Research Brown Bag Presentation

Bank Risk and Deposit Insurance

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Overview

1. Introduction
2. Motivation
3. CAMELS framework
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Introduction

- EWS are statistical tools structured to monitor financial and economic variables and measure the probability of their decline so as to signal, in an early stage, the imminence of an event that could lead to bank impairment.
- The CAMELS framework was developed to ensure uniformity in rating of banks in the United States.

Introduction

- EWS involves the strengthening of bank supervision and decreasing the scope of decision making
- Banks such as the Bank of Italy and Bundesbank employ the duration models in the development of EWS and can be used to estimate both the probability of failure and the estimated time to failure.

Introduction

- It is also more useful for rating institutions to determine weak institutions
- If a bank is flagged as weak it would be more prudent for supervisors to focus more efforts on the particular institution allowing for corrective actions to be taken and this could become progressively stronger as a bank reaches more trigger points

Motivation

- Use CAMELS framework to Develop an Early Warning System for bank failures in Kenya

CAMELS Framework

- Capitalisation; total equity/total assets
- Asset quality: loan loss provisions/total loans
- Managerial quality: non interest expense to average assets
- Earnings: return on equity, return on assets
- Liquidity: liquid assets/deposits, Net loans and leases to core deposits
- Sensititvity to market risk: total securities over total assets

The Kenyan Banking Industry

- During the fiscal year ended June 30, 2017, the Kenyan banking industry comprised of 44 commercial banks, 1 mortgage finance company, 13 microfinance banks, 8 representative offices of foreign banks, 79 foreign exchange bureaus, 17 money remittance providers and 3 credit reference bureaus

The Kenyan Banking Industry

	Institution name	Liquidation Date
1	Postbank Credit Ltd.	20-May-93
2	Trade Bank Ltd.	18-Aug-93
3	Middle Africa Finance Ltd.	20-Aug-93
4	Pan-African Bank Ltd.	18-Aug-94
5	Pan-African Credit & Finance Ltd.	18-Aug-94
6	Thabiti Finance Co. Ltd.	19-Dec-94
7	Meridien BIAO Bank Ltd.	15-Apr-96
8	Kenya Finance Bank Ltd.	29-Oct-96
9	Ari Bank Corporation Ltd.	05-Dec-97
10	Prudential Bank Ltd.	05-May-00
11	Reliance Bank Ltd.	12-Sep-00
12	Fortune Finance Co. Ltd.	14-Sep-00
13	Trust Bank Ltd.	15-Aug-01
14	Euro Bank Ltd	21-Feb-03
15	Prudential Building Society	18-Jan-05
16	Daima Bank Ltd.	13-Jun-05
17	Dubai Bank Ltd.	24-Aug-15
18	Inter-Africa Credit Finance Ltd.	31-Jan-93
19	Central Finance Ltd.	19-May-93
20	Nairobi Finance Ltd.	20-Aug-93
21	Diners Finance Co. Ltd.	20-Aug-93
22	Trade Finance Ltd.	18-Aug-93
23	Allied Credit Ltd.	20-Aug-93
24	International Finance Ltd.	16-Apr-93
25	Heritage Bank Ltd.	13-Sep-96

Data

- The sample consisted of banks supervised by the CBK between 2004 to 2016
- The data is obtained from the CBK bank supervision reports, and annual published accounts.

Analysis

- The main objective of PCA is to determine the important dimensions which can explain the changes in financial conditions of the banks
- The patterns of the relationships must be *correlated* to each other for the PCA to be appropriate

