Northern Cyprus would help bank examiners, supervisors, regulators, investors and policy makers in their decisions to alert management in time and to prevent a recurrence. The ability for early detection of any financial weaknesses will help to minimize any costs brought about by financial instability.

In December 1999, the International Monetary Fund (IMF) supported the pegged exchange rate base anti-inflation programme implemented in Turkey. However, after fourteen months from the start of the programme, in February 2001, the programme had to be abandoned with the collapse of the TL. During the period of 2000 to 2002, ten financial banks were forced by the Government of North Cyprus to suspend their operation. In 2000, five banks, namely the Cyprus Credit Bank Ltd., Cyprus

Liberal Bank Ltd., Everest Bank Ltd., Kibris Yurtbank Ltd. And Cyprus Finance Bank Ltd., were put under the Saving Deposit Insurance Fund (SDIF), and then these banks were closed in the year 2001. The bankruptcy of these five banks started a serious banking crisis in North Cyprus. Another four banks, namely Cyprus Commercial Bank Ltd., Yasa Bank Ltd., Tilmo Bank Ltd. and Asia Bank Ltd., were put under the SDIF in 2001, and Cyprus Industrial Bank Ltd. was put under SDIF in 2002. Furthermore, Finba Ltd. was taken over by Artam Bank Ltd. in 2000 and Med Bank Ltd.; Hamza Bank Ltd. were taken over by Seker Bank Ltd. in the years 2001 and 2002, respectively; Mediteranean Bank was taken over by Vakıflar Bank Ltd. in the year 2005 and Altınbaş Bank Ltd. was taken over by Creditwest Bank Ltd. in the year 2009.

In December 2009, three banks namely; Deniz Bank Ltd., Yeşilada Bank Ltd. and Continental Bank Ltd. were failed to meet a capital adequacy ratio set by the Central Bank of TRNC and put under the SDIF.

Theoretical models of crises can be examined under three categories: the first, second and third-generation

models. The first-generation models focus on the role of weak fundamentals in the policy of government as a triggering factor of currency crises. The fiscal deficit, growth of money supply, current account balance and the level of foreign exchange reserves are the economic indicators that are derived from this framework. This model assumes that the government budget deficit is the root of speculative attacks on pegged exchange rates. In general, the main features of the crisis in Latin America in the early 1980s, can be defined by first-generation models (Krugman, 1979; Saxena, 2004).

However, the first-generation models failed to explain the crises in Europe (1992 - 1993) and in Mexico (1994 - 1995). This failure led to the development of second-generation models. The second-generation currency crises models offered no critical developments to fundamental macroeconomic variables; instead, it provided model of self-fulfilled speculative attacks in foreign exchange markets. In this model, market expectations directly influence macroeconomic policy decisions in a rational direction (Obstfeld, 1986).

When financial crises erupted in South East Asia in 1997, neither first nor second-generation models explained the reasons for failure. During this crisis period in Asian countries inflation, government deficit and unemployment were low and credit was high. Hence, this crisis in Asia has revealed the need for a new framework that integrates weaknesses in the banking sector into the early generation models. This new framework, which takes into account the weaknesses of the financial sector, is called the third generation models or the term twin crises, which emphasize the occurrence of both banking and currency crises (Krugman, 1999; Radelet and Sachs, 1998; Kaminsky and Reinhart, 1998).

The theoretical framework of third-generation models is the analysis of financial crises that combine two important principles (weak macroeconomic fundamental and self-fulfilled attack) of first and second-generation models with the banking sector. In addition, this new framework considers new issues such as moral hazards, the herding behaviour of bankers and portfolio managers and international contagion effects appearing as a result of trade or financial linkage between countries. In this context, the financial fragility-based explanation relies on the third-generation models.

## LITERATURE REVIEW

The empirical literature on banking fragility is investigated under two categories. These are micro and macro approaches. At the micro level, institutional weaknesses are the main causes of bank failure. These studies focus on individual banks' balance sheet data and aim to identify micro variables that determine the reasons for individual bank failure. In particular, various financial ratios that are consistent with the CAMELS rating system are employed to produce an evaluation of the condition of

the banks (Martin, 1977; Avery and Hanweck, 1984; Espahbodi, 1991, Kolari et al., 2002; Persons, 1999; Canbas et al., 2004; Rahman et al., 2004; Molina, 2002).

