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European Monetary Policy Shocks and Their Impact on Corporate Bond Credit Spreads: An Empirical Analysis of Cross-Market Dynamics and Sectoral Implications

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Abstract

This study analyzes the impact of variations in the European Central Bank's interest rates on the credit spreads of European corporate bonds from January 2022 to June 2024. In response to inflationary pressures, central banks implemented tighter monetary policies, resulting in significant changes in corporate bond markets. The study examines the response of investment-grade and high-yield bonds to fluctuating interest rate conditions, emphasizing sectoral differences through the lens of Option-Adjusted Spreads.

The study starts by delineating significant macroeconomic and financial trends during the period, highlighting the transition from expansionary policies to monetary contraction. It establishes a theoretical framework by examining credit risk indicators including ratings, default probabilities, and bond spreads. The study investigates the influence of monetary policy on investor sentiment and evaluates the effects of credit rating agencies, liquidity conditions, and market uncertainty on bond yields.

The study utilizes a dataset of European corporate bonds, categorized by credit rating and sector, to implement multiple linear regression models for evaluating the correlation between credit spreads and the Compounded Euro Short-Term Rate Average. Sector-specific control variables, including energy prices, industrial production, and stock market performance, are integrated to enhance the analysis. Research demonstrates that monetary tightening yielded disparate effects on investment-grade and high-yield bonds. Investment-grade bonds exhibited relative stability, while high-yield spreads contracted despite increasing interest rates, propelled by robust investor demand and enhancing corporate fundamentals. Sectoral disparities arose, with energy and industrial bonds demonstrating heightened sensitivity to inflation and fluctuations in commodity prices, while technology and healthcare bonds displayed more muted responses to macroeconomic changes.

The study examines the impact of monetary policy decisions on corporate debt markets, offering insights into the determinants of credit spread fluctuations. The findings underscore the significance of sectoral dynamics and investor sentiment in evaluating credit risk. The research provides a comprehensive analysis but

acknowledges specific limitations, such as data frequency and external economic factors. Subsequent research may expand upon this analysis by integrating higher-frequency data and supplementary macroeconomic variables to improve comprehension of corporate bond market dynamics under varying financial conditions.

Key Words: Interest Rates, Monetary Policy, Credit Spread, Risk Free Rate.

Introduction

In recent years, significant events have greatly impacted the global economic and financial landscape, disrupted market dynamics and changed strategies among economic players. The COVID-19 pandemic stands out as a crucial event that has notably influenced consumption, savings, and production, leading to widespread effects in financial markets. This project aims to analyze how corporate bond yields responded to rising international interest rates during the turbulent and transformative period from 2022 to 2024.

The first chapter explores the factors that led to the current situation, emphasizing the short- and medium-term effects of the pandemic. While the real economy and financial systems operate on different paths, they are deeply interconnected; a global economic crisis like the one triggered by COVID-19 inevitably shifted priorities and responses in financial markets. During the peak of the crisis, declines in consumption, slowed production, and widespread uncertainty forced major institutions like the Federal Reserve (FED), the European Central Bank (ECB), and the International Monetary Fund (IMF) to implement extraordinary measures. These actions highlighted various challenges, including increased market volatility, credit deterioration, and heightened risk perception. After the pandemic, attention shifted to a new challenge: rising inflation and subsequent interest rate hikes by central banks. The period from 2022 to 2024 marks a transition from crisis management to normalization, during which markets grapple with the combined effects of restrictive policies and inflationary pressures. This shift had a significant impact on corporate bond yield spreads which are key indicators of risk premiums and perceived liquidity among investors.

The second chapter offers a comprehensive review of relevant literature, examining the intricate relationships between interest rates, credit spreads, ratings, and default probabilities (PD). This analysis investigates how expansionary monetary policies enacted during the pandemic to mitigate economic fallout influenced market conditions and contributed to the initial narrowing of credit spreads. The gradual winding down of these policies, as central banks moved towards normalization, serves as a pivotal point for assessing the ensuing volatility and changes in credit spreads. The chapter investigates how these changes

reflected broader economic trends, including shifts in inflation expectations and evolving risk assessments by market participants. A key focus is the relationship between agency ratings and default probabilities, shedding light on how investor perceptions of creditworthiness evolved during this time. The distinction between Investment Grade (IG) and High Yield (HY) bonds is thoroughly examined, highlighting the different trajectories these categories took under varying market conditions. Investment-grade bonds, typically viewed as safer investments, often showed more resilience during periods of rising interest rates, while high-yield bonds, known for their higher risk-reward profile, were more sensitive to restrictive monetary policies. This chapter delves into the dynamics of credit ratings, clarifying their dual role as both a stabilizing and reactive force in bond markets.

The upcoming chapters focus on an empirical analysis of the collected data, aiming to connect theoretical insights with observed market behavior. The research questions investigate the changes in OAS across various sectors from January 2022 to June 2024, particularly emphasizing the differences between IG and HY bonds. The study seeks to uncover the key factors that drive changes in spreads through an examination of the OAS database, which includes sector-specific risk exposures and macroeconomic changes. A particular focus is placed on how ratings interact with market responses to rising interest rates. The analysis assesses which bonds have maintained more stable spreads in terms of rating and sector.

The final chapters outline the findings and conclusions, discussing the main implications of the analysis and highlighting the factors that had the most substantial impact on OAS behavior during periods of economic and financial turmoil. The study will also recognize its limitations and propose directions for future research, aiming to deepen the understanding of the relationship between monetary policies and bond markets. This analytical investigation underscores the importance of a comprehensive approach to studying financial markets, illustrating how global events and institutional responses shape the risk and return dynamics that influence investor decisions.

1.1 From Crisis to Normalization: The Economic and Financial Impact of the COVID-19 Pandemic

The COVID-19 pandemic was an unforeseen global crisis that placed significant pressure on the stability of economic and financial systems. Initially a health emergency, the crisis rapidly expanded into a global economic and financial downturn, revealing vulnerabilities across sectors and demanding swift, coordinated institutional responses. This chapter explores the extraordinary measures taken by governments, central banks, and regulators, assessing their effects on the banking sector, inflation trends, and financial markets.

During the pandemic, banks played a crucial role as key intermediaries, ensuring continued access to credit despite facing considerable uncertainties. Their ability to provide credit was vital for supporting businesses and households, but the economic strain on borrowers raised concerns about the quality of their assets. In response, policymakers implemented extensive measures to maintain financial stability. The ECB introduced the Pandemic Emergency Purchase Program and targeted longer-term refinancing operations (TLTRO III) to secure liquidity and prevent a collapse in credit markets. At the same time, regulatory authorities allowed banks to use their capital buffers more flexibly, enabling them to withstand the crisis without limiting lending activities.

The recovery phase saw renewed economic growth alongside a notable rise in inflation. Expansionary fiscal and monetary policies, essential for stimulating demand, also heightened inflationary pressures. Additionally, supply-side disruptions, such as global supply chain bottlenecks and rising commodity prices, further fueled inflation. These dynamics caused the aggregate demand curve to shift to the right due to stimulus measures, while supply shocks led to a leftward shift in the aggregate supply curve, resulting in ongoing upward pressure on prices. Central banks, including the ECB and the FED, responded by gradually raising interest rates; however, managing inflation proved to be a complex and lengthy challenge.

