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What Explains Bank Risk? Evidence from An Emerging Economy

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Abstract
Banks face both systematic and idiosyncratic risks in their operations. Using annual hand collected bank level data of 39 commercial banks for the period 2000–2017; this study investigates the determinants of bank risk. Estimation results revealed a significant positive effect of inflation and exchange rate on bank risk while a significant negative effect was reported for bank operational efficiency, liquidity, profitability, age, economic growth, government borrowing and industry competition.
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1. Introduction

Financial systems are the nerve centers of economic development across the globe. They provide intermediation services by channeling funds to investments that guarantee positive return. They also mobilize savings, allocate resources and pool risks (Alper and Anbar, 2011). Since the Global Financial Crisis 2007-2009, banks' stability has become a focal point by policy makers. Enhancing financial soundness has been a key agenda adopted by the Basel Accord and the financial Stability Board (Claessens and Kodres, 2014). The main objective of this study was to investigate factors that may influence bank risk in Kenya. Specifically, the study sought to establish the effects of bank specific characteristics, macroeconomic factors and industry specific characteristic on bank risk.
The survival of commercial banks like every other financial institution depends largely on their profitability. However, banks' profitability depends on external and internal factors. Some of the factors that affect performance of banks are usually beyond the control of the bank management. For instance, the global financial crisis of 2007-2009 posed a systemic risk in the global and international financial markets thus compromising the stability of the financial system at large (Rahman, 2010).

Kenya's financial sector is bank led; therefore any bank failure may result to a systematic risk. Recent cases of bank collapse include Imperial bank, Dubai bank and Chase bank. However, it is also worth noting that the macroeconomic environment may also contribute to bank risk. The banking industry also remains highly segmented as evidenced by the interbank market structure. In addition, tier one banks account for more than 57 percent on the market (CBK, 2016). This poses risk by hindering healthy competition within the industry.

Motivated by these concerns, this study sought to address the following questions: Do bank specific factors influence bank risk? To what extent does macroeconomic environment pose systematic risk among banks? Do industry specific factors pose risk on banks? This paper makes several contributions to an emerging literature on financial stability. First, it is timely in view of the broader issue of financial system stability since banks are the predominant source of finance for firms and households. Second, this study is based on a dataset sufficiently large to enable robust conclusions to be drawn. We will translate our empirical findings into instruments for policy reform and decision making by initiating new policies on bank risk management.

2. Previous evidence

An extensive literature has provided convincing evidence to support the view that differences in macroeconomic environment and bank specific factors may influence bank risk. External factors that affect operations of bank are mainly macroeconomic variables (Karkrah and Ameyaw 2010; Bashir, 2000). These include foreign exchange rate inflation, GDP growth and interest rate (Weersainghe and Perera 2013). Business cycle fluctuations may also negatively impact on the growth of an economy thus significantly influencing the ability of the borrower to repay the loan. This in turn shocks the levels of nonperforming loans (NPL) thus raising bank risk (Soyemi *et al.*2013). There is a correlation between business cycles and bank profits, since profits rise during upswings and decline during downswings (Demirguc-Kunt & Huizinga 1998; Bikker& Hu, 2002).

Existing literature shows that irresponsible lending happens during economic boom (Saurina 2006; Al-Smadi and Ahmed 2009). While analyzing the determinants of bank credit risk in Greece, Italy, and Spain for the period 2004-2008, Beside, Messiah & Jouini, (2013) found GDP to have a significant but negative effect on credit risk. However, the real interest rate, loan loss reserves to total loans and rate of unemployment, had a positive relationship with bank's credit risk. Klein, (2013) finds inflation, business cycle and unemployment to positively influence credit risk, while Škarica (2014) concluded that unemployment, GDP and inflation had a statistically significant relationship with credit risk for the in Central and Eastern European economies. Using a Structural Vector Autoregressive (SVAR) model, Janvisloo *et al.* 2013 established a positive relationship between NPL and monetary shocks. Using non-performing loan ratio as a measure of credit risk, Islamoglu (2015) found public debt

stock to GDP ratios and commercial loan interest rates to significantly influence credit risk.

