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The Use of Derivatives and the Systematic Risk of European Banks

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Abstract

This dissertation studies whether European banks' use of interest-rate (IR) and foreign exchange (FX) derivatives is associated with their systematic market risk. Using weekly stock returns for 28 listed Euro-area banks from 2013-2023, I estimate time-varying IR and FX betas in rolling 104-week windows and assign each estimate to the calendar year of its window end, yielding a bank-year panel of annual betas. I then relate these exposures to bank characteristics and to the intensity and purpose of derivative use, distinguishing trading from hedging, within a panel framework with bank and year fixed effects and inverse-precision weights of the first-stage estimators. Data on notionals (scaled by assets) come from BankFocus and hand-collected hedge disclosures in IFRS notes; prices and yields are from Refinitiv and the ECB's NEER series.

Results show that, within banks over time, greater trading derivatives intensity is associated with higher IR and FX betas, whereas hedging notional effects are small and statistically indistinguishable from zero at observed scales; effect sizes are economically modest at realistic changes in intensity. Better capitalization (higher Tier 1 ratios) coincides with lower FX beta, while equity-to-assets co-move positively with IR beta.

I interpret these findings as consistent with a post-crisis, matched-book intermediation model under FRTB/EMIR and margining, where very large gross notionals coexist with limited net factor exposures at the annual beta horizon. The study contributes updated Euro-area evidence spanning the modern policy era and the 2022-2023 rate shock and ties exposure dynamics to the purpose of derivative usage.

Keywords: Derivatives Usage; Euro-Area Banks; Trading vs Hedging; Interest-Rate Exposure; FX Exposure

JEL-Codes : G21, G32, C23, C58

Resumo

Esta dissertação analisa se a utilização de derivados de taxa de juro (IR) e de câmbio (FX) por parte dos bancos europeus está associada ao respetivo risco sistemático de mercado. Com base em rendibilidades semanais das ações de 28 bancos cotados da área do euro entre 2013 e 2023, estimo betas de IR e FX variáveis no tempo através de janelas móveis de 104 semanas, atribuindo cada estimativa ao ano civil correspondente ao final da janela, obtendo assim um painel banco-ano de betas anuais. Relaciono depois estas exposições com características bancárias e com a intensidade e finalidade do uso de derivados , distinguindo entre negociação (trading) e cobertura (hedging) , num enquadramento de painel com efeitos fixos de banco e de ano e ponderações inversamente proporcionais à variância dos estimadores de primeira fase. Os dados sobre montantes nocionais (escalados pelo total dos ativos do banco) provêm do BankFocus e de divulgações de cobertura recolhidas manualmente nas notas IFRS; preços e taxas de juro são obtidos no Refinitiv e na série NEER do BCE.

Os resultados evidenciam que, ao longo do tempo, uma maior intensidade no uso de derivados para negociação está associada a betas de IR e FX mais elevados, enquanto os efeitos dos notionals de cobertura são reduzidos e estatisticamente indistintos de zero nas escalas observadas; as magnitudes dos efeitos são economicamente modestas para variações realistas na intensidade. Uma melhor capitalização (maiores rácios Tier 1) coincide com betas de FX mais baixos, enquanto a razão capital próprio/ativos se relaciona positivamente com o beta de IR.

Interpreto estes resultados como consistentes com um modelo de intermediação pós-crise baseado em matched-book, sob os regimes FRTB/EMIR e de exigências de margens, em que volumes brutos muito elevados coexistem com exposições líquidas reduzidas ao horizonte anual dos betas. O estudo contribui com evidência atualizada para a área do euro, abrangendo a era de nova regulação e o choque de taxas de juro de 2022-2023, e relaciona a dinâmica das exposições com a finalidade da utilização de derivados.

Palavras-chave: Uso de Derivados; Bancos da Área Euro; Negociação vs Cobertura; Exposição a Taxa de Juro; Exposição Cambial

JEL-Codes : G21, G32, C23, C58

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1. Introduction

Banks are central intermediaries in interest-rate (IR) and foreign-exchange (FX) risk. They take deposits, extend loans, make markets for clients, and manage trading books that can transmit macro-financial shocks to equity valuations. Classic work shows that bank stock returns embed exposures to the level of rates and to exchange rates, despite asset-liability management that often mutes the average interest-rate sensitivity (Choi & Elyasiani, 1997; Flannery & James, 1984). Later cross-country studies confirm high market betas alongside heterogeneous rate and currency loadings, reflecting business-model and balance-sheet differences (Au Yong et al., 2009; Reichert & Shyu, 2003). Whether observed derivatives usage is associated with banks' systematic IR/FX exposure, and by how much in today's regime, remains an empirical question with direct implications for risk management and supervision.

This dissertation examines that question for a recent European setting. Using weekly simple returns for a panel of 28 listed Euro-area banks from 2013-2023, I estimate time-varying IR and FX betas in a first stage and relate them in a second stage to the scale and purpose of derivative use, separating trading from hedging, together with bank characteristics. The IR factor is the weekly return on a synthetic 10-year zero-coupon price derived from the home-country yield (a duration-like shock), while the FX factor is the weekly percentage change in the ECB's nominal effective exchange rate (EER-41). Yearly betas are obtained from 104-week rolling OLS and then modeled within-bank over time as a function of derivative intensity (gross notional/total assets) for trading and for hedge accounting designations, plus standard controls (size, liquidity, income diversification, Tier 1 capital, NPLs, equity ratio, profitability). Prices and yields come from Refinitiv and the ECB; accounting and derivative notionals come from BankFocus and banks' financial statements.

The empirical strategy is designed to identify within-bank relationship between derivatives usage and systematic exposure while absorbing time-invariant bank traits (with fixed effects) and common shocks (with time effects). This approach follows the literature (Chang et al., 2018; Li & Marinč, 2014; Reichert & Shyu, 2003), but it is tailored to a post-2013 European context where regulation emphasizes risk-sensitive measurement and where many economic hedges may not be formally designated under IFRS 9 (IFRS Foundation, 2014; Minton et al., 2009).

The findings previewed are threefold. First, bank equities load strongly on the market factor; IR betas average near zero but display wide dispersion, and FX betas are economically meaningful and heterogeneous, consistent with maturity-gap logic and prior multi-country evidence (Au Yong et al., 2009; Flannery & James, 1984; Hoffmann et al., 2019). Second, trading-derivatives intensity is positively associated with both IR and FX betas within banks, whereas hedging notionals are small and statistically indistinguishable from zero at observed scales; this aligns with the idea that market-making transmits factor shocks at the margin, while designated hedge programs are too small or too targeted to move weekly betas (Li & Marinč, 2014; Chang et al., 2018; Minton et al., 2009). Third, the economic magnitudes of trading derivative usages are modest, which is likely correlated with a matched-book intermediation model and with post-crisis rules (FRTB, SA-CCR, EMIR[1], bilateral margin) that reward rapid offsets and constrain one-sided risk (BCBS, 2019; European Union, 2019; BCBS-IOSCO, 2020; European Union, 2012).

This study contributes in four ways. First, it provides updated Euro-area evidence spanning the unconventional-policy era and the 2022-2023 rate shock, documenting how exposures behave across regimes. Second, it distinguishes trading from hedging derivatives using public disclosures, connecting the purpose of usage to systematic exposure rather than treating derivatives as a single aggregate (cf. Choi & Elyasiani, 1997; Au Yong et al., 2009). Third, it focuses on within-bank variation with fixed effects and robust errors, reducing bias from time-invariant heterogeneity. Fourth, it frames results against the post-crisis regulatory architecture, clarifying why effect sizes should be expected to be statistically detectable but economically limited when risk is managed to DV01/delta [2]rather than to gross notional (BCBS, 2019; European Union, 2019; BCBS-IOSCO, 2020). The implications are practical: risk managers should monitor exposure-based limits and rolling betas alongside internal greeks, and supervisors should privilege risk-sensitive disclosures over aggregate notional totals when assessing market-risk transmission (Adrian & Brunnermeier, 2016; Mayordomo, Rodriguez-Moreno, & Peña, 2014).

