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Cost-Benefit Analysis of Bank Regulation: Does Size Matter?

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Abstract

This study investigates the trade-off between costs and benefits of bank regulation in Kenya. Using the Stochastic Frontier Analysis (SFA) and Annual data for the period 2003 – 2019, extracted from KBA Financial Database and KNBS macroeconomic data, the study models Industry-level and cluster level relationship between bank regulation and cost inefficiency of banks. The industry-level analysis indicates that stringent capital requirement has a positive and significant effect on the cost-efficiency of banks, while tighter liquidity requirements hurt cost efficiency. Further, the bank tier-level analysis established that the double-layered regulatory framework creates Cost inefficiencies amongst middle-tier banks. The key policy implication would be to consider reviewing, identifying, and amending the regulatory provisions that are creating inefficiencies among the listed middle-tier banks.

Key Words: Bank Regulation, Cost-Benefit Analysis, Stochastic Frontier Analysis

JEL Classification: G28, D61, C24

1 The author can reached through email: *hmswahili001@gmail.com*. **Disclaimer:** The views expressed in this paper are solely those of the authors and do not in any way reflect the views of the institutions they are affiliated to.

1.0 Introduction

Banking regulation has gained empirical attention among researchers and policymakers in the recent past. This quest, which focused on establishing the disconnect between bank regulation and stability, was spurred by the global financial crisis (2007- 2009). In that pursuit, the post-global financial crisis studies have alluded the bank failure to weaknesses in the regulations (Cihak, Demirguc-Kunt, Peria, & Mohseni-Cheraghlou, 2013). Prudent regulation in the banking industry concerns issues such as regulation of competition, disclosure requirements, examination and monitoring procedures and restrictions in banking activities, including the limitation of asset holdings, capital requirements and the separation of banking and other financial activities (Mishkin, 2000). In the context of the financial market regulatory model in Kenya, the commercial banks are within the purview of the Central Bank of Kenya (CBK) as the primary regulator.

Additionally, the listed banks comply with the securities market regulations enforced by the Capital Market Authority (CMA). The independent regulatory oversight by CBK and CMA results in a double-layered regulatory scenario among the listed banks. The Central Bank of Kenya, unlike the Capital Market Authority, does not face complex policy trade-offs for consideration, but to facilitate the development of an efficient market. This is mostly, but not exclusively, attained through enhanced disclosures and compliance with corporate governance standards, which potentially raises the operational and compliance costs for listed banks (Barth et al., 2013).

Banking sector regulation is essential due to complex moral hazard problems and the necessity of protecting depositors and minority shareholders (Dewatripont and Tirole, 1993; Santos, 2000). Empirical work on the relationship between bank regulation and efficiency present conflicting results. Barth, Caprio, & Levine (2013), Haque & Brown (2017) and Triki et al., (2017) suggest that imposing restrictions on bank activities decreases efficiency, while a broader range of activities can increase efficiency. However, the empirical literature on the trade-off between costs and benefit of Bank regulation has remained inconclusive.

In contrast, Pasiouras (2008) finds no significant link between activity restrictions and efficiency. Furthermore, Pasiouras et al. (2009) find contradicting results, where restrictions on bank activities have negative impacts on cost efficiency. Similarly, conflicting findings are established on the capital requirement imposed by the regulators. Barth et al. (2004) and Triki et al. (2017) establish that the policy of capital requirements significantly reduces the level of moral hazard when the owners of banks are required to have more capital at risk since this would necessitate them to lend more carefully. On the flip side, other studies have established that with higher capital requirements, banks may pursue a costly financing policy, prioritising equity over deposits (Haque & Brown, 2017). This may reduce the incentives of banks to screen and monitor lending when equity capital becomes more expensive to raise than deposits (Barth et al., 2004), ultimately leading to higher risks and lower efficiency.

Studies on bank regulation in Kenya have leaned more on its impact on the banks' profitability, competition, and stability. Empirical work by Gudmundsson, Kisinguh & Odongo (2013) on the role capital requirements play on competition and stability of banks established a positive relationship between capital regulation and the improved performance of banks and financial stability. Further, Mwega (2014) established that Kenya regulations are not strict. He concluded that, for over ten years, regulations in the financial sector had strengthened the banking sector in terms of customer service, products offered, stability and profitability. With a focus on the financial performance of microfinance institutions, Mureithi (2012) showed that regulations on Deposit-Taking Microfinance institutions had led to the improvement in their financial performance. An increase in the total assets, profit, value of loans outstanding, and shareholders' equity was observed among the Deposit-Taking Microfinance Institutions. In light of the foregoing, this study sought to shift the spotlight to the Cost-benefit Analysis of bank Regulation in Kenya, with sensitivity to the dimensional contrasts.

The objective of this study was to investigate the trade-off between the costs and benefits of bank regulation in Kenya. Specifically, to evaluation proceeds to explore the effects of the banks' dimensional differences and the double-layered regulatory environment on the banks' cost inefficiencies. Using the stochastic Frontier Analysis (SFA) applied on annual data for the period 2003 – 2019, the study models Industry-level and cluster level relationship between bank regulation and cost inefficiencies of banks. At the industry-level analysis, the study establishes that stringent capital requirement has a significant positive effect on the cost-efficiency of banks, while tighter Liquidity Requirements hurts Cost efficiency. Regarding the cluster-level analysis, it was established that the double-layered regulation creates cost efficiencies amongst middle-tier banks. The results have important policy implications. In particular, there exists a need to identify and review regulatory provisions creating inefficiencies among banks.

