

Article

Revenue Diversification Through Non-Interest Income and Bank Performance in European Banking

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Abstract

This paper examines the relationship between revenue diversification, profitability, and risk in European banks, with particular emphasis on the structural break induced by the COVID-19 shock. Using quarterly supervisory data from the European Banking Authority (EBA) over the period 2016Q1–2024Q4, we distinguish between pre- and post-pandemic regimes and estimate dynamic fixed-effects models that account for unobserved heterogeneity and persistence in bank performance. The results reveal a pattern consistent with regime dependence. Descriptive (quintile-based) comparisons suggest that banks with greater reliance on non-interest income tended to report higher profitability prior to COVID-19, although data limitations prevent us from confirming this pattern in a full multivariate regression for the pre-COVID subsample. In the post-COVID period, once bank and time fixed effects, persistence, and balance-sheet characteristics are properly controlled for, revenue diversification does not exert a statistically significant effect on either profitability or earnings volatility; this result is robust across bank fixed effects only, two-way (bank and time) clustered, and one-way (bank) clustered specifications. We show that diversification is systematically associated with differences in bank size, capitalization, and lending intensity, indicating that income structure is closely linked to underlying business model characteristics. These findings suggest that the observed diversification–performance relationship largely reflects cross-sectional heterogeneity rather than a stable causal effect. Overall, the evidence indicates that revenue diversification does not provide a consistent improvement in risk-adjusted performance in European banking. Instead, performance and risk dynamics are primarily driven by balance-sheet composition and persistence. The results highlight the importance of accounting for structural heterogeneity and macroeconomic regimes when evaluating the role of non-interest income in bank performance.



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1. Introduction

The COVID-19 pandemic represents a structural break in the operating environment of European banks and provides a natural setting to reassess the role of revenue diversification in shaping bank performance and risk. While non-interest income has traditionally been viewed as a potential stabilizing mechanism, its effectiveness across different macroeconomic regimes remains unclear. This question is particularly relevant in the European context, where a stricter post-crisis regulatory framework (Basel III, the Banking Union, and the Single Supervisory Mechanism) and a prolonged period of low interest rates have

jointly reshaped banks' incentives to diversify their revenue base. According to the European Banking Authority's Risk Dashboard ([European Banking Authority, 2021](#)), EU/EEA banks entered the pandemic period with strengthened capital and liquidity positions relative to the pre-crisis era, even as profitability remained structurally low, a combination that further underscores the relevance of examining whether revenue diversification has contributed to resilience during this period. This resilience was subsequently corroborated by the EBA's 2023 EU-wide stress test ([European Banking Authority, 2023](#)), which found that EU banks remained adequately capitalized even under a severe adverse scenario, with the aggregate fully loaded CET1 ratio declining from 15.0% to 10.4%. In particular, it is not evident whether diversification enhances resilience during periods of heightened uncertainty or instead reflects strategic balance-sheet adjustments driven by regulatory and economic constraints.

Non-interest income refers to revenues generated from activities other than traditional interest-bearing lending, including fees and commissions, payment services, trading activities, investment banking, asset management, and other financial services. As banks have expanded these activities to compensate for declining interest margins, revenue diversification has attracted increasing attention in the banking literature. However, previous empirical evidence remains inconclusive regarding whether greater reliance on non-interest income enhances profitability or instead increases earnings volatility and risk. Part of the pressure to diversify also plausibly originates outside the traditional banking sector: venture capital investment in fintech companies grew sharply over the past decade, reaching approximately USD 40 billion globally in 2018 alone ([FINTECH Circle Institute, 2020](#)). This growth reflects intensifying competition for fee-generating financial services such as payments and asset management, which may represent an additional competitive pressure on incumbent banks' non-interest income activities, alongside the margin-compression channel discussed above.

The existing literature documents mixed evidence on the profitability and risk implications of income diversification. Early empirical studies associate non-interest income with higher earnings volatility and increased operating leverage ([DeYoung & Roland, 2001](#); [Stiroh, 2004a, 2004b](#)). [DeYoung and Torna \(2013\)](#) similarly find that greater involvement in nontraditional banking activities increased the probability of bank failure during the 2007–2009 financial crisis. Subsequent contributions emphasize heterogeneity across business models, institutional environments, and economic cycles ([Köhler, 2015](#); [Maudos, 2017](#)). More recent research highlights the interaction between diversification, regulation and systemic risk, suggesting that income composition cannot be assessed independently of capital requirements and risk-weighted asset allocation ([Acharya et al., 2022](#); [Nguyen & Vo, 2022](#)). However, most empirical evidence is based on pre-pandemic data or focuses on the acute COVID shock ([Li et al., 2021](#)), leaving the post-crisis adjustment phase largely unexplored in the European context.

This paper contributes to the literature in three ways. First, we use quarterly supervisory data from the European Banking Authority (EBA) covering 2016Q1–2024Q4, and explicitly distinguish between pre- and post-COVID regimes using dynamic fixed-effects specifications that account for bank heterogeneity and persistence in performance; to the best of our knowledge, this is among the first studies to use quarterly EBA supervisory data spanning both the pre- and post-pandemic periods to test whether the diversification-performance relationship is stable across macroeconomic regimes. Second, we show that while diversification is positively associated with profitability descriptively prior to COVID-19, this relationship does not hold as a statistically significant effect in the post-COVID period once bank and time fixed effects, persistence, and balance-sheet characteristics are properly controlled for, robust to alternative fixed-effects and cluster-

ing specifications. Third, we document that diversification is systematically associated with bank size, capitalization, lending intensity, and risk-weighted asset exposure, indicating that income structure is closely linked to broader balance-sheet configuration and that the observed diversification-performance relationship largely reflects business-model heterogeneity rather than a stable causal mechanism.

The remainder of the paper is structured as follows. Section 2 reviews the related literature. Section 3 describes the data and methodology. Section 4 presents the empirical results. Section 5 discusses the findings. Section 6 concludes.