The remainder of the dissertation proceeds as follows. Section 2 reviews the related literature on bank exposures, derivatives usage, and the regulatory environment. Section 3 describes the data and variable construction. Section 4 presents the empirical design and results, including robustness and interpretation. Section 5 concludes with implications for risk management and policy, limitations, and directions for future research.

[1] FRTB – Fundamental Review of the Trading Book; SA-CCR – Standardized Approach for Counterparty Credit Risk; EMIR – European Market Infrastructure Regulation.
[2] DV01 (Dollar Value of 1 basis point, also called PV01/BPV) – change in value for a 1 bp move in yield; Δ (Delta) – sensitivity of a derivative's price to changes in the underlying asset.

2. Literature Review

Over the past two decades, banks have leaned heavily on interest-rate and foreign-exchange derivatives both to hedge balance-sheet exposures and to generate non-interest income. The literature first lays out the theoretical motives for using swaps, forwards, options, and other OTC contracts, showing how they can stabilize net interest margins, manage funding costs, and create trading revenues under shifting regulatory capital rules. It then reviews the main tools for measuring systematic market risk - Value-at-Risk and Expected Shortfall frameworks, factor-beta sensitivities, z-scores, and systemic-risk indicators like CoVaR and SRISK - and explains how these metrics relate to derivative strategies. Empirical studies are next surveyed to assess when and how derivatives have lowered or amplified banks' risk exposures across regions and crises. Finally, the review examines the bank-level, market-level, and regulatory drivers that determine who uses derivatives, how much they use, and with what effect on their risk profile.

2.1 Theoretical Foundations of Banks' Derivative Usage

The European Union's derivatives market has expanded significantly in recent years, with outstanding notional amounts growing by 29% to €314 trillion from 2020 to 2022, driven by a 26% increase in interest-rate derivatives and a 41% rise in currency derivatives (ESMA, 2023b). Interest-rate derivatives account for approximately 78% of notional exposure, while currency instruments represent 14%, underscoring the centrality of these markets for bank risk management and trading activities (ESMA, 2023b). This scale of activity highlights the importance of understanding how the intensity of derivative usage influences banks' market risk profiles.

Banks employ derivatives to address two principal objectives: the pursuit of revenue through trading activities and the management of risk exposures. Derivatives trading serves as a significant source of non-interest income. By acting as intermediaries in over-the-counter markets, banks quote bid-ask spreads, facilitate client transactions, and assume proprietary positions that capitalize on expected movements in interest rates (IR) and exchange rates (FX) (Li & Marinč, 2014; Rampini & Viswanathan, 2010). In many large institutions, trading volumes substantially exceed hedging volumes, reflecting the profitability of market-making operations and directional speculation (Bazih & Vanwalleghem, 2021).

Simultaneously, interest-rate swaps, forward-rate agreements, and currency forwards enable banks to align the interest-rate and currency characteristics of assets and liabilities, thereby stabilizing net interest margins and reducing the likelihood of financial distress (Flannery & James, 1984; Froot et al., 1993). Through hedging, banks can lock in future rates and smooth cash flows, which decreases borrowing costs and enhances funding flexibility. Empirical evidence suggests that greater hedging intensity is linked to lower volatility in earnings and improved credit metrics (Purnanandam, 2007; Titova et al., 2020).

Regulatory frameworks shape banks' derivative strategies by differentiating between hedging and trading exposures. Under Basel III, derivatives employed for hedging purposes may qualify for reduced risk-weight treatment, whereas positions held in the trading book attract higher capital charges under market risk capital requirements. Consequently, banks must carefully document their hedging intentions and demonstrate compliance with standards to optimize capital efficiency.

Beyond the direct effects on risk management and revenue generation, theoretical models highlight potential incentive distortions. Duffee and Zhou (2001) argue that credit-default swaps, while lowering insolvency costs, can diminish banks' incentives to monitor borrower credit quality, creating moral-hazard concerns. Instefjord (2005) further shows that access to deep and liquid derivative markets may encourage speculative behavior when the expected returns justify the hedging costs, and speculative positions can emerge even under the guise of hedging (Li & Yu, 2010). Minton et al. (2009) show that by 2005 only about 6 % of large U.S. bank holding companies purchased credit-default swaps for loan hedging, and under 2% of notional was genuine hedging, suggesting moral-hazard and accounting constraints severely limit banks' use of CDS for risk transfer. These insights show the importance of governance and oversight in ensuring that derivative usage does not inadvertently amplify risk-taking.

Beyond these economic incentives, accounting standards also shape banks' derivative usage. Under IFRS 9, which became mandatory for annual periods beginning on or after 1 January 2018, the introduction of a dedicated hedge accounting chapter permits entities to align the accounting treatment of hedging instruments with their risk-management objectives (IFRS Foundation, 2014). To qualify, a bank must formally document its hedging relationship and demonstrate hedge effectiveness, enabling changes in the fair value of designated hedging instruments to be recognized in profit or loss in sync with the hedged item. This alignment reduces earnings volatility attributable to timing mismatches and provides an additional incentive for banks to undertake genuine risk-mitigating derivative transactions.

2.2 Defining Systematic Risk and Alternative Risk Metrics

In practice, banks' undiversifiable market risk, often referred to as systematic risk , is managed under the Basel capital framework rather than treated as a standalone category. Basel II's market risk amendment occurred in 1996 and the post-crisis Basel 2.5 enhancements (BIS, 2009) define market risk as potential losses from adverse movements in interest rates, equity prices, foreign exchange rates, commodity prices, and credit spreads. Banks can choose to adopt a standard approach, applying fixed risk weights to broad position buckets, or an internal model's approach (IMA) based on a 10-day, 99% Value-at-Risk (VaR) calculation with rigorous backtesting and profit-and-loss attribution (Basel Committee on Banking, 2009). Subsequent revisions introduced Stressed VaR and, under the Fundamental Review of the Trading Book (FRTB) effective January 2019, a 97.5% Expected Shortfall (ES) framework and more risk-sensitive standardized measures (Basel Committee on Banking, 2019); Reichert and Shyu (2003) illustrate how VaR techniques can incorporate derivatives by simulating yield-curve shifts and currency shocks to assess potential losses in swap portfolios.

Despite the regulatory emphasis on VaR and ES, academic studies frequently employ beta-based proxies to isolate the systematic component of market risk. Choi and Elyasiani (1997) and Reichert and Shyu (2003) estimate IR-β and FX-β through time-series regressions of bank equity returns on interest-rate and currency factors. Building on this foundation, Li and Marinč (2014) extend the analysis to credit risk by incorporating credit betas, demonstrating that sensitivities to interest-rate, FX, and credit factors jointly shape banks' derivative strategies.

In addition to market-risk measures like VaR, ES, and beta estimates, the literature recognizes that derivative usage also correlates with broader bank vulnerabilities. For example, the z-score, calculated as the sum of return on assets and the equity-to-assets ratio divided by the standard deviation of ROA, captures a bank's distance to default by combining profitability and capital volatility, highlighting resilience to both idiosyncratic and market shocks (Ghosh, 2017; Li & Yu, 2010). Many banks gauge short-term earnings risk using the income-gap, which multiplies the net cash-flow difference between assets and liabilities repricing within one year by an assumed rate change. A positive gap (more short-term assets) means income rises when rates increase, and vice versa (Drechsler et al., 2021; Flannery & James, 1984).