Apart from the macroeconomic environment within which banks operate, banking competition and banking system stability are reported to be inversely related to bank credit risks as measured by NPLs (Ozil, 2017). The structure of the banking industry will largely affect bank's risks from a competition point of view. A highly segmented banking industry implies that the industry is less competitive and as such the possibility of asymmetric credit allocation is evident. For instance, highly segmented interbank market pose a risk in the banking industry through inefficient credit allocation within the market. High interbank market segmentation implies that the role of the interbank market in ensuring that banks co-insure each other is hindered. Such segmentations arise if the market is less competitive (Weersainghe and Perera 2013). Competition is healthy for banks since banks tend to take more diversified risks so as to remain competitive in the market and as a result they become less affected in case of shocks. In such cases, competition narrows the margin between liability and assets costs thus trading-off bank risks (Rose and Hudgins 2008; Anginer et al. 2012; Demirguc and Huizinga 1998).

Bank risk may also be influenced by bank–specific characteristics. Existing literature points to deposit composition, efficiency management, ownership structure, asset quality, reserve requirement, operating expenses and capital adequacy as factors that influence bank risk. Banks with significant foreign shareholding have a bigger profit margin in developing countries and are less likely to encounter liquidity risk (Garcia-Herrero 2006; Bashir 2000; Demirguc-Kunt and Huizinga 1998). Using NPL as a proxy for credit risk, Al-Wesabi & Ahmad, (2013) finds that liquidity and management quality significantly influence credit risk among the Islamic banks in the Gulf Cooperation Council. Further evidence has been documented by Aemir & Rafisa, (2014) among Ethiopian commercial banks for the period 2007-2011.

These initial findings suggest that bank, industry specific as well as the macroeconomic environment within which banks operate may influence bank risk. It is also evident that the use of z-score in measuring bank risk is scanty and is only mentioned in the theoretical conceptualization but the studies are mute in applying the z-score in their empirical modeling. This study sought to fill this research gap.

3. Methodology and data

Based on the theory and empirical evidence it is evident that a number of factors may cause bank risk. During recession and stagnation credit risk increases and hence banks become vulnerable. The converse is also true during periods where there is economic boom or growth (Fainstein & Novikov, 2011). Increased levels of inflation unfavorably affect the productivity of the banking sector as a result of cyclical downturns. Equity and assets of banks may also be affected when there is hyperinflation thus exacerbating bank risks (Fofack, 2005).

Debt burden is highly affected by the real interest rate. There is a positive causal effect between real interest rates and credit risk: large non-performing loan ratio can be a result of increased interest rates (Louzis, Vouldis& Metaxas, 2012; Aver, 2008; Nkusu, 2011). When the foreign currency appreciates against the national currency, it results to expensive imports (Ngerebo, 2011). Indeed loan portfolio quality and exchange rate are negatively related (Castro 2013). At the bank level, liquidity, profitability and size have negative effect on bank risk (David 2013).

Empirical Model

Consistent with Das and Ghosh (2007), and Rajaraman et al. (1999) the empirical model is specified as follows:

$$BankRisk_{it} = \alpha_i + \sum \phi X_{it}^F + \sum \varphi X_{it}^I + \sum \gamma X_{it}^M + \varepsilon_{it} \quad (1)$$

Where:

Bank risk is proxied by z-score, computed as return on assets which is the profitability indicator plus leverage which is the ratio of equity to assets divided by the risk which is the standard deviation of return on assets.

$$Z - score = \frac{ROA + (Equity / Assets)}{\delta(ROA)} \quad (2)$$

X^F is a vector of bank level characteristics,

X^I is a vector of industry characteristics

X^M is a vector of macroeconomic indicators

$\varepsilon_{it} = \upsilon_i + \gamma_t + \mu_{it}$ is the disturbance term; γ_t is the unobservable time effects, υ_i is the unobserved individual bank-specific effect and μ_{it} is the idiosyncratic error. We used bank size, age, efficiency, return on assets, capital ratio and bank's liquidity level as bank specific variables. Competition as an industry specific variable is captured

by Hirschman-Herfindahl Index (HHI) which represents the squared sum of total assets of banks in the financial industry at a particular year *t*.
Therefore:

$$HHI_t = \sum_{i=1}^{n_{jt}} S_{it}^2 = \sum_{i=1}^{n_{jt}} \left(\frac{ta_{it}}{TA_t} \right)^2 \quad \text{.......} (3)$$

The macroeconomic variables include: the short term risk free interest rates (91– Treasury Bill Rate), inflation rate, GDP per capita growth rate, exchange rate, and government borrowing. In order to determine the extent to which the government relies on the domestic banking sector, we include government borrowing. Therefore, the empirical model is augmented as follows:

$$BankRisk_{it} = \alpha_0 + \beta_1 S_{it} + \beta_2 A_{it} + \beta_3 Eff_{it} + \beta_4 ROA_{it} + \beta_5 Cap_{it} + \beta_6 Liq_{it} + \beta_7 Infl_t + \beta_8 GDP_t + \beta_9 TBR_t + \beta_{10} Gov_t + \beta_{11} Exch_t + \beta_{12} HHI_t + \varepsilon_{it} \quad \text{.......} (4)$$

