Policy Research Journal
ISSN (E): 3006-7030 ISSN (P) : 3006-7022 Volume 3, Issue 3, 2025

ANALYZING THE IMPACT OF INSTITUTIONAL AND ENVIRONMENTAL SUSTAINABILITY FACTORS ON CREDIT RISK IN BANKING SECTOR: A MULTIFACETED APPROACH FROM ASIAN ECONOMIES

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DOI: https://doi.org/10.5281/zenodo.15028389

Keywords
Environmental Sustainability, Environmental Tax, Credit Risk

Article History
Received on 04 February 2025
Accepted on 04 March 2025
Published on 14 March 2025

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Abstract
This study examines the relationship between environmental, banking sector specific and country level factors and how they influence credit risk of banking sector in the Asian economies, using the Generalized Method of Movements for estimation. The work analysis how various factors like environmentally related tax revenues, CO2 emissions, World Governance Indicator, capital market development, capital adequacy, real interest rate, and GDP growth determine credit risk. The results show that environmentally related tax revenues are significantly, negatively impacts credit risk, highlighting the importance of environmental sustainability in financial stability. Capital market development has significant and negative impact on credit risk, highlighting the increased credit disbursement to private sector significantly decreases the credit risk. The study finds insignificant, positive relationship of CO2 and insignificant, negative relationship of WGI, capital adequacy, real interest rate, and GDP growth with credit risk. The study concludes that, green fiscal policies have an essential role in macroeconomic stability and ultimately reducing the credit risk. It is highlighted to policy makers that encouraging environmental responsibility leads to economic stability and financial resilience, particularly in addressing financial risks involved in banking sector.

INTRODUCTION

There is an important role of banks in the development of a country's economy. That's why stability and performance are the crucial tasks to be achieved in the banking sector that the policy makers would consider in order to encourage investment and to enhance economic growth (Bucevska & Hadzi, 2017). However, not having a control on increase in operation risk, financial risk, business risk, and particularly Credit Risk (CR), the economic development is expected to be severely impeded. Having a rise in Credit Risk (CR), the banking sector collapses and confronts instability. Resultantly, it hinders economic growth and leads to shrinking the economic output (Vouldis & Louzis, 2018). As the banking sector's sustainability has significant importance in the economic development, the policy makers and bank managers use different techniques in order to minimize the risks associated with the banks and in particular the Credit Risk (CR) to avoid instability and failure. Right after the global

financial crisis in 2008-09, and COVID-19, the CR became of major concern in the banking sector sustainability as the CR increased in both the developing and advanced economies.

Considerable studies have been undertaken to investigate the key factors that contribute to the ups and downs in the non-performing loans. To understand these key driving factors of Credit Risk (CR) we better mitigate the bank risk, failure and instability, and hence can achieve banking sector sustainability and economic growth. By studying the current literature, the factors that influence CR can be either internal or banking sector specific and external or country level. Prior studies evidenced that, sector-specific factors are size, profitability, liquidity, income diversification, capital adequacy and inefficiency while country-level factors can be lending interest rate, capital market development and other macroeconomic factors like economic growth and inflation (Dimitrios et al., 2016).

As far as environmental sustainability is concerned, it refers to the use of natural resources in a responsible way to safeguard and preserve them for the future generations. Meeting the increasing demand of the population and gaining economic development has triggered the industrialization. Contrarily, it has made a disturbance in the ecological balance and the environmental sustainability is being compromised to a great extant (Yadav & Pathak, 2013).

Statement of the Research Problem

There are numerous micro and macroeconomic factors that may throw banks into crisis. As the Asian banking sector holds a significant importance in economic development in Asia. Moreover, the institutional and environmental sustainability factors were not taken into account as the investor main focus was on the profit maximization and not the long term environmental sustainable goals. Therefore, identifying the factors that impact and contribute in the stability and sustainability of the banks is of paramount importance. Additionally, this work aims to see how various distinctive factors, particularly the environmental sustainability contributing in the banking-sector sustainability and credit risk.

Research Questions

What are the institutional and environmental sustainability factors that impact the credit risk?

Objectives

i. To investigate the how country level institutional factors, influence the Credit Risk (CR).
ii. To investigate the environmental sustainability influence on Credit Risk (CR).

