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Credit Risk Management Can Gear Up Bank Performance – Moderating Effect of Interest Rate in Developed Countries

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ABSTRACT

This research explores the role of interest rate as a moderator in credit risk management, influencing the performance of banking industry in selected developed countries using a two-step GMM model. The annual data of the top 10 banks of the selected 10 developed countries ranging from 2001 to 2020 was used. The developed countries or G-10 are Belgium, Canada, France, Germany, Italy, Japan, Sweden, Switzerland, the United Kingdom, and the United States, which are the originators of the Basel Accords. Bank performance, proxied by ROA, ROE, ATO, and NPM, is dependent. Interest rate is a moderator, independent and indexed, developed after netting off lending interest rate (LIR), interest rate spread (IRS) & net interest margin (NIM). The credit risk management index (CRM index) was derived after netting off the effects of extra ordinary financing of net loans and leases, negativity of nonperforming loans, and secured cushioning of risk-weighted assets. The results confirmed that CRM improves the growth of banking, especially in case of ROA, ROE, and NPM, improves more by the induction of the moderator of the interest rate index and enhances more with the induction of the interaction. This research guides for rearranging the determinants of CRM, identifying loopholes of CRM, fixing interest rates, and looking after natural fixation of interest rate. CRM policies should be stringent, security analysis must be centralized, offered interest rate must be natural and savings must be used in a productive usage rather than multiple financing at lower interest rates. The research contributed two indexes, the CRM index and the interest rate index (IR index), which were developed by NPLs, NLLs, RWAs and LIR, IRS, and NIM, respectively. The results highlighted that loanable fund theory is starving without remedial measures of CRM for leakage of "credit", drainage of "capital" or seepage of "money". The researcher selected ten developed countries with the 10 highest scoring banks in a period of 2001-2020 and used a two-stage GMM technique.

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1. Introduction

Banks are constrained to invest in risk management for the good economic reasons and safe, strong financial markets. CRM is a multidimensional term that encompasses the banking sector for its growth, performance and profitability. After the implementation of Basel Accords stability of the banking sector is beholden by CRM. CRM not only encompasses the financing and its risk management but also affects the interest rate, its constancy, NPLs and performance of banking sector (Awoyomi, 2020). Interest rate affects the economic growth of a country, increase or decrease in net loans and leases, NPLs and number of risk weighted assets. Hubbard (2020) claimed that risk management started at the debris of Second World War from the market insurance and converted into burning issue of the bank performance; not only the regulatory requirement, but it is technique to maintain the supply of credit, to survive in financial ebbs and troughs and political turmoil. Kaplan and Mikes (2016) declared that "good risk management is not only a defensive mechanism, but also an offensive weapon for commercial banks". Awoyomi (2020) endorsed that CRM is important for financial activities, imperative regulatory requirements and necessary for the financial survival (Fiebiger & Lavoie, 2021).

A huge number of research volume is available for the CRM in different locations, but it has failed to investigate the moderating effect of interest rate in the banking sector of developed countries, particularly in Basel originating countries from 2001- 2020. Therefore, the partial nature of the literature in this respect motivates the authors to explore the following questions regarding the impact of CRM and interest rate in the performance of the banking industry of developed countries (G-10). Is there any significant relationship between CRM and bank performance in developed countries? Is there any moderation effect of interest rate between CRM and bank performance in developed countries? Is there any significant interaction of CRM and interest rate on bank performance in developed countries?

This study explores the influence of interest rate with CRM on bank's performance, measured as lending interest rate (LIR), interest rate spread (IRS), net interest margin (NIM) with non-performing loans, net loans and leases and risk weighted assets of top 10 commercial banks of developed countries from 2001-2020. The role of interest rate remains significant in the pre GFC, era of GFC, post GFC and after the implementation of remedial policies. The research is motivated by the number of latest studies, including: Lopez, Rose, and Spiegel (2020); Safitri, Suyanto, Taolin, and Prasilowati (2020) and Taiwo, Ucheaga, Achugamonu, Adetiloye, and Okoye (2017). Policy makers, researchers and regulators of central banks are worried about the performance of banking sector instead of implementation of Basel Accords, new standards of CRM and insufficient to enhance the performance of the banking industry Kolapo, Ayeni, and Oke (2012) and Serwadda (2018).

Developed world is facing different dived situations in the banking industry and at present monetary effects of interest rate, fluctuation of interest rate are important burning discussion (Claessens, Frost, Turner, & Zhu, 2018; Lopez et al., 2020) for the growth of NLLs, number of NPLs, RWAs and performance indicators of banks as ROA, ROE, ATO and NPM. However, at yet there has been no work studying the moderation impact of interest rate with CRM on bank's performance in G-10 countries as per our best of knowledge. Yuksel, Mukhtarov, Mammadov, and Ozsarı (2018) evaluated interest rate as one of the factors which are increasing the credit risk in Azerbaijani banks. Banking sector of the developed countries has an important contagious effect on all over world, so this analysis is very much needed. Zhonghai (2020) stressed that management of credit risk is a basis of survival and most important banking risks as well as interest rate (Bouteille & Coogan-Pushner, 2021; Silahtaroğlu, Dinçer, & Yüksel, 2021).

This research contributes to the existing literature of CRM on bank's performance of commercial banks on many ways. First, this research systematically investigates the impact of CRM in the commercial banking industry of top 10 banks of G-10 countries. These countries are

the Basel originating countries and behaviors of CRM is important to discuss. This study explores the moderation effect of interest rate, interaction of both independent variables and adds impact of CRM on bank performance, moderation of interest rate on developed countries and behaviors. Provided a guideline for the policy makers, financial analysts and bank managements that CRM is not only a mathematical formula but also a "behavior" to socio economic factors, political grounds and many more aspects of capital adequacy, availability of loanable funds and provisioning of risk weighted assets, exports of goods and services.