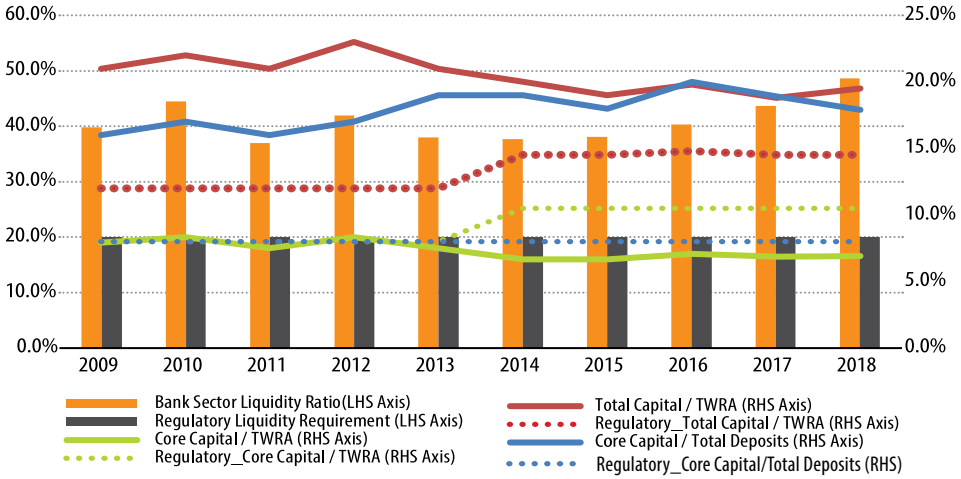
2.0 Stylised Facts: Bank Performance, Prudential and Capital Market Regulatory Environment

2.1 Prudential Regulatory Environment

The responsibility to develop the Global regulatory framework for banks is bestowed on the Basel Committee on Banking Supervision (BCBS). In Kenya, this mandate is undertaken by the Central Bank of Kenya (CBK). The CBK has maintained a relatively stable banking regulatory landscape with minimal changes being experienced in the recent past. Regarding compliance with the internal standards on bank regulations, CBK adopted a piecemeal approach in the implementation of Basel III accord, thereby being included among thirteen African countries currently implementing the Basel III accord (ABSA, 2019).

In 2012, the core capital requirements for banks were increased from KES 250 Million to KES 1 Billion, with the ultimate objective of attaining a more stable and efficient banking system. In January 2015, Banks' total capital to total risk-weighted assets ratio was increased by 2.5 percent (from 12 percent to 14.5 percent) while core capital to total risk-weighted assets ratio was increased from 8 percent to 10.5 percent. The capital adequacy ratio was moved up by 2.5 percent to set a new limit of 12.5 percent. The statutory minimum liquidity requirement is maintained at twenty percent (20 percent) of all deposit liabilities, matured and short-term liabilities in liquid assets (CBK, 2013). The banking industry has recorded compliance with the minimum prudential requirements (Figure 1).

Figure 1: Capital Adequacy and Liquidity Ratios for the Banking Sector 2009 - 2018



Source: CBK

Interest rate controls were reintroduced to the industry in 2016 through the Banking (Amendment) Act 2016. The Act established a ceiling on lending rates at 4.0 percentage points above the Central Bank Rate (CBR) and a floor on deposit rates at 70 percent of the CBR. Having proved to be ineffective in enhancing accessibility to credit, the Act was repealed in 2019. On other policy issues, the CBK issued the policy guidance note on the implementation of IFRS 9 reporting standards in 2018 and banks are expected to be fully compliant within 5 years. Given the stringent recognition requirements enshrined in IFRS 9, the reporting standard is expected to tighten Kenya's regulatory landscape.

2.2 Securities Market Regulatory Environment

At the core, security market regulation is hinged on investor protection and transparency, which consequently contributes positively to financial system efficiency. The implementation of the Capital Market Master Plan (CMMP) 2014 – 2023 has led to immense developments and reforms in the Kenyan Capital Markets. The NSE became demutualised and self-listed in 2014. In 2017, the company registration and compliance procedure were streamlined through the Companies (Amendment) Act No. 28 of 2017, which made registration of companies more efficient and streamlined obligations of listed

companies. The Act extended the meaning of a beneficial owner to a natural person who ultimately owns or controls a legal person or a natural person on whose behalf a transaction is conducted and includes those persons who exercise ultimate effective control over a legal person or arrangement. The law on foreign ownership capping framework was reviewed in 2015 by eliminating the 30 percent shareholding limit for foreign investors in Kenyan companies. However, the Cabinet Secretary for the National Treasury has powers to prescribe the maximum foreign holding in a company that is considered of "strategic interest."