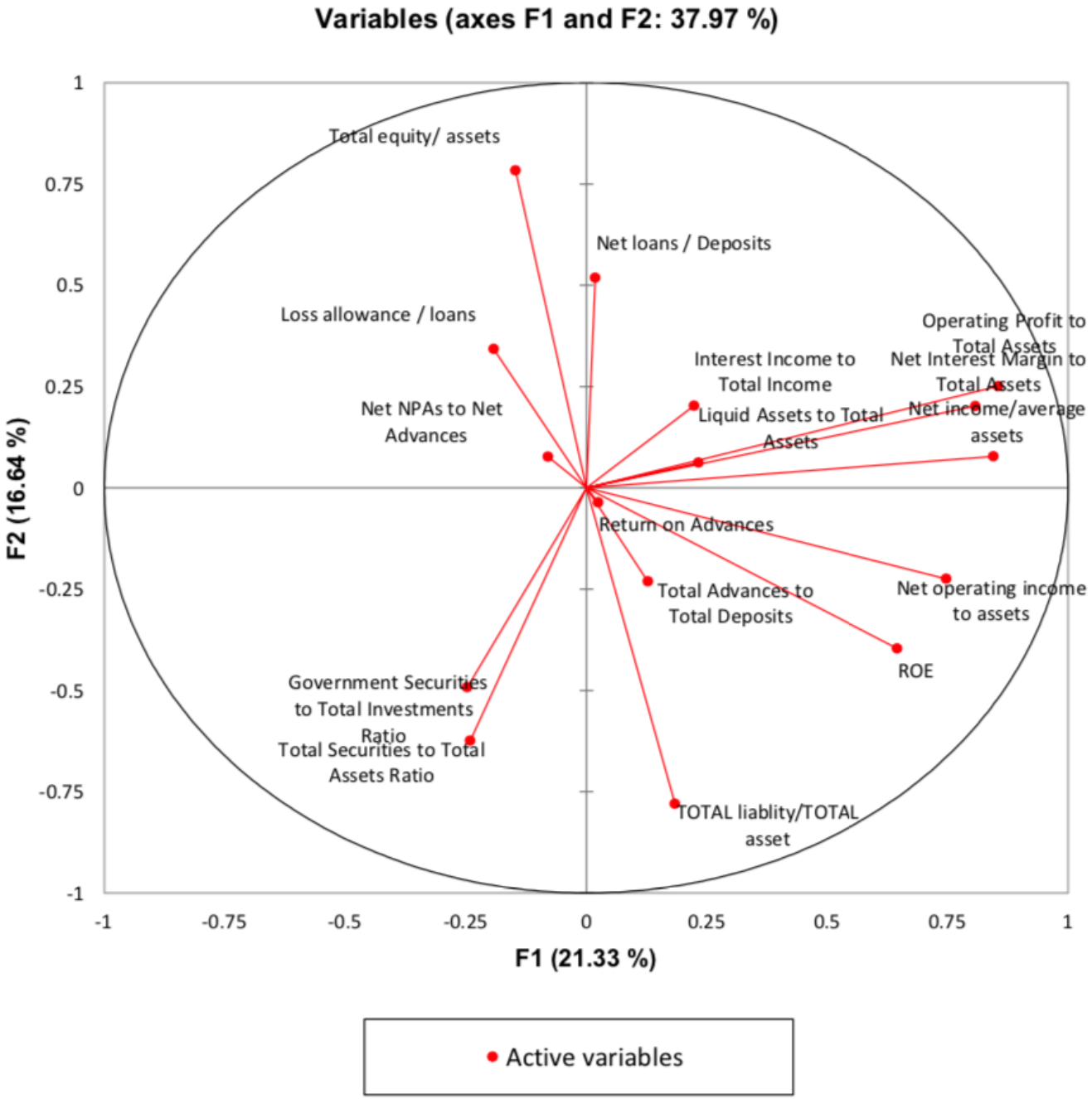
Correlation Matrix of the Ratios

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18
x1	1																	
x2	0.5853	1																
x3	0.2973	0.2765	1															
x4	0.0466	-0.0661	-0.11	1														
x5	0.0983	0.2192	0.015	0.0331	1													
x6	0.0005	0.0214	0.0132	-0.015	0.1303	1												
x7	-0.0151	-0.0229	-0.1589	-0.1151	-0.1047	-0.0589	1											
x8	-0.0242	-0.1079	0.0291	-0.0356	-0.8004	0.0153	0.0695	1										
x9	-0.0126	-0.0195	-0.0056	0.0429	0.0528	0.4093	0.0321	0	1									
x10	-0.1832	-0.1371	-0.2896	0.1084	-0.0507	-0.0649	0.5336	-0.0674	0.0643	1								
x11	-0.2556	-0.3171	-0.1014	0.0657	-0.0691	-0.0661	0.3783	0.0058	0.0711	0.7308	1							
x12	0.0623	0.1403	-0.1048	-0.2473	-0.0621	-0.0541	0.7427	0.0594	-0.0174	0.5579	0.4023	1						
x13	0.0822	0.0921	-0.1129	-0.1184	-0.0535	-0.02	0.664	0.0539	0.0025	0.5031	0.3589	0.7606	1					
x14	-0.1719	-0.1387	-0.1539	-0.1978	-0.0135	0.0595	0.2662	-0.0044	0.0434	-0.0451	-0.0819	-0.0117	0.2504	1				
x15	0.1445	0.39	-0.0291	-0.0158	0.1009	0.0311	0.0264	-0.0213	-0.0051	0.0002	-0.09	0.0887	0.119	0.1495	1			
x16	-0.1143	-0.1489	-0.0916	-0.5177	-0.0558	0.0193	0.1432	0.029	-0.0198	0.0135	-0.0431	0.2003	0.0786	-0.0482	-0.1758	1		
x17	-0.5123	-0.8849	-0.2544	0.1309	-0.2004	-0.0155	0.1162	0.0989	0.0208	0.1573	0.3253	-0.1201	-0.0665	0.1757	-0.335	0.1526	1	
x18	0.0851	-0.1652	-0.0585	0.7291	-0.0224	-0.0286	-0.1785	0.0019	0.0297	0.1063	0.1029	-0.237	-0.1306	-0.4814	-0.2269	-0.1877	0.1884	1