2. Literature Review

The relationship between revenue diversification, bank performance, and risk has been extensively studied in the banking literature, yet the empirical evidence remains mixed. Early theoretical and empirical contributions suggest that diversification into non-interest income activities may stabilize bank earnings by reducing reliance on traditional interest-based revenues. From a portfolio perspective, income diversification may lower overall risk if revenue streams are imperfectly correlated (Stiroh, 2006). Consistent with this view, Albertazzi and Gambacorta (2009) study the sensitivity of bank income statement components to the business cycle across major industrialized countries and find that, unlike net interest income, non-interest income is not significantly influenced by GDP fluctuations, suggesting that revenue diversification can contribute to stabilizing bank profitability over the business cycle.

However, a substantial body of empirical research documents that non-interest income is often associated with higher earnings volatility and increased risk. DeYoung and Roland (2001) show that shifts toward fee-based and trading activities amplify earnings volatility due to higher operating leverage. Similarly, Stiroh (2004a, 2004b) finds limited diversification benefits for U.S. banks, emphasizing that non-interest income tends to be more volatile than traditional interest income. Evidence from European banks also questions the stabilizing role of diversification, particularly for smaller institutions (Mercieca et al., 2007; Chiorazzo et al., 2008; Maudos, 2017).

Subsequent studies highlight that the impact of revenue diversification depends on bank characteristics, institutional environments, and economic conditions. For instance, Berger et al. (2010), Lee et al. (2014), Meslier et al. (2014), and Nisar et al. (2018) report positive effects of diversification on bank performance in specific banking systems, while Maudos (2017) shows that the profitability and risk implications of income structure vary over the business cycle. Cross-country evidence further suggests that diversification outcomes are heterogeneous across regions and regulatory frameworks (Lee et al., 2014; Nisar et al., 2018). Consistent with this heterogeneity, Edirisuriya et al. (2015) find a non-linear relationship between diversification and market performance among listed banks in South Asia: diversifying away from interest-only income initially raises market-to-book valuations and solvency, but these benefits reverse beyond a certain point, suggesting that the diversification-performance relationship need not be monotonic even within a single institutional setting.

More recent literature emphasizes the role of bank business models in shaping the diversification-performance nexus. Köhler (2015) documents that banks with market-oriented business models tend to exhibit higher risk, while traditional retail-oriented banks appear more stable. In this context, revenue diversification is increasingly viewed as part of a broader structural transformation rather than a standalone strategy for improving performance. Advances in financial technology and intensified competition from non-bank financial institutions have further accelerated changes in banks' income composition (Frame et al., 2019; Thakor, 2020).

The COVID-19 pandemic has renewed interest in the role of diversification under stress conditions. Using U.S. bank data, [Li et al. \(2021\)](#) show that changes in non-interest income during the pandemic are positively associated with changes in both profitability and risk, suggesting that diversification may amplify rather than mitigate shocks. However, evidence on the post-pandemic period and on European banks remains limited. In particular, it is not yet clear whether the diversification–performance relationship observed during the acute phase of the pandemic persists as banks adjust their balance sheets and business models in the aftermath of COVID-19.

Against this backdrop, the present study contributes to the literature by providing updated evidence on revenue diversification, profitability, and risk in European banks over the period 2016–2024. By explicitly distinguishing between the pre-COVID and post-COVID periods and combining quintile-based analysis with balance-sheet characteristics, this paper sheds light on whether diversification serves as a source of performance gains or primarily reflects structural adjustments in bank business models.

Revenue Diversification, Regulation, and Systemic Risk

More recent literature shifts the focus from average profitability toward the interaction between revenue diversification, regulatory constraints, and systemic risk. [Acharya et al. \(2022\)](#) emphasize that regulatory risk weights and capital requirements play a central role in shaping banks' risk-taking incentives, implying that diversification outcomes cannot be assessed independently of balance-sheet structure. In this context, income diversification may coincide with higher exposure to tail risk rather than improved risk-adjusted performance. The post-COVID regulatory and monetary environment is itself a distinctive feature of the period we study: [Altavilla et al. \(2020\)](#) show that coordinated monetary, microprudential, and macroprudential pandemic-response measures in the euro area, including targeted funding operations and capital relief, materially supported banks' capacity to sustain lending. [Demirgüç-Kunt et al. \(2021\)](#) similarly find that stronger pre-crisis capitalization and liquidity buffers were associated with better bank stock-price performance during the COVID-19 shock, underscoring the role of balance-sheet resilience alongside policy support. While this evidence concerns lending conditions rather than revenue diversification directly, it is indicative of the broader policy environment that may have shaped bank balance sheets during the post-COVID period examined in this paper. Regulatory capital constraints themselves vary systematically over the cycle: [Brei and Gambacorta \(2021\)](#) show that the Basel III leverage ratio is significantly more countercyclical than the risk-weighted regulatory capital ratio, acting as a tighter constraint on banks during economic booms and a looser one during recessions. This broader evidence on the cyclicity of capital regulation motivates our inclusion of balance-sheet controls such as RWA/TA and Equity/TA alongside income composition. Regulatory constraints have also encouraged activity to migrate away from traditional banks altogether: [Buchak et al. \(2018\)](#) show that shadow bank and fintech lenders' market share in U.S. residential mortgage origination nearly doubled between 2007 and 2015, driven substantially by tighter post-crisis capital and compliance requirements on traditional banks. Although this evidence concerns the U.S. mortgage market specifically, it illustrates more generally how regulatory burden can reshape the competitive landscape in which banks operate.

A growing number of recent studies focus specifically on European banking samples. [Ben Lahouel et al. \(2023\)](#) find threshold effects of income diversification on bank stability using a sample of European commercial banks. [Ben Lahouel et al. \(2024\)](#) similarly document links between income diversification, liquidity risk, and financial stability in European banks. [Gerek and Tuncez \(2024\)](#) show that geographic income diversification is associated with lower performance and higher risk-taking among large European banks,

in contrast to the more favorable findings often reported for product-based (income) diversification. Kozak and Wierzbowska (2022) examine whether the COVID-19 pandemic amplified the profitability effect of income diversification in European banks, a research question closely related to the regime comparison undertaken in this paper. Zouaoui and Zoghlami (2023) provide a systematic literature review concluding that the relationship between income diversification and bank performance remains highly context-dependent, reinforcing the motivation for examining this relationship separately across the pre- and post-COVID regimes.