Significance of the Study

The aim of this work is to contribute in the body of knowledge by improving understanding regarding the elements that affect credit risk in the banking sector and also shall provide guidance for the policy makers of the countries through incorporating banks- specific and macroeconomic factors and particularly a new aspect, the environmental sustainability, in the study, that how the environmental dimension influences the non-performing loans of the banks in the Asian Developing economies. This study will explore the new insights and benefits of the countries' involvement in fostering the natural resources' safeguarding and control over the pollution in the field of banking sector. To the best of our knowledge, credit risk is not being studied, by taking the environmental aspect into account, previously. Moreover, the results of this work will potentially be of vital importance for evidence based policy making, risk management, and enhancing environmental sustainability in the region.

LITERATURE REVIEW

This chapter provides literature focusing on the determinants of credit risk, considering sector-specific and country level factors.

Theoretical Review

This section presents relevant theories regarding the non-performing loans and banks sustainability.

Information Asymmetry Theory

According to this theory there is asymmetry of information in the credit market among the borrowers and lenders (Akerlof, 1970). Pagon and Jappelli (1993) argued that the adverse selection of

borrowers reduces as the banks improve and share the information. Furthermore, Auronen, (2003) has showed that the information asymmetry makes it difficult to identify the bad or good borrowers, which might result in wrong selection of credit applicant. He further explains that in the market, the party that has more information than the other about a particular item, is in a better position to negotiate terms. Therefore, adverse selection may lead to a significant increase in non-performing loans (Bofondi and Gobbi, 2003).

Markowitz Portfolio Theory

Markowitz portfolio theory (1952) is a prominent theory regarding finance and investment management. This theory is based on the concept of "not putting all the eggs in one basket", which means to make various portfolios of the investment in order to minimize the investment risk. Commercial banks should diversify their lending activities in order to maximize the returns and to minimize the default risk of borrowers in loans repayment (Kirui, 2014).

Banking Sector-Specific Factors:

Numerous authors have performed works to understand the factors of the banking-sector (CR). Concerning the banking sector specific factors, the existing literature disclosed that liquidity, inefficiency, profitability, size, income diversification and capital adequacy are crucial factors impacting the (CR).

Illustratively, Boudriga et al, (2009) evidenced that capital requirements are negatively associated with the (CR). Kartikasary et al., (2020) & Louzis et al., (2012) discovered a negative relationship of profitability with the (CR). Abid et al., (2014) & Khan et al., (2020) evidenced a straight connection between inefficiency and (CR).

The liquidity risk is also positively associated with the (CR) (Anastasiou et al., 2019). Additionally, Naili & Lahrichi, (2022) & Cotugno et al., (2010) evidenced that the size is positively related to the banks' CR.

Moreover, Khan et al., (2020) evidenced that income diversification is negatively associated with the credit risk as more the income is diversified into the non-interest activities like derivatives and trading there is lower risk of credit. Similarly, Ghosh, (2015), also evidenced an inverse relationship between income diversification and credit risk. However, Hu, (2022) and Rachman et al., (2018) have revealed that income diversification does not has any effect on the credit risk.

Macroeconomic Factors:

Several studies can be found highlighting the significant effect of the macroeconomic factors like economic growth and inflation on CR. Such as Adebola et al., (2011) & Messai & Jouini, (2013) revealed that the effect of interest rate on CR is positive. Likewise, Skarica, (2013) & Prasanna et al., (2014) the inflation positively influences CR. Additionally, prior studies revealed that the domestic credit (Foglia, 2022) and exchange rate (Akkoc & Vatansever, 2013; Khan et al., 2018) positively influence CR.

Various research studies pointed out significant impact of the country governance in CR. Such as Kaufmann & Kraay, (2007) has shown that improving governance quality results in lower CR. Similarly, Anastasiou et al., (2019) revealed that country governance is inversely associated with CR and also enhancing governance is a useful tactic to have control on the CR. Arham et al., (2020) indicated that country governance plays a pivotal part in Emerging Asia to decrease the unpleasant behavior of the macroeconomic cycles on the CR. Likewise, Elamer et al., (2020) found that banks operating in well-governed environments, are more likely better at risk management and also good at disclosure practices comparatively other counterparts banks in the MENA countries.