Where:
$BankRisk_{it}$ is the risk of bank *i* in time *t*.
S -is the size of the bank estimated by the total assets of the bank.
A - is the age of the bank
Eff - is efficiency of the bank's operation.
*RO*A - is the return on assets which captures profitability
Cap - is the capital ratio
Liq -is the liquidity level
Infl -is inflation rate
GDP -is the GDP per capita growth rate.
TBR -is the 91– day Treasury Bill rate
Gov - is the government borrowing
Exch -is the exchange rate
HHI - is the Herfindahl Index to measure banking industry competition

Econometric Approach
When analyzing variables that change over time and change within entities, the fixed effects model is the most suitable. Individuality of firms is taken into account by holding the slope coefficients fixed and allowing the intercept to keep changing across firms. Under this model, entities are allowed to have their individual features and the dependent and independent variables relationship within entity (in our case banks) is explored. Time invariant traits are done away with to allow us access the overall relationship between dependent and independent variables.

Random effects would be suitable when we expect correlation across entities and dependent variables. Under this approach, the disparities among individuals are captured by entity specific error and not intercept which together with the slope of regressors resemble across individuals (Park 2011). Time-invariant variables can be used as explanatory variables because the independent variables are not correlated with the error term.

In panel data analysis, it is always the case that the two models may be estimated. However, the question always arises as to which of the two models is more appropriate in fitting the data at hand. In order to choose the best model, we used Hausman Specification test. Normally, under null-hypothesis, the random effects (RE) is preferred due to higher efficiency, while for the alternative hypothesis, Fixed effects (FE) is consistent and thus preferred (Baltagi, 2013).

Data sources
This study utilized secondary panel data for period of 2010 to 2017. The data was obtained from various sources. Although the banking industry comprises of 42 banks, a total of 39 were sampled since 3 banks are under receivership. Banks level data was obtained from annual audited publications. Macroeconomic data was obtained from Central Bank of Kenya. GDP per capita was obtained from Kenya National Bureau of Statistics.

4. Empirical findings
The descriptive statistics are presented in Table 1. It is evident that the mean z-score as a measure of bank risk for

the 39 commercial banks for period under analysis was 2.86 with the minimum score of -3.08 and a maximum of 6.56. On the distribution, the z-score has a negative skewness. In addition, its distribution is non–normal since it has a fat tail as evidenced by kurtosis value which is greater than 3. The average bank size measured by the total assets was Ksh 63, 100million. A mean value of the operational efficiency as measured by operating cost as a proportion of total costs is 2.55 percent with the mean ROA measured by net profit margin as a proportion of total assets being 3.34 percent.

The average capital ratio for the studied banks measured by ratio of a bank's core equity capital to its total risk-weighted assets was 12.64 percent with the average bank liquidity level measured by current assets to current liabilities being 42.24 percent. Regarding the macroeconomic variables, descriptive results show that the mean values for the inflation rate measured by annualized inflation, GDP measured by annual real GDP growth, short term risk free interest rate measured by 91–Treasury bill rate and the $/Kshs exchange rate measured by annual average of exchange rate were 7.09%, 5.83%, 9.28% and 99.03 respectively. The mean of the government borrowing stood at Ksh 4,133.86 million for the period under review. The industry competition on average was 2.0225 with the minimum value of 0.01 and maximum value of 14.10.

Table 1: Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	skewness	kurtosis
Z-score	312	2.8575	1.3466	-3.08	6.56	-0.3572	4.1574
Bank size	312	63100.0000	85400.0000	491000	50500	2.1135	7.8847
Bank age	312	34	19	2	102	0.9692	4.4798
Efficiency	312	0.0255	0.0193	0.01	0.29	8.5229	114.7960
ROA	312	3.3403	4.8701	-27.62	47.73	1.4088	30.6839
Capital ratio	312	12.6381	56.2083	0.58	711.41	12.2845	152.5863
Liquidity	312	42.2380	26.4839	9.92	39.79	8.0689	105.7133
Inflation	312	7.0938	1.2845	5.61	9.64	0.6837	2.4157
GDP	312	5.8250	1.1038	4.50	8.40	1.2716	4.0847
91TB rate	312	9.2825	0.7535	8.62	10.93	1.1154	3.1528
Govt borrowing	312	4133.8640	2238.6170	1799.24	8476.19	0.8316	2.3583
Exchange rate	312	99.0288	4.5443	89.62	103.10	-1.1554	2.7431
HHI	312	2.0225	2.9018	0.01	14.10	2.0008	6.6502