The pandemic had a significant effect on financial markets. Initially, equity markets experienced considerable volatility but later rebounded strongly due to central bank interventions and expansive fiscal policies. In contrast, bond markets

faced more severe challenges related to liquidity and risk perceptions. In the U.S., corporate bond spreads widened significantly at the onset of the crisis, reflecting heightened uncertainty, before narrowing again due to Federal Reserve initiatives like the Primary and Secondary Market Corporate Credit Facilities. The ECB's Corporate Sector Purchase Program in Europe helped stabilize corporate bond spreads and ensured favorable financing conditions for businesses. By 2022, rising interest rates exerted new pressures, particularly on high-yield bonds, reducing liquidity in debt markets.

As extraordinary policy measures are gradually withdrawn, attention has turned to managing the transition back to normalcy. Central banks face the complex task of controlling inflation while promoting economic recovery, as financial systems remain susceptible to new shocks, particularly amid geopolitical uncertainties and increasing borrowing costs. This chapter examines institutional responses to the pandemic and their broader implications, highlighting key lessons and areas for improvement. Understanding the factors that shaped this period is essential for both academic research and strengthening the resilience of global economic systems in anticipation of future challenges.

1.2 Resilience in Banking: Lessons and Challenges from Global Crises

The stability of the banking system is a vital issue, especially during extraordinary events that put significant stress on the global economy. Banks play a crucial role in maintaining credit flow, becoming even more essential during crises that endanger business liquidity and household solvency. Numerous studies conducted after the COVID-19 pandemic have emphasized the unique nature of the market shock, which was not just a health crisis but also an abrupt halt in productive activities and consumption, putting immense pressure on bank balance sheets. Historical evidence suggests that the banking sector can act as a stabilizing force if it has adequate capital reserves, contingency plans, and a robust regulatory framework (BIS, "Annual Economic Report", 2020)[1]. However, the situation post-2020 has revealed potential weaknesses, prompting monetary and fiscal authorities to take extraordinary actions. These measures ensure continued

[1] BIS. 2020. *Annual Economic Report [R]*. Bank for International Settlements, Basilea.

lending, preventing a wave of defaults that could deepen the recession. Such government interventions have extended beyond Europe to a global scale. The Federal Reserve in the U.S. and the Bank of England in the U.K. have reduced benchmark interest rates and launched extensive asset purchase programs to maintain financial stability (Financial Stability Board, 2020)[2]. In this scenario, the banking sector's role as a "guardian of stability" is crucial; without a secure banking system, other policy measures could be undermined by credit paralysis and reduced investor confidence.

In times of crisis, banks can act as both a source of contagion and a pillar of stability. Their exposure to struggling businesses and households can lead to non-performing loans, while strong institutions serve as a key defense against economic downturns. When interbank markets tighten, weaker banks quickly feel the effects of limited risk capital, often forced to cut back or stop lending (European Commission, 2020)[3]. Ensuring the security of the banking system during crises means reducing the rise in default risk that could hinder the operational effectiveness of financial institutions. International prudential standards, as detailed in the Basel Committee on Banking Supervision's "Basel III monitoring report", set minimum capital and liquidity requirements designed to address such situations. The core idea is that during turbulent times, these "buffers" can absorb shocks without requiring banks to further restrict their lending activities. Simultaneously, central banks may implement targeted measures, including favorable refinancing options, asset purchases, and policy rate cuts. Early in the pandemic, the European Central Bank launched the PEPP to enhance market stability and prevent excessive increases in sovereign spreads in countries (ECB, 2020)[4]. While not specifically aimed at banks, these measures positively impacted their resilience by stabilizing markets and alleviating speculative pressures.

Trust serves as the cornerstone of the banking system. Without it, depositors might quickly withdraw their money, leading to a “bank run” with serious consequences. At the same time, businesses could face rising interest rates, making it difficult to manage debt. Therefore, the key issue in discussions about banking security is maintaining trust: stakeholders need to be confident that banks can meet

[2] Financial Stability Board (FSB). 2020. *COVID-19 pandemic: Financial stability implications and policy measures taken [R]*. Financial Stability Board, Basilea.
[3] European Commission. 2020. *Economic Forecast: Spring 2020 [R]*. European Commission, Bruxelles.
[4] ECB. 2020. *ECB Pandemic Emergency Purchase Programme (PEPP) [R]*. European Central Bank, Francoforte.

withdrawal demands and provide financing during critical times. Public interventions and regulatory oversight aim to keep risk perceptions within manageable limits (BCBS, 2021)[5]. These perceptions are influenced by macroeconomic factors like government debt-to-GDP ratios and the overall health of the economy, as well as microeconomic factors such as bank balance sheets, internal risk management, and governance structures. As a result, during crises, authorities often encourage banks to use their capital buffers without excessive concern about temporarily breaching certain metrics. This approach helps prevent "procyclical" reactions that could restrict credit during tough times.

In the face of unexpected shocks like a pandemic, coordinated efforts across sectors become essential. Governments typically implement fiscal measures to support businesses and workers, reducing the likelihood of widespread bankruptcies (Thomsen, 2020)[6]. Central banks also provide emergency financing to help banks avoid liquidity issues during stressful periods (Lane, 2020)[7]. Regulatory authorities have granted banks more leeway in managing non-performing loans and utilizing capital reserves, provided there is full market transparency. The duration of the crisis is a critical factor. If restrictions like lockdowns last too long, the economic structure may suffer lasting damage, forcing some businesses to close permanently. In such cases, even strong banking reserves may fall short, as credit quality deteriorates. In extreme situations, public recapitalization of the hardest-hit banks may be necessary to prevent systemic crises. Economic crises can manifest as liquidity shortages, where otherwise viable businesses face temporary cash flow problems, or as solvency issues, where losses exceed capital. In the former case, bridge resources like emergency loans or state guarantees can help businesses navigate tough times. However, in solvency cases, businesses may be fundamentally unable to meet their obligations, complicating banks' roles significantly. Renegotiating insolvent debt becomes increasingly challenging, and postponing losses can lead to major distortions (European Commission, 2020)[8]. To maintain credibility, banks must avoid hiding non-performing loans beyond a certain level, as this could lead to negative surprises in future financial statements. Regulatory bodies recommend a balanced approach:

[5] Basel Committee on Banking Supervision (BCBS). 2021. *Basel III monitoring report [R]*. Bank for International Settlements, Basilea.
[6] Thomsen, P. M. 2020. *La crisi COVID-19 in Europa e la risposta del Fondo Monetario [Blog]*. International Monetary Fund, Washington D.C.
[7] Lane, P. 2020. *The monetary policy package: An analytical framework [C]*. In: Mitigating the COVID Economic Crisis: Act Fast and Do Whatever It Takes, a cura di R. Baldwin e B. Weder di Mauro, CEPR Press, p. 140–143.
[8] European Commission. 2020. *Economic Forecast: Spring 2020 [R]*. European Commission, Bruxelles.

encouraging proactive credit management, including moratoriums and renegotiations, while steering clear of artificially obscuring economic realities (BCBS, 2021)[9].