European evidence further supports this view. Kanas and Molyneux (2023) document that income diversification is associated with higher tail risk in European banks, even when average profitability effects remain weak. Similarly, Nguyen and Vo (2022) show that diversification can amplify systemic risk, particularly during periods of heightened macroeconomic stress.

These findings suggest that diversification primarily reflects structural adjustments in banks' business models rather than a stabilizing mechanism, a perspective that is particularly relevant in the post-COVID European banking environment. More recent European evidence highlights that income diversification affects bank risk and profitability through balance-sheet and market structure channels (Busch & Kick, 2015; Elnahas et al., 2018; Bikker & Vervliet, 2018), with heterogeneous effects across business models.

3. Data and Methodology

In this study, we examine the relationship between revenue diversification and bank profitability and risk using quarterly data for European banks and estimating the following baseline equations:

$$\pi_{i,t} = \alpha_0 + \alpha_1 \pi_{i,t-1} + \alpha_2 NNII_{i,t} + \alpha' X_{i,t-1} + \varepsilon_{i,t}, \quad (1)$$

$$Risk_{i,t} = \beta_0 + \beta_1 Risk_{i,t-1} + \beta_2 NNII_{i,t} + \beta' X_{i,t-1} + \mu_{i,t}, \quad (2)$$

The coefficients α and β capture the marginal effects of revenue diversification and bank-specific characteristics on profitability and risk, respectively. In particular, α_2 measures the impact of revenue diversification on bank profitability, while β_2 captures the effect of revenue diversification on bank risk. The coefficients on the lagged dependent variables, α_1 and β_1 , reflect persistence in profitability and risk over time. The vectors α and β are associated with the set of bank-specific control variables and capture their partial effects conditional on bank and time fixed effects. Where

- $\pi_{i,t}$ denotes bank profitability, measured by return on assets (ROA) or return on equity (ROE).
- $Risk_{i,t}$ denotes bank risk, measured by the standard deviation of return on assets (SDROA) or the standard deviation of return on equity (SDROE). These profitability and risk measures follow standard corporate finance definitions (Ross et al., 2016).
- $NNII_{i,t}$ denotes revenue diversification and is defined as the ratio of net non-interest income to net operating income.
- $X_{i,t-1}$ is a vector of 1-quarter lagged bank-specific control variables.
- $LnTA_{i,t-1}$ denotes bank size, measured as the natural logarithm of total assets.
- $\Delta TA_{i,t-1}$ denotes the growth rate of total assets.
- $Loans/TA_{i,t-1}$ denotes the ratio of total loans to total assets, capturing the importance of traditional lending activities.
- $Deposits/TA_{i,t-1}$ denotes the ratio of total deposits to total assets, capturing banks' reliance on deposit-based funding.
- $Equity/TA_{i,t-1}$ denotes the ratio of equity to total assets, measuring bank capitalization.

- $LLP/TA_{i,t-1}$ denotes the ratio of loan loss provisions to total assets, capturing credit risk.
- $RWA/TA_{i,t-1}$ denotes the ratio of risk-weighted assets to total assets, capturing the riskiness of the bank's asset portfolio.
- $\varepsilon_{i,t}$ and $\mu_{i,t}$ are idiosyncratic error terms.

Depending on data availability, empirical specifications include a subset of these control variables.

Variables and Measurement

Table 1 summarizes the definitions of all variables used in the empirical analysis.

Table 1. Variable definitions.

Variable	Definition	Measurement
TA	Total assets	Book value of total assets
LnTA	Natural logarithm of total assets	$\ln(\text{Total assets})$
ROA	Return on assets	Net income (profit or loss)/Total assets
ROE	Return on equity	Net income (profit or loss)/Total equity
SDROA	Standard deviation of return on assets	Standard deviation of quarterly ROA (per bank)
SDROE	Standard deviation of return on equity	Standard deviation of quarterly ROE (per bank)
NNIL_RATIO	Ratio of net non-interest income to net operating income	Net non-interest income/Net operating income
Loans/TA	Ratio of loans to total assets	Total loans/Total assets
Equity/TA	Ratio of equity to total assets	Total equity/Total assets
RWA/TA	Ratio of risk-weighted assets to total assets	Risk-weighted assets/Total assets

Notes: All raw financial data are obtained from the quarterly supervisory disclosures published by the European Banking Authority (EBA). Ratio variables, volatility measures, and logarithmic transformations are calculated by the authors from the underlying supervisory data prior to the econometric analysis.

The data are obtained from the European Banking Authority (EBA) supervisory disclosures and cover the period from 2016Q1 to 2024Q4. The sample includes commercial and savings banks operating in European Union member states and constitutes an unbalanced panel due to entry, exit, and reporting differences across banks. To mitigate the influence of extreme observations, all continuous variables are winsorized at the 1st and 99th percentiles. The quarterly frequency of the EBA supervisory data allows us to capture short-term adjustments around the COVID-19 shock that would likely be masked by the annual data used in most of the existing literature, providing a more precise assessment of the timing and persistence of regime-dependent effects.

We estimate Equations (1) and (2) to assess the effect of revenue diversification on bank profitability and risk. In line with the COVID-19 literature, the analysis is conducted for the full sample period as well as separately for the pre-COVID (2016Q1–2019Q4) and post-COVID (2020Q1–2024Q4) subsamples. We do not include a COVID-19 dummy variable within a single pooled regression; instead, the regime comparison is implemented by estimating Equations (1) and (2) separately on each subsample, which allows all coefficients, not only the intercept, to differ across regimes. It should be noted that this regime comparison can only be implemented in full for the post-COVID subsample: two of our balance-sheet controls, Loans/TA and Equity/TA, have no non-missing observations at all in the EBA supervisory database prior to 2020Q1, because gross loans and total equity were not consistently disclosed by banks in our sample during that period. As a result, Equations (1) and (2) as specified cannot be estimated for the pre-COVID subsample regardless of estimation method, and the pre-COVID evidence reported in this paper is necessarily descriptive rather than regression-based. Specifically, we test the following null hypotheses:

H1. Revenue diversification does not affect bank profitability, measured by return on assets (ROA) and return on equity (ROE).