From the macro perspective, banks are strongly influenced by contractions that the economy experiences over time. In particular, banking sector and currency crises are highly influenced by a number of macro variables.

For instance, high interest rate, increasing inflation, output downturns, adverse terms of trade shocks, decline in asset prices, credit expansion, market pressure and losses of foreign exchange reserves are some of the macro variables that influence the functioning of financial and economic systems as a whole. Severe studies on banking crisis has been carried on by Demirguc-Kunt and Detragiache (1998a, b, 2000), Hutchison and McDill (1999), Hutchison (2002), Eichengreen and Arteta (2000), Hardy and Pazarbasioglu (1998), and Domac and Mertinez-Peria (2003) while Frankel and Rose (1996), Sachs et al. (1996) and Eichengreen and Rose 1998) studied currency crises. Further, causality between currency and banking crises can run in either direction: banking sector fragility can lead to a currency crisis or a currency crisis can lead to banking sector fragility (Glick and Hutchison, 2001; Kaminsky and Reinhart, 1995; Miller (1996).

However, the recent empirical studies have started to give more importance to both micro and macro factors. Originally, Gonzalez-Hermosillo (1996) developed a theoretical framework that combined the role of both bank-specific (mainly financial ratios from bank balance sheets) and macro environment, for determining the banking sector distress in Mexico. Severe studies have been conducted on empirical examination of both micro and macro variables by Gonzalez-Hermosillo et al. (1996, 1999), Langrin (2001), Heffernan (1996), Borovikova (2000) and Yilmaz (2003).

## MATERIALS AND METHODS

### The logit model

This article uses a logit model in a panel data framework. Using pooled time series cross-section data (panel data); it is convenient to measure the sensitivity of bank-specific data, macro data over time for each bank. In this article, the standard regression model of bank fragility is pooled as follows (Equation 1):

$$Y_{it}^* = \beta_1 + \sum_{k=1,2,3\dots k} \beta_2 \text{ Micro kit} + \sum_{k=1,2,3k} \beta_3 \text{ Macroeconomic kit} + \sum_{k=1,2,3k} \beta_4 \text{ External shocks kit} + u_{it} \quad (1)$$

Where,

$i=1,2,3,\dots,N$ , represents a cross-sectional unit.

$t=1,2,3,\dots,T$ , represents annual time-series (a time effect).

$k=1,2,3,\dots,K$ , represents a specific potential explanatory variables

$Y_{it}^*$  represent the binary dependent variable for unit  $i$  and time  $t$ .

$u_{it}$  is the disturbance term.

$\beta_1$  refers to constant intercept.

$\beta_{2,3,4\dots}$  refers to the slope parameters.

The data set consisting of observations made from a sample of 24 commercial banks (number of banks  $i$ ) over the period of 1984 to 2008 (over,  $t$  time period) in North Cyprus.

In the context of the logit model, the binary dependent variable  $Y_{it}$  takes the value of 1 if a bank fails (transferred to SDIF, closed or taken over by another bank) during the year, and 0 otherwise.

In practice,  $Y_{it}$  is the latent variable, which is not observable by the researcher and assumed to depend on  $k$  explanatory variables, ranging from  $-\infty$  to  $\infty$ . The latent variable is linked to the observable  $Y_i$  variable by a measurement equation.

The latent variable  $Y_{it}^*$  is linked to the observable categorical variable as follows (Madalla, 2001):

$$Y_{it} = \begin{cases} 1 & \text{If individual banks fail} & \text{If } Y_{it}^* > 0 \\ 0 & \text{otherwise} & \text{If } Y_{it}^* \leq 0 \end{cases} \quad (2)$$

The latent variable link to the explanatory variables is as follows:

Where,

$Y_{it}^*$ : Represents latent variable and its scale can not be determined.

$u_{it}$ : is a composite error term.

$\beta_j$ : coefficient of  $j$  th independent variable, and measures the effects on the odds of failure of a unit change in the corresponding independent variables.

$X_{itj}$ : is a vector of  $k$  number of explanatory variables in period  $t$  for bank  $i$ .

