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Bank performance during the COVID-19 pandemic: does income diversification help?

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ABSTRACT

The Covid-19 pandemic's economic effect led to tighter credit standards and a decline in the market for many types of loans. With a rich database of 1,231 banks in 90 countries from 2018Q1 to 2021Q4, we conducted a timely, broad-based international study to investigate whether non-interest activities, serving as a shock absorber, can promote bank performance before and during the Covid-19 pandemic. When using a dynamic panel data model with a system GMM estimator, our findings indicate that banks should be encouraged to diversify their income sources to reduce the adverse effects of the shock. With comparative analysis, we also found heterogeneous effects of income diversification on bank performance by its components, in pre-Covid-19 and during-Covid-19 periods, in both developed and developing countries. This study implies that bank managers should diversify income sources, especially fee-based services, trading activities, and foreign currency, to foster financial performance and stability during exogenous shocks.

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Diversification; Profitability; Risk-taking; Covid-19

1. Introduction

Compared to the Global Financial Crisis (GFC) in 2008, the Covid-19 turmoil, a rare exogenous shock, has posed a threat to the world economy in terms of its nature, extent, and speed (Mehmood & De Luca, 2023; Song et al., 2020; Wen & Liao, 2021; Zarembo et al., 2021). Governments have implemented policies such as social distancing, travel restrictions, border closures, and lockdowns in response to the spread of the Coronavirus, which experienced a variety of new challenges in various economic activities (Almutairi, 2022; Koutoupis et al., 2021). For instance, it has increased both unemployment and poverty by slowing down overall demand and supply, production, trading, savings, investments, and other economic actions in every sector of several countries (AlAli, 2020; Alon et al., 2020; El-Chaarani, 2021; Xie et al., 2021). Scholars are currently debating how well firms perform across different sectors and how resilient

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they are to the Covid–19 crisis; in which they are attempting to measure and examine the effects of the ongoing pandemic on the firm’s financial performance (El-Chaarani et al., 2022; Song et al., 2020; Weaver, 2020), of which banks were believed to be one of the sectors most at risk from the Covid–19 pandemic (Hassan et al., 2022; Simoens & Vander Vennet, 2022). Consequently, not only has it impacted the operation of banking systems directly as other sectors (Miah et al., 2021), but the pandemic has also impacted the banks’ performance indirectly by affecting households’ income and businesses’ revenue, thus surging non-performing loans and reduced their profits, solvency, and capital (Chen et al., 2021; De Vito & Gomez, 2020; Duan et al., 2021). Simoens and Vander Vennet (2021) predicted that the pandemic induced a wave of non-performing loans and reduced interest rates in the long term, thus would reduce anticipated bank profitability and leading to low market valuations. Though the impact of the Covid–19 pandemic on the financial system has been documented, evidence regarding the banking system is still limited, with mixed results between developed and developing countries (Barua & Barua, 2021; Demirgüç-Kunt et al., 2021; Duan et al., 2021; Elnahass et al., 2021; Hassan et al., 2022). Furthermore, several researchers claimed that the banking sector is crucial in absorbing shocks like the Covid–19 pandemic, and its resilience is a significant factor in the global economy’s revival (Demirgüç-Kunt et al., 2020; Álvarez-Botas et al., 2021). Currently, there is a growing body of academic research on this subject, but there is not a clear consensus among academics about how the pandemic will affect the banks’ performance yet (Boubaker et al., 2022; EL-Chaarani et al., 2023; Jadah et al., 2020).

Due to the different effects, various nations and regions are expected to use different strategies to recoup the pandemic (EL-Chaarani et al., 2023; Hassan et al., 2022). Recently, researchers have begun to return to an essential principle of modern finance theory – diversification, investing in various assets, because it helps alleviate some of the risks (Ross et al., 2008). In the banking sector, diversification may traditionally come from changing their lending portfolios’ geographic and loan-type compositions (X. Li et al., 2021). Alternatively, banks can diversify their revenue into non-interest income (or income un-associated with deposit-taking and loan-advancing activities), including fees and commission income, trading income, investment income, and other financing income (Abuzayed et al., 2018, Duho et al., 2020; L. Li & Zhang, 2013). By expanding beyond traditional lending activities, banks potentially reduce volatility in their revenue during crises, thereby improving their profitability and overall performance (Berger et al., 2010; Chiorazzo et al., 2008; Köhler, 2015; Lee, Yang, et al., 2014; Wang & Lin, 2021; X. Li et al., 2021). Adversely, some may argue that diversified revenue streams may be risk exposure (DeYoung & Roland, 2001; DeYoung & Torna, 2013; Mercieca et al., 2007; Kevin J. ; Stiroh, 2004) and raise agency issues and moral hazard problems (Abedifar et al., 2018; Akhigbe & Stevenson, 2010; Berger et al., 2010).

The existing literature reveals several gaps that we expect to contribute significantly to the literature in four ways. First, according to our knowledge, the scantier literature regarding the relationship between income diversification and bank performance during the Covid–19 pandemic focuses on a single developed country like the U.S (X. Li et al., 2021). and cross economies in Europe (Simoens & Vander Vennet, 2022; Taylor, 2022) or in Gulf Cooperative Council (El-Chaarani, Abraham, et al., 2022), but not for emerging economies or even the global context (perhaps Demirgüç-Kunt et al. (2021) is the only exception, but it was conducted in the first wave of the