Systemic-risk indicators such as CoVaR and SRISK extend this analysis by quantifying a bank's potential to transmit distress to the financial system under adverse scenarios, often incorporating derivatives exposures in their models (Adrian & Brunnermeier, 2016; Mayordomo et al., 2014).

Regulatory and internal stress tests further complement these metrics by simulating parallel yield-curve shifts, currency devaluations, or credit-spread widenings to estimate potential losses on derivatives portfolios, thereby capturing nonlinear and option-like risks. Additionally, derivative programs can affect credit risk - as banks use credit-default swaps to hedge borrower defaults (Hirtle, 2009) - and liquidity risk, since short-dated derivatives help manage funding mismatches and meet liquidity requirements during market stress (Purnanandam, 2007). Derivative activities also introduce operational and legal risks, including settlement failures and documentation disputes, underscoring the need for robust governance frameworks (Basel Committee on Banking, 2013).

2.3 Empirical Evidence on Derivative Usage and Systematic Risk

Early contributions establish a participation effect by comparing banks that do and do not use derivatives. Sinkey and Carter (2000) show that adopters exhibit larger maturity mismatches, measured via on- and off-balance-sheet interest-rate gaps, even before they develop full hedging programs, implying that mere entry into derivatives markets introduces new systematic exposures. Purnanandam (2007) extends this to a panel of nearly 8,000 U.S. banks and finds that, although initial derivatives participation coincides with higher baseline interest-rate risk, institutions under liquidity or default stress subsequently ramp up hedging notional and narrow their gaps, suggesting a reactive rather than proactive reduction in systematic exposures.

Building on this, a series of intensity-based studies link changes in instrument volumes to shifts in measured betas. Choi and Elyasiani (1997) examine 59 large U.S. banks from 1975-1992 and report that heavier interest-rate swap usage lowers a bank's interest-rate beta, while greater currency-forward volumes similarly reduce its foreign-exchange beta. Reichert and Shyu (2003) confirm these hedging benefits in U.S., European, and Japanese dealer banks, finding that interest-rate and currency swaps generally dampen both rate and exchange-rate betas, whereas options, more often used for speculative trading, tend to raise those systematic exposures.

Yang et al. (2006) analyze Korean banks under GAAP No. 70 and find that higher notional derivatives volumes are negatively associated with both ex-post equity betas (marginally significant) and ex-ante earnings-forecast dispersion, evidence that, on average, market participants view banks' derivative activity as genuine risk-management rather than mere speculation. Au Yong et al. (2009) bring an Asia-Pacific perspective by estimating long-term and short-term interest-rate betas for 110 banks in 2002-2003. They document that total derivative activity is positively associated with long-term interest-rate beta but negatively with short-term beta, with no significant effect on foreign-exchange beta. This split suggests that Asia-Pacific banks use derivatives both to take longer-horizon rate positions and to hedge short-term funding mismatches.

Stulz (2010) shows that U.S. banks active in the CDS market bear higher credit-market betas, highlighting how trading intensity can amplify credit risk. Li and Marinč (2014) study a sample of 140 U.S. bank holding companies (1997-2012). In a two-stage regression, they first show that larger total derivatives notional predicts higher market-beta estimates and then decompose holdings into hedging and trading motives. The study finds that both hedging and trading volumes are positively linked to higher interest-rate and foreign-exchange betas, even though hedging-driven positions enjoy a modest valuation premium. Chang et al. (2018) employ this same method in a European sample of 797 banks (2004-2008), demonstrating that the small hedging slice lacks power to move rate or FX betas, while the dominant trading slice remains the primary driver of higher interest-rate beta.

While these beta-based studies build the core narrative that derivatives can both mitigate and magnify systematic exposures, alternative risk measures enrich our understanding. Titova et al. (2020) track 109 European banks through the 20050-2010 period and find that higher hedging volumes curb return volatility before 2008, but when the crisis hits, both hedging and trading are associated with increases in volatility and broader systematic-risk measures.

Deng et al. (2017) document for 70 publicly traded U.S. Bank-Holding Companies (1996-2011) that greater hedging activity increases bond yield-spreads, interpreted as higher cost of debt and thus higher risk. However, this effect flips during the 2007-09 crisis, consistent with disrupted risk-allocation channels. Bazih and Vanwalleghem (2021) further show, using a sample of 60 emerging-market banks, that although weaker margins and institutions motivate greater derivative use, heavier usage coincides with improved bank stability (lower Z-score probability of default), even as effects on valuation remain mixed. Recently, at the system level, Wang et al. (2025) analyze 30 OECD jurisdictions and demonstrate that a one-standard-deviation rise in aggregate derivatives holdings leads to meaningful jumps in both ΔCoVaR and market-risk betas, underscoring the potential for derivatives to amplify distress across the financial system.

2.4 Determinants of Bank's Derivative Usage

Banks' decisions to engage in derivative transactions reflect a combination of their internal capabilities, their specific risk-management needs, and the surrounding regulatory and institutional environment. At the most basic level, scale and operational capacity are fundamental. Larger and systemically important institutions routinely bear the fixed costs associated with sophisticated risk-management systems, dedicated trading desks, and in-house legal and compliance functions, all of which facilitate both client-facing market-making and proprietary use of swaps and forwards. Empirical evidence from European and UK banks confirms that these organizations hold substantially greater notional volumes of interest-rate and FX derivatives than their smaller peers, who often lack the staff, technology, or counterparty networks to deploy these instruments effectively (Al Fazari et al., 2022; Purnanandam, 2007; Rampini & Viswanathan, 2010; Titova et al., 2020).

Beyond sheer scale, a host of bank-level characteristics predict whether a bank enters the derivatives market. Using a panel logit across thirty European countries, Chang et al. (2018) evidence that a bank's profitability, net interest margin, deposit inflows, liquidity buffers, market concentration in its home jurisdiction, capital ratio, and even its loan portfolio mix each materially influence the odds that it will transact in derivatives. These findings underscore that derivative adoption is not simply a function of size but also of how profitable and well-funded a bank is, how squeezed its traditional lending spreads have become, and how much regulatory capital it can devote to potential market swings (Chang et al., 2018).

Governance practices can further impact derivative usage decisions. Whidbee and Wohar (1999) show that a bank's ownership and board composition materially shape its hedging choices. In firms with high insider shareholdings (>10%), greater CEO or outside-director equity stakes reduce derivatives use , reflecting risk-shifting incentives under deposit insurance, whereas in low-insider-ownership banks, a higher proportion of independent directors increases hedging activity through stronger monitoring (Whidbee & Wohar, 1999).

Once a bank has entered the market, its risk profile and business model determine the nature and intensity of its usage. Institutions with strong capital buffers are typically able to absorb the occasional large losses that can arise from imperfect hedges and so tend to use derivatives more proactively to lock in funding costs or immunize net interest income against rate volatility (Purnanandam, 2007). Conversely, banks whose balance sheets are dominated by concentrated or high-risk loan portfolios, whether in commercial real estate, emerging-market credits, or segments with volatile net interest margins, frequently turn to swaps and forwards defensively, aiming to smooth earnings and maintain access to external funding when markets turn against them (Bazih & Vanwalleghem, 2021; Froot et al., 1993; Reichert & Shyu, 2003). Meanwhile, banks that derive a significant share of revenue from trading and fee-based businesses will deploy derivatives not only for hedging but also to generate non-interest income via bid-ask spreads and directional positions, effectively melding risk management and proprietary profit-seeking (Li & Marinč, 2014).

