WHAT FACTORS CAN PREDICT THAT A BANK WILL GET IN
TROUBLE DURING A CRISIS? EVIDENCE FROM UKRAINE.

by

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Abstract

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During the 2008-2009 crisis a wave of bank failures hit Ukraine. Thousands of
people lost their money or spent a lot of time, money and health to get their
money back. This study is devoted to the identification of early warning signs
which could help to identify the weak banks, which would become insolvent if a
crisis would come to Ukraine. I use bank level data for the crisis periods 1997-
1998 and 2007-2008 in order to find the variables that could have been helpful
for predicting banking troubles during both of these periods of financial crises.
Capital adequacy and liquidity indicators are shown to be consistent predictors of
banking failure across crises.

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GLOSSARY

Credit and Investment Portfolio (CIP). Aggregate of all loans and investments that a bank possess.

Loan-Loss Provisions (LLP). An expense set aside as an allowance for bad loans (customer defaults, or terms of a loan have to be renegotiated, etc).

Net Income (NI). An entity's income minus expenses for an accounting period.

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INTRODUCTION

Ukraine has had two massive crises in its 20-year history – in 1998-1999 and 2008-2009. And both of them started with currency crises, resulting in hryvna devaluation. These were then followed by bank runs. Deposit outflows badly affect the liabilities of the banks, reducing their resources. On the other hand, the setback in production and personal income decreased the creditworthiness of borrowers, which further negatively affected the asset side of the bank's balance sheet (Dryha, 2009). Thus, many banks found themselves in a situation of enormous net money outflow.

Despite seemingly huge similarities, the two Ukrainian banking crises were very different in nature, because of the structure and operational environment of banking sector. At the end of the first transition decade Ukraine suffered from high inflation and a declining economy. Ukrainian banks dealt mainly with enterprises, while crediting to individuals was absent. However, a number of firms during transition were ineffective and could easily go bankrupt. The banking system was dominated by "pocket" banks that did not practice borrowing and lending, but kept attracting cheap financing from the NBU for their creators. Thus, a number of banks did not perform real banking activities. The regulatory system had just been established and was still very weak. (Popruga, 2001). Hence, the Ukrainian banking system was quite immature in the 90's. Hence the factors that influenced banking failures were likely to be different from those on the developed markets.

In the late 2000's the situation on the banking market was quite different. Ukraine moved ahead along the transition path - soviet-style enterprises almost disappeared, the economy was growing, the monetary sphere stabilized. This

allowed the banking sector to develop at a high speed starting from 2003. Almost all banks were accumulating individual loans during 2003-2008, and by the end of 2008 such loans compiled an important share of the banking system credit portfolio (36% in the second quarter of 2008 according to the NBU website). Compared to the late 90's the number of foreign banks with 100% of foreign capital increased from 7 to 17. Foreign banks brought capital, competitiveness and new technologies to the Ukrainian banking sector. However, they also "imported" financial shocks from the home countries to Ukraine. (De Haas, 2011). Overall the banking system became much more mature during the 2000's and the factors that determined banking failure became similar to those on developed markets, as shown by Bobykin (2010).

This thesis will develop a failure prediction model, based on the data from these two Ukrainian banking crises and check to what extent the factors that determine bank failure have changed. For each analyzed crisis episode I will have the regressions on three time periods. It will allow me to capture the dynamics of failure indicators before failure and compare results for the same time points prior to the first and second wave of failures. If the coefficients on some variable will be significantly different from zero for both crisis periods, one could conclude that the importance of this variable for the probability of a bank crash determination is do not changes over time.

If the research will uncover the variables that have a consistent effect on the probability of bank failure across these periods, one might have some confidence in the ability of these variables to predict future crisis. Variables that are 'crisis'-specific, however, will be only of limited predictive use though they can help to understand the past.

This paper is organized as follows: first literature review will concentrate on the previous researches in field of bank failures prediction, methodology section will provide insights into the Ukrainian banking crises and contain the description of the econometric model and the data review; it will be followed be the discussion of the results in the results part; the conclusion section will summarize the paper.

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LITERATURE REVIEW

The first part of the literature review will focus on the papers devoted to theories about the determinants of banking failure .Then I review the empirical works that try to test the relevance of the determinants proposed by theory. Then I will examine the most popular methodologies, used to estimate the determinants of bank failure. A brief survey of studies that focus on the Former Soviet Union countries will be the last part of the literature review.

There exists a small number of theoretical works concerning the factors that influence the probability of banking failure. Diamond and Dybvig (1983) examined the shortage of liquidity, as the cause of a banking crises. According to this study, the main purpose of the banks is to transform liquidity, and the situation when each depositor expects other depositors to withdraw money is the main reason for banking failure. Chinn and Kletzer(2000) developed a theoretical model of a financial crises and concluded that countries accumulation of foreign debt is one of the major reasons for the banking failures during currency devaluation. However, other theoretical studies, e.g. Dekle and Kletzer(2001), emphasized the domestic debt risk and high leverage ratio as the main factors that influence the probability of a breakdown. The size of the credit portfolio was also shown to be positively related to the probability of bank failure by Caminal and Matitutes (2002). According to the study large banks are able to diversify individual risk, and thus will accept higher exposure to the aggregate shocks. That will make large banks more vulnerable to the country-level crisis.

The main idea of the empirical studies that examine bank-level data is to find those explanatory variables which help to predict the probability of failure.