pandemic), not to mention their mixed findings. For this reason, our study first provides empirical evidence on the nexus of non-interest income sources and banks' profitability and risk-taking before and during the Covid-19 pandemic with a global banking database (including 1,231 banks in 90 countries). Second, such a rich dataset from 2018Q1 to 2021Q4 will shed light on whether bank performance is promoted by using non-interest revenue sources before and during the pandemic. Specifically, such a rich dataset also allows us to compare the heterogeneous effects of income diversification on banks' profitability and risk-taking between developed and developing countries, given tightened standards and decreased demand for most loans in the economic crisis (X. Li et al., 2021). Therefore, we can identify the differences, if any, between these settings in terms of the transmission mechanisms between income diversification and bank overall performance. Third, in contrast to prior studies using aggregate-level of non-interest income (X. Li et al., 2021; Sharma & Anand, 2018; Kevin J. ; Stiroh, 2004; Wang & Lin, 2021), we follow L. Li and Zhang (2013) that we break income diversification down into five main components: (1) fees and commission income, (2) exchange gains, (3) investment revenue, (4) foreign currency gains, and (5) other income. Thereby, we can examine which component play which role in mitigating the adverse effects of Covid-19 on the banks' profitability and stability. Fourth, we use confirmed cases as a proxy for the Covid-19 pandemic instead of using a dummy variable as previous study (Demirgüç-Kunt et al., 2021; Duan et al., 2021; Elnahass et al., 2021; Hassan et al., 2022), we further investigate if Covid-19 May encourage banks to focus on non-interest income to cope with the negative impact of the exogenous shock and then increase their performance by treating Covid-19 as a moderator in the primary relationship.

This study, therefore, aims to answer the following research questions. First, how does income diversification affect bank performance during the Covid-19 pandemic? Second, is the effect heterogeneous between before and during the Covid-19 periods? Third, among the components of non-interest income sources, which effect bank performance most? Fourth, is income diversification likely to reduce the negative impact of the Covid-19 pandemic on overall bank performance.

Our results indicate that there is a positive relationship between bank performance, measured by ROA, ROE, and ZSCORE, and non-interest income, which implies that the higher level of banks' income diversification is associated with the higher level of banks' profitability and the lower level of banks' risk-taking. We further find that diversification (especially trading, securities, and fee-based income sources) helps alleviate the adverse effects of Covid-19: diversified banks in countries with a higher number of confirmed cases still have their performance improved, compared to their counterpart. In terms of comparative analysis, Covid-19 has reduced the bank's profitability yielded from non-traditional activities, but it is an incentive for banks to move away from risk-taking activities. In addition, income diversification in developed countries helps banks increase their profitability and financial stability much more than in developing countries.

The remainder of this study is structured as follows. [Section 2](#) outlines the theoretical framework and reviews the relevant research on income diversification, bank profitability, and risk-taking to consequently propose the research hypotheses. [Section 3](#) explains the methodology and the details of the data used in this study. [Section 4](#) reports

the empirical results and discussions, while [Section 5](#) offers a summary of our findings and concluding remarks.

2. Literature review

2.1. Theoretical background

In this section, we present the two theories that inform our study. On the one hand, the *portfolio theory* of Markowitz (2015), also called *mean-variance portfolio theory*, contends that efficient diversification of investments can lower unsystematic risk, then enhance overall performance. Specifically, the income diversification levels will rise, and the risks encountered by banks will decrease when banks' investments or operating activities are diversified, which is not perfectly correlated with the traditional interest income business. On the other hand, *the economies of scope under the synergy effect* (Panzar & Willig, 1981) states that banks can generate low-risk income when they engage in new activities thanks to the improved information provided by their traditional activities. For instance, by screening loan applicants and keeping track of loans that have been approved, bank diversification can help overcome information asymmetry (Diamond, 1984; Ramakrishnan & Thakor, 1984).

2.2. Income diversification and bank performance

This section reviews the empirical evidence of the nexus between income diversification and bank performance under two controversial strands.

The recent global financial crisis and the associated credit risk (due to traditional activities such as loans) in banks are to blame for the growing focus on revenue diversification and non-traditional activities (Boussemart et al., 2019; DeYoung & Torna, 2013; Duho et al., 2020). Hence, the first strand argues that banks would function better if they diversified their income sources to include fee-based activities. In Europe, Gurbuz et al. (2013) found that income diversity can strengthen Turkish banks' risk-adjusted financial performance and stability via engaging in new activities such as brokerage, securities trading, and investment. Köhler (2015) examined the effect of non-interest income sources on bank stability in 15 EU nations. They claimed that banks were both considerably more stable and profitable if they invested more in fee-based income sources. The same results were found in prior studies by Baele et al. (2007), Chiorazzo et al. (2008), and Mergaerts and Vander Vennet (2016). Recently, Sharma and Anand (2018) used a panel data set of 169 BRICS banks from 2001 to 2015 and found a positive relationship between diversification and performance in bank risk and returns for medium and large-sized banks. Like Sharma and Anand (2018), when investigating South Asian banks, Nisar et al. (2018) revealed that the profitability and stability of the banks increased with greater revenue diversification. For the global context, After completing research in 29 Asia Pacific, Europe, and US banks from 1995 to 2009, Lee, Hsieh, et al. (2014) concluded that income diversification might generate significant returns in underdeveloped countries due to less integrated financial markets. They also suggested that income diversification produced better resources and

competitiveness, resulting in improved performance. In the U.S., Saunders et al. (2020) concluded that banks with higher non-interest income were associated with greater profitability and lower risk.

In terms of the second strand, scholars claim that non-interest income might not be as stable as traditional banking operations and thus cause bank earnings to be more volatile. For these reasons, DeYoung and Roland (2001) explained three things, including (1) fee-based relationships are more unstable because of low information costs and competition; (2) fee-based businesses might also involve higher fixed labor costs for expansion, raising operating leverage; and (3) banks may have more financial leverage and hence more volatile earnings by utilizing non-interest income sources since they are not required to hold regulatory capital against these sources. Kevin J. Stiroh (2004) suggested that dependence on non-interest income is associated with higher bank risk and lower risk-adjusted profits. He indicated a possible drawback of diversification is that banks can enter markets with either little expertise or a competitive disadvantage. Kevin J. Stiroh (2006), using U.S. bank holding companies, further found that banks relying on non-interest income generate lower equity returns and are riskier. In addition, another study by DeYoung and Torna (2013) of banking institutions in the U.S. stated that not all non-interest sources of income provide the expected diversification benefits (i.e., venture capital, asset securitization, and investment banking). Banks could take greater risks in traditional banking activities if they also take higher risks in non-traditional ones.