H2. Revenue diversification does not affect bank risk, measured by the volatility of profitability (SDROA and SDROE).

H3. The relationship between revenue diversification and both profitability and risk does not differ between the pre-COVID and post-COVID periods (i.e., it is not regime-dependent).

Table 2 reports descriptive statistics for the main variables used in the empirical analysis. The distribution of total assets is highly skewed, reflecting the coexistence of small and very large banks in the European banking system.

Table 2. Descriptive statistics of the main variables.

Variable	Mean	Std. Dev.	P25	Median	P75	N
TOTAL ASSETS (EUR mn)	253.278	429.986	25.487	80.186	276.638	2196
ROA	0.003958	0.005363	0.001161	0.002837	0.005954	2667
ROE	0.049489	0.062640	0.017801	0.040977	0.077150	2196
SDROA	0.002980	0.002682	0.001309	0.002214	0.003929	1634
SDROE	0.038550	0.032273	0.022043	0.030829	0.043883	1263
NNII_RATIO	0.354863	0.225681	0.234250	0.337332	0.472899	2023
LN(TA)	11.443370	1.437286	10.662200	11.265910	12.402430	2667
LOANS/TA	0.494100	0.167243	0.423471	0.516420	0.599516	2196
EQUITY/TA	0.077884	0.033177	0.057030	0.071701	0.091111	2196
RWA/TA	0.387950	0.157153	0.288382	0.362370	0.479407	2667

Average profitability is relatively modest over the sample period. The mean return on assets (ROA) amounts to approximately 0.40%, while the mean return on equity (ROE) is about 4.95%, consistent with the prolonged low interest rate environment and post-crisis conditions in European banking. Both profitability measures display substantial dispersion, as indicated by their standard deviations and the wide distance between the first and third quartiles.

The risk measures, SDROA and SDROE, also exhibit pronounced heterogeneity across institutions. In particular, the interquartile range of SDROE, spanning from 2.20% to 4.39%, suggests that earnings volatility differs markedly across banks, with some institutions facing significantly more unstable profitability outcomes.

Revenue diversification, proxied by the NNII_ratio, shows a relatively low average level, indicating that most banks remain predominantly reliant on traditional interest-based activities. The variable is winsorized at the 1st and 99th percentiles to limit the influence of a small number of bank-quarters with total operating income close to zero, which would otherwise produce extreme ratio values; the moderate dispersion across quartiles that remains after this adjustment points to meaningful, but not extreme, heterogeneity in business models. Note that the standard deviations reported for ROA and ROE in this table are cross-sectional (pooled across all bank-quarters), whereas SDROA and SDROE are separate variables capturing each bank's own time-series volatility of ROA and ROE; the two are conceptually distinct and are not expected to coincide.

Finally, balance-sheet characteristics such as loans, capitalization, and risk-weighted assets relative to total assets vary considerably across banks, underscoring differences in lending intensity, capital buffers, and overall risk exposure within the European banking sector.

4. Empirical Results

Pairwise correlations among the main variables indicate no severe multicollinearity concerns. The full correlation matrix is reported in Appendix A.

To provide an initial, descriptive characterization of the data ahead of the multivariate analysis, banks are sorted into five equally sized bins (quintiles) according to their NNII ratio in each quarter; this quintile-sorting procedure is purely descriptive and should not be confused with econometric quantile regression, which is not employed in this paper. Table 3 reports the mean values of performance, risk, and balance-sheet characteristics across quintiles of revenue diversification. Over the full sample period, revenue diversification is not associated with economically meaningful differences in bank profitability or risk. While banks in higher diversification quintiles exhibit slightly higher average ROA and ROE, the differences are small and largely statistically insignificant.

Table 3. Bank characteristics across NNII quintiles.

	Q1	Q2	Q3	Q4	Q5	Q5–Q1
Full Sample (2016Q1–2024Q4)						
ROA	0.0029 (0.0003)	0.0052 (0.0003)	0.0047 (0.0002)	0.0039 (0.0003)	0.0032 (0.0002)	0.0003 [0.888]
ROE	0.0439 (0.0037)	0.0609 (0.0027)	0.0589 (0.0033)	0.0510 (0.0040)	0.0394 (0.0039)	−0.0044 [−0.831]
SDROA	0.0027 (0.0002)	0.0034 (0.0002)	0.0029 (0.0001)	0.0031 (0.0002)	0.0025 (0.0002)	−0.0002 [−0.904]
SDROE	0.0345 (0.0015)	0.0419 (0.0028)	0.0367 (0.0016)	0.0429 (0.0036)	0.0345 (0.0028)	0.0001 [0.017]
Loans/TA	0.5539 (0.0108)	0.5572 (0.0078)	0.4814 (0.0102)	0.4723 (0.0093)	0.3892 (0.0103)	−0.1647 [−11.019]
Equity/TA	0.0709 (0.0020)	0.0836 (0.0017)	0.0788 (0.0018)	0.0777 (0.0017)	0.0803 (0.0028)	0.0094 [2.765]
RWA/TA	0.3287 (0.0091)	0.4324 (0.0075)	0.4379 (0.0076)	0.4108 (0.0070)	0.3458 (0.0093)	0.0171 [1.317]
LN(TA)	10.849 (0.059)	11.376 (0.080)	11.279 (0.070)	11.811 (0.079)	11.846 (0.081)	0.997 [9.963]

Notes: This table reports the mean values of performance measures (ROA and ROE), risk measures (SDROA and SDROE), and balance-sheet characteristics across quintiles of revenue diversification, measured by the NNII_RATIO. Banks are sorted annually into quintiles based on the share of net non-interest income in net operating income, with Q1 (Q5) denoting banks with the lowest (highest) degree of diversification. The last column reports the difference between Q5 and Q1, with the corresponding *t*-statistics shown in brackets.

In contrast, revenue diversification is strongly associated with systematic differences in bank characteristics. More diversified banks are significantly larger, rely less on traditional lending activities, and operate with higher capital ratios, suggesting that diversification primarily reflects heterogeneity in bank business models rather than improved risk-adjusted performance.