This study provides various other insights as fluctuation of interest rates, management of NIM with long term cheap mortgages and funded by short term heavy paid deposits. Central banks must overarch the banks, competing for expensive deposits for liquidity and at the same selling loans at low prices. These results proved that CRM is not responsible for the reduction of NPLs, but also interest rate affects and its moderation seamlessly provides loanable funds, reduces NPLs and generates higher export of goods and services. Provided a guideline for the policy makers, financial analysts and bank managements that CRM is not only a mathematical formula but also a "behavior" to socio economic factors and many other aspects of capital adequacy, availability of loanable funds, provisioning of RWAs and exports of goods and services.

This study is organized as follows: section one briefly explains the present literature, second for hypotheses development, third section pertains to data and econometric model, fourth section is discussion of results and the fifth and final is for conclusion and policy recommendations.

2. Literature Review

2.1 Theoretical Framework

There are many theoretical bases of bank performance as Campbell (1977) theory of performance assessment, eight principles of growth by Peter & Waterman (1983), Quinn and Rohrbaugh (1983) theory of output quality, CAMELS (Lopez, 1999), and then many elaborations of CAMELS (Ferrouhi, 2017). Bank performance is the essence of banking activity which is endangered by the credit risk. Credit risk is not only a quantitative angle but also qualitative and legal framework. Basel Accords erected the foundations of CRM, policies and procedures developed after GFC 2007-2008 and diagnosed that interest rate is also an important devastating risk. Wicksell (1898) presented the theory of loanable funds which is the base of financing and its pricing revolves around supply and demand. Many theoretical bases of interest rate are for example, capital theory (Menger, 1996), Keynes Theory of liquidity preferences (Hicks, 1936) natural rate of interest (Robertson, 1937), ethical reasoning of interest rate (Rothbard, 1995), supply and demand justification (Bondone, 2011). Researchers adopted loanable fund theory as the basic moderation relationship of CRM and interest rate but not proved. Supply of loanable funds cannot be discussed in aura of singularity and management of credit risk maintains the supply and ensure the uninterrupted flow of funds.

2.2 Hypotheses Development

Literature provides many evidences that bank performance is a complicated phenomenon which cannot be segregated and delinked with the internal and external factor of the organization. CRM is used as index of proxies of NPLs, NLLs and RWAs; whereas dependent bank performance is measured by the variables of ROA, ROE, ATO and NPM. Siddique, Masood, Javaria, and Huy (2020) declared that ROA, ROE and NIM are one of the eminent performances expressing indicators and have reciprocal negative relationship with non-performing loans.

Witzany and Witzany (2017) emphasized the dire need of management credit risk for bank's performance. Ishak (2017) find the positive impact of CRM on profitability of listed banks of Bursa Malaysia by TL to TA, TL to TD, NPLs to Total Loan as independent variables and ROE &

ROA as dependent variables. Nwanna and Oguezue (2017) measured the effects of credit management on profitability of deposit money banks in Nigeria from 2006-2015 and adopted ROA & ROE as a function of financing to total deposit and NPLs to total loans as credit management indicators and concluded that NPLs and LLPs have positive indicating relationship with banking performance. N. Ali, Bagram, and Ali (2018) critically evaluated the role of risk management and its impact on bank performance, traced the impact of the CRM on performance of the banking sector, used variables of EPS, ROA and NPA and concluded that NPLs has an inverse relationship with bank efficiency. Shahid, Gul, and Naheed (2019) evaluated the credit risk, its importance for profit maximization of banking industry; selected ROA, ROE, NPLs and concluded that "credit risk is not a single element and it affects the bank's performance till bankruptcy. Management and Central bank's regulator authority has evolved systematic solutions to save the banking sector".

Ebenezer, Islam, Yusoff, and Rahman (2019) and Kola, Gjipali, and Sula (2019)endorsed the relationship of CRM and bank's performance and concluded that macroeconomic indicators of GDP, inflation rate, real effective exchange rate and interest rate are affecting factors. Ajao and Oseyomon (2019) have selected CAR, NPL ratio, LLP ratio, ROA to measure the performance due to CRM and find out that there is substantial contrary relationship between CAR and DMB's profitability. Darwish and Abdeldayem (2019) analyzed banking risk management and analyzed interest rate as risk. Siddique et al. (2020) empirically discussed the impact of NPLs on the financial performance, cost efficiency ratio, of the developed and developing countries and prove that ROA and ROE have negative relationship with NPLs and positive relationship with sale growth and CAR.

Wu, Mitchell, and Lambert (2021) divided the risk facing financial institutions into two main divisions as systematic and non-systematic and declared that risk management is an established framework to aim to develop theories, practices and procedures to handle risks. Naili and Lahrichi (2022) endorsed that aftershocks of Global Financial Crunch of 2007-2008 has proved the terrible requirement of the implementation of CRM and "riskiest" risk which has different names, structures and locations but the causes were the same; as financial issues of liquidity, interest rate, market, foreign exchange, solvency, operational and compliance. Ajao and Oseyomon (2019) also declared that credit, its speedy growth, vigilant loan processing and pricing is important practice to survive, and it can be possible by strict CRM, especially in emerging economies. Naili and Lahrichi (2022) emphasized that "still" credit risk as the core and deep-rooted risk of the banking industry.

H1: CRM Index positively affects Bank's performance.

Interest rate is the end product of length of the lending period, cost of fund, sensitivity to the risk, economic climate of the country, volume of amount lent, relaxation to the customer and foreign exchange rate fluctuations. In this research interest rate is included as moderator which affects the bilateral relationship of CRM with bank's performance. Interest rate is evolved as index developed by LIR, IRS and NIM. Ogede (2013) discussed lending interest rates as the base of the economic activities, helpful for the growth of the economic nourishment, determined by the federal reserves' volume, assessed by flow of money, political climate, savings rates, bond market, risks of investment, tax culture, investor's demand of notes and bonds and the banking industry (Bhattarai, 2015; Shafiq, Hua, Bhatti, & Gillani, 2021). Mason and Jayadev (2015) discussed lose money and high rates of interest rate spreads in historical perspective and endorsed Keynesian interest rate theory of rewards.