In the face of an unexpected crisis, like a pandemic, it is crucial to act on several fronts at the same time. First, governments implement fiscal measures to support businesses and workers, which helps reduce the risk of widespread corporate bankruptcies (Thomsen, 2020)[10]. Next, central banks offer emergency funding to ensure that banks do not face liquidity issues during stressful periods (Lane, 2020)[11]. Regulatory bodies have also granted banks more leeway in how they account for non-performing loans and use capital reserves, provided there is full transparency in the market. A particularly sensitive issue is the duration of the crisis. Extended restrictions, such as lockdowns and temporary closures, can cause lasting damage to the economy, forcing some businesses to shut down permanently. In such cases, even the strongest bank reserves may fall short, leading to a widespread decline in credit. In extreme circumstances, it may be necessary for the government to recapitalize the hardest-hit banks to prevent a systemic crisis.

Economic crises may manifest as liquidity shortages, wherein otherwise viable entities encounter temporary cash flow difficulties, or as solvency issues, characterized by actual losses that exceed capital value. In the former scenario, the provision of bridge resources—such as emergency loans or state guarantees—generally suffices to support businesses during this critical period. Conversely, in the latter situation, the entity is fundamentally unable to meet its obligations, thereby complicating the role of financial institutions. Under these conditions, renegotiating unsustainable debt becomes increasingly challenging, and deferring losses may result in significant economic distortions (European Commission, 2020)[12]. Financial institutions must avoid obscuring non-performing loans beyond a certain threshold to maintain their credibility, as such actions could precipitate unforeseen adverse effects on future balance sheets. Regulatory authorities advocate for a balanced approach: actively monitoring credit, which includes

[9] Basel Committee on Banking Supervision (BCBS). 2021. *Basel III monitoring report [R]*. Bank for International Settlements, Basilea.
[10] Thomsen, P. M. 2020. *La crisi COVID-19 in Europa e la risposta del Fondo Monetario [Blog]*. International Monetary Fund, Washington D.C.
[11] Lane, P. 2020. *The monetary policy package: An analytical framework [C]*. In: Mitigating the COVID Economic Crisis: Act Fast and Do Whatever It Takes, a cura di R. Baldwin e B. Weder di Mauro, CEPR Press, p. 140–143.
[12] European Commission. 2020. *Economic Forecast: Spring 2020 [R]*. European Commission, Bruxelles.

implementing moratoriums and facilitating renegotiations, while steering clear of the artificial concealment of economic realities (BCBS, 2021)[13]. The distinction between flexibility and opacity is nuanced, necessitating clear regulations and transparent accounting practices to prevent a crisis of confidence.

Following the financial crisis of 2008, numerous central banks initiated the adoption of unconventional monetary policies, such as Quantitative Easing (QE) and targeted asset acquisition programs. These measures, originally designed to address low inflation and promote economic recovery, assumed critical importance during the COVID-19 pandemic (Lane, 2020)[14]. The ECB significantly expanded its asset purchase programs within the Eurozone, particularly through the PEPP, thereby signaling a strong commitment to maintaining stable financing conditions for both governments and financial institutions. These interventions enhanced the stability of the banking system by reducing volatility in sovereign bonds, which in turn mitigated the risk of portfolio losses for banks. Additionally, the relatively low borrowing costs for governments facilitated the implementation of expansive fiscal policies aimed at alleviating the economic impacts of the crisis. However, these policies also raise important medium- to long-term concerns. The prolonged maintenance of ultra-low interest rates and the significant expansion of central bank balance sheets may lead to new market distortions, such as excessive leverage or an overly aggressive search for yield. These unintended consequences highlight the delicate balance that central banks must navigate between providing immediate crisis support and ensuring long-term financial stability.

International organizations tasked with ensuring the stability of the banking system, notably the Financial Stability Board (FSB) and the Basel Committee on Banking Supervision (BCBS), have adopted a strategy that emphasizes coordination and flexibility. The core tenet of this approach is that each country must possess the ability to utilize its accumulated capital and liquidity reserves without inadvertently compromising the integrity of its banking sector (Financial Stability Board, 2020)[15]. Concurrently, national regulators are urged to avoid abrupt regulatory changes that could destabilize markets, while maintaining

[13] Basel Committee on Banking Supervision (BCBS). 2021. *Basel III monitoring report [R]*. Bank for International Settlements, Basilea.
[14] Lane, P. 2020. *The monetary policy package: An analytical framework [C]*. In: Mitigating the COVID Economic Crisis: Act Fast and Do Whatever It Takes, a cura di R. Baldwin e B. Weder di Mauro, CEPR Press, p. 140–143.
[15] Financial Stability Board (FSB). 2020. *COVID-19 pandemic: Financial stability implications and policy measures taken [R]*. Financial Stability Board, Basilea.

vigilant oversight of the most significant banking risks. A consensus among experts suggests that these strategies have, to date, successfully prevented the anticipated cascading failures of numerous banks (IMF, 2020)[16]. However, the most significant challenge arises when fiscal and monetary support measures are gradually withdrawn. If the real economy does not achieve a robust recovery, there is a risk of delayed defaults, which could place renewed strain on bank balance sheets. Thus, the primary challenge lies in managing the transition away from emergency measures without triggering market disruptions.

Ensuring the resilience of the financial system during periods of crisis requires a concerted effort among governments, central banks, regulatory authorities, and financial institutions. The utilization of available tools, such as fiscal support initiatives and emergency liquidity provisions, is crucial for maintaining public confidence and preventing an economic downturn from escalating into a systemic financial failure. Concurrently, it is essential to uphold high standards of transparency, avoiding accounting manipulations and promptly disclosing any losses incurred. The COVID-19 pandemic has highlighted the importance of well-capitalized banks and the necessity for policies that can withstand external non-financial shocks. The crisis has also emphasized the role of international organizations in fostering financial stability. The reforms enacted following the 2008 financial crisis have produced positive outcomes; however, new challenges continue to emerge. A key takeaway is the need to integrate new insights into more flexible regulatory frameworks without compromising prudence. While capital and liquidity buffers enabled banks to absorb some of the shocks, the events underscored the urgent need for effective protocols to manage liquidity crises and facilitate debt restructuring (European Commission, 2020)[17]. Well-structured procedures can reduce the likelihood of disputes and support business continuity during temporary crises. Future discussions on potential reforms may involve reassessing the role of central banks as providers of emergency liquidity during global lockdowns, establishing supranational deposit insurance systems (notably, the European banking union remains incomplete), and formulating common principles to address significant increases in insolvencies (IMF, 2020)[18]. Failing to adopt a cohesive strategy would leave national banking institutions more

[16] IMF. 2020. *Financial Stability Report [R]*. International Monetary Fund, Washington D.C.
[17] European Commission. 2020. *Economic Forecast: Spring 2020 [R]*. European Commission, Bruxelles.
[18] IMF. 2020. *Financial Stability Report [R]*. International Monetary Fund, Washington D.C.

susceptible to external shocks and speculative attacks, particularly during various crises, including those related to climate change or geopolitical tensions. Ultimately, the protection of the banking system during crises necessitates a collaborative approach across all sectors. It is not a matter of implementing a singular, miraculous solution but rather of constructing a comprehensive network of defenses—normative, institutional, financial, and communicative. Strengthening the overall credibility of the sector provides tangible benefits for economic stability and the well-being of businesses and households. Recent challenges have underscored the critical importance of proactive monetary policy and macroprudential oversight, supported by a regulatory framework designed to ensure the resilience of banks during extraordinary circumstances.