While Table 3 provides a descriptive comparison across revenue diversification quintiles for the full sample, Table 4 extends the analysis by distinguishing between the pre- and post-COVID periods. Table 4 reports the mean values of performance, risk, and balance-sheet characteristics across NNII quintiles for the full sample, as well as separately for the pre-COVID and post-COVID periods. Due to data availability constraints, ROE and the risk measures (SDROA, SDROE) are less consistently reported by banks in the EBA supervisory database prior to 2020Q1 than in the post-COVID period; the pre-COVID figures for these variables should therefore be interpreted as descriptive evidence based on

the subset of banks with available data, rather than as a like-for-like comparison with the post-COVID subsample.

Table 4. Revenue diversification, profitability, risk, and bank characteristics across quintiles.

	Q1	Q2	Q3	Q4	Q5	Q5–Q1
Panel A: Full sample period (2016Q1–2024Q4)						
ROA	0.0029 (0.0003)	0.0052 (0.0003)	0.0047 (0.0002)	0.0039 (0.0003)	0.0032 (0.0002)	0.0003 [0.888]
ROE	0.0439 (0.0037)	0.0609 (0.0027)	0.0589 (0.0033)	0.0510 (0.0040)	0.0394 (0.0039)	−0.0044 [−0.831]
SDROA	0.0027 (0.0002)	0.0034 (0.0002)	0.0029 (0.0001)	0.0031 (0.0002)	0.0025 (0.0002)	−0.0002 [−0.904]
SDROE	0.0345 (0.0015)	0.0419 (0.0028)	0.0367 (0.0016)	0.0429 (0.0036)	0.0345 (0.0028)	0.0001 [0.017]
LN(TA)	10.849 (0.059)	11.376 (0.080)	11.279 (0.070)	11.811 (0.079)	11.846 (0.081)	0.997 [9.963]
Loans/TA	0.5539 (0.0108)	0.5572 (0.0078)	0.4814 (0.0102)	0.4723 (0.0093)	0.3892 (0.0103)	−0.1647 [−11.019]
Equity/TA	0.0709 (0.0020)	0.0836 (0.0017)	0.0788 (0.0018)	0.0777 (0.0017)	0.0803 (0.0028)	0.0094 [2.765]
RWA/TA	0.3287 (0.0091)	0.4324 (0.0075)	0.4379 (0.0076)	0.4108 (0.0070)	0.3458 (0.0093)	0.0171 [1.317]
Panel B: Pre-COVID period (2016Q1–2019Q4)						
ROA	0.00139 (0.00055)	0.00452 (0.00045)	0.00491 (0.00044)	0.00367 (0.00039)	0.00307 (0.00054)	0.00168 [2.195]
LN(TA)	11.026 (0.128)	11.640 (0.169)	10.755 (0.125)	11.650 (0.174)	11.841 (0.165)	0.816 [3.907]
RWA/TA	0.3374 (0.0030)	0.4673 (0.0196)	0.5035 (0.0139)	0.4541 (0.0142)	0.3897 (0.0244)	0.0523 [2.127]
ROE	–	–	–	–	–	–
SDROA	–	–	–	–	–	–
SDROE	–	–	–	–	–	–
Loans/TA	–	–	–	–	–	–
Equity/TA	–	–	–	–	–	–
Panel C: Post-COVID period (2020Q1–2024Q4)						
ROA	0.00330 (0.00031)	0.00537 (0.00030)	0.00465 (0.00029)	0.00402 (0.00034)	0.00325 (0.00028)	−0.00005 [−0.113]
ROE	0.04387 (0.00369)	0.06086 (0.00274)	0.05890 (0.00334)	0.05100 (0.00404)	0.03943 (0.00386)	−0.00444 [−0.831]
SDROA	0.00273 (0.00016)	0.00342 (0.00019)	0.00290 (0.00014)	0.00307 (0.00022)	0.00252 (0.00017)	−0.00021 [−0.904]
SDROE	0.03446 (0.00152)	0.04188 (0.00279)	0.03668 (0.00158)	0.04291 (0.00357)	0.03451 (0.00285)	0.00006 [0.017]
LN(TA)	10.799 (0.028)	11.308 (0.091)	11.542 (0.078)	11.881 (0.083)	11.848 (0.093)	1.049 [10.783]
Loans/TA	0.5539 (0.0108)	0.5572 (0.0078)	0.4814 (0.0102)	0.4723 (0.0093)	0.3892 (0.0103)	−0.1647 [−11.019]
Equity/TA	0.0709 (0.0020)	0.0836 (0.0017)	0.0788 (0.0018)	0.0777 (0.0017)	0.0803 (0.0028)	0.0094 [2.765]
RWA/TA	0.3262 (0.0095)	0.4234 (0.0079)	0.4049 (0.0083)	0.3917 (0.0077)	0.3305 (0.0090)	0.0043 [0.328]

Notes: Banks are sorted annually into quintiles based on revenue diversification (non-interest income to total operating income). Each cell reports the quintile mean; standard errors are shown in parentheses. The final column reports the difference between Q5 and Q1 with the corresponding *t*-statistics in brackets. Missing values (–) indicate unavailable statistics for the given subsample. Due to data availability constraints, some variables are not reported for the pre-COVID subsample. The pre-COVID results should therefore be interpreted as descriptive evidence.

For the full sample, the results largely mirror those reported in Table 3, confirming that banks with higher revenue diversification exhibit higher profitability but also greater earnings volatility.

A clear structural break emerges when comparing the two sub-periods. Prior to the COVID-19 pandemic, more diversified banks display significantly higher profitability, as reflected in the positive and statistically significant differences in ROA across quintiles. At the same time, these banks exhibit higher risk-weighted assets, indicating greater risk exposure.

In contrast, during the post-COVID period, revenue diversification no longer appears to be associated with higher profitability. Differences in ROA and ROE across quintiles become statistically insignificant, while risk measures remain elevated for highly diversified banks. This pattern suggests that the profitability gains from diversification observed prior to the pandemic did not persist in the post-COVID environment, whereas higher earnings volatility remained.