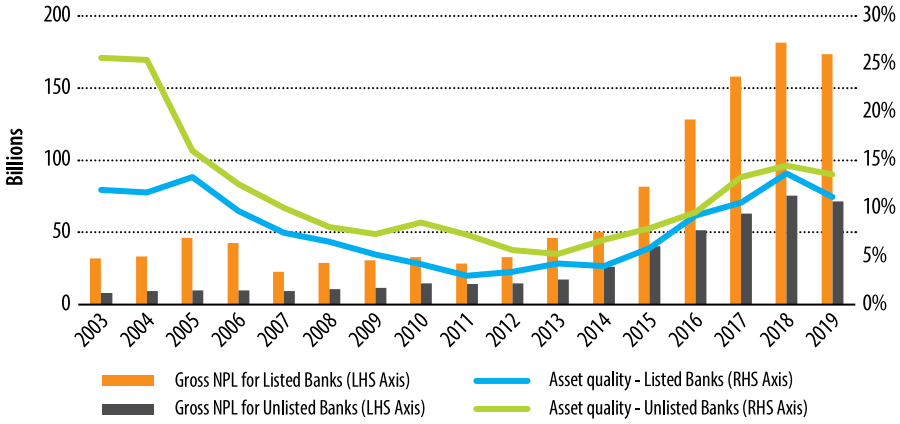
Corporate Governance Standards has been Strengthened. The Code of Corporate Governance for Issuers of Securities to the Public 2015 was gazetted on 4 March 2016 and became fully effective on 4 March 2017. Consequently, in collaboration with the IFC in consultation with issuers, CMA developed the Corporate Governance Reporting Template and the Corporate Governance Scorecard in June 2017. The scorecard has been deployed to monitor the progress of listed firms towards strengthening their corporate governance.

Regulatory environment to support the issuance of new products in the Capital Markets Space has been operationalised through the issuance of Policy Guidance Notes (PGN) and various regulations. The Capital Markets Securities Lending Borrowing and short-selling regulations (2017) governs capital Markets securities lending and borrowing. The PGNs issued are on Exchange Traded Funds (2017), Asset-Backed Securities (2017), Global Depositary Receipts and Notes (2017) and Green bond (2019). In 2019, NSE launched and began operating the Derivatives Exchange Market. The Regulatory Sandbox, which is a form of "no action" arrangement that allows for testing of innovative products, solutions and services was also launched in 2019 to support a variety of FinTech platforms.

2.3 Overview of Banks' Performance

Figure 2 Compares the strength of financial performance of listed and unlisted banks on account of their asset quality positions. The figures for Gross Non-performing Loans are given in Kenya shilling billions. Overall, differential performance is evident between the listed and unlisted banks. Over time, the Gross Non-Performing Loans have been growing exponentially for both the listed and unlisted banks. However, growth is higher among the listed banks. Further, the listed banks manifest somewhat stronger asset quality compared to unlisted banks. The asset quality for the industry strengthened from 2003 to its peak in 2013, thereafter, it steadily began to deteriorate.

Figure 2: Performance of Listed and Unlisted Banks in Kenya, 2003 – 2019



3.0 Literature Review

3.1 Theoretical Literature

Theories on regulations have been anchored on two broad paradigms: The public interest and the private interest theories. Proceeding from the public interest theories of regulation is the assumption that regulators have sufficient information and enforcement powers to promote the public interest effectively. Thus, regulation is supplied in response to the demand of the public for the correction of inequitable or inefficient market practices (Baumol, 1952). The implication being that regulation is geared at benefiting society as a whole rather than popular vested interests.

The public interest view holds that regulation facilitates the efficient functioning of banks by merely evading market failures for the benefit of broader civil society (Whynes and Bowles, 1981). Since regulators are considered to be a neutral arbiter, they would not be plagued by failures in the information market, and they could more easily bundle information to determine the point where the marginal cost of intervention equalises the marginal social benefits (Leland, 1979; Asch, 1988). Hence, the public interest would be served if the banking system allocated resources in a socially efficient manner that is maximising output and minimising variances, that is, it maximises social welfare. In contrast, the private interest theory of regulation is more cynical about the regulators' behaviour and motives, seeing regulation being socially inefficient. The regulators are assumed to be deficient of sufficient information to cost, demand, quality, and other dimensions of firm behaviour. Also, they are susceptible to regulatory capture by advocacy groups or special interest groups. Hence, they can only imperfectly, if at all, promote the public interest when controlling firms or societal activities (Hertog, 2010).

3.2 Review of Related Literature

3.2.1 Capital Requirements and Cost Efficiency

Capital adequacy for banks is fundamental in mitigating against financial insolvency. Studies have shown that stringent capital requirement has a positive effect on the cost-efficiency of banks (Barth et al. 2013; Haque and Brown, 2017; Pasiouras et al. 2009; Chortareas et al. 2012). Triki et al. (2017) find that the positive effect of stringent capital requirements holds for large banks only. In contrast, other studies have argued that stringent regulation of the financial market has the potential of hampering banks' performance by preventing them from exploiting economies of scale and scope through a more diversified range of banking products or a larger scale of operations (Claessens & Klingebiel, 2001; Barth, Brunmgaugh & Wilcox, 2000; Barth et al. 2010). In this context, regulations could lead to an inefficient allocation of resources, and hence, deregulation enables and encourages banks to take advantage of more efficient production techniques (Evanoff, 1998 and Claessens & Laeven, 2004). Oino (2017) finds a negative association between tier 1 capital and the financial performance of European banks.

Anginer, Demirguc-Kunt, and Zhu (2014) finds that the effect of prudential capital requirements on bank stability appears to be positive in those banking sectors with (1) relatively weak supervision and monitoring, and (2) underdeveloped institutions. Further, he established that banks in transition countries experienced increases in the demand for bank loans over the study period since the majority of those countries had experienced sustainable growth and low inflation rates for over the two decades. However, the presence of prudential capital requirements had limited the growth opportunities of banks.

