Does banking sector support for achieving the sustainable development goals affect bank loan loss provisions? International evidence

Ozili, Peterson K

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Peterson K. Ozili

Abstract

This study investigates whether banking sector support for the realization of the SDGs affects bank LLPs. Using country-level data for 28 countries from 2011 to 2018 and using the panel fixed effect regression estimation method, it was found that banking sector support for achieving SDG7 and SDG10 leads to a significant decrease in bank loan loss provisions. Banks that support the realization of SDG6, and operate in countries that have strong institutions, experience a significant decrease in LLPs while banks that support the realization of SDG7, and operate in countries that have strong institutions, experience a significant increase in LLPs. The regional results are mixed. In the Asian region, banking sector support for achieving SDG13 decreases bank LLPs while banking sector support for achieving SDG8 and SDG10 increases bank LLPs. In the European region, banking sector support for achieving SDG3 decreases bank LLPs while banking sector support for achieving SDG4 and SDG6 increase bank LLPs. In the African region, banking sector support for achieving SDG6 increases bank LLPs.

Keywords: bank performance, sustainable development, sustainable development goals, loan loss provisions, institutional quality, economic growth, credit risk.

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1. Introduction

This study investigates whether banking sector support for the realization of the sustainable development goals (SDGs) affects bank loan loss provisions (LLPs). Banks play an important role in society. For many decades, the core business of banks is to (i) accept customer deposits, (ii) issue loans, (iii) earn interest income from loans, and (iv) generate fee income from offering other financial services (Jokipii and Monnin, 2013; Koetter and Wedow, 2010). Recently, there have been calls for banks to support the realization of the United Nation's sustainable development goals by 2030 (Decker and Kingdom, 2021; Avrampou et al, 2019; Zhao et al, 2022). Indeed, banks are in a better position to support the realization of the SDGs by providing funding for sustainable development projects and activities (Mpofu, 2022). Banks have sufficient liquidity which they receive from customer deposits and from other sources (Mpofu, 2022; Ozili, 2023b). The excess liquidity that banks have can be channeled to specific sustainable development projects or activities that banks are interested in.

Given the important role of banks, a number of studies have examined how banks can contribute to the sustainable development goals (see, for example, Samour et al, 2022; Mendez and Houghton, 2020; Aslan et al, 2014; Isiksal and Joof, 2021; Ozili, 2023b) while very few studies have examined how banks' commitment to sustainable development activities or projects affect bank performance and risk (see, for example, Galletta et al, 2022; Buallay, 2020; Liang et al, 2018; Scholtens and van't Klooster, 2019; Umar et al, 2021). However, none of the existing studies have examined whether bank support for the realization of the sustainable development goals can give rise to credit risk and whether bank managers signal this risk in the size of bank loan loss provisions. Therefore, it remains unknown whether attaining the sustainable development goals lead to higher or fewer bank loan loss provisions.

In this study, it is argued that banks may voluntarily commit to specific SDGs, or they may be pressured[1] to support SDG activities. Banks' commitment to one or more sustainable

[1] Banks often yield to such pressure to avoid consequences such as a backlash against banks, assigning a low ESG rating to banks who do not support SDG activities, or name-shaming banks that do not support SDG activities.

development goals – whether voluntarily or due to pressure – can lead banks to diversify into low-profit high-risk SDG activities so that they can appear to be supportive of the sustainable development goals (Naqvi et al, 2021). But this can pose a risk to banks' core lending business, and this risk can show up in the size of bank loan loss provisions through increase in bank loan loss provisions which is the amount of money that banks must set aside to mitigate expected credit losses that arise from their lending business (Ozili, 2020). On the other hand, if committing to the SDGs becomes a very profitable venture for banks, it is highly probable that banks will not focus much on their core lending business. They will shift their focus to SDG business so that they can generate significant profit from supporting the sustainable development agenda and this will be a distraction for banks even though it may lower the size of bank loan loss provisions especially if banks decrease lending to pursue profitable SDG business. The resulting decrease in lending will result in fewer bank loan loss provisions.

While these two arguments are profound, the existing literature has not examined whether banking sector support for the realization of the sustainable development goals gives rise to credit risk and whether bank managers signal this risk in the size of bank loan loss provisions by increasing or decreasing loan loss provisions. Therefore, it remains unknown whether banking sector support for the realization of the sustainable development goals affects bank loan loss provisions. Understanding the relationship between attaining the SDGs and LLPs is important because it can offer insights into the type of SDG activities that are closely linked to bank LLPs, how those activities affect bank loan loss provisions, and such insight will reinforce the need for banks to remain focused and committed to their core lending business while supporting the realization of the sustainable development goals in a way that minimizes risk.

In the empirical analysis, several country-level SDG indicators were introduced as discretionary determinants of bank loan loss provisions to determine whether banking sector support for the realization of the sustainable development goals leads to increase or decrease the size of bank loan loss provisions. The model estimates loan loss provisions as a function of the SDG indicators after controlling for other non-discretionary determinants of loan loss provisions. Using cross-country data from 2011 to 2018, the findings reveal that banking sector support for the

realization of specific sustainable development goals lead to a significant decrease in bank loan loss provisions.

This study contributes to the literature in the following way. First, this study is the first in the literature to investigate the relationship between bank loan loss provisions and the sustainable development goals. Such analysis will provide insight on whether banking sector support for the SDGs affects bank loan loss provisions. Second, the study contributes to the banking literature that explore how banks' non-core activities affect their performance. The study test whether banks' increasing focus on non-core activities, such as sustainable development activities, affect their performance in terms of bank credit risk measured as loan loss provisions. Third, this study contributes to the sustainable development literature that investigates banks' contribution to sustainable development, but which has not examined how banks commitment to the SDGs affects their risk performance.

The rest of the study is structured as follows. The next section presents the literature review. The subsequent section presents the research methodology. In the next section, the empirical results are presented. In the next section, the results are discussed. The concluding section presents the conclusion of the study.

2. Literature review

2.1. Theory

Three theories link banks to sustainable development. They are the finance and development theory, the finance and growth theory and the positive signaling theory of sustainable finance.

The finance and development theory states that uncertainty in the economy often lead financial sector agents to carefully choose the innovations they want to finance, and their decision to finance certain innovations will affect the development of the economic system. This theory was proposed by Schumpeter (1912) who emphasized that financial sector agents in capitalist

economies often finance innovative ideas, projects and activities which are profitable and contribute positively to the development of the economy.

The finance and growth theory states that financial institutions can ease external financing constraints and facilitate the allocation of credit to productive activities that lead to economic growth and development. This theory was proposed by King and Levine (1993) and Levine (2005) who argued that financial institutions will develop financial instruments that reduce external financing constraints and ensure efficient allocation of credit to productive activities that contribute to economic growth and development.

The positive signaling theory of sustainable finance states that economic agents have incentives to disclose positive information about their commitment to pursue one or more sustainable finance goals in order to signal good news to external parties who can support their goals. The theory was developed by Ozili (2023c). Among the three theories, the positive signaling theory of sustainable finance is the theory which is relevant for the present study because the theory suggests that economic agents, such as banks, can signal positive information about credit risk through changes in the size of bank loan loss provisions in order to signal good news to creditors and shareholders who can support the banks' SDG effort.

2.2. The theoretical literature

The theoretical literature suggest that banks can contribute to sustainable development. Meena (2013) proposed that the banking sector play an important developmental role by promoting environmentally sustainable and socially responsible investment that contribute to sustainable development. Meena (2013) also proposed that banks can adopt green banking, and they can finance green technology and pollution-reducing projects that contribute to the reduction of carbon emission and internal carbon footprint. Jeucken (2010) argued that, although bank financing is crucial in determining whether society succeeds in following an environmentally sustainable path, banks are often unaware of the role they can play in promoting sustainable development. For this reason, Roy et al (2015) argued that policy makers, particularly bank regulators, should encourage regulated banks to adopt sustainability principles and develop innovative solutions that address important sustainability issues. Other theoretical studies show

that it may be challenging for banks to support the realization of the sustainable development goals. For instance, Eremia and Stancu (2006) show that introducing sustainable development into the core of banking business is difficult and expensive, because incorporating sustainable development into the core of banking business may lead to a major change in bank management, a change in bank policies, a change in existing products, and it might lead to the need to reach new markets. Triner (2000) also argued that banks' effort to support development initiatives may be hindered by weak institutions and deeply embedded institutional constraints such as insecure property rights, continual tension between the role of the private sector and public sector, as well as competition between the Federal, State and Local government.