For research on banks outside of the U.S., Mercieca et al. (2007) used a sample of small European banks to discover no direct benefits (but has inverse relation) from diversifying income sources within and across business sectors since they entered fields of business in which they lack competence and experience, which is contrary to the results of Köhler (2015). Maudos (2017) examined the relationship between non-interest revenue utilization, risk, and profitability for European banks between 2002 and 2012. He found that non-interest income had a detrimental impact on profitability and was linked to increased risks. In Asia regions, Berger et al. (2010) discovered that, for Chinese banks between 1996 and 2006, income diversification was linked to lower profits and higher costs. Meslier et al. (2014) discovered that a greater emphasis on non-interest activities increased risk-adjusted profits for banks in the Philippines. Ho (2020) investigated the association between income diversity and the financial performance of Vietnamese commercial banks from 2007 to 2019. He found no direct impact of income diversification on bank performance due to its low proportion of total operating income.

Other scholars find mixed results on the relationship between the use of non-interest income sources and bank performance. For instance, Lee, Hsieh, et al. (2014), after investigating a sample of banks in 22 Asian countries from 1995 to 2009, suggested that non-interest income sources helped banks reduce risk but had no impact on their profitability. Edirisuriya et al. (2015) found that South Asian banks experienced better solvency and higher valuations of market-to-book ratio as they diversified from traditional loans into non-interest income divisions; however, higher diversification was inversely linked to these indicators above a certain point.

Considering the above observations, we take a step forward in unravelling such complicated linkages by examining whether income diversification (and its components) recently impacted the performance of the banking sector in the global context during the Covid-19 pandemic.

2.3. Income diversification, Covid-19 pandemic, and overall bank performance

In this study, special attention is devoted to the Covid-19 pandemic. Indeed, X. Li et al. (2021) found that revenue diversification is related to greater profitability and reduced risk for US banks. Accordingly, credit risks harmed bank performance amid tightened credit conditions and deteriorating asset quality due to the pandemic economic woes (X. Li et al., 2021). Hence, they further explained that those banks with revenue sources that are not strongly correlated with lending may have benefited from the sudden drop in demand for traditional loans.

Similarly, income diversification is associated with performance and provides an alternate approach to increase long-term performance for European banks (Taylor, 2022). Their findings show that diversity functions as an economically significant shock absorber. In order to define diversification broadly, Simoens and Vander Venet (2022) took into account three types: geographical diversification (i.e., distribution of bank branches across different countries), functional diversification (i.e., interest-based vs. non-interest income sources), and lending counterparty diversification (i.e., loans to households vs. loans to financial firms), in which all of them were constructed as Herfindahl-Hirschman Indices (HHI). Specifically, high functional diversification mitigates banks' stock market decline by approximately ten percentage points. It would be better able to achieve profitability. At the same time, loan portfolio diversification also helps reduce the impact of the exogenous shock, albeit to only 4.4 percentage points, as the results of Shim (2019). Geographical diversification, on the other hand, is ineffective as a shock absorber of the Covid-19 pandemic, which is contrary to the findings of Aldasoro et al. (2022), Bertay et al. (2022), and Pamen Nyola et al. (2021). Besides, they noticed that banks that had reduced pre-Covid systematic risk, larger liquidity buffers, more cost efficiency, and were operating in nations with better post-Covid growth prospects fared better during the storm (Simoens & Vander Venet, 2022).

On the other hand, when scrutinizing the Covid-19 pandemic's roles and the nexus between non-interest income and bank credit risk of listed banks in 14 Asian emerging markets, Mehmood and De Luca (2023) found that non-interest income increased credit risk, aligning with the study of Calmès and Théoret (2015). Nevertheless, non-traditional activities enabled banks to generate profits during the pandemic, declined traditional lending, and thus lowered credit risk. These findings were also consistent with the earlier literature (Abedifar et al., 2018; Dang & Cuong Dang, 2021).

In addition, it is noted that the impacts of the Covid-19 pandemic widely spread across many regions, countries, and sectors (Demirgüç-Kunt et al., 2021; Elnahass et al., 2021; International Monetary Fund, 2021; McKibbin & Fernando, 2021). Therefore, the usefulness of traditional monetary tools such as interest rates and reserve requirements policies were limited (Lane, 2020; Singh et al., 2022); many governments had to release (financial) supporting packages and regulatory reforms to help the businesses, including the banking system. Due to the transparency issue in Vietnam, however, no data is available on which bank gets how much support. We, therefore, have to control the support packages via the lagged value of the bank's overall performance measure. In this sense, we assume that if a bank received a support package in the previous period, the package would improve its performance in the previous period as well; this, in turn, will positively impact the bank's performance in the present period. Consequently, the

generalized method of moments (GMM, more details are presented in [Section 4.1](#) below) is an appropriate estimation technique for such examination.

The current pandemic is a health-related crisis, which marks a significant distinction from the past crises (i.e., the GFC in 2008) (Duan et al., 2021). Thus, the effect of non-interest income on banks overall performance during this pandemic is ultimately an empirical question that needs to be answered. On balance, the first two hypotheses are as follows.

H1: *There is no relationship between income diversification and overall bank performance during the Covid–19 pandemic.*

H2: *There is no relationship between income diversification's components and overall bank performance during the Covid–19 pandemic.*

Given the impact of the Covid–19 pandemic and income diversification, our study further investigates the interaction effect of the Covid–19 shock and income diversification (and its components) on the bank's overall performance. The following hypotheses are then formed:

H3: *Income diversification is likely to reduce the negative impact of the Covid–19 pandemic on overall bank performance.*

H4: *Income diversification's components are likely to reduce the negative impact of the Covid–19 pandemic on overall bank performance.*

3. Data and methodology

In this study, we examine the relationship between income diversification and bank overall performance during the Covid–19 pandemic by the baseline models, followed by X. Li et al. (2021) and Simoens and Vander Venet (2022).

$$\pi_{i,n,t} = \alpha_0 + \alpha_1\pi_{i,n,t-1} + \alpha_2DIV_{i,n,t} + \alpha_3CASE_{n,t} + \alpha_4Bank - Control\ variables_{i,n,t} + \alpha_5Country - Control\ variables_{n,t} + \varepsilon_{i,n,t} \quad (1)$$

$$\pi_{i,n,t} = \beta_0 + \beta_1\pi_{i,n,t-1} + \beta_2Components_{i,n,t} + \beta_3CASE_{n,t} + \beta_4Bank - Control\ variables_{i,n,t} + \beta_5Country - Control\ variables_{n,t} + \mu_{i,n,t} \quad (2)$$