Additionally, Quagliariello, (2007) & Dimitrios et al., (2016) evidenced; the GDP growth inversely influences the CR. Similarly, Arham et al., (2020) explains that the real interest rate directly while the GDP growth inversely affect the NPLs. Whenever higher interests are imposed by the banks, there are chances that more borrowers will default (Ombaba 2013). Maşcu and Pescu (2016) examined the Romanian banking sector and concluded that real interest rate positive affects the CR.

Environmental Sustainability

Recent studies highlight the importance of achieving environmental sustainability by aligning fiscal policies. The studies suggest that environmentally related taxes tend to reduce carbon emissions

(OECD, 2021), while ESG disclosure increases transparency and information asymmetry, which eventually lowers credit risk in financial institutions (European Central Bank, 2022). A recent study by He et al. (2020) suggest that environmentally related tax policies significantly enhances market stability aligning with the research questions in the coming chapter of this study. Similarly, political stability is negatively associated with financial risk (Kaufmann et al., 2020).

Banks progressively accepting the concept of environmental responsibilities and accepting the fact that however banks are not involved in emission of toxic chemicals to the environment directly, they are playing an indirect part in polluting the environment by lending decisions (Cowton and Thompson 2000). This indirect involvement of financial institutions with their clients' degradation of the environment will invite strong criticism and would stand them responsible (Islam et al., 2012; Jo et al., 2014).

Additionally, the impact of environmental sustainability and sustainability disclosure on the corporate performance is being studied widely. Carnevale and Mazzuca (2014) analyzed 176 banks in Europ and concluded that sustainability disclosure has positive impact on the stock prices. Jo et al., (2014) explained that as the environmental costs are reduced the ROA is increased in at least one year or two.

Russo and Fouts (1997) found that the firms that are environmental friendly are likely to accomplish significant economic performance. Miles and Covin (2000) argued that good environmental management companies are likely to gain better reputation and that leads them to higher financial and marketing performance.

Research Methodology

Quantitative approach is to be used for the analysis as it enables us to examine large samples and testing theories easily. The data sample to be used in this study is panel. So panel data approaches shall be used in this study for the analysis of panel data (Pornupatham, 2006).

To find the connection among the independent and the dependent variables, all our analysis shall be carried out on secondary data and panel data analysis or more specifically Panel Quantile Regression PQR or GMM might be suitable based on the nature of data, as the panel data analysis is more appropriate for multicollinearity and heterogeneity issues (Athari et al., 2023). Furthermore, it increases the efficiency of the estimation in the regression analysis.

Population of the study:

The population of this study consists of banks operating within the Asian countries, which are divided into several geographical regions, including Central Asia, East Asia, South Asia, Southeast Asia, and Western Asia, as defined by the United Nations Statistics Division (2023), during the period from 2015 to 2021.

Table 3.1

S. NO	Countries Name	S. NO	Countries Name
1	Afghanistan	25	Maldives
2	Armenia	26	Mongolia
3	Azerbaijan	27	Myanmar
4	Bahrain	28	Nepal
5	Bangladesh	29	North Korea
6	Bhutan	30	Oman
7	Brunei	31	Pakistan
8	Cambodia	32	Philippines
9	China	33	Qatar
10	Cyprus	34	Saudi Arabia
11	Georgia	35	Singapore
12	India	36	South Korea
13	Indonesia	37	Sri Lanka

14	Iran	38	State of Palestine
15	Iraq	39	Syria
16	Israel	40	Tajikistan
17	Japan	41	Thailand
18	Jordan	42	Timor-Leste
19	Kazakhstan	43	Turkey
20	Kuwait	44	Turkmenistan
21	Kyrgyzstan	45	United Arab Emirates
22	Laos	46	Uzbekistan
23	Lebanon	47	Vietnam
24	Malaysia	48	Yemen

Asian countries have been selected in this study due to their growing importance in facing global environmental issues and managing credit risk. Many Asian economies are significant contributors to greenhouse gas emissions (OECD, 2021), which makes it essential to adopt environmentally focused tax policies to reduce climate risks.

Studying Asian countries also helps to address the limited research on the connection between credit risk, environmental policy, and governance in this region. The diversity in policies and regulations across these countries provides important insights into how different factors influence financial risks and promote environmental sustainability.