Equation 2 implies that the larger values of  $Y_{it}^*$  are observed as  $Y_{it}=1$  (failed banks), while those with smaller values of  $Y_{it}^*$  are observed as  $Y_{it}=0$  (non-failed banks). In the logit model, the log-odds ratio is a linear function of the explanatory variables (Madalla, 2001). The estimated multivariate logit model links the likelihood of banking problems to a set of variables (Equation 3).

$$\text{Log} \left( \frac{P_i}{1 - P_i} \right) = \beta_0 + \sum_{j=1}^k \beta_j X_{itj} \quad (3)$$

Where,

$P_i$ : represents the probability that bank  $i$  will fail.

$1-P_i$ : represents the probability that bank  $i$  will not fail.

### Identifying the market pressure in Turkey

Currency crises are identified as extreme values of the speculative pressure index. Following Eichengreen et al. (1996), a measure of speculative pressure on currency crises (exchange rate pressure index) is constructed as a weighted average of changes in the exchange rate, changes in the international reserve and changes in the interest rate. To examine currency crises in Turkey, an index of the weighted average of changes in the exchange rates, foreign exchange reserves and interest rates are calculated. Then, the market pressure index (index of exchange rate pressure on Turkish Lira) is calculated as follows (Equation 4) (Eichengreen et al., 1996):

$$MPI_{i,t} = (\alpha\% \Delta e_{i,t}) + (\beta\% \Delta i_{i,t}) - (\gamma\% \Delta r_{i,t})$$

Where,

$e$  denotes the nominal exchange rate vis-à-vis the USA.

$i_t$  denotes short-term interest rates.

$r$  is foreign exchange reserves.

$\alpha, \beta, \gamma$  are weights.

A higher index is reflected in higher values of these three variables, therefore, this indicates greater pressure on the exchange market depending on the nature of the intervention of the respective Central Bank. That is, speculative pressures are either accommodated by a loss of reserves or can be prevented by the monetary authorities through an increase in interest rates (Eichengreen et al., 1996, Frankel and Rose, 1996, Caramazza et al., 2004).

### Data and explanatory variables

The data of this study were obtained from the Central Bank of TRNC and are available from 1984 to 2008. The logit regression results are obtained with the use of STATA 8 software. The micro approach typically uses financial ratios that are in the context of CAMELS criteria and evaluates bank default probability. The weaknesses of banks can be apparent over time from a number of financial ratios that reflect capital inadequacy (C), excessive credit, poor loan quality or poor fund diversification (A), management inefficiency (M), lower income (E), liquidity risk (L) and small asset size (S) as reported by banks. It is theoretically and empirically proved by other studies that each of the above categories has an affect on the probability of bank failure. Hence, the study employs a set of explanatory variables that capture those weaknesses in the North Cyprus banking sector.

In addition to the selected microeconomic (bank-specific) variables that are identified in the CAMELS context, namely, Ratio of total capital to total asset (C), Ratio of loans to total assets (A), Ratio of net income to total assets (E), Ratio of total deposits to loans (L) and natural logarithm of the total assets (S); and three sets of macro variables, namely macroeconomic variables (namely, real GDP growth, the inflation rate, the real interest rates) and external conditions (namely, terms of trade, real exchange rate and market pressure index in Turkey) are included in the model (Gunsel, 2007, 2008). Descriptions and expected signs of a number of micro and macro factors are considered by theory as good indicators of banking fragility in North Cyprus is illustrated in Table 1.

## RESULTS AND DISCUSSION

### Univariate analysis

Including highly correlated macro variables in a model could result in significant bias to the level of the parameters. For this reason, in order to prevent the collinearity problem, the models formed in this research do not include correlated variables in the same model. In addition, in order to have a consistency between both micro and macro data and to prevent the results from being spurious, we tested the stationarity property by adding the Dickey-Fuller Unit Root Test. The result reveal that both micro and macro data are stationary.