Liquidity. One of the widely discussed variables in this context is the Liquidity measure. Gonzalez-Hermosillo et al. (1996), who examined the causes of banking failures during the Mexican financial crisis of 1994, found that bank liquidity, insignificantly affects the probability of banking failure but increase the expected survival time of a bank. The study argue that a large amount of liquid assets may help a bank to survive an unexpected deposit withdrawal, but that on the other hand a high liquidity ratio may be an indicator of poor management and negative future profit. While Gonzalez-Hermosillo measured liquidity as a share of liquid assets (cash, government securities, etc.) in total assets, an alternative method, used by Arena(2008), is to capture liquidity as a ratio of liquid assets to total liabilities. These two indicators may be different in cases when a bank has a high level of equity, with the latter one being better at describing a bank's resistance to an unexpected deposit run-off. Arena shows the liquidity ratio to have an inverse relationship with the probability of bank crash in both studied regions – East Asia and Latin America - during the 1990's. Ercan and Evirgen(2009) studied the Turkish banks failures in 2000-2001 and included both liquidity ratios in the analysis. Consistently with the previous studies, liquid assets-to-liabilities ratio appears to be significant while the liquid assets-to-total assets ratio does not. Another widely discussed variable in this context is relation of retail deposits to total loans, as well share of retail deposits in bank liabilities. Higher share of such deposits increases bank vulnerability to the unexpected bank run (Gonzalez-Hermosillo et al., 1996; King, 2006). Reliance on interbank deposits may indicate intentions to conceal the liquidity problems (Andersen, 2008). The reason is that interbank financing is usually relatively expensive and short-term but easy to obtain.

However, in contrary to the majority of studies, two out of three studies of the Ukrainian financial crisis of 1998-2000 concluded that liquidity was not useful to predict bank failures. Nikolsko-Rzhevskyy (2003) results may be explained by the

fact that such unusual ratios as individual deposits-to-net assets and demand deposits-to-individual deposits were used in order to control for liquidity. Popruga(2000), who also examined the Ukrainian banks crashes during the end of 1990's and used more traditional ratios, such as cash and correspondent account in the central bank to clients' checking accounts andnet assets to net liabilities, also did not find the significant influence of these factors for bankruptcy forecasting. Only Bobykin (2010) found an inverse relation between the probability of banking failure in Ukraine and a liquidity indicator, proxied by the cash to assets ratio. However this study was dedicated to the recent financial crisis of 2008-2010.

Earnings. The classical indicator for earnings is return on equity (ROA), which is general measure of bank profitability (Whalen, 1991; Bongini et al.,2001; Lanine and Vennet, 2005). Interest income to earning assets ratio (Jordan et al., 2010) is not so popular due to the frequent data limitations, while return on equity indicator (Popruga, 2001; Andersen, 2008) may be misleading, as one needs to control for equity size (banks with high amount of assets and banks with low equity may have the same ROE, but still be of different nature). However, the effect of the earnings factor is quite ambiguous. From one side, earnings may reflect the efficiency and operational performance and thus have a negative effect on the probability of failure (Lanine and Vennet, 2005). But from the other side, high profitability may reflect a high level of portfolio risk, and thus has the positive impact on the likelihood of crash (Jordan et al., 2010).

Management performance. The factor of Management performance is difficult to capture with balance sheet data. Andersen (2008) claim that it may be proxied with the location variable: banks operating in small towns have less access to the skilled labor, than banks operating in large cities. A dummy for foreign ownership may reflect management quality, as foreign banks usually have better risk

management practices (Bongini et al., 2001; Arena, 2008). Ploeg (2010) used ratio of total operating expenses to total operating income as a measure of management performance. Banks with high operating expenses relative to operating income are expected to be less efficient and thus have higher probability of failure. Net income relative to the number of branches (Ercan and Evirgen, 2009) or to the number of employees (Halling and Hayden, 2006) also could be indicators of management performance, indicating the bank's productivity. The more productive is the bank the lower is the likelihood of collapse.

Asset quality. This indicator is best measured by the shares of non-performing loans and non-securitized loans to the total loans. A high level of non-performing loans may cause huge losses and thus insolvency (Gonzalez-Hermosillo et al., 1996). Another important indicator of bank risk is the composition of the loan portfolio – e.g. high share of mortgages may indicate that bank is vulnerable to a housing market crisis (King et al., 2006). Several studies, e.g. Logan (2001), Jimenez and Saurina (2005) argue that fast loan portfolio growth is an early warning sign of trouble for a bank. They argue that in order to achieve a high loan growth banks usually tend to accept a large number of unreliable borrowers. Asset quality also includes risk diversification. In this context Herfindahl-index may be used (Thomson, 1992; Andersen, 2008). It is computed by summing up the squares of the shares of loans to the different industries in the total credit portfolio and then dividing this sum on the square of the total loan portfolio. A zero value of Herfindahl-index indicates perfect risk diversification, while value of one indicates the maximum risk concentration.

Capital adequacy. The level of bank equity shows to what extent bank is able to absorb losses, usually caused by risky operations. Total equity plus loan loss reserves to total assets ratio is a traditional measure of solvency and was found to

be a relevant indicator of a bank failure by many studies (Gonzalez-Hermosillo et al., 1996; Lanine and Vennet, 2005; Arena, 2008). Total equity to total liabilities is also proved to be an important warning sign (Ploeg, 2010).

So far we have been focusing on the variables, next we will focus on the estimation methodology. A wide range of methodologies has been used in empirical research on banking failures. The first modern econometric model was univariate discriminant analysis presented by Beaver (1966). Two years later Altman(1968) extended this approach to multivariate discriminant analysis, which allowed to estimate the overall effect of the variety of financial characteristics. This model has been very popular in bankruptcy studies, especially during 70's. However, the assumptions of the model, such as data normality and equality of variance-covariance matrix for sound and failed banks, are frequently violated. As a result Martin(1977) introduced the logit model, which did not have such restrictive assumptions about the variables' distribution. Furthermore, the logit and probit models, which include multi-period observations, were shown to have higher predictive and explanative power than models containing only one period variables, such as Multiple Discriminant Analysis (Shumway, 2001; Chava and Jarrow, 2004). A lot of modern literature is based on the logit/probit models, e.g. Estrella et.al(2000), Arena(2008), Anderson(2008). However, these models can predict the probability of banking failure during a certain time period but cannot determine the exact timing of the failure. The Cox proportional hazards model, first developed by Cox(1972) is the instrument to solve the problem of finding the probable time to failure. The model does not contain any restrictions on distribution of predictive variables and widely used in survival analysis, e.g. Gonzalez-Hermosillo et al.(1996). However, Cox Hazard Proportional model was shown to have almost the same predictive power as logit and probit models (Ploeg, 2010).