Furthermore, we figure out the moderating effect of the Covid–19 and non-interest income sources (and their components) on banks' profitability and risk-taking by the following equations.

$$\pi_{i,n,t} = \alpha_0 + \alpha_1\pi_{i,n,t-1} + \alpha_2DIV_{i,n,t} + \alpha_3DIV_{i,n,t} * CASE_{n,t} + \alpha_4CASE_{n,t} + \alpha_5Bank - Control\ variables_{i,n,t} + \alpha_6Country - Control\ variables_{n,t} + \varepsilon_{i,n,t} \quad (3)$$

$$\pi_{i,n,t} = \beta_0 + \beta_1\pi_{i,n,t-1} + \beta_2Components_{i,n,t} + \beta_3Components_{i,n,t} * CASE_{n,t} + \beta_4CASE_{n,t} + \beta_5Bank - Control\ variables_{i,n,t} + \beta_6Country - Control\ variables_{n,t} + \mu_{i,n,t} \quad (4)$$

where:

$\pi_{i,n,t}$ is bank overall performance (including return on assets (ROA), return on equity (ROE), and bank risk-taking (ZSCORE)) of bank i in country n , and in time t (adapted from Fu et al., 2014; Laeven & Levine, 2007; Lepetit et al., 2008; X. Li et al., 2021).

$DIV_{i,n,t}$ is income diversification, measured by the ratio of net non-interest income to net operating income (adapted from X. Li et al., 2021; Sharma & Anand, 2018; Kevin J. ; Stiroh, 2004; Wang & Lin, 2021).

$Components_{i,n,t}$ is income diversification's components, proxied by (adapted from L. Li & Zhang, 2013):

- $FEE_{i,n,t}$: the ratio of fees & commissions from operations to net operating income,
- $DEAL_{i,n,t}$: the ratio of dealer trading account profit to net operating income,
- $INVEST_{i,n,t}$: the ratio of investment securities (gains/losses) to net operating income,
- $FOREIGN_{i,n,t}$: the ratio of foreign currency gains to net operating income,
- $OTH_{i,n,t}$: the ratio of other income to net operating income.

$CASE_{n,t}$ is the natural logarithm of confirmed Covid-19 cases (adapted from Le et al., 2022).

$\varepsilon_{i,n,t}$ and $\mu_{i,n,t}$ are error terms.

Additionally, we also include the control variables that we expect to impact banks' overall performance. According to the current literature, they consist of: $SIZE_{i,n,t}$ is bank size, measured by the natural logarithm of total assets; $LOAN_{i,n,t}$ is the ratio of net loans to total assets; $DEPOSIT_{i,n,t}$ is the ratio of total deposits to total assets; $CAP_{i,n,t}$ is the ratio of total equity to total assets; $LLP_{i,n,t}$ is the ratio of loan loss provisions to total assets; $CIR_{i,n,t}$ is the ratio of operating expenses to operating income; and $GDP_{n,t}$ is the growth rate of GDP (adapted from Abuzayed et al., 2018; Fu et al., 2014, Fu et al., 2016; L. Li & Zhang, 2013; Paltrinieri et al., 2020; Simoens & Vander Venet, 2022, Williams, 2016; X. Li et al., 2021). The descriptions of used variables are presented in Table 1 below.

For the individual level, we collected a quarterly database (panel data), adapted from X. Li et al. (2021), from the Refinitiv Eikon for most bank variables between 2018Q1 and 2021Q4. Regarding the country-level database, $CASE_{n,t}$ downloaded from WHO Coronavirus Dashboard,¹ and $GDP_{n,t}$ extracted from the World Bank Database. To achieve the objective

¹<https://covid19.who.int/info?openIndex=2>.

Table 1. Descriptions of used variables.

No.	Variable	Definition	Source
<i>Dependent variables</i>			
1	ROA	Return on assets = Net income/Total assets	Refinitiv Eikon
2	ROE	Return on equity = Net income/Total equity	
3	ZSCORE	Risk-taking = (ROA + capital ratio)/ σ ROA	
<i>Independent variables</i>			
4	DIV	Income diversification = Net non-interest income/Net operating income	Refinitiv Eikon
4.1	FEE	Fee-based income = Fees & commissions from operations/Net operating income	
4.2	DEAL	Dealing-based income = Dealer trading account profit/Net operating income	
4.3	INVEST	Investment-base income = investment securities/Net operating income	
4.4	FOREIGN	Foreign-based income = Foreign currency gain income/Net operating income	
4.5	OTH	Other income = Other income/Net operating income	
5	CASE	Covid-19 cases = ln (confirmed Covid-19 cases)	WHO Coronavirus Dashboard
<i>Control variables</i>			
6	SIZE	Bank size = ln (Total assets)	Refinitiv Eikon
7	LOAN	Bank loans = Net loans/Total assets	
8	DEPOSIT	Bank deposits = Total deposits/Total assets	
9	CAP	Capital ratio = Total equity/Total assets	World Bank Database
10	LLP	Loan loss provisions = Loan loss provisions/Total assets	
11	CIR	Cost efficiency = Operating expense/Operating income	
12	GDP	Annual GDP growth rate	

Source: Synthesized by the authors.

of conducting a broad-based international study, we tried to collect data from listed banks across countries as much as possible. However, after matching and cleaning the data, we ended up with a sample that includes 1,231 banks headquartered in 90 countries (equivalent to approximately 18,000 observations). Its descriptive statistics are presented in the next section.