Appelt (2016) criticized the Keynesian theory and stated that declared rate of interest as "chief tool" of intervention by the government through monetary policy and endorsed Wicksell's statement that equilibrium interest rate is the natural or market interest rate which hinges around the natural level. Ozmen and Yılmaz (2017) discussed "fragile economies" in co-movement perspective of exchange rates, interest rate differential and risk premium. Capital is

a scarce factor of production which cannot be paid; rented, lent and leased without any interest, rent, cost and profit (Abrar, 2019; Yang & Shafiq, 2020). Brunnermeier and Koby (2018) declared that interest rate must be watched in both ways of lending and borrowing, its reduced minimal rates can be burden that further rate reductions may be contractive rather than expansive (Lopez et al., 2020).

Marouf and Guellil (2017) and Vouldis and Louzis (2018) declared interest rate as important component of lending which can increase the debt burden. Researchers declared that interest rate leads to asset demand, project financing, customer retention, current and future consumption, production gap and inflation. Wang, Lin, Werner, and Chang (2018) highlighted the importance on interest rate spread as "tool for transfer of wealth" and declared interest rate must be profitable and maintain a reasonable spread. Banking sector must try to raise savings at reasonable rates in order to lend to the borrowers at a productive rate (Mbowe, Mrema, & Shayo, 2020). Interest rate spread and profitability of the banking sector are important and having positive relationship; inferred in many studies tend to empirically decide that interest rate spread is one of the key determinants of commercial banks profitability.

Samorodov, Azarenkova, Golovko, Miroshnik, and Babenko (2019) highlighted that interest rate spread is the "speed regulator for activity" and confirmed that it underpins the borrowing and lending relationships. Another proxy of interest rate is a net interest margin and it analyze investment decisions and judge performance of lending decisions. A negative ratio or decline in NIM defines loss and declare interest expenses are above than investment earnings. More credit risk in the banking industry usually earns higher asset yields. Saiful and Ayu (2019) inferred that credit, and liquidity risks management have a positive relationship with bank's performance and implications of credit risk increases with ROA and ROE. Brei, Mohan, and Strobl (2019) discussed intermediation activity of the banking sector in low interest rate due to the natural hazards and cause widespread destruction and disruption in economic activity. Puspitasari, Sudiyatno, Hartoto, and Widati (2021) empirically studied net interest margin (NIM) as a proxy of market risk and established relationship with non-performing loan (NPL) as a proxy of credit risk; higher NIM produces less paying capacity in the borrowers and banking industry ends at NPLs. Butola, Dube, and Jain (2022) discusses the statistical finding indicates that in the presence CRM policies bank's profitability increases and NIM has a negative relationship.

H2: Interest rate moderates the relationship between CRM index and Bank's Performance in developed countries.

Interest rate affects the banking industry is a simple question which is answered by the literature many times but the interaction of interest rate index and CRM index is an important and new addition in this context. Bondone (2011) described, "Historical development of interest theory went from a divine, mystical, ethical-moral beginning (Greeks) to the intent of removing it from the divine and mystical sphere, without abandoning the ethical and moral aspect." Researcher also declared that interest rate cannot be defined in an "aura of singularity"; all the definitions of interest rate, rules, definitions, and maxims of economics cannot be complete without all internal and external forces working on supply and demand of the "Money".

H3: Interactive effect of CRM and interest rate affect the bank performance in developed countries.

3. Data and Methodology

3.1 Data and Sample Selection

To obtain results on how interest rate influences the CRM for performance of the banking industry in developed countries, top 10 banks of every country were chosen for 2001-2020 from the balance sheets, income statements of commercial banks at Federal Deposit Insurance

Corporation (FDIC) and websites of the relevant banks. Explanatory variables are bank size, GDP, inflation, exports of goods and services and loanable funds. Here bank size and loanable funds are from the accounts of the relevant bank, whereas, other three were taken from the World Bank's indicators database.

For a complete picture and participation of all countries, marked variations and developed index of interest rate (moderator) by LIR, IRS and NIM and index of CRM by NPLs, NLL and RWAs. Detailed and complete grouped countries, a clear-cut description and analysis of data in a transformed manner are necessary for checking, statistical adjustments of outliers and change the pattern of presented data into a grouped or indexed variables are necessary for result-oriented inferences (Tabachnick & Fidell, 2007). Nevertheless, for sufficient, balanced and reliable data analysis, the study sample were of same IFRS standards, accounting policies, as on date active banks, top ten banks as per central bank's declaration, no missing entries, applicable same standards of disclosures and certifications as per Basel Accords.

Table 1
Variables Measurement

Variables		Measurement
Bank Performance	(ROA)	Net Income / Average Total Assets (R. Ekinci & Poyraz, 2019)
	(ROE)	Net Income / Shareholders Equity (Gazi et al., 2021)
	(ATO)	Total Sales / Average Total Assets (Duho, Duho, & Forson, 2021)
	(NPM)	Net Profit / Total income or Revenue (Su, Lee, Chou, & Chen, 2020)
CRM Index	(NPLs)	NPLs / Total Loan Portfolio x 100 (K. Z. Islam, Alam, & Hossain, 2019)
	(NLLs)	Net Loans & Leases (Ahmadyan, 2018)
	(RWAs)	Risk Weighted Assets (Milojevic & Redžepagic, 2021)
Interest Rate Index	LIR	Lending interest Rate (Belas, Smrcka, Gavurova, & Dvorsky, 2018)
	IRS	Interest rate Spread (Ermolova et al., 2021)
	NIM	Net Interest Margin (Busch & Memmel, 2017)
Explanatory Variables	Bank Size	Natural of total assets (Hamza, 2017)
	GDP	Real gross domestic product annual growth rate (Abbas & Masood, 2020)
	Inflation	Consumer price index (Abbas & Masood, 2020)
	Exports of Goods	Total number of exports from resident to non-resident (Mileris, 2012)
	Loanable Funds	Cash available to lend (Taiwo et al., 2017)