The first research that studied bank failure forecasting in CIS countries was Borovikova (2000), which studied the banking failures in Belarus in 1992-1998 and found out that profitability along with loan and securitization ratios were important for bankruptcy forecasting. Another fundamental conclusion of that work was that failure factors are very different in CIS and the developed countries, because factors that are significant for Western countries studies appear to be negligible in case of Belarus. Popruga (2001) study of Ukrainian banking sector also does not confirm the existence of a link between profitability and failure.

However, the most important problem for both researchers, who studied Ukrainian banks, was the lack of data. Nikolsko-Rzhevskyy concluded that the amount of loans to companies is important as an early warning sign as well as with managerial performance, location and size of the bank. However, all the other liquidity and profitability ratios appeared to be insignificant in this work. Bobykin (2010) developed a theoretical model of prediction banking failures using efficiency measures and tested it empirically using the data on Ukrainian banks during 2006-2010. He found that capital, asset quality and liquidity measures influenced the probability of banking failure during the examined period.

Existing studies of Ukrainian banking crises can be good at explaining which factors influence the probability of banking failure during the particular crisis on which their studies were based. However, all of the existing studies have used different methodologies and different variables and thus their results cannot be compared in order to detect reliable predictors of failure over two past crises. Therefore, the question remains whether the model created for only one crisis episode will be useful to predict the bank failures during the future crises, when circumstances will be different. In this thesis, I investigate whether it is possible

to develop a forecasting model that is independent of the specific features of a crisis.

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METHODOLOGY

During the second half of 1998 Ukraine was severely affected by a currency crisis, which seriously damaged the newly established banking system of the country. The wave of bank liquidations began in October of 1998, when liquidation committees were introduced into four banks. In 1998- 2000 a further 14 banks became troubled. I assume that all of these banks got into troubles because of the crisis. However, time was needed for discrepancies to sharpen and for the NBU to make liquidation decisions. Hereafter by banking failure I mean the introduction of a temporary administration or a liquidation committee at the bank.

Table 1.Bank liquidations and temporary administration introductions in 1998-2000

Year	Total number of operating banks	Number of temporary administration or liquidation committee introductions
1998	177	4
1999	163	9
2000	158	5

Source: NBU

In 2008 this situation was repeated. A Hryvna devaluation made many banks to find themselves in trouble at the end of 2008. The NBU introduced temporary administrations and liquidation committees into 26 banks during 2008-2010.

Table 2. Bank liquidations and temporary administration introductions in 2008-2010

Year	Total number of operating banks	Number of temporary administration or liquidation committee introductions
2008	175	1
2009	184	22
2010	182	3

Source: NBU

Econometric model

First I introduce the econometric technique for the analysis and then specify the variables that will be used for predicting bank failures.

First of all a separate logit regressions for each of three time periods for the 1998-2000 crisis episode will be estimated. Than the same will be done for the 2008-2010 episode. The second step will be the computation of marginal effects. Then significance of each variable marginal effects will be examined in each of the three pairs of the corresponding equations for both episodes. If the marginal

effects of some variables are significantly different from zero in both corresponding equations (e.g. in the first equation for 1998-2000 and the first equation for 2008-2010 episode), conclusion could be made that these variables are robust warning signs of banking failure at the certain time period prior to crisis.

The logit regression has the form:

$$y^* = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n + u_i \qquad (1)$$

where y* is unobservable latent variable, which has no defined unit of measurement. The binary variable y, which we actually observe is 1 when y*>0 and 0 otherwise. As a result β_i is the effect of i's factor on the latent variable y* not on observed variable y. Thus, we need to transform the found β_i's into the marginal effects of change in x_i on the probability that y=1.

$$\frac{P(y=1 \mid x)}{x_i} = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n)}{(1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n))^2} \beta_i \qquad (2)$$

One of the most serious drawbacks of the logit model is its vulnerability to omitted variables. The second important drawback is inconsistency of estimators as a result of heteroskedasticity. I will address it with computation of the robust estimates.

Then I will combine the data on the corresponding time periods for the first and the second crisis episode in order to test the whether the coefficients of such variables are stable over time. The regression with crisis period dummies will be employed (equation 3).

$$y* = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots \beta_n x_n + d * \beta_0^d +$$
$$+ \beta_1^d * d * x_1 + \beta_2^d * d * x_2 + \beta_n^d * d * x_n + u_i \tag{3}$$

Where is the dummy for the second period, which is 0 for all the observations of 1990's crisis and 1- for observations of 2000's one. If the coefficient β_n^d will be insignificantly different from zero the conclusion will be made that the average marginal effect of x_n variable is not significantly different across crises.

I assume that 1998-2000 crisis started immediately with the currency devaluation at the end of the August-beginning of the September of 1998, while the 2008-2010 crisis is assumed to start on September, 2008. The last period of 90's crisis I assume to be year 2000, because GDP growth in 2001 was positive first time since 1997. For the 2000's crisis is assumed to have been ended at the first half of 2010. GDP began to grow in 2010. However, all the banks, which welcomed NBU temporary administration in the first half of 2010 were involved in NBU stabilization activities in 2009, and thus they are included into the analysis.

NBU data is usually published on a quarterly basis, however, in order to have sufficient variability between observation periods I will use half-yearly data. As far as I assume both crises to start around September of the corresponding year, than for the first period of time we will have the data on 146 banks at three time points – several months prior to crisis(on 01.07.1998), then about 9 (on 01.01.1998) and 15 months (on 01.07.1997) prior to the crisis. Several banks were excluded from the analysis, because data on them was not available at all of the analyzed periods. Usually these were newly created banks or banks that stopped operating in 1997-1998 (see Table 3).

The same is true for the 170 banks that are available for the analysis in the second crisis episode. Data on several months prior to crisis (on 01.07.2008), then about 9 (on 01.01.2008) and 15 months (on 01.07.2007) prior to the crisis will be employed.

Table 3. Number of the analyzed and problematic banks.