### The multivariate analysis

Table 2 reporting the result of the multivariate logit analysis for 5 alternative model specifications, standard

**Table 1.** Definition and expected signs of macro variables.

Variable	Definition	Expected sign failure
<b>Bank-specific variable</b>		
Capital/Asset	Total capital as a percentage of total assets	-
Loan/Asset	Total loans as a percentage of total assets	+
Net income/Asset	Net income as a percentage of total assets	-
Deposit/Loan	Total deposit as a percentage of total loans	- / +
Asset size (1)	Logarithm of total asset	-
<b>Macroeconomic variable</b>		
GDP	The growth rate of real GDP	-
Inflation (INF)	The inflation rate	+
Real interest rate (RIR)	The real interest rates	+
<b>External conditions</b>		
Terms of trade (TT)	The terms of trade change	-
Market pressure index	Index of market pressure in Turkey	+

Notes: 1, Change in the price of export over import.

errors are given in parentheses. Each column presents the results for a specific combination. The number of observations is 309, depending on data availability. The quality of model specification is assessed based on the criteria of the Model Chi-square, Pseudo  $R^2$  and AIC criteria.

In the model, the pseudo  $R^2$  ranges from 61.81 - 63.52, implying that most of the variation of the dependent variable is explained by the model explanatory variables. Model (6) seems to have the highest pseudo  $R^2$ . A chi-square likelihood ratio test of the significance of the overall model indicates that all of the specification models are highly significant (Prob>Chi-square: 0.000). The Akaike's Information Criterion (AIC) compares the model with different degrees of freedom and eliminates the model specification when irrelevant explanatory variables are added into the regression.<sup>1</sup> A model with a lower value of the AIC is judged to be preferable. From the tables, Model 4 appears to have the lowest AIC.

### Bank-specific characteristics

As expected, the coefficient on the measure of capital adequacy is negative and statistically significant, indicating that the lower a bank's shareholders equity to total assets ratio, the higher the probability that the bank will fail in North Cyprus. The results suggested that the ability

of banks to absorb the cost of domestic and external shocks was seriously limited due to being under-capitalized. At that time, regulations were allowing banks to work under low capital requirements, also contributing to the problem. This result is consistent with Martin (1977), Avary et al. (1984), Heffernan (1996), Langrin (2001) and Yilmaz (2003). Since loans are generally the most risky assets that banks hold, the findings on asset quality indicate that banks with high leverage are more likely to fail. Results reveal that asset quality ratio (ratio of loan to total asset) is insignificant.

The results on the profitability measures are negative and for most specifications, it is statistically significant at 1% level, which means an increase in the ratio of net income to total assets decreases the probability of failure. These results are in agreement with those obtained by Martin (1977), Avary et al. (1984), Thompson (1991), Heffernan (1996) and Persons (1999). The findings on the liquidity risk (the ratio of deposits to total loans) are negative and statistically insignificant.

Finally, the measure of bank size (the ratio of total assets of a bank to total banking sector assets) is negative and for most of the specification statistically significant at 95 or 99% confidence level. This suggests that, larger banks experienced a lower probability of failure than smaller banks. The result suggests that large banks are perceived to be "too-big-to fail". Hence, the probability of failure is low.

### Macroeconomic characteristics

The results showed that the growth rate of the GDP is negative and statistically significant at 10% significance level. This suggests that, a sharp fall in the real GDP growth, a reduction in economic activities, is associated

<sup>1</sup>The use of AIC criterion introduces a statistic that gives a measure of the precision of the estimate and a measure of the parameterisation of the model. According to this criteria, a model with the lowest AIC is chosen. The AIC is computed as minus the log likelihood plus the number of estimated parameters of explanatory variables. Then, as is obvious from the model, as the number of variables increases it is less advantageous to the value of the AIC (Fijisoki and Satoh (1997).

**Table 2.** Logit analysis of determinants of bank fragility (Macroeconomic characteristics, financial variables and external shocks).

Variable	1	2	3	4	5
<b>Bank-specific variable</b>					
Capital/Asset	-0.029*** (0.011)	-0.025** (0.011)	-0.032*** (0.012)	-0.044*** (0.011)	-0.029** (0.013)
Loan/Asset	0.009 (0.012)	0.008 (0.013)	0.010 (0.013)	0.007 (0.013)	0.008 (0.013)
Net Income/Asset	-0.107*** (0.033)	-0.111*** (0.030)	-0.113*** (0.033)	-0.099** (0.042)	-0.107*** (0.033)
Deposits/Loan	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Asset Size	-0.307** (0.137)	-0.479 (0.180)	-0.306* (0.170)	-0.328** (0.295)	-0.401** (0.169)
<b>Macroeconomic variable</b>					
Real Interest Rates	-0.005 (0.007)				
Inflation		0.008** (0.004)			
GDP			-0.067* (0.037)		
<b>External condition</b>					
Terms of Trade				-0.138** (0.058)	
MPI(Turkey)					0.242** (0.106)
<b>Constant:</b>	-5.110 (0.931)	-6.764 (1.690)	-4.860 (1.714)	1.224 (3.158)	-5.888 (1.600)
<b>Model statistics</b>					
Wald Chi2	37.83***	35.65***	37.37***	28.10***	30.61***
Pseudo R <sup>2</sup>	61.81	63.01	63.32	63.63	63.52
Log pseudo-lik	-58.053	-57.26	-57.056	-56.856	-56.925
AIC	64.053	63.26	63.056	62.856	62.925