To deal with the endogenous problems and unobserved heterogeneity between income diversification and bank overall performance (Demsetz & Strahan, 1997), we used a dynamic panel data model with a system generalized method of moments (system GMM) estimator, as proposed by Arellano and Bover (1995) and Bond (2002). For instance, because we could not observe the data on the government's support packages provided to the banks, they can be treated as an unobserved heterogeneity variable in our model. In this sense, the lagged value of the dependent variable (i.e., $\pi_{i,n,t-1}$) can be used as an independent variable accounting for such unobserved data; this method is popularly used in the banking and finance literature (Addai et al., 2022; El-Chaarani, Abraham, et al., 2022; Ho et al., 2021; L. Li & Zhang, 2013; Mehmood & De Luca, 2023; Ngo & Le, 2019; Wang & Lin, 2021).

4. Empirical results and discussions

4.1. Baseline results

The descriptive statistics for all used variables in our study are presented in Table 2. Accordingly, the mean values of profitability (ROA & ROE), risk-taking (ZSCORE), and income diversification (DIV) are 0.002, 0.022, 16.693, and 0.316, respectively. The values

Table 2. Descriptive statistics for all used variables.

Variable	Obs.	Mean	Std. Dev	Min	Max
ROA	17,872	0.002	0.003	−0.011	0.012
ROE	17,834	0.022	0.023	−0.099	0.085
ZSCORE	14,690	16.693	3.681	8.812	26.738
DIV	17,673	0.316	0.169	0.022	0.869
FEE	17,673	0.119	0.102	0.000	0.463
DEAL	17,673	0.008	0.027	−0.001	0.174
INVEST	17,673	−0.203	1.174	−6.778	3.524
FOREIGN	17,673	0.013	0.031	0.000	0.187
OTH	17,673	0.083	0.104	−0.028	0.505
SIZE	9,376	13.554	3.099	5.024	17.796
LOAN	17,872	24.992	3.599	18.988	33.717
DEPOSIT	17,872	0.596	0.174	0.000	0.861
CAP	17,872	0.752	0.154	0.000	0.928
CIR	17,872	0.105	0.045	0.032	0.322
LLP	17,673	0.755	0.592	−0.090	3.590
CASE	17,872	0.001	0.002	−0.002	0.011
GDP	19,424	2.878	2.017	−3.800	7.727

ROA is return on assets; ROE is return on equity; ZSCORE is bank risk-taking; DIV is income diversification, measured by the ratio of net non-interest income to net operating income; its components include FEE, DEAL, INVEST, FOREIGN, OTH; CASE is the natural logarithm of confirmed Covid−19 cases; SIZE is bank size, measured by the natural logarithm of total assets; LOAN is the ratio of net loans to total assets; DEPOSIT is the ratio of total deposits to total assets; CAP is the ratio of total equity to total assets; CIR is the ratio of operating expenses to operating income; LLP is the ratio of loan loss provisions to total assets; and GDP is the growth rate of GDP.

Source: Authors' estimation by using STATA.

indicate that, on average, banks have low profitability and financial stability. Further, with respect to income diversification, most banks seem to rely mainly on traditional activities since non-interest income makes up approximately 30% of total operating income. Specifically, Japan has the highest value of 0.869, while Taiwan has the lowest value of 0.022. The results contradict the study of Wang and Lin (2021), which investigated 14 Asia Pacific economies from 2011 to 2016. Wang & Lin claimed that India had the highest income diversification, whereas the opposite was true for Japan. It proves that banks across countries have changed their income diversification strategy a lot year by year, which needs to be re-investigated in the current period, especially during the Covid−19 pandemic.

The correlation matrix and VIF test ensure no multicollinearity in our data – such results are not presented here but will be available upon request. In Table 3, we report the estimation results of Equations (1) and (3). For ease of exposition, we focus on our primary interest variable. First, concerning the lagged value of the dependent variables, the positive and statistically significant results of ROA and ROE (columns 1, 2, 3, and 4 of Table 3) recommend that efficient performing banks kept operating well when Covid−19 occurred. More interestingly, risk-taking's estimated coefficients (columns 5 and 6 of Table 3) are positive and significant at the one-percent level, inferring that the safest banks would operate safer under the pandemic. This is in line with the findings of Fahlenbrach et al. (2012) and Simoens and Vander Venet (2022).

For the main independent variables, the positive and statistically significant coefficients of DIV (columns 1, 3, and 5 of Table 3) imply that diversification boosts bank profits and improves bank stability; hence, we reject Hypothesis H₁. Our results are consistent with the results of Mehmood and De Luca (2023), X. Li et al. (2021), Simoens

Table 3. The results of income diversification and bank overall performance.

π	ROA (1)	ROA (2)	ROE (3)	ROE (4)	ZSCORE (5)	ZSCORE (6)
π_{t-1}	0.157*** (0.050)	0.189* (0.104)	0.129** (0.065)	0.160** (0.073)	0.935*** (0.088)	0.964*** (0.020)
DIV	0.003*** (0.001)	-0.013 (0.008)	0.071*** (0.022)	-0.068 (0.058)	0.336* (0.203)	-0.477 (0.361)
CASE	-0.000* (0.000)	-0.000* (0.000)	-0.001* (0.000)	-0.004** (0.002)	-0.006 (0.008)	-0.017* (0.009)
DIV*CASE		0.001* (0.001)		0.009** (0.004)		0.043* (0.024)
SIZE	-0.000 (0.000)	0.000 (0.000)	-0.005 (0.003)	-0.006 (0.003)	0.100 (0.082)	0.087*** (0.020)
LOAN	-0.007 (0.005)	-0.003 (0.005)	-0.178 (0.073)	-0.165 (0.067)	0.237 (0.700)	0.436** (0.208)
DEPOSIT	0.001 (0.008)	0.028 (0.017)	0.066 (0.108)	0.030 (0.074)	1.159 (1.435)	3.025*** (0.696)
CAP	0.081*** (0.030)	-0.019 (0.029)	0.076 (0.216)	-0.046 (0.121)	4.830 (3.382)	3.001*** (0.726)
CIR	-0.003*** (0.000)	-0.001 (0.002)	-0.010*** (0.003)	-0.008** (0.003)	-0.108 (0.086)	0.010 (0.012)
LLP	-0.337 (0.068)	-0.636 (0.594)	-2.107 (1.947)	-2.146 (1.144)	-51.366 (41.189)	-21.685 (6.194)
GDP	0.000*** (0.000)	0.000** (0.000)	0.002** (0.001)	0.002*** (0.000)	0.008 (0.018)	0.009 (0.010)
Constant	0.013 (0.017)	-0.006 (0.015)	0.199 (0.187)	0.285 (0.155)	-2.838 (2.643)	-4.283 (0.891)
No. of Obs.	8034	8034	8009	8009	6865	6865
No. of Groups	1063	1063	1061	1061	871	871
No. of Instruments	32	23	27	31	20	48
AR1 (p-value)	0.011	0.049	0.035	0.046	0.087	0.091
AR2 (p-value)	0.431	0.150	0.206	0.124	0.840	0.471
Hansen test (p-value)	0.656	0.590	0.753	0.651	0.824	0.893