2.3. Studies showing bank support for the SDGs

Ozili (2023b) explored how banks can support the SDGs. The author urged banks to develop a green loan loss provisioning system that can align bank LLPs with the sustainable development goals. The author argued that the proposed green LLP system will permit banks to adjust their LLP estimates to reflect the environmental benefits and costs arising from extending loans to borrowers, and that the green LLP system will allow banks to allocate fewer LLPs when they issue loans to eco-friendly or green borrowers and allocate more LLPs when they issue loans to borrowers whose activities harm the environment. Jan et al (**2023**) also examined the support of non-interest banks for achieving the sustainable development goals. Jan et al (**2023**) evaluate the sustainability reporting performance of non-interest banks that have adopted the Global Reporting Initiative in Malaysia from 2011 to 2020. The bank-level result showed that most of the banks outperform on SDG disclosure scores while the SDG-level analysis showed that banks made greater disclosures on SDG9, SDG17, SDG11, and SDG1 while SDG16 had the least disclosure. La Torre et al (**2024**) examined the case of Italian banks. They evaluated the sustainability profile of banks in Italy to determine whether Italian banks comply with the regulatory requirement to integrate ESG into their risk management and governance frameworks. They found that many Italian banks are yet to integrate ESG requirements into their risk management and governance frameworks. Tashtamirov (**2023**) also argued that banks should incorporate ESG risk into their risk management systems by adjusting business and risk strategies, issuing ESG-embedded risk appetite statements, and ensuring full transparency.

Meanwhile, Mendez and Houghton (2020) identified some obstacles that prevent multilateral development banks from developing sustainable banking initiatives. They include (i) lack of profitable projects; (ii) opacity in tracking sustainable capital flows; and (iii) the absence of a universal mechanism for matching green investment supply and demand. Collectively, the above studies showed evidence that banks have the potential to support the attainment of the sustainable development goals.

2.4. Empirical studies on the effect of banking sector developments on the SDGs

Other studies examine how banking sector development may affect the realization of the sustainable development goals. For example, Samour et al (2022) assessed whether banking sector development improved the quality of the environment in South Africa from 1986 to 2017. They used the ARDL estimation method and found that higher banking sector development reduced the quality of the environment which indicates that greater banking sector development is detrimental to environmental sustainability in South Africa. Aslan et al (2014) analysed the association between bank development and energy consumption in some Middle Eastern countries from 1980 to 2011. They used the panel cointegration and causality methods and found that greater bank development improved energy demand in Middle Eastern countries. Isiksal and Joof (2021) also examined the association between bank performance and energy demand per capita. They analysed 26 countries from 1996 to 2017 and found a positive correlation between bank performance and energy consumption which indicates that energy demand increases when banks have better performance. Mehmood (**2023**) argued that banks play a crucial role in the clean energy transition because they can fund clean energy projects. The author investigate the effect of banking sector development on CO2 emissions (CO2) in eleven countries from 1990 to 2020 using the cross-sectional autoregressive distributed lag approach and found that great credit supply to the private sector enhances economic activity and decreases non-renewable energy consumption. Collectively, the above studies showed that banking sector developments have a significant effect on the sustainable development goals.

2.5. Empirical studies on the effect of SDGs on bank performance

Existing studies also investigate the effect of sustainable development efforts on bank performance and risk. For instance, Galletta et al (2022) examined whether banks contribute to sustainable development with respect to gender equality in the directorship of banks. More specifically, they were interested in whether the presence of female directors could improve the sustainability performance of banks. In their study, they investigate banks in 48 countries from 2011 to 2019 and found that the presence of more female directors had a positive impact on banks' sustainability performance. Buallay (2020) focused on the ESG component of sustainable development. The author was interested in whether greater ESG disclosures by banks lead to better market and financial performance. The study found that banks in developed countries that provide ESG disclosures had better market performance while banks in developing countries that adopt ESG principles experience better financial performance. In a related study, Liang et al (2018) examined whether sustainable banks have higher cost efficiency. The authors compared 36 banks that are listed on the Dow Jones Sustainability Index (DJSI) with 36 banks that are not listed on the index from 15 countries. The authors found that the DJSI banks are more cost efficient than the banks that are not on the index. Scholtens and van't Klooster (2019) also investigate whether banks' support for sustainability affect the default risk and systemic risk of banks. They found that default risk is lower among banks that support sustainability. Ozili (**2023a**) examined the correlation between achieving the SDGs and banking sector non-performing loans using Pearson correlation test statistic and found a significant positive correlation between achieving the SDGs and banking sector non-performing loans. The positive correlation is persistent in European countries and in countries in the Americas region. However, the study found a negative correlation between bank NPLs and the attainment of SDG3 and SDG7 in African countries and European countries. Collectively, the above studies showed that the pursuit of the SDGs can affect bank performance.

2.6. Gap in the literature

Existing studies have investigated the association between banking sector developments and the sustainable development goals, and how bank support for sustainable development affect bank performance and risk. But the existing literature has not examined how banking sector support for the realization of the sustainable development goals might affect bank loan loss provisions. Thus, it remains unknown whether attaining the SDGs is a discretionary determinant of bank loan loss provisions.

The present study extends the existing literature by investigating whether banking sector support for the realization of the sustainable development goals affect bank loan loss provisions. This study also adds to the literature by examining how bank support for the realization of the sustainable development goals affect bank loan loss provisions in the African region, the European region, and the Asian region. The study further adds to the literature by examining the moderating role of institutional quality on the relationship between attaining the SDGs and bank loan loss provisions.

3. Research methodology

3.1. Data

Country-level data for banking sector loan loss provisions, nonperforming loans ratio and economic growth were collected from the global financial development indicators of the World Bank. Country-level data for sustainable development indicators were collected from the world development indicators of the World Bank. Country-level data for institutional quality were collected from the world governance indicators of the World Bank. Data were collected for 28 countries that have sufficient data observations. Countries with insufficient or missing data were excluded from the sample. See table 1 for source of data and variable description. The countries included in the sample are Argentina, Brazil, Cambodia, Cameroun, China, Democratic Republic of Congo, Cote d'Ivoire, Egypt, Georgia, Ghana, India, Indonesia, Japan, Kenya, Korea Republic, Malaysia, Mexico, Netherlands, Nigeria, Pakistan, Philippines, Russia, Singapore, Tanzania,

Thailand, United Kingdom, United States and Vietnam. The sample period is from 2011 to 2018. The sample period begins from 2011 to avoid the effects, and after-shock effect, of the 2007-2009 global financial crisis that affected the balance sheet of banks up until 2010.