Barth et al. (2004) find that while stringent capital requirements are associated with fewer non-performing loans, capital stringency is not robustly linked with banking sector stability, development, or bank performance (measured with overhead and margin ratios) when controlling for other supervisory, regulatory policies. Further, Pablo (2018) in examining whether higher capital requirements is worth it, established that with higher capital requirements, large banks grow larger, putting pressure on small banks to merge or close. As large banks' market power increases, they extract higher profits by raising loan rates, which tightens credit and depresses the economy's output. Also, far fewer fail even as they take more risks since their charter value is higher under the tighter capital requirements.

3.2.2 Liquidity Requirement and Cost Efficiency

Liquidity is key to the stability of the banking industry, given that it signifies the ability to fund assets and meet obligations as they fall due. Ryan (2014) argues that tighter liquidity regulations would necessitate banks to alter both their asset and liability organisations to meet these tighter requirements. This implies that their strategies lean towards improving

their share of high-quality liquid assets and funding from more stable non-financial deposits while at the same time, try to reduce the short-term intra-financial loans share and short-term wholesale funding. Liquidity ratio also influences corporate lending rates and interbank funding costs. Bonner and Eijffinger (2012) established that the Dutch banks below their liquidity requirements did not charge a higher interest rate on corporate loans. In addition, the banks also paid higher interest rates on unsecured interbank loans, even though there was no public revelation of this regulatory information.

3.2.3 Interest Rate and Cost Efficiency

Akowuah (2013) notes that interest rates have a positive impact on the domestic demand for credit in the short-run and a negative relationship in the long-run. Increases in the real lending rates may not immediately hamper the demand for credit; however, in the long run, it may eventually lead to a fall in demand for credit and vice versa. Thus, the notion that interest rate regulation could be seen as a counterproductive policy option transpires. Affirming to this, Maimbo & Gallegos (2014) points that interest rate caps are ineffective at addressing the root causes of high rates - such as lack of market competition, market inefficiency, large fiscal deficits and legal bottlenecks that prevent customers from switching banks, and they also introduce additional distortions in the system as banks try to circumvent caps.

3.2.3 Quality of Funding and Cost Efficiency

Guillaume, Cosimo & Dawid (2020) posit that high funding costs resulting from bank-specific vulnerabilities can erode banks' earnings and deplete banks' capital buffers in bad times or decelerate their build-up in good times. This implies that high funding costs prompted by bank vulnerabilities can hurt banks' ability to withstand macroeconomic shocks and endanger the overall stability of the banking sector. In addition, ECB (2017) and Guillaume, Cosimo and Dawid (2020) argue that if higher funding costs are passed through into higher lending rates, the real economy can also be adversely affected, by depressing the demand for new lending, prompting deleveraging, and leading to lower economic activity. The connection between capital levels and interest rates is presented by Ellis & Flannery (1992) and Flannery & Sorescu (1996). Through their empirical work, they provide evidence that lower capital levels are associated with higher interest rates on uninsured deposits.

3.2.4 Security Market Regulation and Cost Efficiency

Security market facilitates the development of an informationally financial efficient market. Avgouleas & Cullen (2014) observes that countries with poorly developed capital markets and incomplete legal systems render market discipline an ineffective tool to improve efficiency in the banking sectors. In addition,

a lack of transparency in financial transactions and low quality of information leads to principal/agency relationships break down with severe limitations in understanding and assessing risks, making established models of corporate governance ineffective. Regulations that enhance disclosures and provide incentives for private monitoring result in higher cost and profit efficiency (Pasiouras, 2008) and the empowerment of private monitoring facilitates efficient corporate finance and has a beneficial effect on the integrity of bank lending in countries with sound legal institutions (Beck et al. 2006). In contrary, Barth et al. (2013) and Peek & Rosengren (1995) posit that regulatory oversight has been adversely affecting the efficiency of the banks by imposing costs, including higher origination standards, slower loan growth, compliance costs and inefficiencies.

3.2.5 Bank size and Cost Efficiency

Bank size, often determined in terms of the total assets, influences both the scale of operation and the nature of clientele it serves. For instance, large banks clientele leans more towards stable clients such as governments, large corporates, and multinational corporations. On the other part of the spectrum, small banks predominantly serve poor and low-income households and their microenterprises. Miller & Noulas (1996), Ataullah & Le (2006) and Tecles & Tabak (2010) established that larger banks are more efficient. In contrary, Isik & Hassan (2002), Girardone et al. (2004) and Altunbas et al. (2007) concluded increases in bank sizes leads to diseconomies of scale thereby deteriorating the efficiency levels of the banks. On the other hand, Berger & Mester (1997), Ariff & Can (2008) and Staub et al. (2010) established that the size of a bank has an insignificant influence on its efficiency levels.