1.3 Inflation Dynamics Post-Pandemic: The Role of Demand, Supply, and Policy Responses

In the aftermath of the pandemic, advanced economies, such as the United States and the euro area, witnessed a notable increase in inflation. This increase ignited considerable discussion concerning the principal factors behind these price pressures. Conventional inflationary causes, such as supply shocks, were exacerbated by robust demand growth, which became a principal factor propelling the swift rise in prices. Recent research (Giannone and Primiceri, 2024)[19] indicates that although supply shocks adversely affected economic activity, the principal catalyst of inflation was a significant increase in demand, which propelled price escalation more persistently than previously expected. In the aftermath of the pandemic, inflation was driven by a blend of expansive fiscal measures and accommodative monetary policies, leading to a swift resurgence in aggregate demand. Demand became the main driver of inflation (Giannone and Primiceri, 2024)[19], as consumer behavior returned to pre-pandemic norms, often amplified by government assistance. While supply shocks, including supply chain disruptions and escalating energy costs, affected the availability of goods and services, it was the increase in demand that propelled price levels upward, exerting mounting pressure on both consumers and businesses.

[19] Giannone, D., & Primiceri, G. 2024. *The Role of Demand in Post-Pandemic Inflation* [Article]. Economic Review.

The research conducted by Forbes et al.[20] emphasizes that although supply shocks have contributed to a decline in economic activity and production, it is demanding shocks that have been crucial in propelling inflation. When demand is high and supply is constrained, companies typically raise prices to maximize profits. The global increase in energy consumption has substantially raised energy costs, which have directly affected the prices of goods and services (Giannone and Primiceri, 2024)[19].

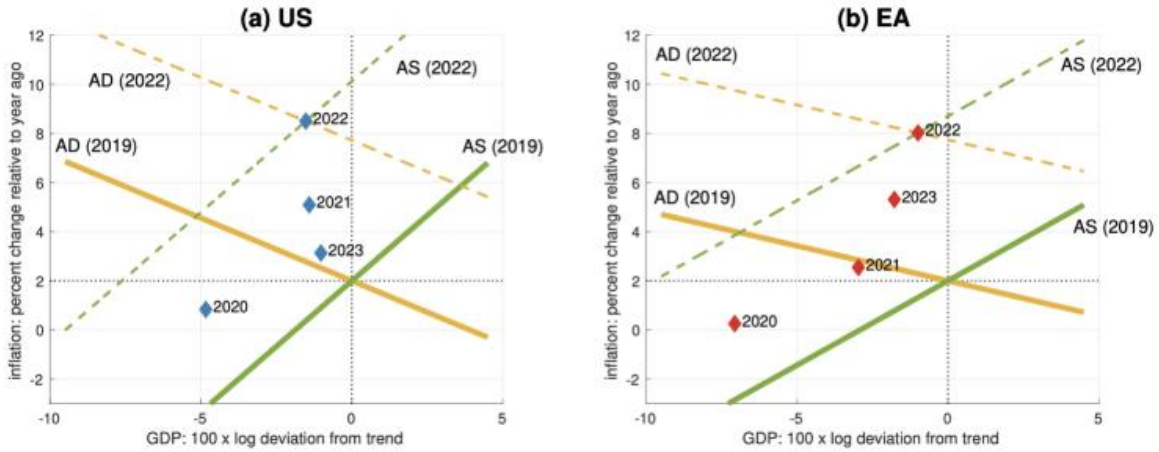
Central banks' response to post-pandemic inflation involved the difficult task of reconciling the need for growth stimulation with the imperative of managing inflationary pressures. The accommodative monetary policies implemented by the FED and ECB were instrumental in stimulating aggregate demand. The ECB specifically enacted policies including low interest rates and asset purchase programs to invigorate the economy. The main goal was to stimulate economic recovery and mitigate the decline in economic activity resulting from the pandemic. Nonetheless, although these policies were crucial in addressing recessionary trends, they inadvertently increased demand, consequently intensifying inflationary pressures. Expansive policies augmented household purchasing power and credit accessibility, stimulating a surge in demand for goods and services. This consequently resulted in increased consumption levels, which conflicted with supply limitations, especially in critical sectors like energy and durable goods manufacturing. Understanding this phenomenon requires analyzing the interaction between aggregate demand (AD) and aggregate supply (AS) curves. Expansive monetary policies displaced the AD curve to the right, augmenting demand, whereas supply shocks—particularly those associated with energy—moved the AS curve to the left, intensifying inflation. The interaction of increasing demand and limited supply generated a conducive environment for heightened inflation rates (Lane, 2022)[21].

Energy shocks have played a crucial role in post-pandemic inflation. The increase in energy prices, fueled by rising global demand and diminished energy supplies, directly affected economies, especially those dependent on energy imports, like the euro area. Giannone and Primiceri[22] contend that the increase in energy prices was

[20] Forbes, K., et al. 2024. *The Demand-Side Inflationary Pressures in the Post-Pandemic Recovery* [Article]. Journal of Monetary Economics.
[21] Lane, P. R. 2022. *Inflation Diagnostics* [Blog]. European Central Bank, Frankfurt am Main.
[22] Giannone, D., & Primiceri, G. 2024. *The Role of Demand in Post-Pandemic Inflation* [Article]. Economic Review.

primarily driven by robust global demand for energy, rather than merely supply chain disruptions, and was further intensified by the conflict in Ukraine. The confluence of escalating energy expenses and substantial domestic demand resulted in price surges that significantly impacted European economies, necessitating intervention by the ECB. Despite attempts to stimulate demand via accommodative monetary policies, the ECB encountered rising costs for businesses, prompting them to increase prices to offset these elevated expenses. This dynamic established a self-perpetuating cycle of inflation that was challenging to control. An examination of aggregate demand and aggregate supply curves demonstrates that, although the ECB endeavored to shift the AD curve to stimulate the economy, the influence of energy shocks on the AS curve prevailed, exacerbating inflation (Lane, 2022)[21].

Figure 1 - AD AS Curves



In response to heightened inflation, central banks confronted the difficult challenge of increasing interest rates to restrain excessive demand while mitigating adverse effects on economic growth. Beginning in 2022, the Federal Reserve and the European Central Bank initiated cycles of interest rate increases to mitigate inflation. Nonetheless, the impacts of these measures necessitated considerable time to be completely manifested in the wider economy. More stringent monetary policies displaced the AD curve to the left, aiming to curtail domestic demand. However, the immediate effects of these policies were constrained, highlighting the delay between policy execution and its results. The Bank of England's choice to maintain interest rates despite robust wage growth indicated its evaluation that, although there are immediate indications of increasing inflation, the current

monetary policy would steer inflation back to the 2% target in the medium term (Tenreyro, 2023)[23]. This strategy corresponds with a comprehensive post-pandemic monetary policy framework, highlighting future expectations and the progression of aggregate demand as essential components in economic stabilization. Tenreyro emphasizes that a "forward-looking" approach by central banks significantly influenced monetary policy and averted rampant inflation.