Table 1. Variable description and source

Variable	Indicator	Measurement	Source
LLP	The LLP ratio measures the protection against expected loan losses	Ratio of loan loss provision to gross loans (%)	Global Financial Development indicators
NPL	The NPL ratio is a measure of credit risk in the banking sector	Bank nonperforming loans to gross loans (%)	Global Financial Development indicators
DCP	Size of aggregate private credit in the economy	Domestic credit to private sector (% of GDP)	Global Financial Development indicators
GDPR	Economic growth measured as real GDP growth	Annual change in real gross domestic product (%)	World Development Indicators
ISI	Institutional quality index	The average of the six (6) governance indicators: voice and accountability index; political stability and absence of violence/terrorism index; government effectiveness index; regulatory quality index; rule of law index and corruption control index.	World Governance Indicators
SDG3	Good health and well being	Current health expenditure (% of GDP)	World Development Indicators
SDG4	Quality education	Total current education expenditure (% of total expenditure in public institutions)	World Development Indicators
SDG6	Clean water and sanitation	People using safely managed drinking water services as a percentage of the total population.	World Development Indicators
SDG7	Affordable and clean energy	Renewable energy consumption (% of total final energy consumption)	World Development Indicators
SDG8	Decent work and economic growth	Average of the employment rate variable and GDP growth variable	World Development Indicators
SDG10	Reduced inequalities	Ratio of vulnerable employment to total employment (modeled ILO estimate)	World Development Indicators
SDG13	Climate action	CO2 emissions from gaseous fuel consumption (% of total)	World Development Indicators
AFR	Binary variable representing African countries	Binary variable equals one if the country is an African country and zero otherwise.	Author construct

EUR	Binary variable representing European countries	Binary variable equals one if the country is a European country and zero otherwise.	Author construct
ASN	Binary variable representing Asian countries	Binary variable equals one if the country is an Asian country and zero otherwise.	Author construct

Source: World Bank database and author

3.2. Theoretical framework – positive signaling theory

This study builds on the positive signaling theory of sustainable finance which argues that economic agents have incentives to disclose positive information about their commitment to pursue one or more sustainability goals in order to signal good news to external parties who can support their goals (Ozili, 2023c). The model used for the study is hinged on the positive signaling theory because the model uses LLP as the signaling outcome variable while the SDG variables are the predictor variables. It is expected that information about banks' involvement in SDG activities will be signaled through the LLP variable.

3.3. Model specification

A baseline model is specified to determine whether banking sector support for the sustainable development goals has a significant impact on bank loan loss provisions. The baseline model is a modified form of the model used in Ghosh (2022), Danisman et al (2021) and Ozili (2020), **Mpofu (2022) and Ozili and Iorember (2023)**. In the model, the SDG variables are the discretionary determinants of bank loan loss provisions, implying that banks will use their discretion to decide on which of the sustainable development goals they want to support or contribute to. The first model, Eq. (1), estimates the SDGs as discretionary determinants of bank loan loss provisions. The second model, Eq. (2), estimates the joint impact of the SDGs and institutional quality on bank loan loss provisions. The third model, Eq. (3), estimates the effect of the SDGs on bank loan loss provisions across regions. The model is specified below.

$$LLPi,t = c + \beta 1NPLi,t + \beta 2GDPRi,t + \beta 3DCPi,t + \beta 4SDGi,t + ei,t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Eq.(1)$$

$$LLPi,t = c + \beta 1NPLi,t + \beta 2GDPRi,t + \beta 3DCPi,t + \beta 4SDGi,t + \beta 5ISIi,t + \beta 6(SDG * ISI)i,t + ei,t \ \ldots\ldots\ldots\ldots\ldots\ldots Eq.(2)$$

$$LLPi,t = c + \beta 1NPLi,t + \beta 2GDPRi,t + \beta 3DCPi,t + \beta 4SDG + \beta 5AFRi + \beta 6(AFR * SDG)i,t + \beta 6EURi + \beta 7(EUR * SDG)i,t + \beta 8ASNi + \beta 9(ASN * SDG)i,t + ei,t \ldots\ldots\ldots\ldots Eq.(3)$$

where the subscript i, t represent country i, in year t. The LLP ratio is the dependent variable which is the loan loss provisions to gross loan ratio. The SDG variable is a vector of several sustainable development goals (i.e., SDG3, SDG4, SDG6, SDG7, SDG8, SDG10 and SDG13). The control variables are the nonperforming loan ratio (NPL) variable, the real GDP growth rate (GDPR) variable and the domestic credit to the private sector (DCP) variable. The ISI variable is the institutional quality index. The AFR variable is a binary variable representing the African countries in the sample. The EUR variable is a binary variable representing the European countries in the sample. The ASN variable is a binary variable representing the Asian countries in the sample. ε = error term.

The models are estimated using the panel fixed effect regression method. The Hausman test (reported in appendix 1) shows that the fixed effect panel regression model is appropriate because the p-value of the chi-square of the Hausman test is less than 0.05. Previous SDG and LLP studies have also used the panel fixed effect regression method (see, for example, Shala et al, 2023; Mnif and Slimi, 2023; Singh et al, 2020; Van Krevel, 2021). The panel fixed effect regression method is used because it allows us to control for all time invariant omitted variables especially when there are variables which are difficult or impossible to observe (Pesaran, 2015). Thus, it accounts for unobserved heterogeneities and provide more accurate estimates of the panel model (Pesaran, 2015; Brüderl and Ludwig, 2015).

3.4. Variable justification

The dependent variable is the loan loss provisions ratio. This variable has been used as the dependent variable in most studies that investigate the determinants of bank loan loss provisions (e.g., Danisman et al, 2021; Salem et al, 2021; Hegde and Kozlowski, 2021).

The main explanatory variables of interest in the model are the SDG variables (i.e., SDG3, SDG4, SDG6, SDG7, SDG8, SDG10 and SDG13). A negative association between the SDG variables and

the loan loss provision variable is expected because bank support for the realization of one or more sustainable development goals can distract banks from their core lending business (Gambetta et al, 2021; Ozili, 2023a), or it can lead banks to diversify into low-profit high-risk SDG activities which pose a risk to their core lending business (Ozili, 2023a), and such risk may show up in higher loan loss provisions. For this reason, banks that show greater commitment and support to achieve the sustainable development goals may experience higher loan loss provisions. However, if committing to the SDGs becomes a very profitable venture for banks, it is highly probable that banks will not focus much on their core lending business. They will shift their focus to SDG business so that they can generate significant profit from supporting the sustainable development agenda. Banks may decrease core lending to pursue profitable SDG business. The resulting decrease in lending may result in fewer bank loan loss provisions.

Seven SDGs out of the 17 SDGs were selected which are SDG3, SDG4, SDG6, SDG7, SDG8, SDG10 and SDG13. The reason for selecting the seven SDG variables is because existing studies have identified meaningful economic indicators that can be used to measure the selected seven SDGs (Anton and Nucu, 2020; Shahbaz et al, 2020; Ozili and Iorember, 2023), and the selected SDG variables are influenced by the size of available bank financing to support the realization of the sustainable development goals which in turn can affect bank loan loss provisioning (Ozili, 2023). However, the effect on bank loan loss provisions will depend on banks' credit exposure to specific SDG related activities. Another reason for selecting the seven SDGs is because proxy variables for the seven SDGs were available and there is sufficient data for each of the seven SDG proxy variable.

Regarding SDG3 'good health and well-being', Brollo et al (2021) show that increase in healthcare expenditure is beneficial for good health and well-being. The study linked healthcare expenditures to GDP and argue that greater healthcare expenditures relative to GDP leads to greater sustainable development; therefore, the current health expenditure as a percent of GDP is used as a measure of SDG3 in this study. Banks can show their support for SDG3 activities by providing loans for SDG-related healthcare expenditures. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks' credit exposure to SDG3 related activities.

Regarding SDG4 ‘quality education’, Vorisek and Yu (2020) show that higher education spending is a necessary SDG-related expenditure for greater human capital development and greater sustainable development. Their study suggest that higher education spending is correlated with better sustainable development outcomes especially higher education spending in terms of the ratio of current education expenditure to total expenditure in public institutions. Banks can show their support for SDG4 activities by providing loans for SDG-related education expenditures. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks’ credit exposure to SDG4 related activities.

Regarding SDG6 ‘clean water and sanitation for all’, Bain et al (2018) and Celeste (2023) show that greater access to safely managed drinking water services is associated with greater sustainable development because it prevents people from contracting water-borne diseases and allows them to live a healthy life; therefore, the percentage of people using safely managed drinking water services in the population is used as a measure of SDG6 in this study. Banks can show their support for SDG6 activities by providing loans for SDG-related clean water and sanitation expenditures. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks’ credit exposure to SDG6 related activities.

Regarding SDG7 ‘clean and affordable energy’, existing studies such as Shahbaz et al (2020) and Abdulqadir (2024) show that clean energy such as renewable energy does not pollute the environment, thereby promoting sustainable development; therefore, the ratio of renewable energy consumption to total final energy consumption is used as a measure of SDG7 in this study. Banks can show their support for SDG7 activities by providing loans for SDG-related clean energy expenditures. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks’ credit exposure to SDG7 related activities.