Sample

The study aimed to take all Asian countries as categorized by United Nations Statistics Division (2023) for analysis but due to data constraints, 14 countries were seleted for analysis. The selected 14 countries had comparable and adequate data for the study period of 2015 to 2021.

Data Analysis Approaches

Various data techniques are applied to scrutinize the distinctive features of the data set (Asteriou & Hall, 2007). The secondary data mostly is considered in three categories.

Firstly, the cross sectional data set involves collecting information about individuals, organizations, countries, at single point of time or during a specific period (Asteriou & Hall, 2007). Time series data set consist of data and information about different variables over more time periods (Asteriou & Hall, 2007). The other category of data set is panel data, which is the combination of cross-sectional and time series components, where data is collected for multiple entities over a span of time (Asteriou & Hall, 2007).

In this study the data shall be based on the third pattern of data set i.e. panel data. As the various banking specific-sector and country level data will be involved for different countries over a time span of 2011 to 2022.

The data shall be obtained from the banks' yearly reports, countries' central banks, World Bank and other necessary databases.

Hausman Test

Ahn and Moon (2001) suggest that the Hausman test can be used as a tool for choosing a suitable method for estimation, whether it be the fixed effect or random effect method, in our estimations. When the p-value is low, fixed effects model is to be used as the method for estimation otherwise random effect model to be used (Asteriou & Hall, 2007).

Endogeneity Test

Endogeneity issues arises when the exogenous variable is not truly independent and influenced by other factors in the model. This may result in biased and inefficient estimation and could be accurate about the relationship between the exogenous and endogenous variables. Additionally, exogenous variables are supposed to be independent from the error terms within the model. Consequently, exogeneity is crucial for econometric analyses (Castineira & Nunes, 1999).

Evidently, if there is endogeneity in our model the results may be biased and inefficient. Therefore, the hausman test shall be conducted to find if our model

is free from any endogeneity (Castineira & Nunes, 1999).

Generalized Method of Movement (GMM)

Currently, the problem of endogeneity is not been addressed empirically however, numerous methods have been recommended to deal with the endogeneity. Such as a common technique is lagged independent variable. Rather applying Fixed-Effect method, the authors have used GMM predictor for cancelling the biased nexus linked with the exogenous variables (Jimenez and Saurina, 2005; Quagliariello, 2007; Espinoza and Prasad, 2010; Louzis, et al., 2010).

Endogeneity is technically the correlation of the error term with the exogenous variables. Traditional regression methods assumed the error term is unrelated to the explanatory variables, however, it causes the partiality and biased expectations in the estimation (Wooldridge, 2002).

In this study GMM method for estimation shall be used to address the issue of endogeneity (Roodman, 2006).

Variable Descriptions

This study has employed various variables and are elaborated below:

Dependent Variable

Credit Risk (CR): This is measured by the ratio of non-performing loans to the total loan portfolio. A higher ratio indicates higher credit risk and is represented as CR (Makri et al., 2014; Klein, 2013).

Independent Variables

Environmental Sustainability (EnTax): This variable represents the share of environmentally related tax revenue as a percentage of total tax revenue. It is labeled as EnTax, following the approach used by He et al., (2020).

Greenhouse Gas Emissions (CO2): The CO2 emissions KGs per 2015 US$ of GDP, reflecting the environmental impact of a country. This is denoted as CO2 (Gatto et al., 2021; Guan et al., 2017).

Control Variables

Banking Sector-Specific Factors

Capital Adequacy (CapAdv)

This ratio represents the bank capital as a percentage of total assets and assesses a bank's financial health. It is represented by CapAdv, as discussed by Khan et al, (2020), and Makri et al., (2014).

Capital Market Development (DcPv)

This variable calculates the share of domestic credit provided by banks as a percentage of GDP. It is symbolized as DcPv (Dimitrios et al., 2016).

Macroeconomic Factors

Country Governance (WGI): The Worldwide Governance Indicator, specifically the Political Stability and Absence of Violence/Terrorism, is used as an indicator of governance quality. This variable is denoted as WGI and follows Kaufmann et al., (2008).

Real Interest Rate (RIR): This is the nominal interest rate adjusted for inflation. Represented as RIR, it is used to evaluate the economic cost of borrowing (Khemraj and Pasha 2009).