The AD-AS model offers a significant framework for comprehending inflationary dynamics and monetary policies. The AD curve depicts the correlation between price levels and the overall quantity of goods and services demanded. Positive demand shocks, including fiscal stimulus or expansive monetary policies, result in a rightward shift of the AD curve, causing heightened demand and elevated price levels. Conversely, supply shocks, such as increasing energy expenses, shift the aggregate supply curve to the left, elevating production costs and propelling prices upward. The interaction between demand and supply dynamics provides essential understanding of the fundamental factors driving inflation. For example, when fiscal policies enhance consumer expenditure amid ongoing supply-side limitations, the concurrent rightward shift in the AD curve and leftward shift in the AS curve can exacerbate price inflation. These dynamics underscore the necessity of meticulously calibrated monetary responses to stabilize inflation without intensifying supply-side pressures. The AD-AS framework continues to be a fundamental instrument for assessing policy trade-offs in times of economic instability.

Accommodative monetary policies that stimulate demand may yield short-term economic benefits; however, in the absence of a proportional increase in supply, they frequently result in inflationary pressures. Central banks, including the European Central Bank, have confronted the complex challenge of reconciling these dynamics, striving to promote growth while preventing an increase in inflationary pressures (Forbes et al., 2024)[24]. In the post-pandemic context, where demand had markedly increased, the ECB was necessitated to implement restrictive policies to avert the continued rightward shift of the AD curve, which would have further escalated price levels.

[23] Tenreyro, S. 2023. *Monetary Policy in the Face of Large Shocks* [Speech]. Resolution Foundation, London.
[24] Forbes, K., et al. 2024. *The Demand-Side Inflationary Pressures in the Post-Pandemic Recovery* [Article]. Journal of Monetary Economics.

The post-pandemic inflation analysis reveals that escalating prices were predominantly propelled by heightened demand, stimulated by expansive fiscal and monetary policies. Nonetheless, supply shocks, especially in the energy sector, intensified inflationary pressures by causing a leftward shift in the aggregate supply curve. Notwithstanding the increase in interest rates, the European Central Bank's monetary policies failed to promptly mitigate inflation, as domestic demand persisted at high levels due to continuous expansionary measures (Lane, 2022)[25]. Central banks confronted the essential dilemma of fostering economic growth while managing inflation, simultaneously mitigating the risk of instigating a recession. The proactive strategy employed by prominent central banks exhibited strategic foresight; however, progressing ahead necessitates ongoing vigilance to maintain both price stability and enduring economic growth.

In the long term, sustaining equilibrium between aggregate demand and aggregate supply will continue to be a primary challenge for inflation control and monetary policy. The interplay of the AD-AS curves is essential for comprehending the effects of economic shocks and monetary policies on price levels. The economic stability in the post-pandemic period will primarily rely on central banks' capacity to adeptly manage demand via precisely calibrated monetary policies, while concurrently promoting sustainable economic growth. The interaction between demand and supply necessitates vigilant observation, as minor discrepancies can induce substantial price variations. Policies designed to enhance demand without tackling supply-side limitations may intensify inflationary pressures. Conversely, excessively stringent measures may inhibit growth, necessitating that central banks achieve an appropriate equilibrium. Maintaining this balance will be essential for facilitating recovery and alleviating the risks of future economic disruptions.

1.4 Financial Markets Under Pressure: COVID-19 and the Shift in Central Bank Policies

This paragraph belongs to the chapter on the ramifications of COVID-19, analyzing financial market fluctuations from 2020 to 2024, a period marked by unprecedented events. The pandemic initiated an unparalleled global crisis that

[25] Lane, P. R. 2022. *Inflation Diagnostics* [Blog]. European Central Bank, Frankfurt am Main.

disrupted both the real economy and equity and bond markets, significantly affecting investor behavior and central bank policies. This section analyzes variations in financial markets to elucidate the connections among the monetary and fiscal policies implemented during the crisis, inflation patterns, and alterations in interest rates. Equity markets initially experienced high volatility, later recovering mainly due to public interventions. Moreover, the bond markets experienced significant alterations in spreads because of liquidity policies. The analysis focuses on European corporate bonds, where the ECB's large-scale asset purchases played a crucial role, and on Option-Adjusted Spreads (OAS), which reflect investors' risk assessments amid rising inflation and interest rates since 2022. This analysis offers critical insights into the responses of financial markets to global challenges and the influence of policy decisions on these reactions.

The COVID-19 pandemic exerted an unparalleled influence on global stock markets in 2020, resulting in an immediate and significant correction across all major indices. The significant decline in the initial months of the year reflected widespread apprehension regarding the economic ramifications of the pandemic, the cessation of production activities, and increasing global uncertainty. The coordinated monetary and fiscal response was crucial in facilitating a gradual recovery in financial markets. The Euro Stoxx 50 in Europe rebounded at a slower pace than in the United States. This partially illustrates the disparity among EU member states in their crisis management approaches and the duration required to implement unified support measures, such as the Recovery Fund. Conversely, despite the European Central Bank's ongoing initiatives via the asset purchase program and historically low interest rates, European indices concluded the year below their pre-pandemic levels, highlighting the subdued nature of economic recoveries in 2020. Conversely, the US equity markets exhibited considerable resilience, with the S&P 500 concluding the year in positive territory. This was effectively supported by the Federal Reserve's assertive stimulus measures, including interest rates reduced to nearly zero and the implementation of quantitative easing programs. Thirdly, the substantial fiscal packages provided by the federal government to support businesses and households resulted in increased confidence among investors overall. The Federal Reserve[26] indicated

[26] Federal Reserve. 2020. *Financial Stability Report, November 2020*. Washington D.C.

that the exceptional performance of technology stocks was significantly driven by substantial demand for their services in the digital realm. The extraordinary advancements in technology firms surpassed the declines in conventional sectors such as energy and finance, which were significantly impacted by the plummet in oil prices and increased economic instability. Additional contributing factors, as per the OECD[27], encompass the implementation of historically low interest rates, which reduced the cost of capital and stimulated investments in higher-risk assets such as equities. The subdued inflation in the early stages of the crisis fostered a conducive atmosphere for stock market investments, facilitating a more rapid recovery in certain indices relative to others (ECB, 2020)[28].

The 2020 pandemic-induced crisis severely disrupted the US bond market, with institutional investors intensifying selling pressure in the corporate bond sector to boost liquidity amid economic uncertainty. The rush to safe-haven assets resulted in a significant widening of spreads between corporate bonds and Treasury securities, indicating heightened risk aversion and a worsened perception of credit conditions. By March 2020, investment-grade bond spreads had expanded to approximately 400 basis points, a level last observed during the 2008 financial crisis. This increase indicated both the declining prospects for the global economy and an initial skepticism regarding the efficacy of economic policies to mitigate the crisis (IMF, 2020)[29]. The pivotal moment in this trend occurred as a reaction from the Federal Reserve. The Federal Reserve unequivocally committed to ensuring liquidity and bolstering financial stability by initiating the asset purchase program and establishing credit facilities like the PMCCF and SMCCF. These instruments enabled the central bank to acquire corporate bonds from both primary and secondary markets, alleviating price pressures and enhancing liquidity conditions. These interventions soon started to yield results. The investment-grade corporate spreads, which expanded to over 150 basis points at the beginning of the crisis, consistently contracted to below 150 by year-end. The primary factors contributing to this improvement were identified as Federal Reserve policies, clarity regarding economic outlooks, and anticipations of decreasing inflation in the upcoming months. The reduction in spreads indicated restored investor confidence and, consequently, the efficacy of measures implemented to stabilize the bond market.