Date	Number of operating banks	Number of banks included in the analysis (incl.state, foreign)	Number of banks included in the analysis (excl.state, foreign)	Number of banks treated as future problematic
01.07.1997	184	147	143	18
01.01.1998	178	147	143	18
01.07.1998	172	147	143	18
01.07.2007	173	170	139	26
01.01.2008	173	170	139	26
01.07.2008	178	170	139	26

Source: NBU data

The variable choice is based on the review of the recent papers, which are reviewed in detail in the literature review part.

The variables that I intend to use are presented in the Table 4. The intuition behind each variable inclusion is presented after the table.

Table 4. Variables used in the analysis.

Category	Variable and Formula	Expected sign
Failure (dependent variable)	1 – if NBU introduced a liquidation committee or temporary administration in the bank during 1998-2000 or 2008-2010, 0 – otherwise	
Capital adequacy	Total Equity/Total Assets	-
Asset quality	Loans to private persons/ Credit and Investment Portfolio	+/-
	Securities/ Credit and Investment Portfolio	+/-
	Credit portfolio growth	+
Management Performance	Total operating expenses/ Net operating income	+
Earnings	Profit/Total assets	+
Liquidity	(Cash+Government securities)/ Total assets	+/-
	Retail deposits/Total Liabilities	+
	Interbank deposits/Total Liabilities	+
Size	Ln(Total Assets)	+/-

Amount of capital in total assets generally indicates the extent to which a bank is able to absorb shocks, thus I expect capital to CIP ratio to affect negatively the probability of failure. A High growth of the credit and investment portfolio may make the bank to accept a significant level of risk, thus it may increase the probability of banking failure. The signs of other variables in the "Asset quality" section is uncertain, because they depends on who of the bank clients suffered more as the result of the currency crisis and which collection instruments a bank has for each of the category of borrowers.

High level of management performance undoubtedly must lower the probability of going into trouble. The higher is the expense of the bank to earn one unit of profit the lower the management performance is supposed to be. The problem

with this indicator appears if the profit is negative. However, in the dataset used the quantity of banks with negative profit does not exceed 5% of the sample size. The sign of the liquidity variable is ambiguous, because excessive liquidity may be not only the indicator of ineffective asset management, but also may help bank to meet an unexpected withdrawal of deposits. Foreign and state ownership dummies are likely to be negatively related to the probability of failure, because state or foreign banks have never failed in Ukraine. Intuitively, such banks have higher level of support from their owners, compared to the other banks.

The effect of the size variable is also questionable. From one side large banks have more space for diversification and staff selection, from the other – they are more vulnerable to the unexpected bank runs due to the importance to the society and close media coverage, which was shown in the cases of Ukrprombank and Nadra bank during the 2008 crisis.

The composition of deposit is also a possibly important for banking failure predetermination – a high level of individual deposits in a bank's credit and investment portfolio makes that bank more vulnerable to a panic. The extent to which bank relies on the interbank deposits is important, because interbank market usually provides only a short-term and expensive but immediate financing - thus interbank deposits usually help troubled banks to hide their problems and to delay dealing with structural imbalances.

Table 5. Mean equivalence testing (incl. state and foreign banks, 1997-1998).

	01.07.1997			01.01.1998			01.07.1998		
Variable	Failed	Non-failed	Diff.	Failed	Non-failed	Diff.	Failed	Non-failed	Diff.
Size (Nominal)	9.19	10.17	0.97**	9.00	10.2	1.2**	8.88	10.36	1.47**
Liqudity	0.20	0.24	0.04	0.09	0.10	0.01	0.05	0.08	0.03*
Securities/CIP	0.11	0.18	0.06	-	-	-	-	-	-
Loans-to-individuals/CIP	-	-	-	0.10	0.10	0.00	0.16	0.09	-0.07*
Bank Deposits/Liabilities	0.08	0.10	0.03	0.13	0.14	0.01	0.16	0.16	0.00
Retail Deposits/Liabilities	0.16	0.18	0.02	0.12	0.15	0.04	0.16	0.18	0.02
Capital Adequacy	0.36	0.31	-0.05	0.48	0.38	-0.10*	0.53	0.38	-0.15**
Expences/NI	-	-	-	-	-	-	43.72	21.09	-22.63
Profit/Assets	0.02	0.04	0.02**	-	-	-	0.01	0.02	0.01
Credit Growth	0.18	4.59	4.41	-0.02	0.75	0.77	0.09	0.38	0.28

On average 1998-2000 problematic banks had substantially less assets than healthy banks (see Table 5). Beginning from the first observed period the difference in assets had been growing – non-problematic banks have increased their size (in nominal terms) over the three periods while assets of future problematic banks were declining. Future insolvent banks also had on average 16% of the credit and investment portfolio, consisting of loans to individuals, which is significantly higher than the group of healthy banks had and this difference is statistically significant. The 1998 currency crisis has hit the households severely and therefore a large portion of retail loans might have been converted into a high proportion of bad loans causing problems for banks. An

unexpected result is that according to the summary statistics future bankrupt banks had much more capital on average than the other banks. Capital adequacy of failed banks ranged from 0.05 to 0.97(as of 01.07.1998). However, the banks with strong capital adequacy might be very weak on some other factors. Thus, we need to control for the other factors in order to find the true effect of the variable.

Table 6. Mean equivalence testing (incl. state and foreign banks, 2007-2008).