GDP Growth (ΔGDP): The annual rate of GDP growth, labeled as ΔGDP, indicates the overall economic health of a country and its potential impact on credit risk (Louzis et al., 2011; Rajan & Dhal 2003).

Following is a tabular presentation of the variable employed in this study;

Table 3.7

Factors	Explanation	Symbol	Source
Dependent Variable			
Credit Risk (Dependent Variable)	Value of non-performing loans to total value of the loan portfolio ratio (CR)	CR	Makri et al.,(2014), Klein(2013),
Independent Variablyyes			
Environmental Sustainability	Environmentally related tax revenue as Percentage of total tax revenue.	EnTax	He et al, (2020)

Green House Emission	CO2 emissions (kg per 2015 US$ of GDP)	CO2	Gatto et al., (2021) Guan et al., (2017)
Control Variables			
Banking Sector-Specific Factors			
Capital Adequacy	Ratio of bank capital to total assets (%)	CapAdv	(Khan, Siddique, & Sarwar, 2020) (Makri, Tsagkanos, & Bellas, 2014)
Capital Market Development	The percentage of domestic credit provided by banks in relation to GDP.	DcPv	(Dimitrios et al., 2016).
Macroeconomic Factors			
Country Governance	World Governance Indicator score. (Political Stability and Absence of Violence/Terrorism: Percentile Rank)	WGI	Kaufmann et al., (2008)
Real Interest Rate	The nominal interest rate adjusted for inflation	RIR	Khemraj and Pasha, (2009)
GDP Growth	Annual Growth of GDP	ΔGDP	Louzis et al., (2011), Rajan & Dhal (2003),

Regression Models for Analysis

The following regression model is being developed based on the variables presented in table-1 for banking sector-specific, country level, and environmental factors.

A regression model is given in equation-1 whichh shows the relationship between the dependent variable and all other independent variables.

$$CR_{it} = \alpha_0 + \beta_0 EnTax_{it} + \beta_1 CO2_{it} + \beta_3 CapAdv_{it} + \beta_4 DcPv_{it} + \beta_7 WGI_{it} + \beta_5 RIR_{it} + \beta_8 \Delta GDP_{it} + \varepsilon_{it}$$

(Eq-3.8)

In the equation it means country and time, while ε_{it} represents error term in the model.

Conceptual Framework

Based on the above mentioned literature review, the following conceptual framework is being developed which shows the relationship between the dependent variable and all the independent variables.

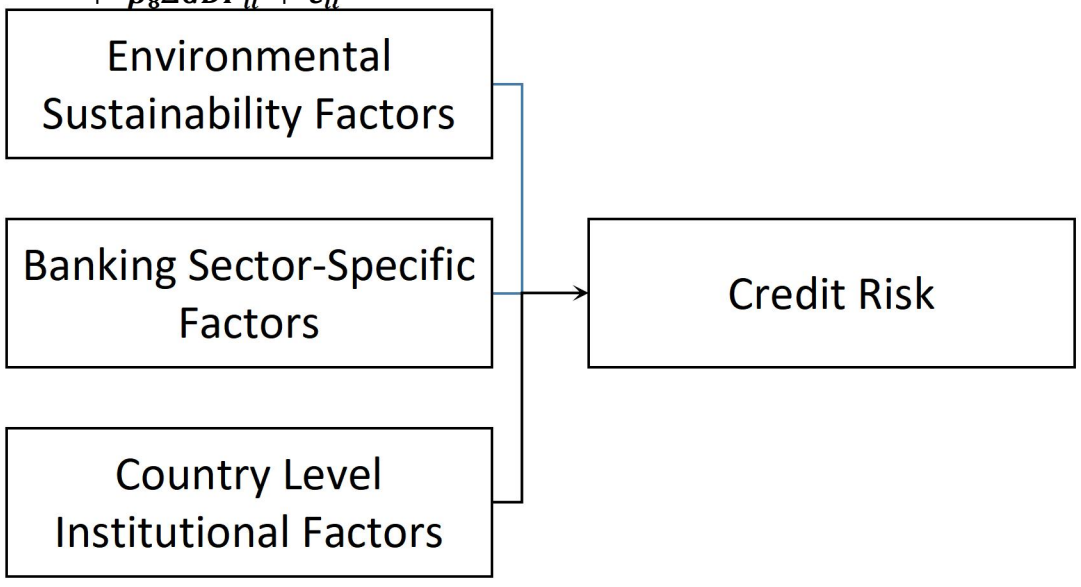

Figure (3.9)