Bartlett's test

- Few of the ratios in the correlation matrix are correlated to each other
- It is used to test the null hypothesis that the correlation matrix of the financial ratios is an identity matrix
- The observed significance level of the test is large 0.691 (threshold is 0.05) hence the null hypothesis cannot be rejected

Correlation Circle



Factor Loadings

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Uniqueness
x1							0.584
x2		0.818					0.1261
x3							0.8281
x4			0.6962				0.2197
x5				-0.7607			0.2462
x6						0.5435	0.6704
x7	0.7572						0.3395
x8				0.7847			0.2551
x9						0.5208	0.703
x10	0.7349						0.296
x11	0.6518						0.4397
x12	0.7481						0.1638
x13	0.692						0.3228
x14					0.5836		0.354
x15							0.7619
x16							0.5642
x17		-0.7849					0.1832
x18			0.6763				0.2495

Factor Variables

- The first factor F_1 consists of the variables $x7, x10, x11, x12, x13$ and thus represents earnings.
- Factor F_2 contains variables x2, x17 and thus represents capital adequacy
- Factor F_3 contains variables x4, x18 and thus represents sensitivity
- Factor F_4 contains variables x5, x8 and thus represents management
- Factor F_5 contains variables x14 and thus represents liquidity
- Factor F_6 contains variables x6 and thus represents asset quality

Eigen Values

- To enhance the interpretability of the financial factors the varimax factor rotation method is used in PCA. This method minimises the number of variables that have high loadings on the factor. [See factor loadings table]
- Variables with large loadings for the same factors are grouped and small factor loadings are omitted.

Eigen Values

Variable	Eigenvalue	Variability (%)	Cumulative %
F1	3.413	21.328	21.328
F2	2.662	16.637	37.966
F3	2.093	13.084	51.049
F4	1.668	10.426	61.475
F5	1.426	8.910	70.385
F6	1.273	7.953	78.338
F7	0.784	4.903	83.241
F8	0.653	4.078	87.320
F9	0.575	3.595	90.914
F10	0.372	2.324	93.238
F11	0.337	2.104	95.342
F12	0.230	1.436	96.779
F13	0.169	1.055	97.834
F14	0.148	0.926	98.760
F15	0.106	0.662	99.422
F16	0.092	0.578	100.000

Eigen Values

- Factor 1 accounts for 21.328% of the variance of financial conditions of banks. Factors F2, F3, F4, F5, and F6 account for 16.637%, 13.084%, 10.426%, 8.910% and 7.953% of the changes in financial conditions of banks respectively
- The estimated 6 factor model explains 78.338% of the total chnages of financial conditions of Kenyan banks

The Logit Model

- The logit analysis is based on cumulative logistic function, provided the probability of a bank belonging to one of the prescribed classes given the financial characteristics of the bank.
- The probability of a bank a to go to failure (P_{La}) is calculated using the logistic function

$$P_{La} = \frac{1}{1 + e^{-Z_{La}}},$$

where

$$Z_{La} = \beta_1 F_{1a} + \beta_2 F_{2a} + \beta_3 F_{3a} + \beta_4 F_{4a} + \beta_5 F_{5a} + \beta_6 F_{6a}$$

The Logit and Probit Model

- Based on that probability a bank is classified as failed or non-failed using the cutt-off probability attempting to minimise type I error(failed banks classified as healthy and type II(healthy banks classified as failed banks)
- Maximisation is by the log-likelihood function
- In the probit method the probability ($P_P a$) of a bank a to go to failure is given cumulative standard normal function

$$P_{P_a} = \int_{-\infty}^{Z_{Pa}} \frac{1}{\sqrt{2\pi}} e^{-z/2} dz$$

The Probit Model

- Principal Component Analysis, logit and probit can are systematically combined together to construct an EWS
- When evaluating a new bank according according to EWS all the system parameters will remain unchanged and only the rations of the evaluated bank will change

Conclusion

- The prediction of failed banks was predicted with an82.22% accuracy and non-failed banks at 78.97% accuracy level, thus the logit model had a predictive capability of 79.21%.

Concerns

- Need for better data(Training and validation datasets)
- Better credit scoring beyond CAMELS
- Better robustness checks
- More categorization - healthy/weak(troubled)/failed banks
- Better identification mechanisms of weak banks