The broader market and macroeconomic context also shape banks' derivative strategies. Bazih and Vanwalleghem (2021) show that tighter net interest margins, common in emerging markets or highly competitive banking systems, drive more aggressive derivative trading as banks seek alternative income streams. At the same time, greater banking-sector concentration tends to depress derivative uptake by limiting counterparty choice and market liquidity, whereas competitive markets spur derivative usage both to manage funding risks and to recoup thinning spreads. Periods of monetary tightening or elevated funding costs similarly encourage banks to substitute derivatives for costly cash buffers, using swaps to manage interest-rate and liquidity risks without lock-in lower-yield assets (Purnanandam, 2007).

Finally, regulatory and institutional frameworks can either encourage or constrain derivative usage. Under Basel III and the EU's EMIR requirements, hedges receive preferential capital treatment while trading-book positions endure higher risk weights, motivating banks to demonstrate clear hedging intent and robust documentation to optimize capital efficiency (Basel Committee on Banking, 2019). IFRS 9's hedge-accounting provisions align the P&L treatment of hedged items and hedging instruments, smoothing earnings volatility when effectiveness tests are met (IFRS Foundation, 2014). Conversely, in countries with weak legal enforcement and fragmented oversight, even well-capitalized banks may struggle to implement and validate effective hedging programs, reducing their overall derivatives activity (Bazih & Vanwalleghem, 2021)

2.5 Motivation and Gaps in Literature

Although the literature has documented that derivatives can both mitigate and amplify banks' interest-rate and FX exposures, key gaps remain. Most empirical work concludes before the prolonged low interest rate era of the 2010s or focuses on the fallout from the 2008 crisis (Choi & Elyasiani, 1997; Reichert & Shyu, 2003), leaving unanswered whether hedging or speculative effects persist through subsequent regimes with different characteristics like low yields, the COVID-19 liquidity surge, and rapid policy tightening. Evidence is also heavily U.S.-centric, despite Europe's complex structure of funding markets, mortgage conventions, and post-crisis reforms under EMIR, FRTB, and IFRS 9 (Badarinza et al., 2018; Hoffmann et al., 2019). Finally, very few papers disaggregate client-facing hedges from proprietary, trading-driven positions when measuring systematic-risk impacts; Li and Marinč (2014) and Au Yong et al. (2009) both evidence that hedging instruments often influence IR-β and FX-β differently (or not) than instruments designated for trading.

Filling these gaps is not only of academic interest: as IR and FX markets evolve, banks' derivative programs remain as a key area in regulatory stress tests, internal risk limits, and investors' credit assessments. By examining total notional volumes over the full 2013-2023 this dissertation provides up-to-date evidence on how banks' derivative intensity continues to shape their market-risk exposures.

3. Data and Methodology

3.1 Data

Our empirical dataset is a bank-year panel covering 28 publicly listed European commercial banks from 11 distinct Eurozone countries, with data ranging from 2013 to 2023 (Table 1). The backbone for this choice of panel is the availability of data in Moody's BankFocus, which we use to extract bank-level accounting information and derivative intensity metrics. In line with the study's scope, we restrict the derivatives universe to interest rate and exchange rate instruments, and we maintain the trading versus hedging split. Because BankFocus systematically reports trading notionals more completely than hedging positions, we hand-collect hedging notionals from each bank's audited financial statements, reading the IFRS 7 risk and hedge-accounting notes to ensure a consistent instrument mapping across banks over time.

We choose to measure derivative usage with notional principal amounts scaled by total assets because, in practice, they are the best available proxy for activity intensity that is consistently disclosed across banks and years. In contrast, the other reported option, fair-value balances are poor proxies for usage: they reflect net mark-to-market after netting and collateral, swing with rate/FX levels and volatility even when positions are unchanged and depend on model choices and hedge-accounting designations, which undermines cross-bank comparability. Moreover, the choice of notionals aligns with established empirical practice, as most studies construct derivative intensity as notionals/total assets.

The core variables retained for analysis are bank-level notionals for interest rate and exchange rate derivatives, separately identified as trading or hedging, alongside standard balance-sheet and performance characteristics including assets, equity and related ratios. Additionally, to link derivatives to market-based risk, we obtain daily stock returns and market indices from Refinitiv Workspace, also available within the FEP ecosystem. The details of how these series feed into the computation of market beta and related exposure measures are deferred to the Methodology section.

Table 1. Banks Included in Sample

i	Bank	Country	Total Derivative Notional Value 2023 (€'000)
1	BNP PARIBAS	France	21 246 157 384
2	DEUTSCHE BANK AG	Germany	19 415 816 830
3	SOCIETE GENERALE	France	10 405 961 020
4	BANCO SANTANDER SA	Spain	3 010 350 796
5	CREDIT AGRICOLE SA	France	2 217 711 538
6	UNICREDIT SPA	Italy	1 806 214 538
7	NORDEA BANK ABP	Finland	1 667 471 824
8	KBC GROEP NV	Belgium	1 527 833 786
9	BANCO BILBAO VIZCAYA ARGENTARIA SA	Spain	1 519 821 258
10	INTESA SANPAOLO S,P,A,	Italy	1 191 286 328
11	ABN AMRO BANK NV	Netherlands	526 854 402
12	BANK OF IRELAND GROUP PLC	Ireland	222 423 122
13	RAIFFEISEN BANK INTERNATIONAL AG	Austria	219 492 392
14	MEDIOBANCA - BANCA DI CRÉDITO FINANZIARIO SOCIETA PER AZIONI	Italy	219 247 109
15	ERSTE GROUP BANK AG	Austria	184 302 328
16	BANCO BPM SPA	Italy	171 703 362
17	AIB GROUP PUBLIC LIMITED COMPANY	Ireland	158 256 144
18	CRÉDITO EMILIANO SPA	Italy	67 671 523
19	BANCO COMERCIAL PORTUGUES SA	Portugal	49 703 733
20	BANCA MONTE DEI PASCHI DI SIENA SPA	Italy	47 072 565
21	UNICAJA BANCO SA	Spain	44 432 212
22	BPER BANCA S,P,A,	Italy	40 811 188
23	PIRAEUS FINANCIAL HOLDINGS SA	Greece	31 603 486
24	ALPHA SERVICES AND HOLDINGS SOCIETE ANONYME	Greece	21 419 294
25	NATIONAL BANK OF GREECE SA	Greece	11 944 596
26	BANCA POPOLARE DI SONDRIO SOCIETA PER AZIONI	Italy	7 979 090
27	BANCO DI DESIO E DELLA BRIANZA SPA	Italy	2 339 346
28	BANCA MEDIOLANUM SPA	Italy	322 837

3.2 Methodology

The empirical design uses a two-stage time-series cross-section framework to connect banks' systematic risk to their use of derivatives. In the first stage, time-varying exposures to equity market movements, home-country interest-rate shocks, and euro-area exchange-rate fluctuations are estimated from weekly data with a two-year rolling window. In the second stage, these exposures are explained by bank-level characteristics and by the scale and purpose of derivative use, restricted to interest-rate and foreign-exchange contracts and split between their purpose for trading and hedging, within a panel regression with bank and year effects.