RESULTS AND DISCUSSIONS

Introduction

In this section, dynamic panel data model (GMM) has been conducted on the data of 14 countries for seven years (2015-22) to investigate the contributing factors of credit risk (CR) in the banking sector, particularly to investigate the environmental impact on the credit risk. Alongwith environmentally related tax revenues (EnTax) and CO2 emissions the analysis also include WGI, domestic credit, bank capital advocacy, GDP growth, and real interest rate. The results are discussed in this chapter accordingly.

Descriptive Statistics

Table 4.2

Variable	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
CR	5.1315	3.3539	0.9241	13.6444	0.297759	1.803295
EnTax	5.5266	3.9197	0.1284	22.5065	1.246281	5.541413
CO2	0.5445	0.3213	0.1291	1.5373	1.102683	3.985159
WGI	0.2851	0.8112	-0.9242	2.3249	0.792497	3.166992
CapAdq	9.7322	3.7907	4.742	20.8137	0.974918	3.237285
DcPv	64.5205	42.1106	14.5791	185.3635	1.209987	3.547989
RIR	5.2461	4.7849	-13.6421	19.5334	0.162424	5.08587
ΔGDP	4.3366	6.6288	-33.4928	41.7451	-0.47843	19.85145

It is being indicated in the summary statistics that an extensive variation is present in CR and other measures across varying countries. The CapAdq mean (9.73%) with SD of 3.79% whereas DcPv mean is 64% of GDP, indicating variation in development of banking sector in different countries. Most of the variables show moderately positive skewness like EnTax, CO2, and DcPv. However, GDP growth exhibits a slight negative skewness, indicating a left tailed distribution. Furthermore, EnTax, RIR, and GDP are slightly leptokurtic, indicating some extreme values are existing in the distribution. Contrarily, CR is platykurtic, with comparatively plate curve. However, WGI, CapAdq, and DcPv are nearly having normal kurtosis. As GMM is employed in this model, such issues are addressed upto major extent. However, the White's test in the diagnostics section of this chapter suggests that, there is no significant issues of skewness and kurtosis as the p-values are greater than 0.05.

Dynamic Panel Data Results

To find the key findings, the GMM system for estimation (Arellano-Bond two-step method) is used in order to cope with the potential issues of endogeneity, autocorrelation and heteroscedasticity and to cancel the biased nexus linked with the exogenous variables. The results are explained below step by step. In this study, the GMM method was more suitable than the Panel Quantile Regression method due to the option of lagged effect of the dependent variable.

Table 4.3

Wald Chi2(8)	8539.85
Prob > Chi2	0.000

Variable	Coef.	z	P>|z|
CR (D1)	0.3551	3.1	0.002
EnTax (D1)	-0.1267	-3.3	0.001
CO2 (D1)	6.6315	0.81	0.416
WGI	-1.4472	-1.02	0.310
CapAdq	-0.1335	-1.26	0.209
DcPv	-0.0462	-1.78	0.075

RIR	-0.0299	-1.2	0.229
ΔGDP	-0.0188	-1.34	0.180
_cons	10.1215	4.86	0

Non-Performing Loans

The results reveals that Credit Risk (CR) shows a positive and significant relationship with its lagged value (coefficient = 0.355, p = 0.002). This finding underscores the persistent nature of CR over time, as high levels of past credit risk strongly influence current levels. This aligns with the inherent characteristics of non-performing loans (NPLs), which often require long settlement periods and are difficult to resolve quickly (Louzis, Vouldis, & Metaxas, 2012).

From the Information Asymmetry viewpoint, the persistence of Credit Risk may cause the banks to face challenges in proper assessment of borrower. Such asymmetry leads to adverse selection, where high risk borrowers are identified, results to accumulation of NPLs.

The results showing the persistence of Credit Risk, highlighting the need for such diversification. As banks focus too heavily on specific sectors or types of loans, they become more vulnerable to correlated defaults, increasing credit risk. By applying diversification principles, banks can better balance risk and return, reducing the impact of credit risk over time (Acharya et al, 2006).