3.2 Econometric Model

The primary purpose of this study is to highlight the moderation effect of interest rate between CRM and performance of the banking of developed countries in a period of 2001 to 2020. This econometric relationship can be shown in the following model.

$$y_{it} = \beta_0 + \beta_1 x + \beta_2 z_1 + \beta_3 xz + BC + \varepsilon_{it} \quad (1)$$

Here, Y represents the dependent variable of bank performance (ROA, ROE, ATO & NPM), α is a constant, *i* is a cross-section which is a bank, *t* is time in the form of a year, X represents the independent variable of CRM (NPL, NLL, and RWA), Z represents moderator if interest rate (LIR, IRS and NIM), XZ represent interactive term of CRM index and interest rate index. Control variables are represented by C and included variables are bank size, GDP, inflation, exports of goods & Services and Loanable funds. In order to avoid issues of endogeneity (mainly taken as the correlation of several explanatory variables with their error terms in the respective model)

and a dependence on lagged information from such endogenous variables, this study demonstrates a dynamic panel dataset methodology for the estimation of unbiased, precise, and consistent estimators (Arellano & Bond, 1991; Roodman, 2009; Vithessonthi & Tongurai, 2016). Further, the widely used technique of the two-step linear GMM estimator model is used in the analysis, as it is considered to be more suitable and reliable than the panel estimators described in one-step GMM linear models (Windmeijer, 2005). The model equation below shows the dynamic nature of the two-step panel dataset approach.

$$(\mathrm{ROA})_{it} = a + (\mathrm{ROA})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 C_{1(\mathrm{BK\,SZ})} + \beta_3 C_{2(\mathrm{GDP})} + \beta_4 C_{3(\mathrm{INFL})} + \beta_5 C_{4(\mathrm{EXGS})} + \beta_6 C_{5(\mathrm{LNBFD})} + \in \quad (2)$$

$$(\mathrm{ROA})_{it} = a + (\mathrm{ROA})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 C_{1(\mathrm{BK\,SZ})} + \beta_4 C_{2(\mathrm{GDP})} + \beta_5 C_{3(\mathrm{INFL})} + \beta_6 C_{4(\mathrm{EXGS})} + \beta_7 C_{5\,(\mathrm{LNBFD})} + \in \quad (3)$$

$$(\mathrm{ROA})_{it} = a + (\mathrm{ROA})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 XZ_{(\mathrm{CRM\ X\ IR})} + \beta_4 C_{1(\mathrm{BK\,SZ})} + \beta_5 C_{2(\mathrm{GDP})} + \beta_6 C_{3(\mathrm{INFL})} + \beta_7 C_{4(\mathrm{EXGS})} + \beta_8 C_{5\,(\mathrm{LNBFD})} + \in \quad (4)$$

$$(\mathrm{ROE})_{it} = a + (\mathrm{ROE})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 C_{1(\mathrm{BK\,SZ})} + \beta_3 C_{2(\mathrm{GDP})} + \beta_4 C_{3(\mathrm{INFL})} + \beta_5 C_{4(\mathrm{EXGS})} + \beta_6 C_{5(\mathrm{LNBFD})} + \in \quad (5)$$

$$(\mathrm{ROE})_{it} = a + (\mathrm{ROE})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 C_{1(\mathrm{BK\,SZ})} + \beta_4 C_{2(\mathrm{GDP})} + \beta_5 C_{3(\mathrm{INFL})} + \beta_6 C_{4(\mathrm{EXGS})} + \beta_7 C_{5\,(\mathrm{LNBFD})} + \in \quad (6)$$

$$(\mathrm{ROE})_{it} = a + (\mathrm{ROE})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 XZ_{(\mathrm{CRM\ X\ IR})} + \beta_4 C_{1(\mathrm{BK\,SZ})} + \beta_5 C_{2(\mathrm{GDP})} + \beta_6 C_{3(\mathrm{INFL})} + \beta_7 C_{4(\mathrm{EXGS})} + \beta_8 C_{5\,(\mathrm{LNBFD})} + \in \quad (7)$$

$$(\mathrm{ATO})_{it} = a + (\mathrm{ATO})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 C_{1(\mathrm{BK\,SZ})} + \beta_3 C_{2(\mathrm{GDP})} + \beta_4 C_{3(\mathrm{INFL})} + \beta_5 C_{4(\mathrm{EXGS})} + \beta_6 C_{5(\mathrm{LNBFD})} + \in \quad (8)$$

$$(\mathrm{ATO})_{it} = a + (\mathrm{ATO})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 C_{1(\mathrm{BK\,SZ})} + \beta_4 C_{2(\mathrm{GDP})} + \beta_5 C_{3(\mathrm{INFL})} + \beta_6 C_{4(\mathrm{EXGS})} + \beta_7 C_{5\,(\mathrm{LNBFD})} + \in \quad (9)$$

$$(\mathrm{ATO})_{it} = a + (\mathrm{ATO})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 XZ_{(\mathrm{CRM\ X\ IR})} + \beta_4 C_{1(\mathrm{BK\,SZ})} + \beta_5 C_{2(\mathrm{GDP})} + \beta_6 C_{3(\mathrm{INFL})} + \beta_7 C_{4(\mathrm{EXGS})} + \beta_8 C_{5\,(\mathrm{LNBFD})} + \in \quad (10)$$