Robust standard errors are in parentheses. *, **, *** significance at the 10%, 5%, and 1% levels, respectively. For diagnostic tests, the results show that the p-values of the Hansen test and the Arellano-Bond test for second-order autocorrelation are statistically not significant. This means that over-identifying restrictions do not exist, the moment conditions are fulfilled, and the instruments are justified. Furthermore, the coefficients of lagged measures of bank overall performance are significantly positive, implying that the system GMM is appropriate to use in our study.

ROA is return on assets; ROE is return on equity; ZSCORE is bank risk-taking; DIV is income diversification, measured by the ratio of net non-interest income to net operating income; its components include FEE, DEAL, INVEST, FOREIGN, OTH; CASE is the natural logarithm of confirmed Covid-19 cases; SIZE is bank size, measured by the natural logarithm of total assets; LOAN is the ratio of net loans to total assets; DEPOSIT is the ratio of total deposits to total assets; CAP is the ratio of total equity to total assets; CIR is the ratio of operating expenses to operating income; LLP is the ratio of loan loss provisions to total assets; and GDP is the growth rate of GDP.

Source: Authors' estimation by using STATA.

and Vander Venet (2021), and Wang and Lin (2021). It could be due to reduced traditional activities during the Covid-19 pandemic, and banks would reduce loan growth, a key factor of increasing non-performing loans or credit risk, then increasing their profitability and stability. The negative coefficients of CASE across all models suggest that the banking systems worldwide are being affected by the Covid-19 pandemic, which supports the findings of Elnahass et al. (2021). More importantly, by using the confirmed Covid-19 positive cases in this research, our findings indicate that the more a country is affected by the pandemic (i.e., higher CASE), the less efficient its banking system is, albeit its marginal effect may be smaller than the other variables. Such results could not be found in studies using a dummy variable to represent Covid-19 (Demirgüç-Kunt et al., 2021; Duan et al., 2021; Elnahass et al., 2021).

We further examine the interaction effect of CASE and DIV on the bank performance (columns 2, 4, and 6 of Table 3). Consequently, we find that diversification helps alleviate the adverse effects of Covid-19: diversified banks in countries with a higher number of CASE still have their performance improved compared to their counterpart. We, therefore, do not reject Hypothesis H₃.

Regarding the control variables, the results for SIZE, LOAN, and DEPOSIT (in column 6 of Table 3) provide evidence that the bigger banks would be safer (it aligns with X. Li et al., 2021, but disagrees with ; Kasman & Carvalho, 2014; Wang & Lin, 2021) and banks experiencing high levels of loans and deposits could also help them resile during the Covid-19 pandemic. Additionally, banks holding more capital might improve their overall performance (the estimated coefficients of CAP in columns 1 and 6 of Table 3). This result again confirms the role of capital as a buffer against unexpected losses, as shown in previous studies by Berger and Bouwman (2013) and Demircuc-Kunt et al. (2013), but it is contrary to the study by Nguyen and Le (2022). Lastly, in contrast with Neukirchen et al. (2021) and Simoens and Vander Venet (2022), CIR is negative and significant across banks' profitability (though the value of coefficients is small), shown in columns 1, 2, 3, and 4 of Table 3.

For income diversification's components, Table 4 shows the positive and significant impacts of DEAL, INVEST, and OTH on bank profitability, of FOREIGN and FEE on bank stability and profitability. Those results indicate that investments in trading, securities, and fee-based services will enhance bank profitability, stability, or both. The interaction terms between those components and CASE show similar results as in Table 3. However, only the results of FEE are significant (due to the highest proportion of fee-based services in non-interest income sources). As a result, we can reject Hypothesis H₂ but not reject Hypothesis H₄. Our results, therefore, confirm and extend the findings of L. Li and Zhang (2013) when this study only found a negative relationship between other revenues and ROE (columns 1 and 2 of Table 4).

In addition, both Tables 3 and 4 suggest that the impact of income diversification (or its components) on bank stability is much more apparent than bank profitability. Furthermore, trading income has a more considerable impact on bank profitability than fee-based income despite its smallest proportion in income diversification (see Table 2). These can be explained by the *portfolio theory* (Markowitz, 1952), where efficient diversification of investments could minimize the unsystematic risk. On the other hand, fee-based relationships are more volatile than lending relationships because of low information costs and high competition among banks. It is because expanding into fee-based services may require additional fixed costs, resulting in higher operating expenses (DeYoung & Roland, 2001).

4.2. Sub-sample analysis

This section investigates the heterogeneous impacts of income diversification on bank performance in pre- and during-Covid-19 periods and in developing and developed countries. Table 5 presents the former concern. Accordingly, Covid-19 has reduced the bank's profitability yielded from non-traditional activities. However, it is an incentive for banks to move away from risk-taking activities (i.e., increasing fee-based services, reducing unsecured borrowers), leading to improved financial stability. We again confirm the

Table 4. The results of income diversification's components and bank overall performance.