Regarding SDG8 ‘decent work and economic growth’, Heirman et al (2021) emphasize that a decent work should be decent and should contribute to economic growth and sustainable development; therefore, the average of the employment rate and GDP growth rate is used as a measure of SDG8 in this study. Banks can show their support for SDG8 activities by providing loans for SDG-related decent work and economic growth activities. Such lending can increase

credit risk and lead to higher loan loss provisions depending on the extent of banks' credit exposure to SDG8 related activities.

Regarding SDG10 'reduced inequalities', existing studies such as De Paz et al (2020) and Ozili and Iorember (2023) show that efforts to reduce inequality will give vulnerable people equal opportunities in society especially with regard to employment; therefore, the vulnerable employment ratio is considered to be a measure of reduced inequality in this study. Banks can show their support for SDG10 activities by providing loans for SDG-related inequality reduction programs. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks' credit exposure to SDG10 related activities.

Regarding SDG13 'climate action', Omer (2008) and Quadrelli, Peterson (2007) and Hua et al (2023) show that a reduction in CO2 emissions helps to support the fight against climate change thereby leading to greater sustainable development. Therefore, a decrease in CO2 emissions is a proxy indicator of SDG13 'climate action'. Banks can show their support for SDG13 activities by providing loans for SDG-related climate change mitigation activities. Such lending can increase credit risk and lead to higher loan loss provisions depending on the extent of banks' credit exposure to SDG13 related activities.

The main control variables are the NPL, GDPR and DCP variables. Regarding the non-performing loan ratio (NPL), a positive relationship between NPL and loan loss provisions is expected because banks will increase loan loss provisions when they expect higher loan losses (Danisman et al 2021; Biswas et al, 2024). This positive expectation is confirmed in Danisman et al (2021) and Ozili (2022a) who find a positive relationship between the NPL ratio and LLP ratio. The domestic credit to private sector variable (DCP) measures the share of total domestic credit allocated to the private sector in a country (Ozili and Iorember, 2023). A positive relationship between the DCP variable and loan loss provisions is expected because banks will keep higher provisions when they increase credit supply to private sector agents (Pool et al, 2015; Nguyen and Ho, 2024). The gross domestic product growth rate (GDPR) variable has been used by several studies to control for the impact of fluctuating economic cycle on the size of loan loss provisions (see, for example, Hessou et al, 2021; Peterson and Arun, 2018). A positive relationship between GDPR and LLP is expected

because in good economic times, banks will keep few loan loss provisions (Peterson and Arun, 2018; Biswas et al, 2024). In good economic times, borrowers will generate income from their business activities and will be able to repay their debt to banks, thereby reducing non-performing loans and leading to fewer loan loss provisions. This argument is supported by Hessou et al (2021) and Peterson and Arun (2018).

4. Results

4.1. Descriptive statistics

The mean of the variables is reported in table 2. The LLP ratio is about 84% on average, and is higher in Argentina and Pakistan, and is lower in Korea, Malaysia, and Singapore. Meanwhile, the NPL ratio is 4.51% on average and is much lower in Korea, Singapore, Malaysia, Japan, China, and Argentina, while the NPL ratio is much higher in developing countries such as Ghana, Pakistan, and Cameroun. Domestic credit to the private sector as a share of GDP (DCP) exceeds 50% which is a good signal. The DCP variable is 69.05% on average and is much higher in the United States, China, and the United Kingdom, and is much lower in African countries such as Congo, Cameroun, and Nigeria. In terms of economic growth (GDPR), the average GDP growth rate over the period is 2.79%. GDP growth is higher in India and Vietnam. Institutional quality (ISI) is high in the Netherlands, United Kingdom, and Japan, and is much lower in African countries such as Cote d'Ivoire, Egypt, and Cameroun. Regarding the sustainable development goals, SDG3 is 5.87% on average, and is higher in the United States, the Netherlands and Japan, and is lower in Pakistan and Indonesia. SDG4 is 91.99% on average, and is higher in Cambodia, Mexico, and the United Kingdom, and is much lower in Vietnam and Pakistan. SDG6 is 64.51% on average, and is higher in Singapore, United Kingdom, the Netherlands, and is much lower in Nigeria and Cambodia. SDG7 is 33.40% on average, and is higher in Tanzania, Nigeria, and Kenya, and is lower in Malaysia, Korea, and Singapore. SDG8 is 64.62% on average, and is higher in Vietnam and Thailand, and is much lower in Egypt and Brazil. SDG10 is 42.82% on average, and is higher in Tanzania and Nigeria, and is much lower in Japan, Russia, and the United States. SDG13 is 24.91%

on average, and is higher in Russia, Argentina, Pakistan, and Georgia, and is much lower in Congo, the Philippines, India, and China.

Table 2. Descriptive statistics

Countries	**LLP**	**NPL**	**DCP**	**GDPR**	**SDG3**	**SDG4**	**SDG6**	**SDG7**	**SDG8**	**SDG10**	**SDG13**	**ISI**
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Argentina	147.65	1.92	14.68	-0.37	9.75	92.45	-	9.474	-	20.27	52.86	-0.20
Brazil	167.01	3.31	62.44	-0.14	8.61	95.02	81.64	44.37	57.85	26.95	14.42	-0.07
Cambodia	52.87	2.03	65.48	5.46	6.59	99.85	24.54	65.54	-	56.52	-	-0.74
Cameroun	109.72	10.77	14.10	1.78	3.78	89.31	-	78.58	-	74.25	9.19	-0.97
China	200.43	1.39	143.51	6.88	4.81	-	-	12.16	75.24	45.76	3.36	-0.46
Congo	-	-	5.604	2.89	3.73	83.12	16.09	95.55		78.98	0.32	-1.59
Cote D'Ivoire	-	-	18.87	3.75	3.65	92.28	34.88	69.21	-	74.35	44.11	-0.73
Egypt	-	9.14	28.11	1.19	5.03	-		5.11	42.39	22.79	41.39	-0.86
Georgia	63.56	3.23	48.38	4.89	7.67	-	65.11	29.56	60.45	52.91	49.18	0.31
Ghana	100.76	15.29	14.47	4.245	4.05	93.98	32.35	45.99		70.56	9.62	0.05
India	56.64	6.12	50.94	5.54	3.37	-	-	35.75	-	77.44	4.63	-0.23
Indonesia	58.01	2.23	36.51	4.036	2.93	87.67	-	27.35	67.97	49.57	16.35	-0.27
Japan	-	1.74	164.24	1.18	10.67	88.26	98.35	5.95	58.87	9.03	19.41	1.33
Kenya	60.61	6.96	34.51	2.04	5.15	94.14	-	74.28	-	54.25	-	-0.61
Korea, Rep.	43.52	0.45	133.49	2.51	6.63	84.87	98.50	2.38	63.11	20.41	16.41	0.79
Malaysia	33.18	1.81	118.19	3.75	3.62	92.54	93.54	3.60	68.50	21.73	33.06	0.36
Mexico	163.73	2.44	30.57	1.43	5.58	96.61	42.21	9.33	58.66	27.79	29.82	-0.23
Netherlands	-	2.69	113.06	0.94	10.34	88.49	99.97	5.64	61.61	12.36	46.21	1.68
Nigeria	81.64	7.49	12.15	0.58	3.44	-	19.66	82.39	-	81.35	28.26	-1.09
Pakistan	100.63	11.72	16.82	2.44	2.71	75.43	36.27	45.33	-	59.06	49.66	-1.06
Philippines	74.4	2.01	38.78	4.66	3.99	-	46.23	26.19	63.84	37.39	7.16	-0.32
Russia	83.98	7.91	50.11	1.36	5.16	92.01	75.62	3.29	65.01	5.76	54.37	-0.71
Singapore	36.77	1.07	119.39	2.87	3.88	91.23	100	0.61	67.52	9.17	43.74	-0.09
Tanzania	54.29	7.89	13.13	3.244	4.32	-	-	84.46	-	83.71	16.87	-0.46
Thailand	56.64	2.72	142.39	2.91	3.66	94.61	-	23.02	72.36	50.91	32.31	-0.29
United Kingdom	45.04	2.01	143.53	1.33	9.89	96.95	99.87	7.57	60.29	12.53	35.40	1.42
United States	-	2.02	181.43	1.58	16.44	-	96.32	9.24	60.84	4.11	28.13	1.25
Vietnam	44.82	2.56	111.66	5.12	4.76	78.23	-	33.30	80.53	59.07	10.97	-0.44
Aggregate Statistics:												
Mean	84.35	4.51	69.05	2.79	5.87	91.99	64.51	33.40	64.62	42.82	24.91	-0.15
Median	65.89	2.71	48.02	2.65	4.71	92.89	70.62	27.05	63.18	47.35	22.62	-0.31
SD	47.79	4.13	55.09	2.49	3.13	4.80	31.61	29.75	9.66	26.09	17.76	0.81
No of observations	181	205	223	224	224	101	144	224	175	224	168	224