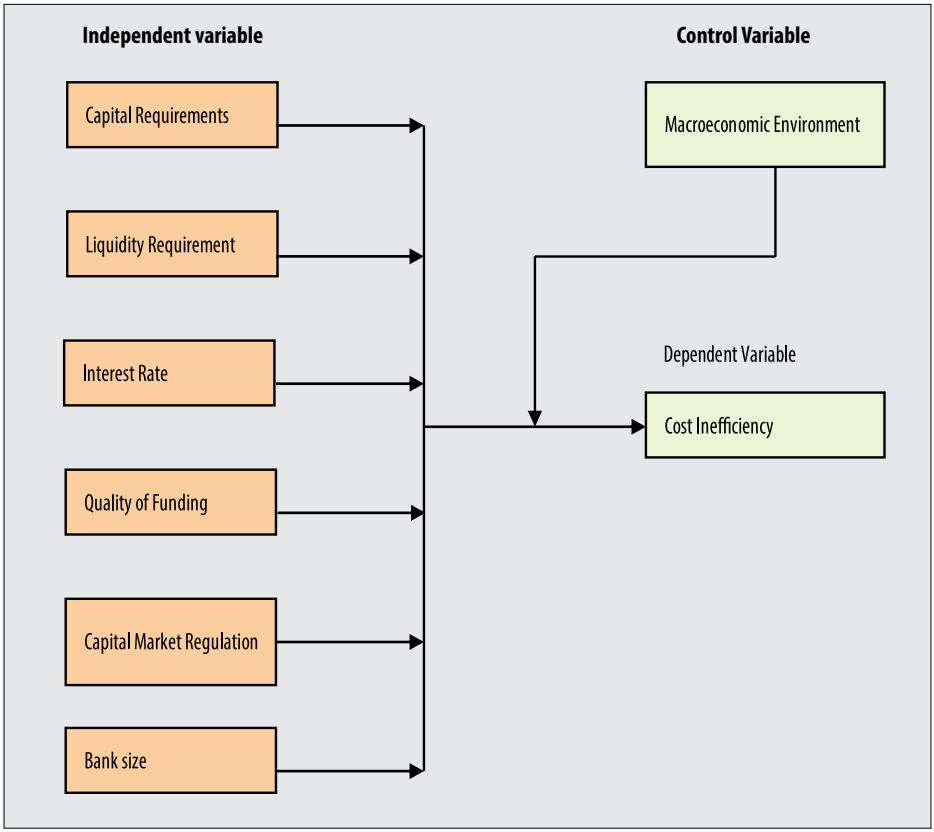
3.2.6 Macroeconomic Environment and Cost Efficiency

Economic growth is cost-efficiency enhancing, whereas inflation is cost-inefficiency enhancing. The negative relationship between GDP growth and Cost inefficiencies is that the real GDP leads to increases in disposable income, resulting in higher demand for goods and services produced by firms. The increased sales would, in turn, improve the debt servicing capacity of firms and households, hence decline in the non-performing loan. A study by Rinaldi and Sanchis-Arellano (2006) found that rising level of inflation worsens the performance of the bank loan portfolio, hence a positive (negative) relationship between inflation and cost inefficiencies. Inflation and GDP growth rate have been used in studies to capture the effect of the macroeconomic environment (Osoro & Kiplangat, 2020; Grigorian & Manole, 2002; Maudos et al., 2002); Hauner, 2005; Pastor & Serrano, 2005; Kasman & Yildirim, 2006; and Pasiouras, 2008.

3.3 Conceptual Framework

The conceptual framework for the study is based on the concept that the bank regulatory environment influences the cost dynamics (Figure 3). Regulatory

tools lead to cost-benefit trade-offs in the banking sector. The banks strive to make rational decisions to optimise their cost-efficiency strategies within the regulatory framework they operate. The extent to which the prevailing macroeconomic environment influences the regulatory framework impact banks' cost inefficiencies. That is the prevailing inflation and GDP growth rate. In this study, therefore, the influence of the capital requirements, Liquidity ratio, Interest rate, Quality of Funding, Capital Market regulation and the size of the bank were investigated.



4.0 Data Variables and Methodology

The study employed a quantitative approach in examining the trade-off between cost and benefit of bank regulations in Kenya. Case study research design was adopted. This implies that the study was able to examine the data in the Kenyan banking sector closely. In modelling the effects of bank regulation on cost inefficiencies, the baseline regression model is specified in Equation 1:

$$\text{и}_{it} = \delta_o + \sum_{i=1}^{6} \delta_i X_{i,t} + \sum_{i=1}^{2} \gamma_i Y_{i,t} + \varepsilon_{it} \quad \ldots\ldots (1)$$

Where и_{it} represents the Inefficiency term, Y_i represents the variables for regulatory characteristics and bank-specific attributes, Y_i captures the Macroeconomic Environment δ_i and γ_i represents the coefficient parameters to be estimated and is a time-variant error term.

In an attempt to unravel whether heterogeneous effect manifests itself along the bank dimensional contrasts, the banks were tiered into three clusters, and then the effect of banking regulation on Cost inefficiency was re-estimated using Equation 2.

$$\text{и}_{it} = \delta_o + \sum_{i=1}^{6} \delta_i X_{i,y,t} + \sum_{i=1}^{2} \gamma_i Y_{i,t} + \varepsilon_{it} \quad \ldots\ldots (2)$$

4.1 Estimation Strategy

The study commenced by constructing the banks cost inefficiency from the cost frontiers. The main problem in measuring inefficiency is separating what is genuinely inefficient behaviour from random circumstances affecting costs. In the case of the banking sector, the four most commonly used approaches differ from each other in the assumptions they make. Firstly, the stochastic frontier approach (SFA) proposes that the observed costs of a bank may deviate from the

cost frontier either because of random fluctuations or because of inefficiency. To separate the two components, an asymmetrical probability distribution for the inefficiency term is assumed. Secondly, the thick frontier approach (Berger and Humphrey, 1991) assumes that the differences in predicted costs within the quartile of banks with lowest average costs for a given size are due to random factors, while the differences in predicted costs between the quartiles with lowest and highest costs are due to inefficiency. Thirdly, Data envelope analysis (DEA), like any determinist technique, assumes that all deviations between observed costs and the minimum costs of the frontier are due to inefficient behaviour. Lastly, the distribution-free approach (DFA) by Berger (1993) is based on the hypothesis that efficiency is persistent over time, whereas random errors tend to cancel each other out with time.