π	ROA (1)	ROA (2)	ROE (3)	ROE (4)	ZSCORE (5)	ZSCORE (6)
π_{t-1}	0.166** (0.082)	0.195*** (0.048)	0.156** (0.087)	0.230*** (0.086)	0.727*** (0.082)	0.946*** (0.018)
FEE	0.001*** (0.000)	-0.052 (0.033)	0.010*** (0.002)	-0.420 (0.264)	0.487* (0.262)	-1.810 (1.118)
DEAL	0.004** (0.002)	-0.157 (0.117)	0.078*** (0.025)	0.207 (0.212)	-0.029 (0.288)	-3.074 (4.545)
INVEST	0.000 (0.000)	0.006*** (0.001)	-0.000 (0.000)	0.007 (0.008)	-0.005 (0.009)	0.052 (0.074)
FOREIGN	0.009 (0.010)	0.456*** (0.042)	0.142** (0.067)	1.451** (0.591)	0.080 (0.427)	7.479* (4.305)
OTH	0.002 (0.001)	0.055 (0.041)	0.028** (0.011)	0.267 (0.254)	0.135 (0.219)	-0.220 (0.945)
CASE	-0.000 (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001 (0.003)	-0.000 (0.005)	-0.024** (0.010)
FEE*CASE		0.005* (0.003)		0.042* (0.025)		0.155* (0.088)
DEAL*CASE		0.015 (0.009)		-0.010 (0.018)		0.331 (0.369)
INVEST*CASE		-0.000 (0.000)		-0.000 (0.000)		-0.004 (0.005)
FOREIGN*CASE		-0.028 (0.002)		-0.098 (0.040)		-0.473 (0.336)
OTH*CASE		-0.004 (0.003)		-0.016 (0.018)		0.032 (0.066)
SIZE	-0.000 (0.001)	-0.000 (0.001)	0.001 (0.002)	-0.002 (0.003)	0.174** (0.076)	0.081*** (0.024)
LOAN	-0.001 (0.001)	0.001 (0.002)	-0.031 (0.008)	0.007 (0.013)	-0.868 (0.519)	0.462*** (0.173)
DEPOSIT	0.002 (0.004)	0.022** (0.010)	0.218*** (0.080)	-0.015 (0.127)	0.765 (0.837)	2.981*** (0.669)
CAP	0.008 (0.007)	0.021** (0.009)	0.187*** (0.061)	0.046 (0.079)	3.230 (4.309)	2.935*** (0.721)
CIR	-0.001*** (0.000)	-0.001*** (0.000)	-0.012*** (0.003)	-0.017*** (0.004)	-0.096** (0.046)	-0.087*** (0.026)
LLP	-0.249 (0.328)	-1.011 (0.214)	-5.767 (1.938)	-2.777 (3.032)	12.345 (7.811)	-7.764 (5.122)
GDP	0.000** (0.000)	0.000 (0.000)	0.001** (0.000)	0.003*** (0.001)	0.254*** (0.094)	0.004 (0.007)
Constant	0.001 (0.010)	-0.013 (0.023)	-0.154 (0.101)	0.101 (0.136)	-0.953 (1.799)	-3.703 (0.935)
No. of Obs.	8034	8034	8009	8009	6865	6865
No. of Groups	1063	1063	1061	1061	871	871
No. of Instruments	27	45	28	29	30	83
AR1 (p-value)	0.013	0.000	0.068	0.037	0.013	0.068
AR2 (p-value)	0.292	0.463	0.155	0.060	0.902	0.400
Hansen test (p-value)	0.533	0.335	0.375	0.239	0.128	0.996

Robust standard errors are in parentheses. *, **, *** significance at the 10%, 5%, and 1% levels, respectively. ROA is return on assets; ROE is return on equity; ZSCORE is bank risk-taking; DIV is income diversification, measured by the ratio of net non-interest income to net operating income; its components include FEE, DEAL, INVEST, FOREIGN, OTH; CASE is the natural logarithm of confirmed Covid-19 cases; SIZE is bank size, measured by the natural logarithm of total assets; LOAN is the ratio of net loans to total assets; DEPOSIT is the ratio of total deposits to total assets; CAP is the ratio of total equity to total assets; CIR is the ratio of operating expenses to operating income; LLP is the ratio of loan loss provisions to total assets; and GDP is the growth rate of GDP.

Source: Authors' estimation by using STATA.

compelling effect of income diversification in promoting banks' profitability and their financial stability during the exogenous shock like Covid-19 (even until the end of the pandemic in Q42021), which was proved in prior studies when the pandemic first occurred (Mehmood & De Luca, 2023; Simoens & Vander Vennet, 2022; X. Li et al., 2021).

Table 5. Pre-Covid –19 vs. during-Covid –19 periods.

π	Pre-Covid–19			During Covid–19		
	ROA (1)	ROE (2)	ZSCORE (3)	ROA (4)	ROE (5)	ZSCORE (6)
π_{t-1}	0.086*** (0.011)	0.067*** (0.024)	0.422** (0.177)	0.134** (0.053)	0.138*** (0.039)	1.054*** (0.066)
DIV	0.006*** (0.002)	0.034* (0.017)	0.535* (0.307)	–0.056 (0.045)	–0.229 (0.204)	–6.368 (3.942)
CASE				–0.002** (0.001)	–0.011* (0.006)	–0.188* (0.108)
DIV*CASE				0.006** (0.003)	0.029* (0.017)	0.544* (0.300)
Constant	–0.024 (0.013)	–0.004 (0.026)	–7.935 (3.060)	0.057 (0.036)	0.223 (0.276)	–3.192 (3.969)
No. of Obs.	7223	7187	6244	7034	7012	6005
No. of Groups	1075	1071	906	1060	1057	870
	37	33	20	20	22	31
AR1 (p-value)	0.006	0.024	0.013	0.030	0.077	0.095
AR2 (p-value)	0.228	0.389	0.137	0.608	0.270	0.256
Hansen test (p-value)	0.223	0.104	0.560	0.324	0.835	0.537

Robust standard errors are in parentheses. *, **, *** significance at the 10%, 5%, and 1% levels, respectively. ROA is return on assets; ROE is return on equity; ZSCORE is bank risk-taking; DIV is income diversification, measured by the ratio of net non-interest income to net operating income; its components include FEE, DEAL, INVEST, FOREIGN, OTH; CASE is the natural logarithm of confirmed Covid–19 cases. The same set of control variables is used: SIZE is bank size, measured by the natural logarithm of total assets; LOAN is the ratio of net loans to total assets; DEPOSIT is the ratio of total deposits to total assets; CAP is the ratio of total equity to total assets; CIR is the ratio of operating expenses to operating income; LLP is the ratio of loan loss provisions to total assets; and GDP is the growth rate of GDP.