All variables are in percentages

Source: Author's computation

4.2. Correlation analysis for the variables

Table 3 reports the Pearson correlation matrix for the variables. Focusing on the correlation of the LLP variable with the rest of the variables, the correlation matrix shows that the LLP variable is significant and negatively correlated with the DCP, GDPR, SDG6, SDG8, ASN and EUR variables. The LLP and DCP variables are significant and negatively correlated. This indicates that higher domestic credit to the private sector is associated with fewer bank loan loss provisions. The LLP and GDPR variables are significant and negatively correlated. This indicates that higher loan loss provision is associated with low economic growth. The LLP and SDG6 variables are significant and negatively correlated. This indicates that higher provision of clean water and sanitation is associated with fewer bank loan loss provisions. The LLP and SDG8 variables are significant and negatively correlated. This indicates that higher decent work and economic growth are associated with fewer loan loss provisions. The LLP and ASN variables are significant and negatively correlated. This indicates that loan loss provisions are lower in Asian countries. The LLP and EUR variables are significant and negatively correlated. This indicates that loan loss provisions are lower in European countries. Meanwhile, the LLP variable does not have a significant correlation with the NPL, SDG3, SDG4, SDG7, SDG10, SDG13, ISI and AFR variables. Overall, the correlations are not extremely high as they are all below 70 percent or 0.70 which means multi-collinearity is not a problem in the analysis.

Table 3. Pearson correlation matrix for the variables

Variables	LLP	NPL	GDPR	DCP	SDG3	SDG4	SDG6	SDG7	SDG8	SDG10	SDG13	ISI	AFR	ASN	EUR
LLP	1.000														

NPL	0.155	1.000													
	(0.35)	-----													
GDPR	-0.446***	-0.197	1.000												
	(0.00)	(0.24)	-----												
DCP	-0.663***	-0.476***	0.006	1.000											
	(0.00)	(0.00)	(0.96)	-----											
SDG3	0.233	-0.204	-0.415**	0.166	1.000										
	(0.16)	(0.22)	(0.01)	(0.32)	-----										
SDG4	0.067	-0.513***	0.046	0.012	0.557***	1.000									
	(0.69)	(0.00)	(0.78)	(0.94)	(0.00)	-----									
SDG6	-0.390**	-0.275*	-0.314*	0.832***	0.066	-0.226	1.000								
	(0.01)	0.09	0.05	0.00	0.69	0.17	-----								
SDG7	0.244	0.130	0.201	-0.457***	0.338**	0.231	-0.607***	1.000							
	(0.14)	(0.44)	(0.23)	(0.00)	(0.04)	(0.16)	(0.00)	-----							
SDG8	-0.497***	-0.089	0.717***	-0.071	-0.195	0.335**	-0.356**	0.387**	1.000						
	(0.00)	(0.59)	(0.00)	(0.67)	(0.24)	(0.04)	(0.03)	(0.01)	-----						
SDG10	0.132	0.185	0.502***	-0.526***	0.015	0.178	-0.799***	0.831***	0.491***	1.000					
	(0.43)	(0.27)	(0.00)	(0.00)	(0.92)	(0.28)	(0.00)	(0.00)	(0.00)	-----					
SDG13	-0.240	0.271	-0.321**	0.245	-0.370**	-0.560***	0.482***	-0.811***	-0.421*	-0.754***	1.000				
	(0.15)	(0.11)	(0.05)	(0.14)	(0.02)	(0.00)	(0.00)	(0.00)	(0.09)	(0.00)	-----				
ISI	-0.262	-0.410**	-0.090	0.771***	0.480***	0.236	0.617***	-0.371**	-0.276*	-0.361**	0.044	1.000			
	(0.11)	(0.01)	(0.59)	(0.00)	(0.00)	(0.15)	(0.00)	(0.02)	(0.09)	(0.02)	(0.79)	-----			
AFR	0.028	0.487***	0.244	-0.241	-0.111	0.022	-0.252	0.184	0.277*	0.412**	-0.260	0.023	1.000		
	(0.86)	(0.00)	(0.14)	(0.14)	(0.51)	(0.89)	(0.13)	(0.27)	(0.09)	(0.01)	(0.11)	(0.89)	-----		
ASN	-0.665***	-0.448***	0.671***	0.330**	-0.484***	0.048	0.059	0.066	0.642***	0.213	-0.213	-0.115	-0.123	1.000	
	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)	(0.77)	(0.72)	(0.69)	(0.00)	(0.20)	(0.20)	(0.49)	(0.46)	-----	
EUR	-0.288*	0.251	-0.388**	0.311*	0.379**	0.022	0.368**	-0.399**	-0.149	-0.551***	0.57***	0.32**	-0.101	-0.448**	1.000
	(0.08)	(0.13)	(0.01)	(0.06)	(0.02)	(0.89)	(0.02)	(0.01)	(0.37)	(0.00)	(0.00)	(0.05)	(0.55)	(0.01)	-----

p-values are in parenthesis. ***, *, * represent statistical significance at the 1%, 5% and 10% level.

Source: Author's computation

4.3. Baseline result: Effect of bank support for the SDGs on bank loan loss provisions: panel fixed effect regression

This section examines whether banking sector support for achieving the sustainable development goals affects bank loan loss provisions. In the analysis, the sustainable development goal variables are the main explanatory variables, after controlling for the non-discretionary determinants of bank loan loss provisions. The result is reported in table 4.

The SDG7 coefficient is significant and negatively related to LLP in column 4. This result indicates that greater bank support for affordable and clean energy leads to few loan loss provisions. This implies that banks that support the provision of affordable and clean energy will experience fewer loan loss provisions. This result supports the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also supports the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities leads to credit risk reduction. Also, SDG10 coefficient is significant and negatively related to LLP in column 6. This result indicates that greater bank support for reduced inequalities in society has a significant negative effect on bank loan loss provisions. This implies that banks that support inequality reduction programs and activities in society will experience fewer loan loss provisions. This result supports the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also supports the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities leads to credit risk reduction.

Meanwhile, the SDG3, SDG4, SDG6, SDG8 and SDG13 coefficients are insignificant. This indicates that bank lending to SDG3, SDG4, SDG6, SDG8 and SDG13 activities does not lead to a significant change in bank loan loss provisions. An explanation for this is that banks do not have significant credit exposure to these SDGs. As a result, these SDGs have no significant effect on bank loan loss provisions.

Regarding the control variables, the NPL coefficient is significant and positively related to LLP in all estimations in table 4. This result is consistent with the expectation that banks will keep high loan loss provisions when they expect high non-performing loans (Danisman et al, 2021; Ozili, 2022a). Also, the GDPR coefficient is significant and positively related to LLP in all estimations in table 4. This result, although significant, is inconsistent with the apriori expectation that banks tend to keep high loan loss provisions in bad economic times and keep fewer loan loss provisions in good economic times. This result is inconsistent with the argument of Hessou et al (2021) and Peterson and Arun (2018). Rather, the result suggests that banks keep high loan loss provisions in good economic times and keep fewer provisions in bad economic times and is evidence of counter-cyclical loan loss provisioning. The DCP coefficient reports a negative sign in all estimations and is significant in columns 3, 4 and 6. The result indicates that the size of loan loss provision is influenced by the share of domestic credit provided to the private sector. The next section examines how institutional quality affects the relationship between the sustainable development goals and banking sector loan loss provision.