Table 2 presents correlation analysis which shows that the bank risk as measured by z score is negatively correlated to the size of the bank, operation efficiency, return on assets, capital ratio, GDP growth, bank liquidity, the short term risk free interest rate and industry competition though weak. However, bank risk appears to be positively correlated to bank age, inflation, government borrowing and exchange rate though the relationship is weak as well. Overall, looking at the correlation coefficient among all the variables, the correlation analysis reveals that there are no two variables that are strongly correlated with each other hence no possibilities of multicollinearity.

Table 2: Correlation coefficients

	Z score	size	Age	Efficiency	ROA	Capital ratio	Liquidity	Inflation	GDPP	91 TBR	Govt	Exchange rate	HHI
Z score	1.0000												
Size	-0.0486	1.0000											
Age	0.0679	0.4649	1.0000										
Efficiency	-0.1004	-0.0893	-0.148	1.0000									
ROA	-0.3189	0.4367	0.4228	-0.0946	1.0000								
Capital ratio	-0.0102	-0.0864	-0.146	0.021	-0.2002	1.0000							
Liquidity	-0.1433	-0.2453	-0.1034	-0.2913	-0.1507	-0.1161	1.0000						
Inflation	0.1850	0.0218	0.0107	-0.0302	-0.1482	0.1049	-0.0012	1.0000					
GDPP	-0.3801	-0.1637	-0.0922	0.0974	0.2538	-0.1076	-0.068	-0.7508	1.0000				
91 TBR	-0.0974	-0.0351	-0.0322	-0.0213	0.065	-0.0425	0.0475	0.1729	0.0742	1.0000			
Govt	0.2477	0.2362	0.1465	-0.0808	-0.1095	0.0312	0.0554	-0.1516	-0.3406	-0.3989	1.0000		
Exchange rate	0.388	0.231	0.1314	-0.1195	-0.2335	0.0465	0.1046	0.0987	-0.5292	-0.2527	0.4837	1.0000	
HHI	-0.1682	0.455	0.2069	-0.0556	0.3242	-0.1187	-0.0974	-0.0365	0.1464	0.2968	-0.4697	-0.1914	1.0000

Prior to running the regressions, unit root test was conducted so as to determine the order of integration among the model variables. The Levin-Lin-Chu unit-root test was applied to conduct the unit root test with the Harris-Tzavalis unit-root test being applied for robustness check. Table 3 presents results of the unit root test. The results indicate that under the Levin-Lin-Chu unit-root test, all the variables are stationary at level. Similar conclusions are arrived at when Harris-Tzavalis unit-root test was applied.

Table 3: Unit root test results

	Levin-Lin-Chu unit-root test			**Harris-Tzavalis unit-root test**	
Variables	Unadjusted t statistic	Adjusted t* statistic	P - value	Z statistic	P - value
Zscore	-12.1586	-6.1328	0.0000	-15.2928	0.0000
Bank size	-6.0715	-5.123	0.0000	-5.8075	0.0000
Efficiency	-11.8296	-5.0365	0.0000	-15.5881	0.0000
ROA	-22.3752	-7.9743	0.0000	-13.5191	0.0000
Capital ratio	-10.0012	-6.8757	0.0000	-15.6546	0.0000
Liquidity	-29.3844	-28.1088	0.0000	-18.2077	0.0000
Inflation	-19.9422	-12.4647	0.0000	-15.9813	0.0000
GDP	-51.917	-42.8115	0.0000	-11.0126	0.0000
91 TBR	-34.5978	-27.3469	0.0000	-17.3953	0.0000
Govt borrowing	9.1607	19.5015	0.0000	-11.8360	0.0000
Exchange rate	-47.2349	-43.7182	0.0000	-1.9495	0.0025
HHI	-7.753	-5.2627	0.0000	-1.2651	0.0071

Based on Hausman specification test, fixed effects model was estimated. The results are presented in Table 4.The estimated equations appear to fit the panel reasonably well as indicated by the R-squared values which have fairly stable coefficients. Interesting results appear in both significant and non-significant findings.