[27] Organisation for Economic Co-operation and Development. 2020. *Economic Outlook 2020*. OECD Publishing, Paris.
[28] European Central Bank. 2020. *Annual Report 2020*. European Central Bank, Frankfurt.
[29] International Monetary Fund. 2020. *Global Financial Stability Report, October 2020*. International Monetary Fund, Washington D.C.

The trend in spreads emphasizes that prompt and focused monetary interventions can mitigate the effects of economic crises and avert systemic decline in credit conditions. The corporate bond market in Europe received significant backing, particularly through the European Central Bank's Corporate Sector Purchase Program. This program facilitated the maintenance of low spreads and secured advantageous financing conditions for enterprises. Since 2022, escalating inflation has compelled the ECB to progressively reduce its asset acquisitions, indicating a transition towards the normalization of monetary policy (JP Morgan, 2024)[30].

The OAS of European corporate bonds serve as a significant indicator of market risk perception and liquidity conditions. The current OAS, approximately 108 basis points, signifies historic lows due to a confluence of favorable elements, such as accommodative monetary policies and persistent investor demand. These factors have fostered a macroeconomic landscape marked by stability and moderate economic expansion (JP Morgan, 2024)[30]. Nevertheless, the acceleration of rate hikes since 2022 has started to exert pressure on specific bond issuances, especially those with inferior credit ratings or heightened sensitivities to capital expenses. This has significantly affected market liquidity, as investors have become more discerning and shifted towards bonds with robust fundamentals and reduced risk profiles. Therefore, despite the diminished levels of OAS, the corporate bond market remains susceptible to external shocks—such as geopolitical occurrences or additional rate hikes—that could negate the trend of spread compression. These factors have enhanced liquidity and reduced financing costs, rendering corporate bonds appealing to yield-seeking investors. Furthermore, the accessibility of financial instruments that aided companies during the pandemic enhanced market confidence.

The sectoral analysis of bond spreads reveals significant disparities. Technology and pharmaceuticals have demonstrated greater resilience thus far, as their profit sources are more stable and the demand for their products and services is inherently high. Energy and commodities firms have exhibited broader spreads. The spread differential signifies persistent uncertainties regarding commodity prices and inflation collapse—issues that continue to challenge investors

[30] JP Morgan Asset Management. 2024. *Fixed Income Quarterly Perspectives*. JP Morgan, New York.

(Morningstar, 2024)[31]. Overall, 2024 presents favorable prospects in the European corporate bond market. Due to diminished inflation, certain analysts anticipate interest rate reductions from the European Central Bank, which could narrow or further widen spreads. Nonetheless, there were also cautions that the default risk would marginally rise, primarily due to the delayed effect of elevated financing costs on corporations.

In this context, investors are increasingly prioritizing financial instruments that provide an advantageous risk-return profile (Morningstar, 2024)[31]. The attractiveness of euro-denominated corporate bonds relative to dollar-denominated bonds is increasing, propelled by advantageous yield differentials and a relatively stable exchange rate environment (JP Morgan, 2024)[32]. These changes signify a significantly more intricate and interrelated system in international financial markets, wherein central bank policies assume an increasingly pivotal role. Institutional investors are crucial market participants that provide liquidity and stability, particularly pension funds and insurance companies during periods of turmoil (OECD 2020)[33].

[31] Morningstar. 2024. *Fixed-Income Market Overview*. Morningstar, Chicago.
[32] P Morgan Asset Management. 2024. *Fixed Income Quarterly Perspectives*. JP Morgan, New York.
[33] Organisation for Economic Co-operation and Development. 2020. *Economic Outlook 2020*. OECD Publishing, Paris.

Literature Review

An intriguing interplay exists between regulatory frameworks, economic dynamics, and market behaviors, as evolving perceptions of credit risk and bond markets influence each other. This chapter provides a comprehensive overview of key reforms, quantitative instruments, and financial system trends and aims to elucidate how financial stability, investment decisions, and market efficiency are influenced by adopting diverse perspectives on credit risk.

The discussion then shifts to the historical evolution of credit risk, showing its transformation from a secondary aspect to a fundamental pillar of financial regulation and market analysis. Subsequently, pivotal events transpired, notably the 2008 financial crisis, which catalyzed substantial reforms through the implementation of the Basel III framework. The reforms encompassed enhanced capital requirements, substantially improved liquidity buffers, and leverage standards that safeguarded a bank from insolvency or failures induced by external factors. The reforms emphasized counterparty credit risk, an area underscored by notable incidents like the collapse of Archegos Capital, which revealed the imperative for robust governance and risk mitigation strategies. The integration of theory and technology has enhanced default probability estimation and market stability, exemplified by the evolution of modeling techniques, including Merton's structural framework and machine learning applications.

The subsequent phase involves a thorough examination of the relationship among credit ratings, default probability, and bond spreads. Credit ratings issued by agencies like Moody's and S&P provide a long-term assessment of an issuer's creditworthiness. Nonetheless, numerous individuals contend that these ratings fail to deliver adequate short-term market efficiency. Conversely, bond spreads serve as more dynamic and immediate indicators of shifts in sentiment, liquidity conditions, and macroeconomic cycles in real time. This contrasts with traditional market indicators. In the realm of monetary easing, quantitative easing policies have momentarily narrowed spreads to stabilize markets; nonetheless, these policies have also concealed inherent risks. This section aims to highlight the integration of qualitative insights and quantitative metrics essential for achieving a balanced and precise credit risk analysis.

A crucial element of this discussion is the Option-Adjusted Spread, a versatile tool that distinguishes credit risk from both market-specific and sector-specific factors. The OAS is especially beneficial for assessing high-yield bonds, callable instruments, and debt from emerging markets, where credit risk is heightened by factors like currency volatility and political instability. By employing advanced quantitative techniques like Monte Carlo simulations, OAS delivers actionable insights, aiding stakeholders in making informed decisions while considering uncertainties and identifying undervalued opportunities to optimize their portfolios.

This chapter also encompasses a discourse on the susceptibility of emerging markets, which is another critical subject addressed. Given their substantial reliance on debt in foreign currencies, these economies exhibit increased sensitivity to global monetary tightening and capital outflows. The escalation of interest rates in the United States and the depreciation of currencies exacerbate these risks by elevating financing costs and jeopardizing the country's fiscal sustainability. The chapter asserts that the advancement of local bond markets, the improvement of regulatory oversight, and the fortification of international collaboration are essential actions to address these challenges. This article emphasizes the significance of transparency, especially in the context of reporting on sovereign and corporate debt, as a strategy to attract investment and maintain market stability.