Table 4. Effect of SDGs on banking sector loan loss provisions

Dependent variable: Loan loss provisions ratio (LLP). Panel fixed effect regression estimation							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
c	73.372*** (3.41)	13.447 (0.41)	39.690 (0.61)	129.233*** (4.74)	71.064** (2.15)	148.313*** (3.44)	81.856*** (4.24)
NPL	2.719*** (3.90)	2.253 (1.09)	1.695*** (2.75)	2.445*** (3.67)	1.982** (2.20)	2.568*** (3.88)	1.326 (1.17)
GDPR	1.659** (2.30)	1.796* (1.80)	1.151* (1.71)	1.338* (1.86)	1.671* (1.84)	1.392* (1.92)	1.424* (1.75)
DCP	-0.153 (-1.06)	0.001 (0.002)	-0.238** (-2.14)	-0.294** (-2.23)	-0.140 (-0.94)	-0.383** (-2.02)	-0.025 (-0.13)
SDG3	-0.004 (-0.001)						
SDG4		0.629 (0.65)					
SDG6			0.701 (0.67)				
SDG7				-1.331** (-2.23)			
SDG8					0.143 (0.31)		
SDG10						-1.302* (-1.79)	
SDG13							-0.387 (-0.68)
Country fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	91.94	95.19	95.52	92.21	93.55	92.11	91.26
F-statistic	62.89	58.06	96.43	65.18	62.92	64.39	46.83
P(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
*, **, *** represent statistical significance at 10%, 5% and 1% levels							

Source: Author's computation

4.4. The moderating role of institutional quality: panel fixed effect regression

This section extends the baseline analysis in section 4.3 by investigating the moderating role of institutional quality on the relationship between the sustainable development goals and banking sector loan loss provisions. In the analysis, the ISI variable is the institutional quality variable which was measured using an institutional quality index (ISI). The ISI is derived from the average of six institutional governance indicators which are the 'voice and accountability index', the 'political stability and absence of violence/terrorism index', the 'government effectiveness index', the 'regulatory quality index', the 'rule of law index', and the 'control of corruption index'. A negative relationship between the ISI*SDG variables and the LLP variable is expected because strong institutions can help to de-risk lending to SDG activities which in turn should lead to fewer loan loss provisions. This is because strong institutions can help to hold debtors accountable and will provide mechanisms that compel debtors to repay their SDG-related debt or face strict penalty for defaulting on loan repayment. This will help to reduce nonperforming loans and reduce the size of loan loss provisions. Therefore, a negative relationship between the ISI*SDG variables and the LLP variable is expected. This expectation is consistent with the arguments of Fonseca and Gonzalez (2008) and Ozili (2022b) who show that institutional quality reduces the size of loan loss provisions.

The SDG6*ISI coefficient is significant and negatively related to LLP. This result indicates that high institutional quality and greater bank support for the provision of clean water and sanitation leads to fewer loan loss provisions. This implies that banks that support the provision of clean water and sanitation (SDG6), and operate in countries that have strong institutions, will experience fewer loan loss provisions. This result supports the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also supports the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities leads to credit risk reduction. The ISI coefficient is positive and statistically significant in column 3. This indicates that strong institutional quality has a positive impact on banking sector loan loss provisions. This implies that there is higher bank loan loss provisioning in countries that have good institutions. This result does not support the findings of Fonseca and

Gonzalez (2008) and Ozili (2022b) who show that institutional quality reduces the size of loan loss provisions. Also, SDG7*ISI coefficient is significant and positively related to LLP. This result indicates that high institutional quality and greater bank support for affordable and clean energy leads to higher loan loss provisions. This implies that banks that support the provision of affordable and clean energy, and operate in countries that have strong institutions, will experience higher loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities leads to credit risk reduction.

Meanwhile, the SDG3*ISI, SDG4*ISI, SDG8*ISI, SDG10*ISI, and SDG13*ISI coefficients are insignificant. This indicates that bank support for achieving these SDGs in a strong institutional environment does not lead to a significant change in loan loss provisions. An explanation for this result is that bank managers do not consider the quality of the institutional environment as an important factor in determining whether to finance these SDGs, therefore, these SDGs have no significant effect on the size of loan loss provisions in strong institutional environments.

Table 5. Moderating role of institutional quality in influencing the relationship between SDGs and loan loss provisions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
c	75.891*** (3.07)	-34.353 (-0.32)	12.866 (0.19)	116.813*** (4.18)	94.455** (2.16)	137.899*** (3.06)	95.919*** (3.95)
NPL	2.703*** (3.84)	2.414 (1.09)	1.146* (1.89)	2.518*** (3.80)	1.693* (1.76)	2.495*** (3.76)	1.873 (0.68)
GDPR	1.591** (2.17)	1.369 (1.25)	0.783 (1.22)	1.191 (1.64)	1.779* (1.91)	1.197 (1.62)	1.185 (1.38)
DCP	-0.169 (-1.14)	0.124 (0.43)	-0.292*** (-2.72)	-0.239 (-1.53)	-0.153 (-0.98)	-0.405** (-2.01)	-0.094 (-0.45)
SDG3	0.131 (0.04)						
SDG4		1.062 (0.99)					
SDG6			1.615 (1.48)				
SDG7				-0.725 (-1.08)			
SDG8					-0.196 (0.32)		
SDG10						-0.801 (-0.99)	
SDG13							-0.453 (-0.77)
ISI	5.971 (0.22)	-148.61 (-0.75)	114.833*** (3.47)	-22.279 (-1.17)	49.149 (0.86)	-22.549 (-0.87)	28.733 (0.98)
SDG3*ISI	0.339 (0.08)						
SDG4*ISI		1.715 (0.82)					
SDG6*ISI			-1.346*** (-3.09)				
SDG7*ISI				0.971* (1.95)			
SDG8*ISI					-0.749 (-0.87)		
SDG10*ISI						0.837 (1.45)	
SDG13*ISI							-0.491 (-0.71)
Year Fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	91.84	95.09	96.02	92.31	93.47	92.15	91.18
F-statistic	58.62	52.93	100.44	62.35	58.67	61.01	43.58

P(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
*, **, *** represent statistical significance at 10%, 5% and 1% levels							

Source: Author's computation

4.5. Regional Analysis

Next, it is important to determine whether banking sector support for achieving the sustainable development goals has a significant effect on bank loan loss provisions in the African region, European region, and the Asian region. To do this, three binary variables were introduced to capture the regional characteristics in the data. The AFR binary variable represents the African countries in the sample. The AFR binary variable equals one if the country is an African country and zero otherwise. The EUR binary variable represents the European countries in the sample. The EUR binary variable equals one if the country is a European country and zero otherwise. The ASN binary variable represents the Asian countries in the sample. The ASN binary variable equals one if the country is an Asian country and zero otherwise.

4.5.1. Effect on African countries

This section examines whether banking sector support for achieving the sustainable development goals has a significant effect on bank loan loss provisions in the African region. The AFR binary variable is introduced into the model and is interacted with each of the SDG variables to determine its effect on bank loan loss provisions. The result is reported in table 6.

The SDG6*AFR coefficient is significant and positively related to LLP in column 3. This result indicates that African banks' support for the provision of clean water and sanitation leads to higher bank loan loss provisions. This implies that African banks' support for the provision of clean water and sanitation will increase loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities lead to credit risk reduction. Similarly, the SDG13*AFR coefficient is significant and positively related to LLP in

column 7. This result indicates that greater emission of CO2 into the climate is associated with higher bank loan loss provisions in African countries. This implies that African banks operating in high carbon-emitting environments will keep higher loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that higher sustainable development is associated with low banking risk, and such banking risk can take the form of fewer loan loss provisions. The AFR coefficient is negative and statistically significant only in column 3. This shows evidence that loan loss provisions are fewer in African countries. Meanwhile, the SDG3*AFR, SDG4*AFR, SDG7*AFR, SDG8*AFR and SDG10*AFR coefficients are statistically insignificant. This indicates that banks' support for the realization of SDG3, SDG4, SDG7, SDG8 and SDG10 activities do not have a significant effect on the loan loss provisions of African banks. This might be due to African banks' low credit exposure to these SDG activities.