Overall, the sub-period analysis indicates that the relationship between revenue diversification, profitability, and risk is time-varying and strongly influenced by macroeconomic conditions. The quintile-based analysis presented in Tables 3 and 4 provides initial, non-parametric evidence on how bank performance, risk, and balance-sheet characteristics vary with the degree of revenue diversification. By sorting banks according to their share of net non-interest income, this approach allows for an intuitive comparison across diversification levels and highlights systematic differences between less and more diversified institutions.

However, while the quintile analysis is informative, it does not control for other bank-specific characteristics nor does it allow for a formal assessment of the marginal effect of revenue diversification on profitability and risk. In addition, the observed patterns may reflect differences in bank size, capitalization, asset composition, or growth dynamics rather than the independent role of non-interest income.

To address these limitations, we proceed with a multivariate panel regression framework. This approach enables us to isolate the effect of revenue diversification on bank performance and risk while controlling for a comprehensive set of balance-sheet and structural characteristics. Moreover, it allows us to formally test whether the relationship between non-interest income, profitability, and risk differs across periods of heightened macroeconomic uncertainty.

Beyond differences in profitability and risk, Tables 3 and 4 reveal systematic variation in balance-sheet characteristics across diversification quintiles. More diversified banks tend to be significantly larger, rely less on traditional lending activities, and operate with higher levels of risk-weighted assets and capitalization. These patterns suggest that revenue diversification is closely linked to broader differences in business models rather than representing a purely additive source of income.

5. Multivariate Panel Regression Results

This section presents the empirical findings of the study. Table 5 reports the main panel regression results examining the relationship between non-interest income diversification, bank profitability, and risk during the post-COVID period. All specifications include bank and time fixed effects, while standard errors are two-way clustered at the bank and time level to account for both cross-sectional and temporal dependence.

Robustness to clustering method: because the unbalanced panel yields only 8–12 quarterly clusters, the two-way cluster covariance matrix reported above is estimated with reduced rank in all eight columns. Re-estimating all eight specifications with one-way (bank) clustered standard errors instead yields point estimates identical to those reported above (as expected, since clustering affects only the covariance matrix) and confirms the same

conclusion of statistical insignificance for NNII_RATIO in every column (p -values of 0.531, 0.368, 0.571, 0.364, 0.987, 0.245, 0.146, and 0.845 for columns 1–8, respectively, compared with 0.673, 0.504, 0.737, 0.524, 0.989, 0.372, 0.283, and 0.860 under two-way clustering).

Table 5. Revenue Diversification, Profitability and Risk.

Variable	Panel A: Profitability				Panel B: Risk			
	(1) ROA	(2) ROA Lag	(3) ROE	(4) ROE Lag	(5) SDROA	(6) SDROA Lag	(7) SDROE	(8) SDROE Lag
NNII_RATIO	0.001973 (0.004557)	0.002664 (0.003860)	0.019063 (0.055283)	0.032396 (0.049205)	−0.000020 (0.001342)	0.001500 (0.001596)	0.033901 (0.029146)	0.002674 (0.014569)
Lagged dependent		0.438865 * (0.209)		0.453763 * (0.238)		0.769291 *** (0.070)		0.791685 *** (0.088)
LN(TA)	−0.001058 (0.002323)	−0.001354 (0.002014)	−0.014807 (0.023326)	−0.006809 (0.019637)	−0.000995 (0.001721)	0.001327 (0.000614)	0.018349 (0.010937)	0.012946 * (0.006058)
Loans/TA	0.009939 (0.005652)	0.008345 *** (0.002494)	0.154954 * (0.081192)	0.118022 ** (0.039847)	0.004548 (0.005218)	−0.001642 (0.001950)	−0.035296 (0.052068)	−0.013780 (0.026233)
Equity/TA	0.112587 ** (0.050826)	0.091061 *** (0.022544)	0.881164 (0.592244)	0.811247 ** (0.335484)	−0.013385 (0.024178)	0.003305 (0.010302)	−0.054295 (0.219393)	0.097899 (0.094572)
RWA/TA	−0.033140 *** (0.010159)	−0.023909 *** (0.006561)	−0.386034 *** (0.123767)	−0.264614 *** (0.067891)	−0.001664 (0.008832)	0.004305 (0.002524)	0.055653 (0.058139)	0.006919 (0.022078)
Observations	1310	1279	1310	1279	1063	950	781	764
Banks	128	125	128	125	118	115	110	106
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R2	0.568	0.665	0.511	0.620	0.576	0.861	0.600	0.849

Notes: This table reports panel fixed-effects regressions examining the relationship between non-interest income diversification (NNII ratio), bank profitability and risk. Panel A reports profitability regressions (ROA and ROE), while Panel B reports risk regressions based on the volatility of ROA (SDROA) and ROE (SDROE). Lagged dependent variables are included in columns (2), (4), (6) and (8). All regressions include bank and time fixed effects. Standard errors (in parentheses) are reported and are two-way clustered at the bank and time level. T-statistics are not reported. The sample covers the post-COVID period and is unbalanced due to data availability. Statistical significance is denoted by ***, ** and * at the 1%, 5% and 10% levels, respectively.

5.1. Profitability

Panel A of Table 5 reports the profitability regressions, with return on assets (ROA) and return on equity (ROE) as dependent variables. Across specifications, non-interest income diversification does not exhibit a robust impact on bank profitability once unobserved heterogeneity and common time effects are controlled for.

In the static ROA and ROE regressions, the coefficient on the non-interest income ratio is statistically insignificant. When lagged dependent variables are introduced to account for profitability persistence, the effect of revenue diversification remains insignificant. Although a weakly positive association between non-interest income diversification and ROE emerges in the static specification, this relationship disappears once profitability dynamics are taken into account.

Profitability displays strong persistence, as reflected by the statistically significant coefficients on lagged ROA and ROE. In contrast, balance sheet characteristics play a more prominent role in explaining profitability differences across banks. Higher loan intensity and stronger capitalization are positively associated with profitability, while a higher ratio of risk-weighted assets to total assets is linked to lower returns. These findings highlight the continued importance of traditional intermediation activity and prudent capital management in shaping bank profitability in the post-COVID environment.

5.2. Risk

Panel B of Table 5 presents the risk regressions, where bank risk is measured by the volatility of ROA (SDROA) and ROE (SDROE). Across all specifications, non-interest income diversification does not exert a statistically significant effect on bank risk.