Environmentally Related Tax Revenue

The impact of EnTax is significantly, negatively (-0.127, **p** = 0.001), related to CR which indicates that, Credit Risk reduces significantly as the taxes increases on environmental harmful practices. This result is consistent with the theoretical expectation that higher taxes on environmentally damaging activities reduce environmental risk exposure and encourage sustainable practices in both firms and financial markets. The negative relationship observed in this study indicates that when governments impose higher taxes on industries contributing to environmental degradation, it serves as an incentive for these industries to adopt greener practices. In turn, the reduction in environmental risks leads to a decrease in credit risk for financial institutions. It is imperative to mention that Sarkar and Searcy (2016) evidenced from India, that stock market acts negatively to firms environmental performance.

As there are no studies which have investigated such relationship yet. However, some studies somehow suggest that, taxing environmentally harmful practices can improve overall environmental sustainability and reduce associated financial risks (OECD, 2017). Moreover, Cavallo & Valenzuela (2021), found that meeting the environmental, social, and governance (ESG) standards in investment decisions leads to reduced credit risk by improving the sustainability of operations. As complying of firms to ESG standards, the investors and financial institution take well informed decisions regarding investing resources in environmentally risky activities and hence the credit risk is affected accordingly.

CO2 Emissions

The results of the model used this study suggest that CO2 emissions have an insignificant impact on CR with coefficient (6.632, **p** = 0.416). It implies that, pollution or environmental degrading activities do not have a direct impact the banking system or the banking sector is well secured from such like risks. The environmental degradation has a broader impact on the economy and specifically the its impact on financial indicator like credit risk is unclear (Omri et al., 2019). As he reports that in early phase of economic development, rise in GDP results in more CO2 emission. However, as the GDP per capita exceed a particular limit, CO2 emission tend to decrease.

World Governance Indicator

The World Governance Indicator (WGI) has a negative but insignificant coefficient (-1.447, **p** = 0.310), implying that governance quality does not have a clear and immediate effect on CR in this dataset. This result matches with studies that however, find a robust relationship between governance and financial sector performance (Lee, Dato Haji Yahya, Habibullah, & Mohd Ashhari, 2020). Good governance typically fosters a healthier financial environment by reducing corruption and improving contract enforcement. The lack of significance in this study may be attributed to the

relatively narrow sample of countries or variations in the governance subcomponents measured.

Capital Adequacy

The capital adequacy ratio (CapAdq) also shows an insignificant relationship with CR (-0.133, **p** = 0.209), which suggests that better-capitalized banks do not necessarily exhibit lower levels of NPLs in this context. Previous studies have shown mixed results, with some suggesting that well-capitalized banks are better equipped to absorb shocks and manage CR (Makri et al., 2014).

Domestic Credit to the Private Sector

Domestic credit to the private sector (DcPv) has a negative and significant ($p<0.1$) impact on CR (-0.046, **p** = 0.075). This result aligns with the argument that higher credit allocation in the private sector can lead to better economic activity and lower default risks (Anjum & Finance, 2024). This is kind of odd that increasing the supply of funds to private sector might increase the credit risk, but by breaking down the formula adopted for Credit Risk (CR) in this study is dividing the NPLs by total loans portfolio (NPLs/Total Loans), it can be understood that the denominator increases proportionately more than the nominator as it is revealed in the results.

Real Interest Rate

The real interest rate (RIR) has an insignificant effect on CR (-0.030, **p** = 0.229). This finding contradicts the expectation that higher interest rates would increase borrowing costs, thereby leading to higher default rates. It suggests that high real interest rate results in strict lending policy and lower demand of loans thus lowering the total NPLs (Mahrous, Samak, & Abdelsalam, 2020)

GDP Growth

GDP growth (ΔGDP) is also found to have no significant effect on CR (-0.019, **p** = 0.180). GDP increase implies that more production resulting in more fund flow and profitability thereby, reducing the CR (Messai & Jouini, 2013). The insignificance in this case may reflect the relatively volatile nature of GDP growth in the sampled countries or the presence of external shocks not captured in the model.

Diagnostic Tests

The Arellano-Bond tests for first and second-order autocorrelation confirm that there is no autocorrelation in the residuals. The Hansen test for over-identifying restrictions indicates that the instruments used in the GMM model are valid (p = 0.952), supporting the reliability of the GMM estimates.