Table 6. Effect of banking sector support for SDGs on loan loss provisions in the African region

Dependent variable: Loan loss provisions ratio (LLP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
c	65.455***	-25.665	179.901***	122.215***	172.462**	119.276***	132.336***
	(3.34)	(-0.31)	(11.44)	(9.17)	(4.08)	(8.94)	(7.45)
NPL	1.820	0.357	-2.808***	0.423	-0.119*	1.056	1.566
	(1.49)	(0.21)	(-2.65)	(0.35)	(-0.07)	(0.88)	(1.06)
GDPR	-0.594	-7.810***	-8.250***	-2.146	0.192*	-1.596	-3.660**
	(-0.38)	(-4.24)	(-5.69)	(-1.42)	(0.08)	(-0.92)	(-1.99)
DCP	-0.245***	-0.748***	-0.883***	-0.323***	-0.220*	-0.297***	-0.289***
	(-2.69)	(-7.56)	(-6.34)	(-3.25)	(-1.92)	(-3.10)	(-2.68)
SDG3	6.246***						
	(3.09)						
SDG4		2.093**					
		(2.45)					
SDG6			0.096				
			(0.42)				
SDG7				-0.235			
				(-0.93)			
SDG8					-1.069		
					(-1.47)		
SDG10						-0.234	
						(-0.97)	
SDG13							-0.592*
							(-1.94)
AFR	42.332	375.163	-124.368***	14.187	1.242	7.041	-50.161***
	(0.94)	(0.92)	(3.61)	(0.58)	(0.02)	(0.24)	(-2.67)
SDG3*AFR	-13.956						
	(-1.40)						
SDG4*AFR		-4.495					
		(-1.03)					
SDG6*AFR			4.537***				
			(3.33)				
SDG7*AFR				-0.355			
				(-0.93)			
SDG8*AFR					-0.187		
					(-0.19)		
SDG10*AFR						-0.327	
						(-0.74)	
SDG13*AFR							1.124*
							(1.71)
Year Fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	7.79	56.39	54.45	4.9	1.57	3.59	4.06
F-statistic	2.165	8.46	10.47	1.71	1.17	1.51	1.52

P(F-statistic)	0.013	0.000	0.000	0.063	0.306	0.117	0.134
*, **, *** represent statistical significance at 10%. 5% and 1% levels							

Source: Author's computation

4.5.2. Effect on European countries

This section examines whether banking sector support for achieving the sustainable development goals has a significant effect on bank loan loss provisions in the European region. The EUR binary variable is introduced into the model and is interacted with each of the SDG variables to determine its effect on bank loan loss provisions. The result is reported in table 7.

The SDG3*EUR coefficient is significant and negatively related to LLP in column 1. This result indicates that European banks' support for good health and well-being through higher health expenditure is associated with fewer bank loan loss provisions. This implies that European banks that support good health and well-being (SDG3) experience fewer loan loss provisions. This result supports the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also supports the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities lead to credit risk reduction. Also, the SDG4*EUR coefficient is significant and positively related to LLP in column 2. This result indicates that European banks' support for quality education through higher education expenditure leads to fewer bank loan loss provisions. This implies that European banks' support for quality education increases loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities leads to a decrease in loan loss provisions and credit risk reduction. Similarly, the SDG6*EUR coefficient is significant and positively related to LLP in column 3. This result indicates that European banks' support for the provision of clean water and sanitation is associated with higher bank loan loss provisions. This implies that European banks that support the provision of clean water and sanitation will experience higher

loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities lead to credit risk reduction.

Furthermore, the EUR coefficient is negative and statistically significant in column 3, 4 and 6, and is also positive and significant in column 1. Meanwhile, the SDG7*EUR, SDG8*EUR, SDG10*EUR, and SDG13*EUR coefficients are statistically insignificant. This indicates that European banks' support for achieving SDG7, SDG8, SDG10 and SDG13 activities does not lead to a significant change in loan loss provisions. An explanation for the insignificant result is that European banks do not have a significant credit exposure to these SDGs. As a result, it does not lead to a significant change in the loan loss provisions of European banks. It could also be that European banks are selective and cautious of the SDG activities they finance, and they avoid lending to SDG7, SDG8, SDG10 and SDG13 activities due to credit risk considerations.

Table 7. Effect of banking sector support for SDGs on loan loss provisions in the European region

Dependent variable: Loan loss provisions ratio (LLP). Panel fixed effect regression estimation							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
C	17.885 (0.87)	-8.112 (-0.09)	147.911*** (11.78)	135.025*** (10.46)	199.644*** (5.91)	134.386*** (10.18)	113.604*** (6.54)
NPL	2.603** (2.50)	-0.069 (-0.04)	-2.018*** (-2.65)	0.915 (0.86)	-0.489 (-0.36)	1.472 (1.29)	-0.138 (-0.11)
GDPR	-0.472 (-0.32)	-10.955*** (-5.87)	-5.708*** (-4.31)	-2.929* (-1.93)	-0.414 (-0.19)	-1.815 (-1.09)	-3.544* (-1.88)
DCP	-0.059 (-0.67)	-0.571*** (-4.94)	-1.285*** (-8.06)	-0.312*** (-3.17)	-0.142 (-1.33)	-0.245*** (-2.61)	-0.174 (-1.55)
SDG3	12.998*** (5.69)						
SDG4		1.910** (2.18)					
SDG6			0.885*** (3.95)				
SDG7				-0.539*** (-3.29)			
SDG8					-1.454** (-2.57)		
SDG10						-0.643*** (-2.89)	
SDG13							-0.009 (-0.03)
EUR	68.555* (1.79)	-106.227 (-0.28)	-160.762*** (3.61)	-37.512*** (-2.25)	-311.075 (-1.34)	-48.809*** (-2.72)	-63.373 (-0.91)
SDG3*EUR	-16.643*** (-3.22)						
SDG4*EUR		1.910** (2.18)					
SDG6*EUR			1.678*** (3.42)				
SDG7*EUR				0.246 (0.29)			
SDG8*EUR					4.529 (1.21)		
SDG10*EUR						-0.516 (1.01)	
SDG13*EUR							0.848 (0.57)
Year Fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Adjusted R^2	19.91	55.29	59.72	9.8	7.32	8.56	1.05
F-statistic	4.42	8.13	12.75	2.501	1.86	2.29	1.13
P(F-statistic)	0.000	0.000	0.000	0.004	0.04	0.008	0.343
*, **, *** represent statistical significance at 10%. 5% and 1% levels							

Source: Author's computation

4.5.3. Effect on Asian countries

This section examines whether banking sector for achieving the sustainable development goals has a significant effect on bank loan loss provisions in the Asian region. The ASN binary variable is introduced into the model and is interacted with each of the SDG variables to determine its effect on bank loan loss provisions. The result is reported in table 8.