$$(\mathrm{NPM})_{it} = a + (\mathrm{NPM})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 C_{1(\mathrm{BK\,SZ})} + \beta_3 C_{2(\mathrm{GDP})} + \beta_4 C_{3(\mathrm{INFL})} + \beta_5 C_{4(\mathrm{EXGS})} + \beta_6 C_{5(\mathrm{LNBFD})} + \in \quad (11)$$

$$(\mathrm{NPM})_{it} = a + (\mathrm{NPM})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 C_{1(\mathrm{BK\,SZ})} + \beta_4 C_{2(\mathrm{GDP})} + \beta_5 C_{3(\mathrm{INFL})} + \beta_6 C_{4(\mathrm{EXGS})} + \beta_7 C_{5\,(\mathrm{LNBFD})} + \in \quad (12)$$

$$(\mathrm{NPM})_{it} = a + (\mathrm{NPM})_{it-1} + \beta_1 X_{(\mathrm{CRM})} + \beta_2 Z_{1\,(\mathrm{Interest\ Rate})} + \beta_3 XZ_{(\mathrm{CRM\ X\ IR})} + \beta_4 C_{1(\mathrm{BK\,SZ})} + \beta_5 C_{2(\mathrm{GDP})} + \beta_6 C_{3(\mathrm{INFL})} + \beta_7 C_{4(\mathrm{EXGS})} + \beta_8 C_{5\,(\mathrm{LNBFD})} + \in \quad (13)$$

4. Empirical Results

4.1 Descriptive Statistics

Table 2 provide detailed information for proxies used to investigate the moderation effect of interest rate with CRM on bank performance of developed countries. The statistics indicate that ROA 1.084%, ROE 11.629%, ATO 0.040% and NPM 22.853% with a standard deviation of 2.632%, 27.111%, 0.041% and 82.289% respectively. Interest rate index, developed by LIR, IRS and NIM indicate that average value is 7.197 with standard deviation of 2.130%. CRM index

developed by NPLs, NLLs and RWAs indicate 3.107 with standard deviation of 2.130%. Interactive term of interest rate and CRM index is 22.173 with the standards deviation of 9.895%. Bank size has average of 12.901%, GDP 1.535%, inflation 1.348%, exports of goods & services 36.974%, loanable funds 7.891 with standard deviations of 3.618%, 1.797, 1.149, 18.976 and 10.895 respectively. This data depicts the complete story of variations of pre-Basel, pre-crisis, amid crisis and after the crisis and remedial measures. Minimum values tell the nose-dived banking industry in the GFC 2007-2008. Minimums are ROA -36.64%, ROE -70.47, ATO 0.010% and NPM -3487.19% with intertest rate index 3.00%, CRM index -1.00%, interaction of IR and CRM -11.000%, bank size 2.950, GDP -5.700%, inflation -2.320, exports 9.040% and loanable funds -1.500 with the maximum values of 40.11%, 35.75%, 0.370%, 350.04%, 15.00%, 6.00%, 84.00%, 21.57%, 6.87%, 4.00%, and 82.64% respectively.

Table 2
Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
ROA 1	2000	1.084	2.632	-36.64	40.110
ROE 2	2000	11.629	27.111	-70.47	35.750
ATO 3	2000	0.040	0.041	-0.010	0.370
NPM 4	2000	22.853	82.289	-3487.19	350.040
Interest rate Index	2000	7.197	2.130	3.000	15.000
CRM Index	2000	3.107	1.005	-1.000	6.000
Interest Rate x CRM	2000	22.173	9.895	-11.000	84.000
Banks size	2000	12.901	3.618	2.950	21.570
GDP Growth rate	2000	1.535	1.797	-5.700	6.870
Inflation	2000	1.348	1.149	-2.320	4.000
Export Of Goods & Services	2000	36.974	18.976	9.040	82.640
Loanable Funds	2000	7.891	10.895	-1.500	125.510

Source: Authors' calculation using Stata

Table 3
Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ROA	1											
ROE	0.473*	1										
ATO	0.428*	0.128*	1									
NPM	0.277*	0.207*	0.009*	1								
IR Index	0.597*	0.077*	0.491*	0.028*	1							
CRM Index	0.611*	-0.039*	-0.031*	-0.049*	0.091*	1						
CRM x IR Index	0.663*	0.023*	0.315*	-0.003*	0.599*	0.706*	1					
Bank Size	-0.052*	0.018*	-0.137*	0.020*	-0.348*	0.099*	-0.193*	1.000				
GDP growth	0.069*	0.071*	0.054*	0.033*	0.033*	0.014*	0.033*	0.037*	1.000			
Inflation	0.100*	0.076*	0.097*	0.013*	0.334*	-0.113*	0.153*	-0.192*	0.126*	1.000		
Exports of Goods & Services	0.102*	0.033*	0.192*	-0.022*	0.449*	-0.052*	0.263*	-0.361*	0.126*	0.047*	1.000	
Loanable Funds	0.123*	0.092*	0.062*	0.056*	-0.023*	0.032*	0.024*	-0.005*	-0.023*	-0.006*	-0.033*	1.000

Table 3 reports the correlation results among the proxies of banking performance, moderation of interest rate index and CRM index and findings confirm that there was no problem with the high correlation between explanatory variables. All performance indicators were moving in the same directions, interest rate index affected the growth of industry and interaction of IR and CRM index proved the significant relationship. Explanatory variables were also found that the relationships among variables as per intellectual economics theories and also indicated that there was no problem with high multicollinearity. The findings of the correlation matrix proved that loanable funds have a positive and growing relationship with CRM index which more strengthen with moderation effect of interest rate index.