Variable	01.07.2007			01.01.2008			01.07.2008		
	Failed	Non-failed	Diff.	Failed	Non-failed	Diff.	Failed	Non-failed	Diff.
Size (Nominal)	13.57	13.46	-0.11	13.87	13.75	-0.12	14.08	13.93	-0.15
Liqudity	0.07	0.08	0.01	0.06	0.09	0.03	0.05	0.06	0.02*
Securities/ CIP	0.05	0.06	0.01	0.05	0.06	0.01	0.06	0.09	0.03
Loans-to-individuals /CIP	0.22	0.26	0.04	0.25	0.29	0.04	0.26	0.29	0.03
Bank Deposits/ Liabilities	0.20	0.22	0.02	0.18	0.24	0.05	0.20	0.22	0.02
Retail Deposits/ Liabilities	0.39	0.32	-0.07*	0.41	0.32	-0.09**	0.41	0.32	-0.09**
Capital Adequacy	0.19	0.24	0.05	0.22	0.36	0.140*	0.16	0.21	0.056*
Expences/ NI	5.04	12.51	7.47	4.81	15.26	10.45	7.68	17.14	9.46
Profit/Ass ets	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Credit Growth	0.50	0.33	-0.17	0.36	0.67	0.31	0.22	0.25	0.03

The descriptive statistics of the data is presented in the Appendix 2. The mean equivalence testing (t-test with H0: difference between two groups' means is zero) shows that problematic and non-problematic banks had no substantial difference

in the majority of the financial ratios. Difference in liquidity and capital adequacy appears to be significant at 10% level only 3 months prior to the crisis. However, the conclusion could be made that three months prior to crisis the future problematic banks already had on average 1,5% lower liquidity level and 5,6% lower capital adequacy than non-problematic banks. The second important finding is that problematic banks had higher share of individual deposits in their liabilities. Moreover, this difference was growing from 6.8% on average 15 months prior to the crisis to 9.1% on average 3 months prior to the crisis and became significant at 5% level already on January 1, 2008.

C h a p t e r 4

RESULTS

A first result about the importance of specific variables can be obtained by simply looking at the historical data: state and foreign banks never failed in Ukraine. Thus the dummies for State and Foreign ownership are perfect predictors of the probability of failure and hence such variables will be excluded from the regression analysis. However, the question is whether state and foreign banks should be included into the analysis. From one point of view these banks are strongly supported by the country or the Mother Company and this may influence their behavior – they may act in a more risky way without having the possibility to go bankrupt due to the strong funding support of the mother entity. On the other hand all the banks, operating in Ukraine, face the same market opportunities and must comply with the same NBU rules. That is why in this analysis two models will be employed – one will include the data on foreign banks and the other will not.

There are missing variables in each of the regressions for the crisis at the end of the nineties: Expenses-to-Profit variable for the 01.07.1997 and 01.01.1998 equations, Securities-to-CIP for the 01.01.1998 and 01.07.1998 equations, Profit-to-Assets variable for the 01.01.1998 equation - therefore, in order to have consistent and absolutely comparable regressions for both periods, I dropped the corresponding variables in corresponding equations in the regressions for the more recent crisis.

First of all 6 logit regressions (three for each crisis period) were estimated. Then the marginal effects for each bank were computed and an average marginal effect will be found (see Table 7).

Table 7. Regressions results (incl. state and foreign banks, average of the marginal effects, robust estimates)

Variable\Regression	07.1997	01.1998	07.1998	07.2007	01.2008	07.2008
Size(Nominal Assets)	**-0.08****	**-0.16****	**-0.24****	-0.015	-0.017	-0.016
Liqudity	-0.064	-0.44	**-1.47****	-0.76	-1.35	**-2.5****
Securities/CIP	-0.032	n/a	n/a	0.31	n/a	n/a
Ret. Loans /CIP	n/a	-0.13	0.15	n/a	-0.18	-0.039
Bank Dep/Liabilities	-0.15	0.03	**0.25***	-0.11	0.08	0.083
Ret.Dep./Liabilities	-0.19	-0.15	0.15	**0.42****	**0.57****	**0.73****
Capital Adequacy	-0.24	**-0.39***	**-0.53****	**-0.54***	**-0.61***	**-0.82***
Expences/NI	n/a	n/a	**0.0002****	n/a	n/a	**-0.006***
Profit/ Assets	**-3.1****	n/a	0.81	5.5	n/a	-3.02
Credit Growth	-0.03	-0.05	0.02	**0.085****	-0.001	0.058
*-10% significance level, **-5% significance level						

I also have done the probit regressions, which confirms the result of the logit model. The exclusion of state and foreign banks from the sample changes the marginal effects only slightly (see Table C2). Pseudo R-squared is not very low and increases with time, which means that the less time is left before the crisis the higher is the explanative power of the model. (see Table C1)

The significance of capital adequacy indicator and liquidity indicator for both periods is the main finding of the empirical model. The lower is the level of equity the less reliable the bank is. The regression also shows that the factor has significant influence on the probability of failure during the crisis for at least two time points prior to the crisis. The liquidity ratio, on the contrary, became an important indicator of future problems only 3 months prior to each of the crises. Banks that faced the downturn which have higher relative amount of cash and other liquid assets were more likely to overcome the crisis.

Some other variables helped to predict failure in one crisis period but not in the other. And this could be easily explained by the changes in the banking sector environment and structure from crisis to crisis. Analyzing 1998-2000 failures one could see the strong significance of the size indicator. The total amount of assets is strongly negatively related to the probability of banking failure. However, in regressions for 2007-2008 the size variable is insignificant. First of all it may be explained by change in concentration of assets in the Ukrainian banking sector - in 1998 first 7 banks accounted for 80% of assets of the banking system, while in 2008 this number was only 40%. The second factor obviously is the problems in Ukrprombank and Nadra bank– two of the biggest Ukrainian banks - during the 2000's crisis. Nominal assets were used in the model, because only variation of the factor between banks is important in static analysis. However, in order to compare the effects across time I used assets, adjusted for inflation.

The regression results of 2008-2010 crisis episode show us that one of the most significant factors for failure prediction are the share of individual deposits in the liabilities, while the effect of this indicator in the regressions for 1990's crisis is insignificant. In 1998, when only about 15% of banks liabilities were money of individuals, it was not a significant factor that did influence banks viability during a crisis. However, in 2008 when private deposits accounted for about 35% of liabilities, depositors became a real force that could influence the future of a bank. Failed banks had on average 41% of liabilities coming from individuals against 32% of sound banks, and this difference is statistically significant at 5% confidence level. Regression shows that, controlling for other factors, an increase in retail deposits as a percentage of the bank liabilities by one percentage points raise the probability of failure during the crisis by from 0.42% to 0.73%, depending of the timing of the beginning of the crisis.