The final section delineates the distinctions between the investment-grade bond market and the high-yield bond market, providing a comprehensive analysis of their divergent behaviors. The spreads on investment-grade bonds have widened due to persistent macroeconomic uncertainties, geopolitical tensions, and diminished investor demand, whereas the spreads on high-yield bonds have narrowed owing to solid corporate fundamentals, strong demand, and limited supply. The conclusion highlights the broader ramifications of these trends, underscoring the intricacies of credit risk and the adaptive strategies necessary in an increasingly integrated and volatile financial landscape.

2.1 Redefining Credit Risk: Evolution, Challenges, and Regulatory Responses

Credit risk has evolved significantly, reflecting the structural transformations in financial markets and the progressively stringent regulations aimed at mitigating associated risks. The Basel Committee on Banking Supervision has significantly contributed to the formulation of global standards for risk management, thereby improving the stability of the financial system. Credit risk was a primary factor contributing to instability during the 2008 financial crisis. The lack of sufficient capital requirements and efficient risk management systems intensified the effects of the crisis. In response, the Basel Committee formulated and implemented the Basel III reforms designed to enhance the resilience of the banking sector and mitigate systemic risks. Key innovations of Basel III included elevated capital requirements, buffers intended to mitigate the credit cycle, and more stringent liquidity and leverage standards than those previously established (Basel Committee, 2010)[34].The Basel III reforms also establish two global liquidity standards—the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR)—intended to ensure that banks sustain an adequate liquidity buffer to address liquidity pressures in both short- and medium-term periods. The Leverage Ratio was established as a safeguard against excessive leverage, a significant vulnerability during the 2008 crisis. These measures have facilitated the establishment of a more resilient and transparent banking system (Bank of Italy, 2023)[35].

Over the intervening years, CCR has emerged as an increasingly significant issue. The 2021 collapse of Archegos Capital Management exposed significant deficiencies in the oversight of CCR, particularly concerning exposures to highly leveraged non-bank financial entities. The Basel Committee released revised guidelines in 2024 that incorporated best practices such as continuous due diligence, the implementation of advanced risk mitigation techniques, and the utilization of additional measures for exposure assessment. The revised guidelines emphasize the significance of effective governance in mitigating risks associated with counterparty exposures, highlighting the importance of robust management

[34] Basel Committee on Banking Supervision. 2010. *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems*. Bank for International Settlements, Basel.
[35] Bank of Italy. 2023. *Annual Report 2023: Financial Stability in Italy*. Bank of Italy, Rome.

by senior leadership and the proper execution of control systems. The measures seek to enhance banks' resilience to potential future shocks, while advocating for a proportional and risk-based methodology in exposure management.

The theory of credit risk has advanced considerably, with the creation of new models that enhance the analysis and quantification of default risk. The structural model proposed by Merton[36] in 1974 is a seminal work and one of the initial systematic efforts to quantitatively estimate the probability of default. The model regards a stochastic process as the fundamental basis for assessing company assets, whereby default transpires when asset value declines below the outstanding debt owed. Such methods introduce concepts such as "distance to default," which serves as a primary metric for assessing a company's proximity to insolvency. This metric, based on option theory, connects a company's capital structure to its credit risk. Merton's model was pivotal in establishing the theoretical framework for credit risk and in providing the groundwork for various subsequent methodologies, including KMV-type models and other structural variants.

The Black and Scholes[37] framework laid the theoretical foundation for structural models. Their option pricing equation introduced the concept that a firm's market value can be viewed as a call option on its assets. In this context, the shareholders hold the entitlement to any residual value remaining after the creditors have been completely compensated. Connecting credit risk to the market value of corporate assets transformed risk assessment methodologies by emphasizing the modeling of the dynamics of underlying assets and corporate liabilities. This framework will enable risk managers and analysts to more accurately quantify default risk, incorporate market data into credit evaluations, and improve the predictive capability of credit models.

In contrast to structural models, reduced-form approaches take a fundamentally different perspective by avoiding the explicit modeling of a firm's asset dynamics (Duffie and Singleton, 1999)[38]. Rather, these methods regard default risk as an exogenous stochastic process defined by a default intensity or an instantaneous hazard rate. The hazard rate represents the likelihood of a firm's default occurring within a specified time frame, contingent upon the condition that it has not

[36] Merton, R. C. 1974. *On the Pricing of Corporate Debt: The Risk Structure of Interest Rates*. Journal of Finance, 29(2): 449–470.
[37] Black, F., & Scholes, M. 1973. *The Pricing of Options and Corporate Liabilities*. Journal of Political Economy, 81(3): 637–654.
[38] Duffie, D., & Singleton, K. J. 1999. *Modeling Term Structures of Defaultable Bonds*. Review of Financial Studies, 12(4): 687–720.

previously defaulted. Focusing on this probabilistic framework, reduced-form models adopt a more concise method to examine the relationship between credit spreads and default probabilities. Many of them incorporate essential market-driven factors such as interest rates, volatility, liquidity, and fluctuations in investor sentiment, facilitating significant adaptability to real-world financial contexts. The efficacy of these complementary models resides not in their comparisons but in their unique contributions to the comprehensive understanding of credit risk. Conversely, structural models offer robust theoretical support and a solid foundation of the economic principles underlying a firm's asset and liability structure, facilitating profound insights into the default process. The reduced-form model is adaptable, market-focused, particularly effective in responding to swift market fluctuations, and more suitably aligns with the practical requirements of financial professionals. The interaction of these two methodologies has established a comprehensive framework that remains fundamental to contemporary practices in credit risk assessment, management, and pricing.

The Basel III reforms constitute a systemic response to the failures that occurred during the 2008 financial crisis. A key aspect of these reforms is the focus on capital quality through the implementation of more stringent Tier 1 capital requirements. The implementation of the Credit Valuation Adjustment increased the risks associated with fluctuations in the market value of derivatives, necessitating targeted measures to manage Counterparty Credit Risk (CCR). A floor on the output represents a significant innovation that establishes the minimum capital savings permitted by internal models in comparison to the standardized approach. This initiative seeks to mitigate the distortions arising from excessive dependence on internal models and to enhance comparability among financial institutions (Basel Committee, 2017)[39]. Credit risk will persist in its evolution as economic and technological developments occur. The growing utilization of financial technologies, such as AI and machine learning, offers novel prospects for enhancing risk management, yet it simultaneously prompts concerns regarding the transparency and dependability of these models. It is imperative that financial institutions and regulators continue to collaborate on innovative

[39] Basel Committee on Banking Supervision. 2017. *Basel III: Finalising Post-Crisis Reforms*. Bank for International Settlements, Basel.

solutions that reconcile efficiency with security.

2.2 Credit Risk Dynamics: Ratings, Default Probabilities and Bond Spreads

The relationship between credit ratings, probability of default (PD), and bond spreads is one of the most extensively studied topics in the field of finance and credit risk. These three elements, while closely interconnected, exhibit characteristics that make them both distinct and complementary in assessing financial risk. Understanding their interaction is essential for analyzing bond markets and crafting effective investment strategies.