4.2 Base Model Results

Table 04 analyses three different models; CRM index, CRM and interest rate index and interactive term of CRM and interest rate index. P value of ROA declares significant performance indicator (Abaidoo & Anyigba, 2020; El-Habashy, 2019; Gwatiringa, 2020). CRM has negative (-11.4%) and significant declining relationship with ROA (Munangi & Bongani, 2020; Riyazahmed & Baranwal, 2021). Moderation effect of interest rate enhances the effect and CRM jumped to -11.7% and interest rate index itself has a positive relationship (5.5%) with the ROA. Interaction of indices of IR and CRM positively affect ROA; CRM converted from negative to positive (24.9%) which is highly result oriented, IR index behaved positive and upsurged with strong relationship with ROA (A. Ekinci, 2016; Rahayu, Lestari, & Kuniawati, 2021). Interaction term proved that negligent behavior of banking industry can reduce (-5.00%) ROA. In the presence of CRM index bank size has a negative and insignificant relationship with ROA (Adusei, 2015); it depicts implementation of CRM policies has no concern with size. Moderation of interest rate affects that bank size with ROA more significantly and positively.

Table 4
Impact of CRM, Interest rate Index & Interaction of both on ROA

Dependent Variable = ROA					
CRM Index		**Interest Rate Index**		**CRM Index*Interest rate index**	
ROA	0.412***	ROA	0.413***	ROA	0.415***
	(.003)		(.003)		(.003)
CRM Index	-.114***	CRM Index	-.117***	CRM Index	.249***
	(.018)		(.018)		(.049)
Bank Size	-0.003*	Interest Rate	.055***	Interest Rate Index	.21***
	(.01)	Index	(.009)		(.024)
GDP Growth rate	0.025***	Bank Size	.017**	Interest Rate Index	-.05***
	(.006)		(.01)	CRM Index	(.006)
Inflation	-0.03***	GDP Growth rate	.027***	Bank Size	.023***
	(.009)		(.006)		(.013)
Exports of Goods	0.052***	Inflation	-.034***	GDP Growth rate	.026***
& Services	(.003)		(.009)		(.006)
Loanable Funds	0.007***	Exports of Goods	.05***	Inflation	-.04***
	(.001)	& Services	(.003)		(.009)
Constant	-0.84	Loanable Funds	0.007***	Exports of Goods &	0.052***
	(.137)		(.001)	Services	(.003)
		Constant	-1.383	Loanable Funds	.008***
			(.155)		(.001)
				Constant	-2.722
					(.287)
AR (2)	1.144	AR (2)	1.148	AR (2)	1.109
Prob > chi2	0.0038	Prob > chi2	0.0030	Prob > chi2	0.0050

Note: Table 04 displays the outcome for a two-stage (GMM) approach of developed countries. Dependent proxy includes bank-performance ratio (ROA). Independent proxies include CRM Index and moderating proxy interest rate Index in second column and interactive term of CRM index and moderator in third column. Significance*** p<1%, <**5%, <*10%.

After the insertion of IR and CRM indices bank size upsurged more and robustly affects the performance of banks. In three different insertions of CRM, moderation effect of IR index and interactive term; GDP has a positive significant relationship with ROA (Shawtari, 2018) with minor changes. Relationship of inflation with ROA created a negative significant relationship (Abaidoo & Anyigba, 2020) and effects aggravated with CRM index, moderation effect and interaction of both.

Inflation affected ROA negatively (Fuadi, Saparuddin, & Sugianto, 2022) with the minor changes in the presence of IR index and interaction term. Exports of goods and services has positive relationship with ROA (Al-Homaidi, Ahmad, Khaled, & Qaid, 2019; Costantiello, Laureti, & Leogrande, 2021; Dubey & Das, 2022; M. R. Islam & Haque, 2018). Loanable funds also

affected ROA in a positive way and it remains the same measurements (approx.) in the presence of IR index and interaction of IR and CRM but significant.

Table 5
Impact of CRM, Interest rate Index & Interaction of both on ROE

Dependent Variable = ROE					
CRM Index		**Interest Rate Index**		**CRM Index*Interest rate Index**	
ROE	.142***	ROE	.142***	ROE	.143***
	(.001)		(.001)		(.002)
CRM Index	-2.125***	CRM Index	-2.185***	CRM Index	8.007***
	(.211)		(.199)		(1.313)
Bank Size	1.541**	Interest Rate	-1.23***	Interest Rate	2.886***
	(.087)	Index	(.151)	Index	(.581)
GDP Growth Rate	.678***	Bank Size	1.293***	Interest Rate	-1.361***
	(.071)		(.104)	Index *CRM Index	(.184)
Inflation	-.543***	GDP Growth	.679***	Bank Size	1.191***
	(.191)	Rate	(.081)		(.154)
Exports of Goods &	-.119***	Inflation	-.513***	GDP Growth rate	.664***
Services	(.013)		(.185)		(.084)
Loanable Funds	.012*	Exports of	-.129***	Inflation	-.61***
	(.019)	Goods &	(.017)		(.021)
		Services			
Constant	.409	Loanable Funds	0.017***	Export of Goods &	-0.087***
	(.575)		(.017)	Services	
		Constant	12.808	Loanable	0.065***
			(1.712)	Funds	
				Constant	-18.75
					(5.296)
AR (2)	0.346	AR (2)	0.354	AR (2)	0.375
Prob > chi2	0.0026	Prob > chi2	0.0026	Prob > chi2	0.0022

Note: Table 5 displays the outcome for a two-stage (GMM) approach of developed countries. Dependent proxy includes bank-performance ratio (ROE). Independent proxies include CRM Index and moderating proxy interest rate Index in second column and interactive term of CRM index and moderator in third column. Significance*** p<1%, <**5%, <*10%.