In the context of this study, the stochastic frontier approach was adopted. This allowed the specification of a composed error that was decomposed into two parts: a one-sided error that measures the non-negative inefficiency effects and a classical random error (Yildririm and Philippatos, 2007). A time-varying inefficiency model was adopted so that the changes over time and across individual banks could be accounted for.

The intermediation approach developed by Sealey and Lindley (1977) was utilised in establishing the inputs and the outputs for the model (Equation 3). Under this approach, three inputs were used: Labour costs, capital (the book value of fixed assets) and loanable funds. Total loans and Securities investments were the two outputs used in the study. The input prices for capital and loanable funds were computed by applying the approach of Schaeck and Cihak (2010), while the approach by Maudos et al. (2002), Beccalli et al. (2006), Carvallo and Kasman (2005) and Carbo et al. (200) was used to calculate the price of labour since the number of employees was not readily available (Table 1).

$$\begin{aligned}Ln(TC_{it}/PF) = {} & \beta_o+\beta_1 Ln\,(TL) + \beta_2\,Ln(SI)+\beta_3\,Ln(PL/PF)+\beta_4\,Ln(PC/PF) + \\ & \beta_5(1/2 * Ln(TL)^2\,) + \beta_6(1/2 * Ln\,(SI)^2) + \beta_7 1/2*(Ln(PL/PF)\,)^2 + \\ & \beta_8(1/2*(Ln(PCPF))^2 + \beta_9+Ln\,(TL) * Ln\,(SI) + \beta_{10}Ln\,(TL) * Ln(PL/PF) + \\ & \beta_{11}Ln\,(TL) * Ln(PC/PF) + \beta_{12}Ln\,(SI) * Ln(PL/PF) + \beta_{13}Ln\,(SI) * Ln(PC/ \\ & PF)+ \beta_{14}Year+ \beta_{15}Ln\,(TL* Year)+ \beta_{16}Ln\,(SI) * Year+ \beta_{17}Ln(PL/PF)* Year \\ & + \beta_{18}Ln(PC/PF)\ \ * Year +v_{it}-u_{it}. \ldots\ldots\ldots (3)\end{aligned}$$

Where TC_{it} represents the total cost of bank i at time t, the outputs are represented by total loan (TL) and securities investment (SI). The input prices are the price of funding (PF), price of labour (PL) and price of capital (PC). The variables that enter these models are discussed in Table 1. β_i represents the parameters to be estimated,

u_{it} and v_{it} represent random error terms that are assumed individually and mutually independent and u_{it} represents a function of factors that affect cost inefficiency.

The random error v_{it} is assumed to be distributed as two-sided normal with zero mean and variance σ_v^2 [$v_{it}N(0, \sigma_v^2)$]. Inefficiency term u_{it} (is assumed to have half-normal distribution truncated at zero with mean μ_{it} and variance σ_v^2 [u_{it} $N^+(\mu_{it},\sigma_v^2)$]. The time variable is added to account for technological changes over time. In addition, we control for the differences in risk preferences by using the equity (Mester, 1996; Altunbas et al. 2001 and Weill, 2003). The price of the fund is also used to impose linear homogeneity restriction by normalising the input prices and the explained variable. Cognizant of the inconsistencies in the two-stage stochastic frontier approach, this study deployed one stage stochastic frontier approach proposed by Battese and Coelli (1995).

Table 1: Definition and Measurement of Variables

Variable		Definitions	Measurement
Capital Adequacy Ratio	X_1	The ratio of a bank's capital to its risk	$X_1 = \frac{Core\ Capital}{(Total\ Risk\text{-}Weighted\ Assets)}$
Liquidity Ratio	X_2	The measure of the bank's ability to meet its short-term obligations.	$X_2 = \frac{Liquid\ Assets}{(\ Total\ Deposit\ Liability)}$
Interest Rate	X_3	The proportion of a loan that is charged as interest to the borrower.	$X_3 = \frac{Total\ Net\ interest\ Icome}{Total\ income\ with\ a\ particular\ interest\ rate}$
Bank funding quality	X_4	The cost of funds available to the banks.	$X_4 = ln\ (The\ total\ customers'\ deposits)$
Bank size	X_5	The total assets of the bank at the end of the financial year	$X_5 = ln\ (book\ value\ of\ a\ banks'\ total\ assets)$
Security Market	X_6	Dummy variable used to distinguish between Listed and unlisted banks.	$X_6 = \begin{cases} 1, Listed\ Bank \\ 0, Otherwise \end{cases}$
Inflation	X_7	The Annual Inflation Rate	$Y_1 = The\ Annual\ inflation\ Rate$
GDP Growth Rate	X_8	The Annual GDP Growth Rate	$Y_2 = The\ Annual\ GDP\ Growth\ Rate$
Computation of Input prices			
Price of loanable funds			$PF = \frac{Interest\ Expenses}{Total\ Deposits}$