Notes: (1) \*\*\*, \*\*, \* indicates significance at the 1, 5 and 10% level respectively; (2) Standard errors are given in parentheses for the logit model; (3) Specification from 1 - 5 is the bank probability of intervention model.

with an increase in credit risk due to an increase in the probability of default on loans in North Cyprus. These findings are consistent with the findings of Hardy and Pazarbasioglu (1998), Hutchison and McDill (1999), Hutchison (2002), Demirguc-Kunt and Detragiache (1998, 2000), Borovikova (2000) and Yilmaz (2003), who suggested that, the slow growth of GDP tends to be associated with bank distress.

Consistent with previous findings, results indicate that

the inflation rate is positive and statistically significant with 95% confidence level. This proves that a high inflation environment seems to make it hard for North Cyprus banks to evaluate the credit risk of companies and results in deterioration in the quality of borrowers. Other authors such as Hardy and Pazarbasioglu (1998), Demirguc-Kunt and Detragiache (1998a, b, 2000), Domac and Martinez-Peria (2003) and Hutchison (2002) also indicated that high inflation is associated with the

banking sector distress.

Contrary to the significant interest rate of Günsel (2008) findings reveal that real interest rate is insignificant. The results of Heffernan (1996) and Yilmaz (2003) suggested that real interest rate is negatively related to the probability of failure. Sign of the results appear to be contrary to the expectation in the literature. This may imply that as a consequence of increased interest rate, an increase in the amount of deposit may prevent the probability of bank failure. However, if banks fail to efficiently invest customer's funds, then at the end of a contract date it is highly probable that an illiquid bank will fail to pay the customers' deposits plus interest.

### External conditions

Consistent with the results of Demirguc-Kunt and Detragiache (1998) and Hardy and Pazarbasioglu (1998) results in this study reveal that at 5% significant level, adverse trade shocks increase the probability of bank distress. On the 5th of July, 1994 the European Court of Justice ruled that the European Union member states should not accept agricultural product exported by an unrecognised area of the TRNC. This imposed an embargo on agricultural products, which was the major export activity of the North Cyprus economy. The deterioration in the terms of trade negatively affected the ability of borrowers (especially the ability of traders to pay their debts) to repay loans, which resulted in the deterioration in bank balance sheets, thus threatening the solvency of domestic banks and increased the probability of banking sector problems in North Cyprus.

The North Cyprus financial sector is highly integrated with Turkey's Capital Market therefore, it has been increasingly subject to the effects of changes in Turkey. The results confirm that the speculative attack in Turkey is statistically significant at 5% level and positive sign suggest that MPI in Turkey increases the vulnerability of the North Cyprus banking sector.

### Conclusions

The main purpose of this paper is to investigate the banking sector distress in the North Cyprus economy. Empirically, the models are estimated with logit estimation to explain the likelihood of bank failure with an annual panel dataset of 24 commercial banks over the period of 1984 - 2008. In the study, 10 variables are used as explanatory variables to analyze the linkage between micro and macro variables and bank failure. The results confirm that both micro and macro factors are important in determining bank fragility in North Cyprus. The empirical findings suggest that banking distress is associated with bank-specific factors such as low capital adequacy (proxy by total capital as a percentage of total assets); low profitability (proxy by total net income as a

percentage of total assets) and small asset size (proxy by logarithm of total assets), as well as macroeconomic characteristics, namely a fall in real GDP growth, high inflation and adverse trade shocks. The findings also suggested that the exchange rate pressure in Turkey (the speculative attack on the Turkish Lira) put stress on banks operating in North Cyprus and led to banking sector.

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