Table 5 investigated the impact CRM index, Interest rate index and interaction of the both on ROE. CRM has negative (-212.5%) and significant relation with ROE (Boateng, 2019; R. Ekinci & Poyraz, 2019; Hamza, 2017; Hurka, 2017; Klaassen & van Eeghen, 2015; Thabet & Alaeddin, 2018). CRM index has negative and significant relation with ROE and confirmed that if not properly managed ROE can be dropped significantly (R. Ekinci & Poyraz, 2019; Mwangi, 2012). Moderation effect of interest rate declared that CRM has negative and significant relation with ROE which indicates that policy violations can gobble up the equity. A negative ROE is not essentially a bad phenomenon, it could be due to higher NPLs and it should be monitored and restructured. This relationship indicate that banks' profitability and performance is contrarywise affected by non-performing loans that could expose them to large amounts of volatility and the global financial crisis. These results suggested that banks need to strengthen their CRM policies not only to generate income but also to maintain a portfolio of qualitative assets (Ellis, Sharma, & Brzeszczyński, 2022).

Interest rate index is an important independent variable which also has positive strong relationship with ROE (Lopez et al., 2020; Topak & Talu, 2017). Moderation effect of IR aggravated the effect (-218.5%). Interest rate has a negative and significant relationship with ROE (-123.00%) and huge decreasing relationship with ROE is highly result oriented (Akims, Omagwa, & Mungai, 2020; Hutasoit, Toni, & Ariesa, 2022). Interactive term proved the importance (800.7%) of CRM index and IR index (288.6%) and both (-136.1%); which recommends remedial measures. Behavior of bank size in respect of ROE is also significant

(Aladwan, 2015; Faure & Gersbach, 2017; Musah, Anokye, & Gakpetor, 2018). Moderation effect as well as interactive term of IR and CRM index also confirms the importance of effects bank size on ROE; positive and significant as more equity more profit (Aladwan, 2015; M. Ali & Puah, 2018). Bank size is also having positive and significant relationship with ROE; large bank with large equity earns more (Balla & Rose, 2015).

Behavior of GDP growth rate proved positive relationship with ROE (Samhan & Al-Khatib, 2015); as well as under the effects of moderation and interactive term. Explanatory variables also supported the intellectual economic theories; positive and significant relationship of GDP with ROE (Ahamed, 2021; Samhan & Al-Khatib, 2015). In the developed countries inflation also structures the economy of the banking industry as in the presence of CRM it depicts negatively strong relationship (-54.3%) with ROE (Adu, Domfeh, & Denkyirah, 2016; Almansour, Alzoubi, Almansour, & Almansour, 2021; Katırcıoglu, Ozatac, & Taspınar, 2020). Inflation decreased ROE significantly and endorsed the empirical diagnosis that improper implementation of risk management, lower exchange rates and violations of foreign exchange regulations banks face losses and negative ROE (Reaz, Bowyer, Vitale, Mahi, & Dahir, 2020; Shane, Roe, & Somwaru, 2008; Ullah, Pinglu, Ullah, Zaman, & Hashmi, 2020).

Under moderation effect of interest rate and interaction term inflation has negative and significant relationship with ROE (-51.3%) & (-61.00%) respectively. Any banking industry cannot survive without the growth of exports of goods and service (Chisiridis & Panagiotidis, 2017). Moderation effect of IR also affected the exports in a negative and significant way. In the presence of interactive term, exports of goods and services negatively affect ROE in a significant way. Loanable funds also behaving and contributing positive relationship with ROE (Faure & Gersbach, 2017; Musah et al., 2018). Loanable funds have positive strong relationship with ROE which complement the loanable fund theory.

Table 6
Impact of CRM, Interest rate Index & Interaction of both on ATO

Dependent Variable = ATO					
CRM Index		**Interest Rate Index**		**CRM Index*Interest rate Index**	
ATO	.997***	ATO	.954***	ATO	.959***
	(.009)		(.012)		(.013)
CRM Index	0	CRM Index	0	CRM Index	.001***
	(0)		(0)		(.002)
Bank Size	.002***	Interest Rate Index	.002***	Interest Rate Index	.003***
	(0)		(0)		(.001)
GDP Growth Rate	0	Bank Size	.002***	Interest Rate Index	0
	(0)		(0)	*CRM Index	(0)
Inflation	-.001***	GDP Growth Rate	0	Bank Size	.002***
	(0)		(0)		(0)
Export of Goods &	0***	Inflation	-.001***	GDP Growth Rate	0
Services	(0)		(0)		(0)
Loanable Funds	0***	Export of Goods &	0	Inflation	-.001***
	(0)	Services	(0)		(0)
Constant	-.027***	Loanable Funds	0**	Export of Goods &	0
	(.002)		(0)	Services	(0)
		Constant	-.042	Loanable Funds	0
			(.004)		(0)
				Constant	-.046
					(.006)
AR (2)	0.963	AR (2)	0.954	AR (2)	0.933
Prob > chi2	0.1099	Prob > chi2	0.1193	Prob > chi2	0.3271

Note: Table 6 displays the outcome for a two-stage (GMM) approach of developed countries. Dependent proxy includes bank-performance ratio (ATO). Independent proxies include CRM Index and moderating proxy interest rate Index in second column and interactive term of CRM index and moderator in third column. Significance*** p<1%, <**5%, <*10%.

Table 6 analyses simple model of ATO with relationship of CRM index, IR index and interaction of the both. CRM has neutral relation with ATO, whereas bank size has a positive and significant relationship with ATO. GDP is also silent and neutral about the relationships. Inflation has a negative relation with ATO but exports have neutral relationship with ATO. Loanable funds are also posing neutral relationship with ATO. CRM index is unable to form any change in ATO. Interest rate has a positive relationship with ATO. Bank size has a positive relationship with ATO and confirmed that ATO increases with the bank's size. GDP is also having neutral relationship with ATO, whereas inflation has negative relationship with ATO. Exports are also silent to do a change in ATO and loanable funds are also silent to do a change in ATO. Interest rate has a positive and significant relationship with ATO. Interactive term has neutral relation with ATO. Bank size has a positive and significant relationship with ATO. GDP has a neutral relationship with ATO. Inflation has negative and significant relation with ATO. Exports has neutral relationship with ATO.