Variable	Definitions	Measurement
Price of capital		$PC = \frac{Non\text{-}Interest\ Expenses}{Total\ Fixed\ Assets}$
Price of labour		$PL = \frac{Personel\ Expenditure}{Total\ Assets}$

4.2 Summary Statistics

Table 2 depicts the descriptive statistics. The average prices of the borrowed funds, labour and physical capital were 0.049, 0.035 and 0.147 respectively, for the period 2003 – 2019. During the same period, it was observed that some banks had not invested in the Securities markets while others had not issued loans, especially during their initial year of operation. During the study period of 2003 – 2019, the average Capital Adequacy Ratio stood at 24.5 percent while the liquidity ratio was 54.0 percent. Approximately 25.6 percent of the banks had been listed at Nairobi Securities Exchange. The economy recorded an average GDP Growth Rate of 9.45 percent and an inflation rate of 4.97 percent.

Table 2: Descriptive statistics

Variable	No. of obs.	Mean	Std. Dev	Minimum	Maximum
Total cost (in Billions)	650	4.953	0.78	1.030	54.10
Loans (in Billions)	648	31.90	5.64	0	447.00
Securities investments (in Billions)	645	9.789	17.40	0	123.00
Price of fund	646	0.049	0.030	0.0005	1.250
Price of capital	649	0.147	1.030	0.0033	1.703
Price of labour	652	0.035	0.027	0.0032	0.677
Capital Adequacy Ratio	647	0.245	0.198	0.005	2.704
Liquidity Ratio	648	0.540	1.138	0	26.5079
Bank funding quality (in Billions)	649	41.80	68.80	0.00073	528.00
Bank size (in Billions)	649	57.40	93.0	0.650	674.00
Capital Market Dummy	731	0.2558	0.4366	0	1
Inflation	731	0.0497	0.0140	0.017	0.071
GDP Growth Rate	731	0.0945	0.0522	0.041	0.261

Source: Author computation

4.2 Empirical Results and Discussions

4.2.1 Industry-level Analysis of the Effect of Bank Regulation on Cost Inefficiency

Table 3 presents the results of the maximum likelihood estimates of parameters of the Translog stochastic frontier Cost function specified in Equation 3. The estimated sigma squared (σ^2) was 3.44 and significant at 1 percent, indicating goodness of fit. The Gamma value (γ) of the MLEs of the Stochastic Frontier cost function is 0.73. The value is statistically significant at 1 percent, indicating that approximately 73 percent of the difference between the observed and frontier output are attributed to the inefficiencies attributed to bank regulations

Table 3: Stochastic Frontier Model Maximum Likelihood Estimates

Dependent Variable $(Ln\ (TC_{it}/PF))$	Coefficient	T-ratio
Constant	-272.35***	4.40

Dependent Variable $(Ln\ (TC_{it}/PF))$		Coefficient	T-ratio
Ln (TL)		30.441***	5.06
Ln (SI)		-13.557***	-2.51
Ln (PL/PF)		-81.782***	-6.93
Ln (PC/PF)		86.124***	7.26
*1/2 * Ln (TL)²*		0.1520***	7.97
*1/2 * Ln (SI)²*		-20.254***	-8.57
*1/2 * Ln (PL/PF)*		0.0436	4.73
*1/2 * Ln (PC/PF)*		0.0654***	7.20
*Ln (TL) * Ln (SI)*		-0.0906***	-6.98
*Ln (TL) * Ln (PL/PF)*		0.0037***	1.42
*Ln (TL) * Ln (PC/PF)*		-0.0102	-0.77
*Ln (SI) * Ln (PL/PF)*		-0.0034*	-1.69
*Ln (SI) * Ln (PC/PF)*		-0.01522*	-1.44
Year		0.15270***	4.91
*Ln (TL) * Year*		-0.01532***	-5.07
*Ln (SI) * Year*		0.00825***	3.05
Ln (PL/PF) Year*		0.0407	6.93
Ln (PC/PF) Year*		-0.0424***	-7.15
(σ)²		3.44***	0.034
Gamma (γ)		0.73***	0.028
Log-likelihood	50.41		
Chi2	18447.97		
Prob > Chi2	0.000		
N	595		

Note: Where TC_{it} represents the total cost, TL - Total Loan, SI - Securities investment, PF - Price of Funding, PL - Price of Labor and PC - Price of Capital. Significance is indicated by * p<0.10, ** p<0.05, *** p<0.010

Table 4 presents the result of the Bank regulation - Cost inefficiency nexus at Industry-level. The result indicates that stringent capital requirement has a positive and statistically significant effect on the cost-efficiency of banks. This result shows that banks' cost optimisation behaviour is positively associated with the tightening of capital requirements. The finding resonates with Barth et al. (2013), Haque and Brown

(2017), Pasiouras et al. (2009) and Chortareas et al. (2012) who also established that stringent capital requirement having a positive effect on cost efficiency of banks.