Source: Authors' estimation by using STATA.

Table 6. Developing vs. developed countries.

π	Developing countries			Developed countries		
	ROA (1)	ROE (2)	ZSCORE (3)	ROA (4)	ROE (5)	ZSCORE (6)
π_{t-1}	0.036* (0.018)	0.204*** (0.012)	0.936*** (0.025)	0.426*** (0.120)	0.273*** (0.081)	0.502*** (0.138)
DIV	–0.001 (0.003)	–0.600 (0.431)	–0.106 (0.076)	–0.024 (0.015)	–0.024 (0.070)	–0.422 (1.220)
CASE	–0.000*** (0.000)	–0.021* (0.013)	–0.003* (0.002)	–0.001*** (0.000)	–0.004* (0.002)	–0.111** (0.044)
DIV*CASE	0.000** (0.000)	0.061* (0.037)	0.014** (0.005)	0.002* (0.001)	0.025** (0.010)	0.182* (0.108)
Constant	0.004 (0.005)	0.994 (0.557)	–1.165 (0.401)	0.085 (0.027)	–0.945 (0.359)	–2.416 (8.326)
No. of Obs.	3360	3360	2717	4674	4649	4148
No. of Groups	450	450	347	613	611	524
AR1 (p-value)	0.088	0.080	0.000	0.005	0.070	0.011
AR2 (p-value)	0.178	0.266	0.757	0.345	0.968	0.369
Hansen test (p-value)	0.175	0.933	0.101	0.697	0.447	0.942

Robust standard errors are in parentheses. *, **, *** significance at the 10%, 5%, and 1% levels, respectively. We classify developing and developed countries base on IMF, retrieved from <https://www.imf.org/external/pubs/ft/weo/2020/01/weodata/groups.htm> on NaN Invalid Date NaN. Accordingly, emerging economies refers to a set of low- and middle-income economies, whereas developed economies mainly denote a set of high-income economies (Wang & Lin, 2021). ROA is return on assets; ROE is return on equity; ZSCORE is bank risk-taking; DIV is income diversification, measured by the ratio of net non-interest income to net operating income; its components include FEE, DEAL, INVEST, FOREIGN, OTH; CASE is the natural logarithm of confirmed Covid–19 cases. The same set of control variables is used: SIZE is bank size, measured by the natural logarithm of total assets; LOAN is the ratio of net loans to total assets; DEPOSIT is the ratio of total deposits to total assets; CAP is the ratio of total equity to total assets; CIR is the ratio of operating expenses to operating income; LLP is the ratio of loan loss provisions to total assets; and GDP is the growth rate of GDP.

Source: Authors' estimation by using STATA.

Unlike the study of Wang and Lin (2021), our results (shown in Table 6) suggest that income diversification in developed countries helps banks increase their profitability (ROA) and financial stability much more than in developing countries, which has already proved in the earlier literature (Addai et al., 2022; Boyd & Graham, 1988; Engle et al., 2014; Lee, Hsieh, et al., 2014; Rogers & Sinkey, 1999). The results prove that in mature economies, income diversification plays a crucial role in reducing the negative impact of the Covid-19 pandemic on overall bank performance. Also, the ability of banks to diversify income sources is better in developed countries than in developing countries, thanks to the effect of financial innovation (Frame et al., 2019; Thakor, 2020). When banks take advantage of diversification opportunities, it facilitates the efficient collection of customer information and greatly lowers information asymmetry. Further, developing countries need longer period to get the economic conditions recovered than developed counterparts (El-Chaarani, 2021).

5. Conclusion

When banks experience an unexpected exogenous disturbance, diversification ought to function as a shock absorber (Simoens & Vander Venet, 2022). Using a rich database (from 2018Q1 to 2021Q4) of 1,231 banks in 90 countries, we examined whether more diversified banks were able to withstand the exogenous Covid-19 pandemic and its impacts (i.e., tightened credit standards and reduced demand for many types of loans). Our results indicate that non-interest income appears to connect to profitability and stability favourably. When breaking down into components, we found that fee-based services, trading activities, and foreign currency can improve banking performance. Such effects, however, differ before and during the pandemic and among the examined countries.

Our study contributes to the existing-academic literature by providing broad-based international empirical evidence of the nexus between income diversification and bank overall performance, lasting from 2018 to the end of the Covid-19 pandemic in December 2020, while most studies related to the banking sector during the Covid-19 pandemic stop at the beginning of the first wave of the pandemic. Further, our findings highlight important implications for bank managers and/or policymakers. First of all, bank managers should diversify income sources, especially trading activities and foreign currency, to foster financial performance and stability in unexpected-loss periods like the Covid-19 pandemic because they are likely to reduce the adverse effect of the shocks. Second, bank managers should figure out a way to utilize fee-based income sources because they make up the highest proportion of operating income but have little effect on promoting bank profitability. In contrast, managers should take advantage of trading-income sources when it proves a high impact on boosting bank profitability. Finally, policymakers in developing countries should impose policies that help the countries approach financial innovation because it is considered a new way for banks to diversify their income sources.

The study has some limitations, which suggests further research in the future. First, the hidden mechanism by which trading activities affect bank performance still needs further investigation because it makes up a minor proportion of income sources but has the most considerable impact. Second, given the expansion of financial innovations (i.e., fintech, digital banking) over the previous decades, which enables banks to target new customers and market segments (and create new sources of fee-based income) (Thakor, 2020; X. Li et

al., 2021), future research should be done to determine how fintech adoption or digitalization impacts banks' financial performance and their strategies of income diversification.

Highlights

- Income diversification may improve overall bank performance.
- Fee-based services improve both bank profitability and financial stability.
- Covid-19 has reduced the bank's profitability yielded from non-traditional activities.
- Income diversification helps banks in developed countries increase performance much more than those in developing countries.

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