Another factor that was shown to be important for the prediction of future problematic banks during 2000's crisis is credit growth. Banks willing to increase their credit portfolio quickly usually tend to accept less reliable borrowers. It may lead to debt cancellation and may hurt the bank severely. Credit portfolio growth was expressed in nominal terms. There is no need to adjust for inflation in one-period regressions, because we are interested in differences between two groups of banks, while inflation is external factor that was the same for all banks. However, for comparison between periods real credit growth was used.

Expenses-to-profit ratio was statistically significant factor in 3-month-prior-to-crisis regression for both periods. The puzzle is that the marginal effects for this variable in 01.07.1998 data equation are positive, while in equation on 01.01.2008 are negative. The same puzzle appears 18-month-prior-to-crisis equations with profit-to assets variable. Both puzzles could be explained by the unreliability of profit indicator in the Ukrainian banking sector. Some banks artificially lowered they reported profit in order to pay less taxes. Such practices were especially widespread in 1990's and thus higher profit-to-assets and lower expenses-to-profit ratio may indicate that a bank is not more efficient but more honest. From the other side the bank profit could be less if a bank make loan loss provisions (LLP) out of net operating income. And in this case bank with lower reported profit and higher LLP is more reliable than bank with higher profit and lower LLP. It may explain positive coefficient of profit-to-assets marginal effect and for the second crisis episode. This hypothesis is indirectly supported by the fact that both marginal effects became insignificant if we exclude state and foreign banks (majority of foreign banks have much higher than average LLP in 2007-2008). An interesting result is that the more a bank spent to earn a unit of profit the lower was the probability of default. It may explained by the following: the banks who earn by bearing higher risk appear to have lower costs and be more effective when there are lucky and economic environment is good, but became the first

candidates to default when the crisis come. However all these hypotheses could not be tested within this paper, because of lack of more detailed data.

Table 8. Pooled regressions results (average of the marginal effects, robust estimates)

Results	15 months prior		9 months prior		3 months prior	
	Pooled	Second-period dummy	Pooled	Second-period dummy	Pooled	Second-period dummy
Size (Real Assets)	**-0.094****	**0.8***	**-0.18****	**0.16****	**-0.29****	**0.28****
Liqudity	-0.08	-0.6	-0.5	-0.72	**-1.85****	-0.27
Securities/CIP	-0.038	0.32	-	-	-	-
Ret. Loans /CIP	-	-	-0.14	-0.02	0.19	-0.22
BD/Liabilities	-0.18	0.082	0.03	0.04	**0.31***	-0.24
Ret.Dep./Liabilities	-0.22	**0.59***	-0.17	**0.68****	0.19	**0.43***
Capital Adequacy	-0.29	-0.2	**-0.44***	-0.11	**-0.67****	-0.03
Expences/NI	-	-	-	-	**0.0003****	**-0.005****
Profit/Assets	**-3.61***	**8.48****	-	-	1.02	-3.58
Credit Growth	-0.04	**0.13****	-0.7	0.7	0.03	0.04
*-10% significance level, **-5% significance level						

The pooled model results (see Table 8) show that the average marginal effects of capital adequacy and liquidity are not only significant across crises, but also that the size of the effect is not significantly different across crises. Increase in liquid assets as a share of total assets by one percentage point decreases the probability of failure during a crisis by 1.85% if the crisis is expected to come in three months. Increase in capital-to-assets ratio by one percentage point can reduce the probability of going bankrupt during a crisis by (depending on the time left to the beginning of the crisis) from 0.44% to 0.67%, controlling for the other factors.

An interesting result is that according to the pooled regression the share of interbank deposits in total liabilities is also a uniform sign of future bank insolvency. This result just confirms that Ukrainian banks usually try to solve liquidity problem with easy-to-obtain but short-term interbank loans.

The general description of a failed bank during the 1998-2000 crisis according to the regression results could be expressed as "small bank with low capital base, low profit and liquidity level". The description of the typical 2008-2010 bankruptcy would be "a bank that relied on retail deposits with low capital adequacy ratio, comparatively low administrative expenses relative to profit and low liquidity".

Policy Implications

Undoubtedly, a policy implication of this research would be that the capital adequacy and ratio of liquid assets to total assets are the only factors that have predictive power across crises and hence are robust predictors of banking failure during a crisis in Ukraine, that are independent of the particular economic and banking sector environment. This implication may be used in two ways. From one side looking at capital adequacy and liquidity indicators could help to identify the problematic banks early, and from the other side, keeping tight capital and liquidity regulations can help to prevent future banking crisis.

Since 2008 the NBU is constantly balancing between two parties. From one side bankers argue for lowering capital adequacy norms to stimulate lending, from the other side World Bank, IMF and other organizations advice to increase the norms in order to enhance the stability of the banking system. This research is another argument for keeping the capital adequacy regulations tight, as it statistically shows the relation between low capital-to-assets ratio level and banking failures in Ukraine. During the beginning of the crisis in 2008 capital

adequacy standard H3 was 4%. Beginning from March, 2009 NBU changed the standard to 9% and simplified the methodology of capital adequacy calculation to just (Assets-Reserves)/Total Equity. Now the standard H3 in Ukraine is still 9%, as it was recommended by the Basel Committee. However the average for the banking system capital adequacy ratio was about 15% at the beginning of 2012. It means that the current H3 standard is not binding for many banks and could be increased quite painlessly. Of course, it may have some negative influence on the economy as it will decreases lending. Thus, it needs to be combined with actions that stimulate lending.

Undoubtedly, in order to prevent future failures these regulations should be combined with tight liquidity and retail deposits regulations. With growth in retail segment of the banking market banks became more exposed to the public views and perceptions of the macroeconomic situation. High retail deposit concentration and low liquidity is a fatal combination for a bank that faces a crisis.

The conducted research was limited by data. The data, that is available for 1997-1998 is highly restricted compared to the data published for 2007-2008. However, NBU is increasing transparency requirements among banks and bank reporting culture is improving. Therefore there is hope for that more data will be available in future and it will allow for more detailed research. Obviously, the effect of such factors as loan loss provisions, obligatory NBU reserves, shares of short- and long term loans, deposit interest rates and share of related party loans may be important for banking failure prediction in Ukraine and thus availability of such factors creates the possibility for further research.