3.2.1 First-stage regression

First-stage exposures are obtained by running overlapping OLS windows for each bank i at week t:

$$r_{i,t}^{e} = \alpha_i + \beta_{i,t}^{Mkt} r_{c(i),t}^{Mkt,e} + \beta_{i,t}^{IR} r_{c(i),t}^{IR} + \beta_{i,t}^{FX} r_t^{FX} + \varepsilon_{i,t}$$

Here, $r_{i,t}^{e}$ is the bank's weekly excess stock return and $r_{c(i),t}^{Mkt,e}$ is the weekly excess return on the broad equity index of the bank's respective country $c(i)$. The interest-rate factor $r_{c(i),t}^{IR}$ is the weekly "price-equivalent" return of $P_{c,t}$ constructed from the home-country 10-year government yield $y_{c,t}$, collected from Refinitiv Workspace, using the synthetic bond price written as (Li & Marinč, 2014):

$$P_{c,t} = \left(1 + y_{c,t}\right)^{-10}$$

which is the weekly return on a zero-coupon bond priced as this adapts their general rule to a 10-year benchmark.

The FX factor r_t^{FX} is the weekly change in the ECB nominal effective exchange rate for the euro (EER-41)[3]. The term α_i is a bank-specific intercept, $\beta_{i,t}^{Mkt}$, $\beta_{i,t}^{IR}$ and $\beta_{i,t}^{FX}$ are the time-varying betas, and $\varepsilon_{i,t}$ is the error term. Each rolling window spans 104 weekly observations, and windows with insufficient valid data are dropped. For every calendar year, the exposure triplet from the last window ending in that year is retained, yielding a bank-year panel of betas used in the second stage.

[3] Nominal EER-41 of the euro (broad group of 41 trading partners), daily index, series key EXR.D.E03.EUR.EN00.A (base 1999Q1=100), European Central Bank Data Portal. The NEER is a geometric trade-weighted average of bilateral euro exchange rates; the weekly FX factor is computed as weekly log changes of this index.

3.2.2 Second-stage regression

In the second stage of the empirical analysis, we examine the determinants of banks' exposure to systematic interest rate and foreign exchange risk. The dependent variables are the estimated betas from the first stage, namely the interest rate beta $\beta_{i,t}^{IR}$ and the foreign exchange beta $\beta_{i,t}^{FX}$ which capture the sensitivity of bank equity returns to changes in the underlying market risk factors. By treating these risk exposures as outcomes to be explained in a panel regression framework, we can assess whether derivative usage and bank-specific characteristics systematically influence the degree of risk that individual institutions bear.

The empirical specification is given by:

$$\beta_{i,t}^{k} = \alpha + \delta_1 \cdot Derivatives_{\mathrm{i,t}} + \delta_2 \cdot Controls_{\mathrm{i,t}} + \gamma_{\mathrm{t}} + \mu_{\mathrm{i}} + \varepsilon_{\mathrm{i,t}}$$

where $\beta_{i,t}^{k}$ denotes either $\beta_{i,t}^{IR}$ or $\beta_{i,t}^{FX}$ for bank i in year t. The term γ_{t} represents a full set of year dummies that capture common macroeconomic shocks, while μ_{i} represents bank fixed effects that absorb unobserved, time-invariant heterogeneity. The error term $\varepsilon_{\mathrm{i,t}}$ is clustered at the bank level to allow for serial correlation and heteroskedasticity within institutions.

The key regressors of interest are the measures of derivative activity, which are constructed as notional values of interest rate and foreign exchange derivatives scaled by total assets, as to ensure comparability across banks of different sizes and to capture the intensity of derivative usage relative to the balance sheet rather than absolute scale. Within each asset class, a distinction is made between trading-related and hedging-related positions, thereby allowing the analysis to separately identify the effects of speculative and risk-reducing activities on banks' market betas. Beyond derivative use, the model incorporates a vector of bank-level control variables that proxy for size, capitalization, liquidity, asset quality, profitability, and income structure. In particular, the controls include the natural logarithm of total assets (Size), the ratio of liquid assets to total assets (Liquidity Ratio), income diversification, the Tier 1 capital ratio, the ratio of non-performing loans to gross loans (NPL Ratio) and return on assets (ROA). These variables are motivated by prior literature, which has shown that each of these dimensions can influence banks' overall risk exposures and their incentives to use derivatives. The variable specification is available on Table 2 presented below.

Table 2. Variable Definition

Variable	Description	Measurement	Source
Excess Stock Return	Weekly return of individual bank stock net of the risk-free rate	$r^{e}_{i,t} = r_{i,t} - r_{f,t}$	Refinitiv Workspace
Excess Market Return	Weekly return on the home-country broad equity index net of risk-free rate	$r^{Mkt,e}_{c(i),t} = r^{Mkt}_{c(i),t} - r_{f,t}$	Refinitiv Workspace
Interest Rate Factor	Synthetic weekly return from the home-country 10-year government yield	$P_{c,t} = (1 + y_{c,t})^{-10}$; $r^{IR}_{c(i),t} = \Delta P_{c,t}$	Refinitiv Workspace (10y yields)
FX Factor	Weekly change in ECB nominal effective exchange rate (EER-41)	$r^{FX}_{t} = \Delta \ln(EER41_t)$	European Central Bank
IR Beta (IR β)	Sensitivity of excess stock returns to home-country 10y yield changes	Estimated from 104-week rolling OLS	Constructed (first stage)
FX Beta (FX β)	Sensitivity of stock excess returns to euro nominal effective exchange rate	Estimated from 104-week rolling OLS	Constructed (first stage)
IR Trading Derivatives	Interest rate derivatives held for trading, scaled by assets	Notional IR trading derivatives / Total assets	BankFocus
IR Hedging Derivatives	Interest rate derivatives designated as hedges, scaled by assets	Notional IR hedging derivatives / Total assets	Bank Financial Statements
FX Trading Derivatives	FX derivatives held for trading, scaled by assets	Notional FX trading derivatives / Total assets	BankFocus
FX Hedging Derivatives	FX derivatives designated as hedges, scaled by assets	Notional FX hedging derivatives / Total assets	Bank Financial Statements
Size	Bank size (proxy for scale)	Natural log of total assets	BankFocus
Liquidity Ratio	Share of liquid assets in balance sheet	Liquid assets / Total assets	BankFocus
Income Diversification	Reliance on non-interest income	(Net income - Interest income) / Net income	BankFocus
Tier 1 Capital	Regulatory capital strength	Tier 1 capital ratio	BankFocus
NPL Ratio	Credit risk exposure	Non-performing loans / Gross loans	BankFocus
Equity Ratio	Leverage measure	Equity / Total assets	BankFocus
ROA	Profitability	Net income / Total assets	BankFocus

Since the dependent variables are not directly observed but estimated in the first stage, the precision of the beta estimates differs across banks and years. To account for this, following Choi and Jiang (2009) and Li and Marinč (2014), the regressions are weighted by the inverse squared standard errors of the first-stage beta estimates. This ensures observations based on more reliable betas exert greater influence in the estimation, while noisier betas contribute less to estimation.

The analysis is carried out by a supplementary pooled OLS regression and a main fixed effects model that absorbs bank-specific heterogeneity. This latter approach focuses on within-bank variation over time, thereby identifying how changes in derivative activity and financial characteristics affect changes in risk exposures for the same bank. Additionally, year dummies are introduced to capture macroeconomic shocks, regulatory reforms, or other time-specific events that may affect all banks in the sample. This ensures that the estimated coefficients reflect the impact of bank-level dynamics, net of temporal influences.