Table 4: Estimation results Using Fixed Effects-within (dependent variable: Z-score)

Fixed effects model		
Variables	Coefficient	Std. Err.
Size	8.9451	2.7694
Age	-0.2004***	0.3911
Operational efficiency	-7.5027**	3.3197
ROA	-0.4243**	1.0273
Capital ratio	0.0116	0.0722
Liquidity	-0.1750**	0.1852
Inflation	4.8013**	34.6862
GDP	-8.1874***	81.4079
91TB Rate	-11.8241	21.7549
Government borrowing	-3.6949*	182.3656
Exchange rate	0.4112**	10.3533
HHI	-0.3957***	2.7552
Constant	-4.3199	11.3682
	F(12,261) = 8.68	
	Prob> F = 0.0000	

*This Table presents regression with robust standard errors results based on fixed effects estimation. Significance at the 10%, 5%, and 1% level is denoted by *, ** and *** respectively.*

Based on a panel data set of 39 banks, what inferences can we draw from the regression coefficients? We find a negative and significant effect of bank age and profitability on bank risk. Therefore, older banks have a larger customer base, more customer loyalty and hence trading off bank risk that would arise from public panic and other changes in the market environment. Higher profitability implies that the bank is less likely to suffer from liquidity challenges that would contribute to bank risk in the long run.

Turning to operation efficiency, we find that banks that are efficient are less likely to be risky. Operational efficiency implies reduction in operation costs which translates to higher profitability. Operational efficiency via automation of loan processing lowers risky lending that adversely affects the quality of the loan portfolio. The findings are contrary to Aemir & Rafisa, (2014). We also found bank liquidity levels to negatively and significantly influence bank risk. Holding high liquidity comes at a cost to the bank since it implies low rate of bank's conversion of its liabilities (customer deposits) into assets (loans and advances). Such costs that are associated with holding

high liquidity levels would therefore increase bank risk.

With regard to industry factors, it is evident that enhanced banking competition lowers bank risk. A competitive industry would imply innovation that enhances diversity in bank lending thus trading off bank risk. Further, a more competitive industry implies less market information trading off the adverse selection problem that is mainly associated with banking. The long run effect is reduced risks that are manifested in market information asymmetry. This finding is consistent with Weersainghe and Perera (2013).

Macroeconomic environment also matters. GDP growth and government borrowing have significant negative effect on bank risk. When the economy is performing well, it implies that businesses are doing well and there is more income in circulation with reduced possibilities of loan defaults. Further increased government domestic borrowing implies increased government's appetite for loans. As such banks have a guaranteed repayment as opposed to lending to general public who are riskier. This finding is consistent with Beside, Messiah & Jouini (2013) who reported that economic performance had a significant negative effect on bank credit risk among commercial banks in Italy, Greece and Spain and Al-Wesabi & Ahmad (2013) who document a negative significant effect of GDP growth on bank risk among the Islamic banks.

On the contrary, higher inflation and exchange rate significantly bolster bank risk. Rise in inflation implies increased cost of living that it likely to trigger loan defaults thus increasing bank risk. Further, exchange risk shocks especially for banks treasury operations could lead to bank baking losses in forex transactions which would adversely affect bank profitability. These findings support Weersainghe and Perera (2013) and Soyemi et al., (2013).

Estimation results indicate that size and capital ratio do not affect the bank risk. The insignificant effect of the bank size implies that it's the quality of bank assets that matter in determining the bank risk. Contrary to theory we do not find significant effect of capital ratio on bank risk which is consistent with Aemir & Rafisa (2014) among Ethiopian commercial banks for the period 2007 -2011. We further established that 91 TB rate does not matter for bank risk.

5. Conclusion

This study sought to investigate the determinants of bank risk in Kenya. To achieve this objective, the study used panel data drawn from 39 commercial banks for the period 2010 to 2017. Estimation results reveal a positive and significant effect on inflation and exchange rate. A significant negative effect is however reported for operational efficiency, liquidity, profitability, age, economic growth, government borrowing and industry competition. A sound macroeconomic environment matters for bank risk. This comes in form of GDP growth, anchoring inflation within the Central Bank target range as well as enhancing stability in the forex market.

Further, results indicate that a competitive banking industry is conducive for trading off bank risk. As such any market dominance in the banking industry poses risk on the bank stability. This would arise from the inefficient resource allocation. When such resources are allocated in a market full of information asymmetry, the risk exposure is amplified and could even result into systemic problem within the industry. Competition in the banking industry is therefore crucial in addressing the adverse selection problem commonly evidenced in credit markets that in the long run leads to credit risks via increased poor quality of borrowers.

We also established that bank specific factors also contribute to bank risk. Therefore, the internal management of commercial banks with regard to their operating efficiency, profitability, total assets as well as liquidity matters is core in trading off risks associated with internal bank's management.

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