Table 4: Bank Regulation - Cost Inefficiency Nexus at Industry-Level

	Coefficient	T-ratio
Constant	4.2336***	3.06
Capital adequacy	-3.9519**	-4.21
Liquidity Ratio	5.4464***	9.60
Interest Rate	-0.00003	-1.96
Quality of Funding	-0.31717	-1.31
Size	-0.93942	-2.89
Security Market Dummy	0.67314	1.11
GDP Growth Rate	-18.9698	-1.90
Inflation rate	-4.0909	-1.46

Significance is indicated by * p<0.10, ** p<0.05, *** p<0.010

Liquidity ratio requirements were found to have a negative effect on cost efficiency. This would infer into the inhibiting effect of high liquidity requirements on the banks' ability to use their asset capacity optimally. In addition, the inability of a bank to meet the regulatory threshold for liquidity negatively affects its funding costs, since it is perceived to be risky by the market. This finding is in harmony with the finding by Eijffinger (2012) who established that the Dutch banks operating below their liquidity requirements paid higher interest rates on unsecured interbank loans, even though there was no public revelation of this regulatory information.

Regarding the interest rate, the results indicate that higher interest rates are positively associated with the cost efficiency of banks. However, this result is not significant. The funding quality and Securities Market Dummy are also insignificant. Finally, both the GDP growth rate and inflation rate have a positive influence on the banks cost efficiency. However, only GDP growth rate is significant.

4.2.2 Cluster-level Analysis of the Effect of Bank Regulation on Cost Inefficiency

The regression results of Banking regulation - Cost inefficiency nexus by bank clusters is reported in Table 5. The categorisation is based on the banks' total assets, whereby three clusters are isolated with banks being classified as Large banks, Middle-tier banks, and the small banks. The results reveal heterogeneity in the effect of bank regulation on cost efficiencies that had been masked by industry-level analysis.

The study establishes an insignificant positive relationship between stringent capital requirements and cost-efficiency amongst large banks, and not with both middle tier and small banks. Triki et al. (2017) came to a similar conclusion with significant coefficients. Concerning liquidity, akin to the industry level analysis, a negative relationship was established between Liquidity Ratio Requirements and cost-efficiency across the clusters, albeit in this study, they are statistically insignificant.

The size of the bank was found to have a positive association with cost efficiency amongst large banks and small banks, and not in the middle tier banks. However, it is only significant among large banks. The positive association of both the large and small banks with cost efficiency would infer to the effectiveness of their respective business models that are customised to suit the peculiar nature of their clientele. The large banks are inclined towards serving stable and low-risk clients such as governments, large corporates, and multinational corporations. In the case of small banks, the adoption of group lending techniques proves to be effective in mitigating cost inefficiencies that could arise from their high-risk profile clients who are predominantly low-income households and their microenterprises. The lending model is a buffer from information asymmetries, and it reduces the operating costs through the provision of a single loan to many small borrowers at once, instead of a much greater number of individual loans. A significant adverse effect is established between security market regulations and cost efficiency, particularly amongst middle-tier banks suggesting that inefficiencies experienced by the middle-tier banks due to the double-layered regulatory environment. Small banks are not participating in the securities markets.

Table 5: Bank Regulation - Cost Inefficiency Nexus at Cluster-Level

	Panel 1: Large Banks		Panel 2: Middle tier Banks		Panel 3: Small Banks	
	Coefficient	T-ratio	Coefficient	T-ratio	Coefficient	T-ratio
stant	-4.7090	-0.35	-4.7107	-0.36	-2.76233	-0.39
ital adequacy	-0.2059	-0.04	0.1581	0.06	0.0513	0.011
uidity Ratio	0.0313	0.11	1.3389	0.60	0.0433	0.004
erest Rate	-0.000047	-0.22	-1.7410	-0.45	-0.000014	0.53
lity of Funding	-0.9775	-0.53	-1.1379	-1.07	-0.07456	-0.03
e	-0.97856***	-8.11	1.0556	1.08	-0.0865	-0.03
ital Market nmy	-0.0623	-0.03	2.1019**	2.69	-	-
P Growth Rate	-0.0228	-0.00	-0.0810	-0.00	-0.0054	0.005
ation rate	0.0759	0.01	-0.0606	-0.01	-0.0150	0.16
of observations	166		335		107	

Significance is indicated by * p<0.10, ** p<0.05, *** p<0.010

5.0 Conclusion

The empirical literature on the trade-off between costs and benefit of Bank regulation has remained inconclusive. In the case of the Kenyan banking industry, most studies that have been conducted have majorly focused on the effect of bank regulations on the profitability of banks. Using the stochastic Frontier Analysis (SFA) and Annual data for the period 2003 – 2019, extracted from KBA Financial Database and KNBS macroeconomic data, the study models Industry-level and cluster level relationship between bank regulation and cost inefficiencies of banks. At the industry-level analysis, the study establishes that stringent capital requirement has a significant positive effect on the cost-efficiency of banks, while tighter liquidity requirements have a negative effect on cost efficiency. Regarding the cluster-level analysis, it was established that the double-layered regulation creates Cost efficiencies amongst middle-tier banks. The results have important policy implications. In particular, there exists a need to identify and review regulatory provisions creating inefficiencies among banks

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Kenya Bankers Association
13th Floor, International House, Mama Ngina Street
P.O. Box 73100– 00200 NAIROBI
Telephone: 254 20 2221704/2217757/2224014/5
Cell: 0733 812770/0711 562910
Fax: 254 20 2221792
Email: research@kba.co.ke
Website: www.kba.co.ke

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