The choice between fixed and random effects estimators is informed by Hausman tests, which compare whether the unobserved effects are correlated with the regressors. The results indicate that, for the interest rate beta specification we cannot reject the null hypothesis, however, by the contrary, for the foreign exchange beta specification, the null hypothesis of no correlation is rejected. As this nuanced finding presents an impasse, we opt for the use of fixed effects, which is mostly present within the broader empirical literature, and is coherent with the theoretical logic of controlling persistent differences in risk profiles and risk appetite across banks (Au Yong et al., 2009; Chang et al., 2018; Li & Marinč, 2014).

4. Results

4.1 Descriptive Analysis

Before turning to the regression analysis, it is useful to present some descriptive statistics and correlations for the key variables in the sample. Table 3 reports the mean, standard deviation, and range of the main explanatory variables used in the second-stage regressions. The sample consists of 270 bank-year observations[4].

Table 3. Descriptive Statistics of Sample

Variables	Mean	S.D.	Min	Max
IR Trading Derivatives	3.180	5.337	0.001	26.701
IR Hedging Derivatives	0.250	0.216	0.000	1.127
FX Trading Derivatives	0.633	1.058	0.001	4.994
FX Hedging Derivatives	0.019	0.027	0.000	0.135
Size	19.173	1.388	16.330	21.676
Liquidity Ratio	0.290	0.130	0.062	0.733
Income Diversification	-5.312	19.643	-118.435	62.796
Tier 1 Capital	0.144	0.267	0.079	0.223
NPL Ratio	0.093	0.116	0.006	0.514
Equity Ratio	0.071	0.024	0.031	0.158
ROA	0.339	0.852	-4.053	4.429
N Observations	270			

Source: Own elaboration.
Notes: See Table 2 for a description of the variables.

Starting with derivative positions, interest rate trading derivatives represent the largest usage intensity, with a mean value of 3.18 percent of total assets, though the high

[4] This is an unbalanced panel dataset, both because of missing variables across certain years and because some banks were only (re-)listed partway through the sample period. ABN AMRO (2015), Banco BPM (2017), AIB Group (2017), and Unicaja Banco (2017) only became publicly listed within the timespan of the study, while Nordea Bank Abp re-domiciled and re-listed in Finland in 2018.

standard deviation (5.34) and wide range, from as low as 0.001 percent to over 26 percent. This reveals substantial heterogeneity across banks. By contrast, interest rate hedging derivatives are relatively small on average, accounting for only 0.25 percent of assets, with a maximum of just above 1.1 percent. Foreign exchange trading derivatives also display considerable variation, with a mean of 0.63 percent but a maximum close to 5 percent, whereas foreign exchange hedging derivatives remain almost negligible in economic magnitude, averaging only 0.02 percent. Taken together, these figures highlight that derivative usage among banks is highly concentrated in trading-related interest rate positions, while hedging activities, particularly in the foreign exchange market, are modest in scope.

The control variables also provide insight into the structure and financial condition of the banks in the sample. The average size, measured as the natural logarithm of total assets, is 19.17, corresponding to a balance sheet size in the order of several tens of billions of euros, though there is still meaningful variation across institutions. The mean liquidity ratio of 0.29 suggests that liquid assets account for roughly 30 percent of total assets, with some banks maintaining much higher buffers. Income diversification exhibits an even larger spread, with a mean close to -5, indicating that non-interest income is, on average, a small or even negative contributor to overall earnings, though some banks report highly diversified revenue structures. Tier 1 capital ratios average 14.5 percent, indicating relatively well-capitalized institutions, although the lower bound is close to 8 percent. The equity-to-asset ratio, a more stringent measure of leverage, averages just over 7 percent. In terms of asset quality, the average non-performing loan (NPL) ratio is 9.3 percent, but the dispersion is wide, with some banks having NPLs above 50 percent of gross loans, pointing to severe distress in parts of the sample. Profitability, proxied by return on assets (ROA), is modest at 0.34 percent on average, with substantial variability, including negative outliers.

The correlation matrix in Table 4 offers valuable information. There is a strong positive correlation between interest rate trading derivatives and foreign exchange trading derivatives, confirming that banks engaging heavily in one form of trading activity are also likely to be active in the other. Hedging activity is also positively correlated across markets, though at a lower level. Bank size is positively correlated with all forms of derivative usage, consistent with the idea that larger institutions have greater capacity and incentives to engage in derivatives markets, whether for trading or hedging purposes. Liquidity is similarly positively related to derivative usage, whereas asset quality and capitalization appear to move in the opposite direction. Both the NPL ratio and the equity ratio are negatively correlated with derivatives, which may reflect the fact that weaker or more constrained banks have limited scope to take on derivative exposures.

Table 4. Correlation matrix between bank-level characteristics of banks

i	Variables	1	2	3	4	5	6	7	8	9	10	11
1	IR Trading Derivatives	1										
2	IR Hedging Derivatives	0,524	1									
3	FX Trading Derivatives	0,894	0,570	1								
4	FX Hedging Derivatives	0,468	0,409	0,454	1							
5	Size	0,653	0,533	0,678	0,450	1						
6	Liquidity Ratio	0,301	0,365	0,343	0,207	0,439	1					
7	Income Diversification	-0,076	-0,018	-0,081	0,017	-0,040	0,025	1				
8	Tier 1 Capital	-0,030	0,145	-0,029	-0,018	-0,012	0,180	0,086	1			
9	NPL Ratio	-0,246	-0,382	-0,256	-0,239	-0,298	-0,416	-0,088	-0,230	1		
10	Equity Ratio	-0,395	-0,238	-0,431	-0,216	-0,432	-0,439	-0,056	0,082	0,503	1	
11	ROA	-0,047	0,098	-0,025	0,033	-0,001	0,169	-0,020	0,315	-0,426	0,066	1

Source: Own elaboration.
Notes: See Table 2 for a description of the variables.

4.2 First-Stage Regression Results

To assess the relationship between Eurozone banks' equity returns and key market risk factors, the first stage of the analysis estimates time-varying betas with respect to equity market movements, domestic interest rate shocks, and euro exchange-rate fluctuations. Table 3 summarizes the distribution of these exposures for the full sample of banks. The results provide a first indication of how sensitive bank equity returns are to systematic market forces and highlight the degree of heterogeneity that exists across institutions before introducing bank-specific drivers in the second-stage regressions.

Table 5. Summary Statistics of estimated bank betas

Variables	Mean	S.D.	Min	Max
Intercept (α)	-0.002	0.006	-0.029	0.012
Market β	1.395	0.419	0.374	3.170
IR β	0.049	0.362	-1.435	1.455
FX β	0.432	1.206	-5.038	4.671
R^2	0.520			

Source: Own elaboration.
Notes: See Table A2 for a description of the variables.

Across the full sample, the mean market beta is 1.40, indicating that bank equity returns are, on average, more volatile than the overall market and respond more than proportionally to aggregate shocks. This heightened sensitivity to market conditions is in line with prior studies on international banks, which typically report betas above one (Au Yong et al., 2009; Li & Marinč, 2014; Reichert & Shyu, 2003).

In contrast, the average interest rate beta is close to zero (0.05), suggesting that, in aggregate, Eurozone banks are relatively insulated from long-term interest rate fluctuations. Nevertheless, the wide dispersion (standard deviation of 0.36, with values ranging from -1.44 to +1.46) signals substantial heterogeneity across institutions in how they manage or are exposed to interest rate risk.

The mean foreign exchange beta is positive (0.43), but again with considerable variation (-5.04 to +4.67). This widespread implies that while some banks benefit from euro appreciations, others are considerably exposed in the opposite direction, reflecting differences in FX positions and risk management strategies.