Variance Inflation Factor

The result shows that all the values are below 10, which is acceptable threshold. It indicates that the model does not affect from multicollinearity issues.

Table 4.4.1

Variable	VIF	1/VIF
WGI	2.68	0.3729
DcPv	2.5	0.4005
RIR	1.71	0.5859
CapAdq	1.54	0.6498
CO2	1.43	0.6986
EnTax	1.07	0.9315
ΔGDP	1.03	0.9688
Mean VIF	1.71	

White's Test

The results in White test suggest by rejecting the Ho of homoscedasticity, potential presence of heteroscedasticity in the model, which means that the variance of the residuals is not constant across all the observations. That's why, the issue of heteroscedasticity would result to inefficient estimation by employing Ordinary Least Squares Method.

Employing GMM method of estimation would be suitable as it provides efficient estimates under heteroskedasticity by using a robust weighting matrix (Hansen, 1982).

Table 4.4.2

chi2(35)	64.74
Prob>chi2	**0.0016**

Source	Chi2	df	p-value
Heteroskedasticity	64.74	35	0.0016
Skewness	6.53	7	0.4791
Kurtosis	2.17	1	0.1409
Total	73.44	43	0.0026

Additionally, the test suggests that there is no significant issues of skewness and kurtosis as the p-values are greater than 0.05.

Conclusion

This study aimed to investigate the determinants of Credit Risk (CR) across 14 countries over a period of seven years using both dynamic panel data (system GMM) and OLS regression techniques. The key findings highlight the persistence of CR, the significant role of environmentally related tax revenue in reducing CR, and the mixed effects of other macroeconomic and financial variables, such as capital adequacy, credit to private sector, and governance indicators.

The positive and significant lag of CR indicates that past CR strongly predict current values, underscoring the need for timely intervention in the banking sector to prevent the accumulation of bad loans. Environmentally related tax revenue appears to play a crucial role in reducing financial instability, suggesting that fiscal policies aimed at promoting environmental sustainability may have broader economic benefits. The insignificant effects of CO2 emissions, governance, and real interest rates in the GMM model, however, warrant further investigation.

Policy Implications

Based on the findings of the study, it is recommended for the policy makers that:

1. The negative impact of environmentally related taxes on CR suggests that policymakers should consider increasing the scope of green fiscal policies such as implementing carbon taxes to discourage unsustainable practices and Mandate ESG reporting standards for financial institutions.
2. The policy makers should shift more towards green fiscal policies in order to discourage irresponsible use of environmental resources with a broad aim of sustainable development. It is recommended that considering tax deductions for sustainable investments and lowering tax rates for environmental friendly.

Establishing techniques by policy makers has substantial effect on firms' activities, like making ESG reporting mandatory, the potential risk associated with the activities of the firms can effectively be identified by the stockholders, especial banks by avoiding investments in the environmentally unsustainable projects. Likewise, Kaufmann et al. (2008) suggested that good governance reduces financial risks by discouraging environmentally harmful activities.

Similarly, employing tools regarding tax deductions for sustainable investments and lowering tax rates for environmental friendly firms would help with the credit risk in banking sector.

Recommendations for Future Research

This study contributes to the body of knowledge on Credit Risk in the banking sector with a novel aspect of environment. However, few limitations have been encountered, and to be addressed properly by future researchers.

1. The use of aggregate governance indicator (WGI) might mislead the results rather Political Stability and Absence of Violence/Terrorism might separately be used for better understandings of its associations with CR.
2. Keeping in view the credit disbursement across different industries, the authors could target more specified sectors like

manufacturing, energy, transport, agriculture etc. for deeper understating of how CR behave.

3. Even though the CO2 emissions have an insignificant effect on CR in the model, yet its behavior of threats and its potential association with the financial stability in the banking sector to be investigated further.

Limitations of the Study

While this work contributes new insights regarding the determining factors of Credit Risk in the banking sector, some limitation to be admitted. As initially the population of the study was limited to all the banks worked for the time span of 2011-22 in Asian countries. However, due to the data unavailability issues the sample size was reduced to 14 countries for seven years 2015-22, which might limit the generalization of analysis to countries in other regions with different structures. Secondly, using the aggregated data for countries might obscure some specific factors that may affect CR.

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