C h a p t e r   5

CONCLUSIONS

The objective of this study was to find the factors that could have predicted banking failure in both of the Ukrainian banking crisis. For these purpose consistent and directly comparable models were estimated for both periods. The study included a complete examination of Ukrainian banks for several time periods before the crisis. The results were obtained through the use of logit econometric model. The results are quite logical and consistent with previous studies.

Capital adequacy and liquidity were shown to be reliable predictors of bank failure across crises. Banks with permanently low capital have higher chance to fail during a crisis. The same is true for the bank with low liquidity level on the threshold of crisis. Other factors that are important for banking failure are dependent on the particular economic and market circumstances. Currently the Ukrainian banking market environment is closer to those of 2008 than to those of 1998, thus the share of the retail deposits in liabilities is a factor one should look at in order to identify reliable banks. The more retail deposits the bank has the higher is its vulnerability to the financial crisis.

The implication of this research for the authorities is to keep tight capital adequacy and liquidity regulations in order to prevent future banking failures.

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APPENDIX

Appendix A. Banks which were put under temporary administrations and/or
liquidation committees

Table A1. Banks which were put under temporary administrations and/or
liquidation committees in 1998-2000.

1998 (after September)	Ukrkharchoprombank Zavodbank Krymkredyt Krym-yurt
1999	Shakhtekonombank Agroinvestbank Azovbank Torhovo-promyslovy Volyntorhinvest Halytsky Armand Trast Antek
2000	Budmbank Arkadia Ukrnaftohazbank Era Kniazhy

Source: Herald of the National Bank of Ukraine 5 (May, 2000): 22-33.

Table A2. Banks which were put under temporary administrations and/or liquidation committees in 2008-2010.

2008 (after October)	Natsionalniy Kredit
2009	Prichernomor'e
	Kyiv
	BIG Energiya
	Ukrprombank
	Nadra bank
	Rodovid bank
	ARMA bank
	Transbank
	Volodymirskiy
	Zahidinkombank
	Stolitsa
	Bank Regionalnogo Rozvitku
	Natsionalniy Standart
	Evropeiskiy
	Ukrainian financial group
	Ipobank
	Shidno-Evropeiskiy bank
	Ukrgazbank
	Dialogbank
	Inprombank
	Dnister
	Odesa-bank
2010	Zembank
	Sintez
	Sozkombank

Source: Letters of NBU (www.bank.gov.ua)

Appendix B. Descriptive statistics

Table B1. Descriptive statistics of 01.07.1997 data.

Variable	Failed		Non-failed		
	Mean	St. Dev.	Mean	St. Dev.	Difference
Size	9.19	1.14	10.17	1.63	0.97
Liqudity	0.20	0.14	0.24	0.15	0.04
Securities/CIP	0.11	0.16	0.18	0.18	0.06
RL/CIP	-	-	-	-	-
ID/Liabilities	0.08	0.12	0.10	0.13	0.03
RD/Liabilities	0.16	0.16	0.18	0.13	0.02
Capital Adequacy	0.36	0.29	0.31	0.18	-0.05
Expences/NI	-	-	-	-	-
Profit/Assets	0.02	0.01	0.04	0.03	0.02
Credit Growth	0.18	0.36	4.59	24.74	4.41

Table B2. Descriptive statistics of 01.01.1998 data.

Variable	Failed		Non-failed		
	Mean	St. Dev.	Mean	St. Dev.	Difference
Size	9.00	1.06	10.19	1.53	1.19
Liqudity	0.09	0.06	0.10	0.08	0.01
Securities/CIP	-	-	-	-	-
RL/CIP	0.10	0.12	0.10	0.15	0.00
ID/Liabilities	0.13	0.22	0.14	0.18	0.01
RD/Liabilities	0.12	0.14	0.15	0.16	0.04
Capital Adequacy	0.48	0.28	0.38	0.20	-0.10
Expences/NI	-	-	-	-	-
Profit/Assets	-	-	-	-	-
Credit Growth	-0.02	0.40	0.75	5.97	0.77

Table B3. Descriptive statistics of 01.07.1998 data.

| Variable | Failed | | Non-failed | | |
	Mean	Standard deviation	Mean	Standard deviation	Difference
Size	8.88	0.87	10.36	1.53	1.47
Liqudity	0.05	0.05	0.08	0.07	0.03
Securities/CIP	-	-	-	-	-
RL/CIP	0.16	0.24	0.09	0.12	-0.07
ID/Liabilities	0.16	0.22	0.16	0.18	0.00
RD/Liabilities	0.16	0.18	0.18	0.18	0.02
Capital Adequacy	0.53	0.29	0.38	0.21	-0.15
Expences/NI	43.72	68.82	21.09	118.96	-22.63
Profit/Assets	0.01	0.03	0.02	0.03	0.01
Credit Growth	0.09	0.44	0.38	1.58	0.28

Table B4. Descriptive statistics of 01.07.2007 data.

| Variable | Failed | | Non-failed | | |
	Mean	Standard deviation	Mean	Standard deviation	Difference
Size	13.57	1.19	13.46	1.51	-0.107
Liqudity	0.067	0.036	0.080	0.074	0.012
Securities/CIP	0.053	0.050	0.061	0.103	0.008
RL/CIP	0.216	0.183	0.255	0.222	0.040
ID/Liabilities	0.201	0.141	0.221	0.187	0.019
RD/Liabilities	0.388	0.130	0.320	0.187	-0.068
Capital Adequacy	0.191	0.125	0.240	0.193	0.048
Expences/NI	5.040	3.535	12.50	25.090	7.467
Profit/Assets	0.006	0.003	0.004	0.012	-0.002
Credit Growth	0.502	0.638	0.327	0.727	-0.175

Table B5. Descriptive statistics of 01.01.2008 data.