Table 7
Impact of CRM, Interest rate Index & Interaction of both on NPM

Dependent Variable = NPM					
CRM		**Interest rate**		**CRM*Interest rate**	
NPM	.032***	NPM	.031***	NPM	.032***
	(.001)		(.001)		(.001)
CRM Index	-.986***	CRM Index	-1.297***	CRM Index	-14.492***
	(.256)		(.214)		(4.259)
Bank Size	-3.041***	Interest Rate	4.621***	Interest Rate	-3.782***
	(.48)	Index	(.606)	Index	(1.186)
GDP Growth Rate	1.697***	Bank Size	-1.771***	Interest Rate	2.049***
	(.224)		(.473)	Index *CRM	(.528)
				Index	
Inflation	-3.694***	GDP Growth	1.791***	Bank Size	-1.435***
	(.654)	Rate	(.222)		(.517)
Export of Goods &	1.899***	Inflation	-4.441***	GDP Growth Rate	1.492***
Services	(.085)		(.646)		(.237)
Loanable Funds	.164***	Export of Goods	1.78***	Inflation	-3.462***
	(.041)	& Services	(.091)		(.701)
Constant	2.925	Loanable Funds	.114***	Export of Goods	1.437***
	(3.361)		(.041)	& Services	(.107)
		Constant	-42.276***	Loanable Funds	.034*
			(6.643)		(.046)
				Constant	23.126***
					(10.838)
AR (2)	0.942	AR (2)	0.958	AR (2)	1.171
Prob > chi2	0.0016	Prob > chi2	0.0008	Prob > chi2	0.0627

Note: Table 7 displays the outcome for a two-stage (GMM) approach of developed countries. Dependent proxy includes bank-performance ratio (ATO). Independent proxies include CRM Index and moderating proxy interest rate Index in second column and interactive term of CRM index and moderator in third column. Significance*** p<1%, <**5%, <*10%.

P value of NPM proves that it is declared performance indicator of banking industry (El Moslemany & Etab, 2017; Waleed, Pasha, & Akhtar, 2016). In this table three different models; CRM index, CRM and interest rate indexes and interactive term of both are included. CRM has negative and significant relationship with NPM (Alshatti, 2015; Kolapo et al., 2012) i.e. (-98.6%). Researchers inferred that NPM has negative strong relationship with CRM; lenient policies and accommodating behavior of CRM reduces bank's profitability. Moderation effect of interest rate upsurged negative relationship of CRM index with NPM (-129.7%) (Alshatti, 2015; Kolapo et al., 2012). Interactive term of IR and CRM index also affected NPM as (-1449.2%); significant and appealing. Here it is important to note that IR index has a positive and strong relationship with NPM (462.1%) (Sukmadewi, 2020). Presence of interaction converts the moderation effect of interest rate into negative (-378.2%) relationship with NPM, highly responsive and proves that

NPM reduces significantly due to the lower lending interest rate, narrowed interest rate spread and lessened net interest margin. At the same interactive term is positive and significant (204.9%) for NPM. Bank size has a negative (-304.1%) and significant relationship with NPM (Boateng, 2018).

Net profit margin decreases as the size of the bank increases which depicts that large banks are more prone to losses (Aziz, 2018; Bikker & Vervliet, 2018). Moderation effect of IR affects the bank size and its negative impact on NPM reduces (-177.1%) and interactive term also helps to reduce the negative impact (-143.5%). At the provision of CRM GDP growth rate affects the performance positively (169.7%) which accelerates up to (179.1%) and slightly reduces (149.2%) at the inclusion of interactive term which depicts the affects of NPLs, extravagant NLLs and blocked assets as risk weighted. Inflation has negative (-369.4%) and significant relation with NPM at CRM index which intensifies (-444.1%) in the presence of moderation effect of IR index and reduces (-346.2%) at the insertion of interactive term. CRM supports exports and has a positive and significant relationship with NPM (189.9%) which slightly reduces (178.00%) and further reduces (143.7%) at the interactive level. Loanable funds have positive and significant relationship with NPM; more loanable funds earn more NPM.

5. Conclusion

Bank performance, measured by ROA, ROE and NPM, all are causative with CRM and interest rate. A strong positive relationship of ROA, ROE, ATO and NPM proves that if the CRM is properly managed then performance of the banking industry accelerates. Interconnectedness is an important element which must the part of policy making, unconventional monetary policies to cater the changes of intra jurisdictions, international capital flows and to handle unproductive and excessive capital flows and investments. To deal with the incidents like US subprime eruption, needs policies of surveillance and monitoring mechanisms, inclusive growth, monitoring of funds' investment and production, ownership of funds must be the part of investment to enhance the vigilance.

Interest rate proved as to be the moderator or regulator; economy can be expanded by the cheaper lending, but its negative repercussions are also there. Low interest rates on the other side discourage investors to deposit money and banks are compelled to borrow from offshore wholesale markets for their loanable funds. Interest rate is not only play on the asset side but also on liability side as well. If the banks are not paying enough to depositors, it may low the lifestyle and decrease their expenses which will slow down the economy; so, the rate of interest could be properly managed to cater cost of funds, inflation, and other aspects.

Concludingly it is evident monetary policies and fiscal regulations can impact a bank's ROA, ROE, ATO and NPM as the direction of interest rates guide towards the borrowing or saving of a customer. Monetary policies and resultant interest rate define net interest margins, savings, consumer financing and affect performance of the banking sector and boost the targeted results of CRM. Limitations were non-availability of data, variations in accounting standards, different implementation standards of Basel Accord, provision of data in broken periods, mergers, new policies, and procedures after GFC and archived data after every five years which cannot be retrieved without permission of that specific institute.

Authors Contribution
Munazza Saleem: study design and concept, critical revision, incorporation of intellectual content
Omar Masood: literature search, data collection, data analysis, data interpretation, drafting

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