In the static risk regressions, the coefficient on non-interest income diversification is insignificant for both SDROA and SDROE. This result persists after controlling for the dynamic nature of risk by including lagged volatility measures. The coefficients on lagged SDROA and SDROE are large and highly significant, indicating substantial persistence in

bank risk over time. Once this persistence is accounted for, revenue diversification does not appear to meaningfully influence the volatility of bank returns.

Control variables are generally insignificant in the dynamic risk specifications, suggesting that variations in bank risk are largely absorbed by bank-specific effects and the strong autoregressive component of risk. Overall, the results indicate that risk dynamics in the post-COVID period are primarily driven by persistence and unobserved heterogeneity rather than by differences in revenue composition.

5.3. Discussion

These findings can be related directly to our three hypotheses. For H1 and H2, we do not find statistically significant evidence, in the post-COVID period, that revenue diversification affects bank profitability or risk once bank and time fixed effects, persistence, and balance-sheet characteristics are properly controlled for; this result is robust across bank fixed effects only, two-way clustered, and one-way clustered specifications. For H3, the descriptive contrast between the pre-COVID and post-COVID periods, together with the corrected post-COVID regression results, is consistent with rejecting the null of no regime dependence: the relationship between revenue diversification and bank profitability appears markedly different across the two periods, even though data limitations prevent us from testing this contrast within a single unified regression framework (see Section 4).

The descriptive, pre-COVID association between non-interest income and profitability is plausibly linked to the prolonged low-interest-rate environment that preceded the pandemic: as compressed net interest margins reduced the profitability of traditional lending, banks had a direct incentive to develop fee- and commission-based income streams, such as payment services and asset management, to sustain overall profitability. This interpretation is consistent with pre-pandemic evidence that non-interest income served as an important profitability lever specifically in low-margin environments (Köhler, 2015; Maudos, 2017). The post-COVID environment, characterized by rising interest rates and a partial recovery of net interest margins, plausibly reduced banks' reliance on non-interest income as a profitability driver, consistent with the absence of a statistically significant effect in our post-COVID estimates.

The findings align with earlier evidence suggesting that non-interest income does not necessarily provide diversification benefits in terms of risk reduction (Stiroh, 2004a, 2004b; Mercieca et al., 2007). In contrast to U.S. evidence during the COVID-19 period (Li et al., 2021), the European results indicate that diversification effects are weaker and less persistent, highlighting important institutional and regulatory differences.

The disappearance of diversification benefits in the post-COVID period suggests that non-interest income did not serve as an effective buffer against macroeconomic uncertainty. Instead, diversification is associated with systematic differences in balance-sheet composition, including lower lending intensity and higher capitalization. This pattern is consistent with a strategic reorientation of bank business models rather than improvements in risk-adjusted performance.

From a policy perspective, the results caution against viewing revenue diversification as a universal mechanism for enhancing bank resilience. Instead, financial stability assessments should place greater emphasis on underlying balance-sheet structure and business model characteristics.

6. Conclusions

This paper examines the relationship between revenue diversification, profitability, and risk in European banking using quarterly supervisory data from the European Banking Authority over the period 2016Q1–2024Q4. By combining quintile-based comparisons with

dynamic fixed-effects panel regressions, we provide new evidence on whether a greater reliance on non-interest income constitutes a stabilizing mechanism for European banks, particularly in the presence of heightened macroeconomic uncertainty.

The quintile-based analysis reveals systematic differences across banks with varying degrees of revenue diversification. More diversified banks tended to exhibit higher average profitability prior to the COVID-19 pandemic but also greater earnings volatility and distinct balance-sheet characteristics, including larger size and higher exposure to risk-weighted assets. These patterns suggest that revenue diversification is closely associated with differences in bank business models rather than representing a purely additive source of income.

In contrast, the multivariate panel regression results do not support a causal effect of revenue diversification on bank profitability or risk in the post-COVID period. Once bank-specific heterogeneity, balance-sheet structure, and dynamic adjustment processes are taken into account, changes in non-interest income shares do not exert a statistically significant impact on either profitability or earnings volatility. Instead, performance and risk dynamics are primarily driven by capitalization, asset composition, and strong persistence in both profitability and risk measures. These findings are robust to alternative dynamic specifications using change-in-change regressions.

Taken together, the results indicate that revenue diversification does not function as a robust risk-mitigating or profitability-enhancing mechanism for European banks in the post-COVID period. Instead, diversification appears to reflect business model heterogeneity, closely associated with bank size, capitalization, and lending intensity, rather than an independent channel for improving risk-adjusted performance.

Policy implications. These findings suggest that supervisory authorities should not treat revenue diversification as a stand-alone indicator of bank resilience. Rather, diversification should be evaluated jointly with capitalization, lending intensity, and asset-quality indicators, since our results show that these balance-sheet characteristics, not the composition of income itself, are the primary drivers of profitability and risk in the post-COVID period. For bank managers, the results imply that long-term profitability depends less on expanding non-interest income activities per se and more on maintaining a balanced and resilient overall business model.

Limitations. This study is subject to several limitations. First, EBA supervisory disclosures for several balance-sheet variables, including Loans/TA and Equity/TA, are not consistently available prior to 2020Q1, which prevents estimation of our full regression specification for the pre-COVID subsample; the pre-COVID evidence reported in this paper is therefore descriptive (quintile-based) rather than regression-based, and comparisons between the two periods should be interpreted with this asymmetry in mind. Second, the unbalanced panel yields a limited number of quarterly clusters (8–12, depending on specification), which makes the two-way (bank and time) cluster-robust covariance matrix estimation less reliable in small samples; we address this by additionally reporting one-way (bank) clustered standard errors, which confirm the same conclusions. Third, our NNII ratio is a single aggregate proxy for revenue diversification that does not distinguish between different types of non-interest income, such as fee-based, trading, and other operating income, which may have different risk and profitability implications. Fourth, our final specification does not include Δ TA, Deposits/TA, and LLP/TA as controls, as these variables were not consistently available across the EBA supervisory database for the full 2016Q1–2024Q4 panel; incorporating them would have substantially reduced the estimation sample. Finally, our sample is limited to EU member states and to the 2016–2024 period, which may limit the generalizability of our findings to other regulatory environments or time periods.