	Failed		Non-failed		
Variable	Mean	Standard deviation	Mean	Standard deviation	Difference
Size	13.866	1.254	13.747	1.573	-0.119
Liqudity	0.064	0.037	0.092	0.088	0.029
Securities/CIP	0.047	0.041	0.056	0.075	0.009
RL/CIP	0.248	0.207	0.289	0.235	0.041
ID/Liabilities	0.184	0.143	0.236	0.203	0.052
RD/Liabilities	0.407	0.134	0.319	0.173	-0.088
Capital Adequacy	0.218	0.108	0.358	0.371	0.140
Expences/NI	4.808	2.971	15.258	33.627	10.450
Profit/Assets	0.011	0.006	0.010	0.010	-0.001
Credit Growth	0.365	0.259	0.674	3.089	0.309

Table B6. Descriptive statistics of 01.07.2008 data.

	Failed		Non-failed		
Variable	Mean	Standard deviation	Mean	Standard deviation	Difference
Size	14.08	1.23	13.92	1.59	-0.151
Liqudity	0.046	0.023	0.060	0.041	0.015
Securities/CIP	0.058	0.028	0.091	0.102	0.034
RL/CIP	0.259	0.210	0.289	0.222	0.030
ID/Liabilities	0.199	0.161	0.221	0.193	0.022
RD/Liabilities	0.412	0.138	0.321	0.169	-0.091
Capital Adequacy	0.155	0.088	0.211	0.142	0.056
Expences/NI	7.681	6.956	17.13	35.047	9.456
Profit/Assets	0.005	0.003	0.005	0.006	0.000
Credit Growth	0.220	0.160	0.250	0.305	0.030

Appendix C. Regressions results

Table C1. Regressions results (incl. state and foreign banks, coefficients, robust estimates)

Variable	01.07.1997	01.01.1998	01.07.1998	01.07.2007	01.01.2008	01.07.2008
Size	-0.88**	-1.7**	-3.2**	-0.12	-0.15	-0.14
Liqudity	-0.71	-4.8	-20.1**	-6.36	-11.8	-23**
Securities/CIP	-0.36	n/a	n/a	2.6	n/a	n/a
RL/CIP	n/a	-1.4	2.1	n/a	-1.54	-0.36
ID/Liabilities	-1.68	0.3	3.4*	-0.9	0.67	0.75
RD/Liabilities	-2.1	-1.6	2.1	3.47**	4.98**	6.7**
Capital Adequacy	-2.69	-4.25*	-7.2**	-4.52*	-5.34*	-7.57*
Expences/NI	n/a	n/a	0.003**	n/a	n/a	-0.053*
Profit/Assets	-34**	n/a	11.1	45.8	n/a	-27.8
Credit Growth	-0.33	-0.08	0.23	0.71**	-0.009	0.53
Constant	9.09**	16.8**	30.9**	-0.42	1.02	0.79
Pseudo R2	*0.19*	*0.19*	*0.37*	*0.09*	*0.15*	*0.19*
Wald chi2	*16.52*	*11.72*	*21.3*	*14.13*	*14.89*	*26.5*
Number of obs	*147*	*147*	*147*	*170*	*170*	*170*

Table C2. Regressions results (excl. state and foreign banks, coefficients, robust estimates)

Variable	07.1997	01.1998	07.1998	07.2007	01.2008	07.2008
Size (Nominal)	**-0.080****	**-0.16****	**-0.24****	-0.007	-0.005	-0.005
Liqudity	-0.066	-0.45	**-1.51****	-0.61	-1.02	**-2.4***
Securities/CIP	-0.034	n/a	n/a	0.19	n/a	n/a
Ind. Loans /CIP	n/a	-0.13	0.16	n/a	-0.14	-0.052
BD/Liabilities	-0.152	0.03	**0.25***	0.01	0.25	0.21
Ind.Dep./Liabilities	-0.195	-0.15	0.16	**0.45***	**0.59****	**0.78****
Capital Adequacy	-0.245	**-0.4***	**-0.54****	**-0.60***	**-0.77***	**-0.86***
Expences/NI	n/a	n/a	**0.0003****	n/a	n/a	-0.005
Profit/Assets	**-3.17****	n/a	0.83	**5.71***	n/a	-2.28
Credit Growth	-0.031	-0.06	0.02	**0.086***	-0.007	0.074
Pseudo R2	*0.19*	*0.19*	*0.37*	*0.09*	*0.14*	*0.16*
Wald(chi2)	*15.9*	*11.46*	*23.17*	*10.41*	*12.74*	*18.3*
Number of obs	*143*	*143*	*143*	*139*	*139*	*139*
*-10% significance level, **-5% significance level						

Table C3. Pooled regressions results (incl. state and foreign banks, coefficients, robust estimates)

Results	15 months prior		9 months prior		3 months prior	
	Pooled	Second-period dummy	Pooled	Second-period dummy	Pooled	Second-period dummy
Size (Nominal)	**-0.87****	**0.76****	**-1.70****	**1.55****	**-3.18****	3.04**
Liqudity	-0.7	-5.64	-4.83	-6.97	**-20.10***	-2.9
Securities/CIP	-0.36	2.96	-	-	-	-
Ind. Loans /CIP	-	-	-1.39	-0.15	2.07	-2.43
BD/Liabilities	-1.67	0.77	0.3	0.36	**3.35***	-2.59
Ind.Dep./Liabilities	-2.1	**5.56****	-1.6	**6.58****	2.07	**4.61***
Capital Adequacy	-2.69	-1.84	**-4.25***	-1.08	**-7.24****	-0.33
Expences/NI	-	-	-	-	**0.003****	**-0.056****
Profit/Assets	**-33.96****	**79.7****	-	-	11.07	-38.84
Credit Growth	-0.39	**1.26****	-0.71	0.7	0.27	0.38
Dummy for the second period	-	**-9.7****	-	**-15.98****	-	**-30.37****
Constant	**9.08****		**16.78****		**30.95****	
Pseudo R2	*0.14*		*0.17*		*0.27*	
Wald(chi2)	*30.77*		*26.7*		*48.23*	
Number of obs	*317*		*317*		*317*	