The SDG8*ASN coefficient is significant and positively related to LLP in column 5. This result indicates that Asian banks' support for decent work and economic growth (SDG8) is associated with higher bank loan loss provisions. This implies that Asian banks that support the realization of decent work and economic growth (SDG8), through high employment and positive economic growth, will experience higher loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities lead to credit risk reduction. Similarly, the SDG10*ASN coefficient is significant and positively related to LLP in column 6. This result indicates that Asian banks' support for reduced inequality (SDG10) is associated with higher bank loan loss provisions. This implies that Asian banks that support inequality reduction programs, through higher employment for vulnerable people, will experience higher loan loss provisions. This result does not support the findings of Choudhury et al (2021) who show that banks' involvement in more SDG-related activities reduce banking risk, and such banking risk can take the form of fewer loan loss provisions which signifies low credit risk. The result also does not support the findings of Umar et al (2021) who show that bank lending to finance SDG-related activities lead to credit risk reduction. Also, the SDG13*ASN coefficient is significant and

negatively related to LLP in column 7. This result indicates that greater emission of CO2 into the climate is associated with fewer bank loan loss provisions in Asian countries. This implies that Asian banks operating in high carbon-emitting environments will keep fewer loan loss provisions. This result supports the findings of Choudhury et al (2021) who show that higher sustainable development is associated with a reduction in banking risk. Furthermore, the ASN coefficient is negative in all estimations and statistically significant in column 4, 5 and 6. This indicates that bank loan loss provisions are low in Asian countries. Meanwhile, the SDG3*ASN, SDG4*ASN, SDG6*ASN and SDG7*ASN coefficients are statistically insignificant. This indicates that Asian banks' support for SDG3, SDG4, SDG6 and SDG7 activities do not have a significant effect on the loan loss provisions of Asian banks. An explanation for the insignificant result is that Asian banks have very little exposure to SDG3, SDG4, SDG6 and SDG7 activities. As a result, their low exposure to these SDGs does not lead to a significant change in the loan loss provisions of Asian banks, possibly because Asian banks have not started to diversify into these SDG activities, and they may be cautious in extending credit to these SDGs due to credit risk concerns.

Table 8. Effect of banking sector support for SDGs on loan loss provisions in the Asian region

Dependent variable: Loan loss provisions ratio (LLP). Panel fixed effect regression estimation							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
c	89.099*** (3.45)	111.733 (-0.72)	146.153*** (8.83)	126.449*** (10.15)	126*** (6.55)	128.897*** (9.92)	105.716*** (6.09)
NPL	-0.390 (-0.28)	-3.824** (-2.14)	-2.112** (-2.37)	-0.723 (-0.67)	-1.975 (-1.45)	-0.364 (-0.32)	-1.265 (-0.97)
GDPR	-0.001 (-0.004)	-6.497*** (-2.91)	-4.521*** (-2.89)	1.338 (0.78)	2.911 (1.29)	1.441 (0.80)	-1.537 (-0.82)
DCP	-0.113 (-1.08)	-0.691 (-0.42)	-0.774*** (-5.02)	-0.181* (-1.68)	-0.096 (-0.87)	-0.114 (-1.10)	0.056 (0.49)
SDG3	2.906 (0.99)						
SDG4		0.605 (0.42)					
SDG6			0.359 (1.34)				
SDG7				-0.497*** (-2.91)			
SDG8					-2.064*** (-3.05)		
SDG10						-0.609*** (-2.68)	
SDG13							0.104 (0.35)
ASN	-24.793 (-0.89)	-15.615 (-0.08)	-15.466 (-0.82)	-39.299*** (-2.81)	-222.886*** (-3.39)	-70.430*** (-4.06)	-5.288 (-0.33)
SDG3*ASN	-0.056 (-0.01)						
SDG4*ASN		0.691 (0.42)					
SDG6*ASN			-0.116 (-0.51)				
SDG7*EASN				0.066 (0.21)			
SDG8*ASN					2.797*** (2.85)		
SDG10*ASN						0.867*** (2.81)	
SDG13*ASN							-1.844*** (-3.54)
Year Fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	6.85	54.19	51.69	11.13	13.51	11.54	14.64

F-statistic	2.01	7.83	9.48	2.72	2.69	2.796	3.11
P(F-statistic)	0.02	0.000	0.000	0.002	0.002	0.001	0.001
*, **, *** represent statistical significance at 10%, 5% and 1% levels							

Source: Author's computation

5. Conclusion

This study examined whether banking sector support for the realization of the SDGs affects bank loan loss provisions. The motivation for this study is that banks want to support the realization of the sustainable development goals, but this might distract banks from their core lending business and pose a risk to banks' core lending business. Bank managers may signal this risk in the size of bank loan loss provisions through a significant increase or decrease in LLPs. The results revealed that banking sector support for reduced inequalities (SDG10) and affordable and clean energy (SDG7) leads to a significant decrease in bank loan loss provisions. Also, banks that support the provision of affordable and clean energy (SDG7), and operate in countries that have strong institutions, experience higher loan loss provisions while banks that contribute to the provision of clean water and sanitation (SD6), and operate in countries that have strong institutions, experience fewer loan loss provisions. The regional results are mixed and showed that, in the Asian region, banking sector support for achieving SDG13 decreases bank LLPs while banking sector support for achieving SDG8 and SDG10 increases bank LLPs. In the European region, banking sector support for achieving SDG3 decreases bank LLPs while banking sector support for achieving SDG4 and SDG6 increase bank LLPs. In the African region, banking sector support for achieving SDG6 increases bank LLPs.

The implication of the findings is that banking sector support for the realization of the SDGs has a significant effect on the size of bank loan loss provisions in countries that have strong institutional quality and in different regions. The policy relevance of the findings is that the study confirms that bank support for the SDGs is a discretionary determinant of bank loan loss provisions. Consequently, policymakers would be keen to pay a close attention to the relationship between banks' SDG activities and the size of their loan loss provisions.

The following policy recommendations are proffered based on the empirical findings. One, it is recommended that bank managers should pay attention to how their support for the sustainable development goals may affect the size of bank loan loss provisions to ensure that they are not supporting a specific sustainable development goal that increase credit risk and increase the size of bank loan loss provisions. Rather, they should only support specific sustainable development goals that decrease credit risk and decrease the size of bank loan loss provisions. Two, it is recommended that bank regulators should ensure that banks remain focused and committed to their core lending business while contributing to the realization of the sustainable development goals. Three, it is recommended that bank supervisors should monitor banks' effort to achieve the sustainable development goals and determine whether the way they go about it increases the risk of loan default which increases loan loss provisions. The outcome of such assessment will assist bank supervisors in determining the type of safeguards to introduce to ensure that banks' involvement in SDG activities do not increase bank loan loss provisions.

The study has few limitations. The first limitation is the short sample period. This limitation exists because the data for the crucial variables were reported only for a short period of time. The second limitation is that the study did not assess how all the 17 SDGs affect bank loan loss provisions. This was due to the difficulty in finding a good proxy variable for all the 17 SDGs. For this reason, this study only assessed how the selected SDGs affect bank loan loss provisions. These limitations create interesting opportunities for future research.

Future studies can examine the impact of the other SDG goals on the size of bank loan loss provisions, particularly, SDG1, SDG2, SDG5, SDG9, SDG11 and SDG12. Future studies can also assess how banking sector support for the sustainable development goals affect other bank performance indicators such as bank profitability and bank efficiency. Future studies can also investigate whether bank support for the realization of the sustainable development goals leads to greater financial stability or leads to financial fragility.

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Appendix 1

Hausman test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	16.869533	4	0.0020

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
NPL	2.496178	2.188152	1.574914	0.8061
GDPR	1.693119	0.910764	0.043962	0.0002
DCP	-0.024982	-0.272351	0.030415	0.1561
SDG4	0.658397	0.747674	0.268859	0.8633

Cross-section random effects test equation:
Dependent Variable: LLP
Method: Panel Least Squares
Date: 02/11/24 Time: 14:21
Sample: 2011 2018
Periods included: 8
Cross-sections included: 16
Total panel (unbalanced) observations: 76

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.95209	86.85366	0.137612	0.8910
NPL	2.496178	1.842411	1.354843	0.1809
GDPR	1.693119	0.852134	1.986915	0.0518
DCP	-0.024982	0.219715	-0.113700	0.9099
SDG4	0.658397	0.890980	0.738959	0.4630

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.967868	Mean dependent var	86.20105
Adjusted R-squared	0.956967	S.D. dependent var	52.15537
S.E. of regression	10.81937	Akaike info criterion	7.821487
Sum squared resid	6555.289	Schwarz criterion	8.434838
Log likelihood	-277.2165	Hannan-Quinn criter.	8.066612
F-statistic	88.78061	Durbin-Watson stat	1.085810
Prob(F-statistic)	0.000000		