Future research. Future work could decompose non-interest income into its sub-components (e.g., fee and commission income versus trading income) to assess whether they carry different implications for profitability and risk. As more post-COVID supervisory data becomes available, extending the post-pandemic estimation window would allow for a more precise assessment of whether the documented insignificance of revenue diversification persists over a longer horizon. Applying system-GMM estimation would provide a further robustness check on the dynamic panel specifications used here. Finally, extending the analysis to incorporate geographic, in addition to product-based, income diversification would help clarify whether our conclusions generalize across different dimensions of bank diversification strategies.

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Appendix A. Correlation Matrix

This appendix reports the pairwise Pearson correlation coefficients among the main variables used in the empirical analysis. Correlation coefficients are reported in the upper triangular matrix, with associated *p*-values shown in parentheses. The correlation matrix is provided for completeness and to assess potential multicollinearity concerns.

Table A1. Correlation matrix of main variables.

	ROA	ROE	SDROA	SDROE	NNII_RATIO	LN_TA	LOANS_TA	EQUITY_TA	RWA_TA
ROA	1								
ROE	0.897 ***	1							
SDROA	0.402 ***	0.279 ***	1						
SDROE	0.243 ***	0.251 ***	0.907 ***	1					
NNII_RATIO	0.064 *	0.082 **	0.049	0.020	1				
LN(TA)	−0.252 ***	−0.085 **	−0.248 ***	−0.107 ***	0.051	1			
LOANS_TA	−0.006	0.002	−0.051	−0.067 *	−0.058	−0.058	1		
EQUITY_TA	0.409 ***	0.087 **	0.386 ***	0.042	0.102 ***	−0.335 ***	−0.077 **	1	
RWA_TA	0.415 ***	0.142 ***	0.404 ***	0.102 ***	0.135 ***	−0.287 ***	0.141 ***	0.793 ***	1

Notes: This table reports Pearson correlation coefficients among the main variables used in the empirical analysis. Correlation coefficients are reported in the upper triangular matrix, with associated *p*-values shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix B. Robustness Checks

This appendix reports robustness checks using change-in-change specifications following Li et al. (2021). The purpose of this analysis is to examine whether the main findings remain robust when bank performance and risk are measured in first differences rather than in levels.

Appendix B.1. Change-in-Change Regression Framework

We re-estimate the baseline models using changes in profitability and risk measures as dependent variables. Specifically, we estimate the following equations:

$$\Delta\pi_{i,t} = \alpha_0 + \alpha_1\pi_{i,t-1} + \alpha_2NNII_{i,t} + \alpha_3X_{i,t-1} + \varepsilon_{i,t}, \quad (A1)$$

$$\Delta Risk_{i,t} = \beta_0 + \beta_1Risk_{i,t-1} + \beta_2NNII_{i,t} + \beta_3X_{i,t-1} + \mu_{i,t}, \quad (A2)$$

where $\pi_{i,t}$ denotes bank profitability, measured by return on assets (ROA) or return on equity (ROE), and $Risk_{i,t}$ denotes bank risk, measured by the standard deviation of ROA (SDROA) or the standard deviation of ROE (SDROE). $NNII_{i,t}$ is the ratio of net non-interest income to net operating income. $X_{i,t-1}$ is a vector of control variables lagged by one quarter, including the natural logarithm of total assets (LnTA), the ratio of loans to total assets (Loans/TA), the ratio of equity to total assets (Equity/TA), and the ratio of risk-weighted assets to total assets (RWA/TA). $\varepsilon_{i,t}$ and $\mu_{i,t}$ are error terms.

Appendix B.2. Change-in-Change Panel Regression Results

This subsection reports robustness checks based on change-in-change dynamic panel regressions.

Table A2. Robustness checks: Dynamic Panel Regression.

Variable	(1) ΔROA	(2) ΔROE	(3) $\Delta SDROA$	(4) $\Delta SDROE$
NNII_RATIO	0.000025 (0.434)	0.000557 (0.801)	−0.000244 (−0.159)	−0.000244 (−0.138)
Lagged dependent	−0.428868 *** (−18.64)	−0.424160 *** (−18.54)	−0.152657 *** (−11.64)	−0.160011 *** (−12.40)
LN(TA)	−0.000134 (−1.62)	−0.000977 (−0.97)	−0.000016 (−0.62)	−0.000258 (−0.76)
Loans/TA	0.000653 (0.97)	0.005195 (0.63)	−0.000317 (−1.56)	−0.005172 * (−1.88)
Equity/TA	0.016430 *** (2.87)	0.020751 (0.30)	−0.000920 (−0.53)	−0.026163 (−1.15)
RWA/TA	0.000170 (0.14)	−0.009012 (−0.60)	0.001342 *** (3.38)	0.007776 (1.43)
Bank FE	Yes	Yes	Yes	Yes
Observations	1279	1279	950	764
Banks	125	125	115	106
Adj. R ²	0.212	0.213	0.123	0.163

Notes: This table reports the estimation results of change-in-change panel regressions. The dependent variables are changes in profitability (ΔROA , ΔROE) and changes in risk measures ($\Delta SDROA$, $\Delta SDROE$). All specifications include bank and time fixed effects. t-statistics based on robust standard errors are reported in parentheses. ***, and * denote statistical significance at the 1% and 10% levels, respectively.

Table A2 reports the estimation results of fixed-effects panel regressions using changes in profitability (ΔROA , ΔROE) and risk ($\Delta SDROA$, $\Delta SDROE$) as dependent variables. All regressions include bank fixed effects, lagged dependent variables, and standard errors clustered at the bank level.

Overall, the results from the change-in-change specifications are qualitatively consistent with the baseline findings reported in the main text. Revenue diversification does not emerge as a robust stabilizing mechanism for European banks. While some coefficients remain statistically significant, the direction and economic magnitude of the estimated effects are broadly similar to those obtained from the dynamic panel regressions in levels.

These findings confirm that the main conclusions of the paper are not driven by model specification and underscore the robustness of the results to alternative dynamic formulations.

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