Finally, the explanatory power of the regressions is moderate, with an average R^2 of 0.52. This suggests that the three factors, namely market, interest rate, and FX, jointly account for roughly half of the variation in Eurozone bank stock returns, which is consistent with findings from comparable studies.

4.3 Second-Stage Regression

Table 6 compares pooled OLS with bank and year fixed effects regressions of interest rate and foreign exchange betas on the intensity of derivative usage, where intensities are notionals scaled by total assets and standard errors are clustered by bank. The fixed effects specifications deliver higher overall fit than pooled OLS and provide meaningful within-bank explanatory power (overall R^2 of about 0.44 for the interest rate models and 0.36 for the foreign exchange models; within R^2 around 0.29 and 0.28-0.31, respectively). This shift in fit, together with the change in coefficients described below, indicates that cross-sectional differences in business models and risk appetite mask relationships that become visible when identification relies on within-bank variation over time.

In the interest rate regressions, the coefficient on trading derivatives is small and insignificant under pooled OLS (0.006) but rises to 0.022 and is marginally significant in the fixed effects model. Interpreted literally, a one percentage point increase in trading notionals as a share of assets is associated with an increase of 0.022 in the interest rate beta. Benchmarked against the distribution of first-stage betas (standard deviation about 0.36), this represents a small fraction of typical movements in exposure. Using the dispersion of trading intensity itself (with mean roughly 3.18 percent of assets, standard deviation about 5.34 percentage points), a one-standard-deviation increase in trading intensity implies an increase in the interest rate beta of approximately 0.117, which is about one-third of the dependent variable's standard deviation. At more common, low-single-digit changes in trading intensity, the implied movements in exposure are modest. Hedging derivatives in the interest rate regressions load slightly negative but are imprecise and never statistically different from zero; given the small average scale of hedging (about a quarter of a percent of assets), the implied changes in the beta are economically negligible.

The foreign exchange regressions show a similar pattern. The coefficient on trading derivatives is close to zero and not significant in pooled OLS (0.033), but in fixed effects it is 0.225 and marginally significant. A one percentage point increase in foreign exchange trading intensity is therefore associated with an increase of roughly 0.225 in the foreign exchange beta. Relative to the dispersion of first-stage foreign exchange betas (standard deviation about 1.21), this is about one-fifth of a standard deviation for a one percentage point change in intensity. Using the dispersion of trading intensity in foreign exchange (mean around 0.63 percent of assets, standard deviation about 1.06 percentage points), a one-standard-deviation increase corresponds to a change in the beta of roughly 0.24. As with rates, hedging derivatives carry negative signs but are very imprecise and never significant; given that reported hedging intensities in foreign exchange are extremely small on average, the implied economic effects are minimal.

Control variables behave in ways that support the main interpretation without overturning it. Size effects visible in pooled OLS mostly dissipate once fixed effects absorb time-invariant bank characteristics. Higher Tier 1 capital is associated with lower foreign exchange betas in fixed effects, consistent with a stabilizing role for capitalization. The equity-to-assets ratio loads positively and significantly in the interest rate fixed effects specification, suggesting that leverage structure co-moves with rate sensitivity in this sample. Liquidity, profitability, and income diversification show small or mixed effects after conditioning on bank and year effects.

Overall, the evidence indicates that increases in trading derivatives are associated with marginally significant higher factor betas once bank fixed effects are included, but the magnitudes are economically small at realistic changes in intensity. Formal hedging programs, at the scales observed here, do not produce statistically detectable reductions in exposures. The results therefore support a nuanced answer to the research question: derivative trading intensity contributes to market risk, while hedging intensity has no measurable effect, and in both cases the size of the effect is modest relative to the natural variability of banks' betas.

Table 6. Pooled OLS and Fixed effects regressions of banks' interest rate and foreign exchange betas on derivatives activity and bank characteristics.

	(1) IR β	(2) IR β	(3) FX β	(4) FX β
IR Trading Derivatives	0.006	0.022*		
	(0.005)	(0.011)		
IR Hedging Derivatives	0.117	-0.148		
	(0.087)	(0.124)		
FX Trading Derivatives			0.033	0.225*
			(0.038)	(0.119)
FX Hedging Derivatives			1.319	-2.322
			(1.297)	(2.018)
Size	0.029**	0.068	0.053**	-0.412
	(0.013)	(0.129)	(0.019)	(0.414)
Liquidity Ratio	0.007	-0.465	0.700	1.304
	(0.135)	(0.307)	(0.417)	(0.898)
Income Diversification	0.002	0.003**	-0.001	-0.001
	(0.001)	(0.001)	(0.003)	(0.004)
Tier 1 Capital	0.012	0.005	-0.021	-0.110*
	(0.007)	(0.009)	(0.020)	(0.063)
NPL Ratio	0.356	0.529**	0.760	0.716
	(0.256)	(0.239)	(0.711)	(1.126)
Equity Ratio	-0.657	4.908***	3.634	3.385
	(0.708)	(1.703)	(3.331)	(11.259)
ROA	0.007	-0.002	0.120	0.144
	(0.022)	(0.023)	(0.132)	(0.153)
Constant	-0.627**	-1.545	-0.619	9.197
	(0.282)	(2.516)	(0.526)	(8.321)
Observations	270	270	270	270
Method	OLS	FE	OLS	FE
Overall R^2	0.260	0.439	0.278	0.358
Within R^2		0.294		0.283

Source: Own elaboration.
Notes: See Table A2 for a description of the variables.
Standard errors in parentheses; Bank fixed effects and year fixed effects included. SEs clustered by bank.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.0$

4.4 Results discussion

The patterns we document line up closely with prior evidence on banks' market risk. First-stage estimates showing strong market loadings, interest-rate betas near zero on average but highly dispersed, and material, heterogeneous FX betas mirror classic maturity-gap and exposure studies (Au Yong et al., 2009; Choi & Elyasiani, 1997; Flannery & James, 1984). In our second stage, the positive within-bank association between trading-derivatives intensity and both IR and FX betas is consistent with the view that market-making and inventory risk transmit factor exposures to equity, even when positions are actively managed (Chang et al., 2018; Li & Marinč, 2014; Reichert & Shyu, 2003). By contrast, the small and statistically indistinct coefficients on hedging notionals accord with evidence that designated accounting hedges are often modest in scale and that many economic hedges are not formally designated under IFRS 9, so they appear in trading buckets, making their effect hard to detect (Minton et al., 2009). Finally, our control results, lower FX beta in better-capitalized banks and a positive link between equity/assets and IR beta, are in line with balance-sheet structure channels emphasized in the literature, including the role of leverage and deposit franchises in shaping equity sensitivity to rate and currency shocks (Hoffmann et al., 2019).

A natural explanation for the modest economic magnitudes in our second-stage estimates is that, in the post-crisis regime, large European dealers predominantly intermediate client flow under matched-book constraints, so very large gross notionals coexist with relatively small net factor exposures (DV01/FX-delta) at the weekly horizon we measure.

This outcome is likely driven by recent regulation design. First, the Fundamental Review of the Trading Book (FRTB) ties market-risk capital to risk-sensitive measures at the desk level and to P&L attribution, penalising warehousing one-sided IR/FX risk and rewarding tight hedging; the EU has embedded FRTB in CRR II (Capital Requirements Regulation) with supervisory reporting via Commission Implementing Regulation (EU) 2021/451, and the EBA (European Banking Assossiation) has recently expanded the reporting as full implementation approaches (BCBS, 2019; EBA, 2024; European Commission, 2021; European Union, 2019).

Second, the standardised approach to counterparty credit risk (SA-CCR), effective in the EU from 28 June 2021, raises capital for unmargined or directional OTC portfolios and explicitly prices net exposure, further nudging dealers toward rapid offsets and flatter books (EBF, 2020; Euronext/Cc & G, 2021; European Union, 2019).

Third, the global BCBS-IOSCO margin framework for non-centrally cleared derivatives (phased in 2016-2022) requires bilateral initial and variation margin, making one-way risk costlier to fund; supervisors have reaffirmed and fine-tuned these requirements in subsequent reviews (BCBS-IOSCO, 2020).

Fourth, EMIR (European Market Infrastructure Regulation) mandates central clearing, robust collateralisation and post-trade risk-reduction, which reduces gross notionals without changing net risk, exactly the pattern we see when relating notionals to betas (D'Errico & Roukny, 2017; ESMA, 2023a; European Union, 2012).

Finally, system-wide balance-sheet constraints, like the Basel III leverage ratio, LCR (Liquidity Coverage Ratio) and NSFR (Net Stable Funding Ratio), discourage large trading inventories funded with unstable liabilities, reinforcing quick hedging and neutralisation of factor risk (Basel Committee on Banking, 2013). Under this regulatory stack, derivative activity as we define it (notional/total assets) is naturally less related with systematic risk, as compression, netting, clearing and margin can leave betas largely unchanged even as gross volumes rise. That is, our finding, that trading usage raises IR/FX betas statistically but only modestly in economic terms, is precisely what we should expect when modern dealer banks intermediate customer risk quickly and manage to exposure-based limits rather than to volume caps.

5. Conclusion

This dissertation set out to examine whether European banks' use of interest-rate (IR) and foreign-exchange (FX) derivatives is associated with their systematic market risk, and if so, through which channels. Using a two-stage design on a panel of 28 listed Euro-area banks from 2013-2023, we first estimated time-varying IR and FX betas from weekly returns and then related those exposures to bank characteristics and the scale/purpose of derivative use. Three empirical facts emerge. First, bank equities load strongly on the market factor; IR betas average close to zero but are widely dispersed, and FX betas are economically meaningful and heterogeneous. Second, within banks over time, greater trading-derivatives intensity is associated with higher IR and FX betas, while hedging notionals are small and statistically indistinguishable from zero at observed scales. Third, the magnitudes are modest at realistic changes in intensity; stronger Tier 1 capital coincides with lower FX beta, and the equity-to-assets ratio co-moves positively with IR beta. These findings are consistent across fixed-effects specifications with clustered errors and are robust to alternative normalizations.

Placed in context, the results largely confirm prior evidence. Classic work shows that banks' equity returns embed maturity-gap and currency exposures even when average IR sensitivity is muted by asset-liability management (Choi & Elyasiani, 1997; Flannery & James, 1984). Cross-country studies similarly document high market betas and heterogeneous rate/FX loadings (Au Yong et al., 2009; Reichert & Shyu, 2003). Our second-stage association between trading activity and higher factor betas aligns with research on market-making and inventory risk transmitting systematic shocks to equity (Chang et al., 2018; Li & Marinč, 2014), while the lack of a detectable hedging effect further reflects evidence that designated hedge programs are often small relative to trading books and that many economic hedges are not formally designated under IFRS 9, making their impact hard to observe in betas (IFRS Foundation, 2014; Minton et al., 2009). At the same time, the modest economic size of the trading coefficients is consistent with mixed findings that derivatives tend to amplify exposures at the margin rather than transform them (Bazih & Vanwalleghem, 2021; Titova et al., 2020).

A key interpretation is that contemporary European dealers primarily intermediate client flow under matched-book constraints: they originate risk and rapidly offset it through back-to-back or interdealer hedges, so very large gross notionals coexist with small net factor exposures (DV01/FX-delta) at the weekly horizon we measure. This outcome is increasingly by design. The FRTB regime ties market-risk capital to risk-sensitive desk-level measures and P&L attribution (BCBS, 2019; European Commission, 2021; European Union, 2019). SA-

CCR and the BCBS-IOSCO margin framework for non-cleared trades raise the cost of one-sided OTC risk and reward netting and offsets (BCBS-IOSCO, 2020; European Union, 2019). Under EMIR, central clearing, robust collateralization, and portfolio compression reduce gross notionals without changing net risk (D'Errico & Roukny, 2017; ESMA, 2023a; European Union, 2012). In such an environment, our main usage measure being notionals scaled by assets is an informative proxy for activity but will struggle to correlated with net risk, naturally attenuating the derivatives-beta link that we identify as statistically present but economically modest.

These findings carry practical implications for risk management. First, banks should manage and disclose exposures rather than volumes: set and monitor limits in DV01, FX delta/vega, and complement internal metrics with rolling betas as a simple, externally observed KPI of systematic sensitivity. Second, hedge design and effectiveness more than gross hedge size; small, well-targeted programs can be effective even when their notionals appear modest (IFRS Foundation, 2014; Minton et al., 2009). Third, capital buffers remain complementary to exposure limits: the negative association between Tier 1 and FX beta supports a capital-plus-limits approach to dampen the transmission of market shocks to equity.

For regulators and supervisors, the results support the direction of travel in post-crisis reforms. Exposure-based standards under FRTB, the leverage ratio/LCR/NSFR, SA-CCR, and margin rules all push banks toward risk-sensitive management of trading books Our evidence suggests treating trading intensity as a supervisory signal but privileging exposure-based metrics in stress tests and Pillar-2 assessments. Strengthening public disclosure of DV01 by currency/tenor bucket and FX delta by currency, alongside a transparent trading vs. hedging split, would improve comparability and help external stakeholders connect derivative activity to system-wide tail risk (Adrian & Brunnermeier, 2016; Hoffmann et al., 2019; Mayordomo et al., 2014).

The study has limitations. Firstly, relevant derivative data serves as a continuous challenge in this study, with the BankFocus platform providing a helpful but faulty database for these metrics, as well as lacking some availability of relevant Euro-Area banks. Another relevant limitation of our design is statistical power. With 28 banks and modest within-bank variation in derivative intensity, our panel may be underpowered to detect small effects, especially for hedging notionals, so future research should aim to collect data (however dificult) of more frequent time periods (quaterly, monthly) as to capture shorter-term deeper variation between variables. We measure usage with notionals/total assets, a consistent and widely reported proxy, but not a risk-sensitive one: it ignores netting, collateral, option greeks, and curve positioning. Our dependent variables are estimated betas and thus measured with error despite rolling windows and inverse-SE weights. The factor set is debatable, a duration-like 10-year rate factor and a broad NEER FX factor, so exposures to slope or to key bilateral pairs may be under-captured (Hoffmann et al., 2019). Endogeneity is possible: shifts in risk appetite or business mix can co-move with both trading intensity and exposures even with fixed effects. Finally, we estimate at the consolidated level; intra-group risk transfer can mask deeper desk-level exposures with group-level equity betas.

Two avenues for future research follow directly. First, replace notionals with risk-sensitive exposures from Pillar-3/FRTB (DV01/vega/delta by bucket) to test whether the trading-exposure link strengthens when measured on the same scale as internal models (BCBS, 2019; EBA, 2024; European Commission, 2021). Second, better identification by separating rate level and slope shocks and estimating bilateral FX betas for banks with concentrated currency books; complement panel estimates with event-study betas around policy shocks. A complementary path is to map derivatives use to tail-risk outcomes (CoVaR, SRISK) and to compare the Euro-area to other jurisdictions and regimes.Together, these steps would sharpen our understanding of when derivatives mitigate or amplify banks' exposure to systematic shocks, and why.

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