The credit rating is an evaluation provided by specialized agencies, such as Moody's, S&P, and Fitch, indicating an issuer's capacity to meet its financial commitments. This indicator offers a broad spectrum of qualitative and quantitative data, integrated into the assessment of the subject's creditworthiness. For instance, ratings such as AAA indicate minimal default risk, while ratings like CCC signify a significantly elevated risk. Rating agencies play a pivotal role in influencing investor confidence and risk assessment. The significance of ratings in assessing default risk and their association with expanding credit spreads is extensively recorded (Altman, 1989)[40]. Ratings serve as a long-term risk indicator; however, they fail to account for short-term fluctuations, which are more accurately represented by credit spreads (Cantor & Packer, 1996)[41]. The consistency of ratings over time is crucial for advising investors to mitigate uncertainty related to investment choices.

Credit ratings significantly influence the financing decisions of companies, even when accounting for alternative theories such as trade-off and pecking order theories. The variables denoting credit ratings are crucial in forecasting managerial conduct regarding capital structure, including dummy variables for nearness to a rating alteration. Companies nearing potential rating changes exhibit reduced debt-equity issuance relative to firms not encountering such changes. Companies with ratings at the extremes of their category exhibit substantial discrepancies in financing decisions. For example, the highest and lowest rated firms within their

[40] Altman, E. I. 1989. "Measuring Corporate Bond Mortality and Performance." *The Journal of Finance*, 44(4), 909–922.
[41] Cantor, R., & Packer, F. 1996. "Determinants and Impact of Sovereign Credit Ratings." *FRBNY Economic Policy Review*, 2(2), 37–54.

classification generate approximately 1.5% less net debt in relation to net equity or vice versa as a percentage of total assets (Kisgen, 2003)[42]. This trend applies to firms nearing a potential upgrade, those approaching a potential downgrade, as well as both large and small enterprises. These findings underscore that managers adopt conservative strategies to maintain or improve credit ratings, as fluctuations in ratings can significantly affect capital costs and investor perceptions. Transitions between critical categories, especially between AA and B ratings or between investment-grade and junk bond status, significantly affect firms' capacity to access debt markets under advantageous conditions.

The probability of default is a fundamental aspect of credit risk assessment, defined as the likelihood that an issuer will fail to fulfill its financial obligations within a designated timeframe. This quantitative metric, derived from sophisticated models, amalgamates historical data, financial statement analysis, and macroeconomic forecasts to assess an issuer's susceptibility. By incorporating these diverse factors, PD offers a comprehensive method for assessing creditworthiness, thereby enabling financial institutions and investors to make judicious decisions regarding risk management and investment strategy.

The correlation between the probability of default and credit ratings is neither linear nor precise, as ratings provide a qualitative assessment that frequently includes factors beyond direct quantification. Ratings do not consistently reflect the likelihood of default, which is often exaggerated by bond markets in times of increased uncertainty (Huang & Huang, 2003)[43]. This discrepancy highlights the significance of idiosyncratic factors, including sector-specific volatility and firms' risk management practices. These factors reflect the intricate nature of credit risk assessment, and a methodology that incorporates both qualitative and quantitative perspectives is likely to produce a more accurate estimate of stability. The probability of default is a fundamental aspect of credit risk assessment, defined as the likelihood that an issuer will fail to fulfill its financial obligations within a designated timeframe. This quantitative metric, derived from sophisticated models, incorporates historical data, financial statement analysis, and macroeconomic forecasts to assess an issuer's susceptibility. By incorporating

[42] Kisgen, D. J. 2003. "Credit Ratings and Capital Structure." *The Journal of Finance*, 58(3), 1035–1072.
[43] Huang, J., & Huang, M. 2003. "How Much of the Corporate-Treasury Yield Spread Is Due to Credit Risk?" *The Review of Asset Pricing Studies*, 2(2), 153–202.

these diverse factors, PD offers a comprehensive approach to creditworthiness, enabling financial institutions and investors to make judicious decisions regarding risk management and investment strategy.

The disparity between PD and credit ratings may be exacerbated under unfavorable market conditions, as evidenced by consecutive downgrades during the pandemic. The Bank of Italy on 2021[44] asserts that a dynamic and integrated strategy for PD management is essential, considering both microeconomic factors, such as corporate health, and macroeconomic elements, including economic growth rates and monetary policies. This would facilitate the prompt identification of risk emergence and the implementation of preventive measures to mitigate the impact of PD on bond markets. According to a Bank of Italy, economic cycles significantly influence the PD: during recessions, increasing unemployment, diminished demand, and credit constraints substantially elevate the risk of business defaults. In contrast, economic booms reduce the likelihood of insolvency risks due to an improved financial condition and increased liquidity within the system. In these circumstances, the Federal Reserve and the European Central Bank have played a crucial role in alleviating the effects of an economic crisis on PD. During the COVID-19 pandemic, expansive monetary policies, such as near-zero interest rates and extensive asset purchase programs, maintained favorable liquidity and financing conditions for businesses, temporarily decreasing default probabilities (ECB, 2020)[45]. The retraction of these measures has heightened vulnerabilities in specific sectors, especially those with elevated leverage ratios. The Basel Committee is prominently emphasized in the management of probability of default concerning global financial stability. The reforms implemented under Basel III mandate augmented capital reserves for banks to address the elevated risk associated with a high probability of default. It also established the Liquidity Coverage Ratio and the Net Stable Funding Ratio to enhance the resilience of the banking system, enabling financial institutions to manage liquidity crises without exacerbating default risk.

Credit spreads, also referred to as bond spreads, are essential in evaluating credit risk within financial markets. It fundamentally assesses the disparity between the

[44] Bank of Italy. 2021. "Probability of Default and the Management of Credit Risk." *Annual Economic Bulletin*. Bank of Italy, Rome.
[45] European Central Bank (ECB). 2020. "The Role of Monetary Policy in Managing Credit Risk During the COVID-19 Pandemic." *ECB Economic Bulletin*. European Central Bank, Frankfurt.

yield of a corporate bond and that of a risk-free security, such as government bonds issued by highly reputable entities like U.S. Treasuries or German Bunds. This spread signifies the premium required by investors to offset the credit risk linked to the bond issuer, excluding considerations of default probability, market liquidity, and other sector-specific or company-specific idiosyncrasies. Credit spreads represent the additional cost of capital for corporations beyond what can be secured through risk-free debt instruments. The spreads fluctuate based on the credit ratings assigned by credit rating agencies such as Standard & Poor's, Moody's, and Fitch. The rating represents a subjective assessment of an issuer's capacity to fulfill interest obligations on existing debts, serving as a primary indicator of credit risk probability. Numerous academic and institutional studies have determined that credit spreads encompass not only intrinsic probability of default or ratings but also a significant market-driven element. Idiosyncratic volatility, defined as the variance in returns specific to an issuer and independent of overall market fluctuations, is regarded as a crucial factor influencing credit spreads (Campbell & Taksler, 2003)[46]. This discovery indicates that, despite the lack of substantial alterations in credit fundamentals, spreads may considerably widen due to heightened idiosyncratic volatility. For instance, in the event of sectoral stress, such as a crisis in the energy or technology sectors, investors require a higher premium to mitigate increased uncertainty, even if ratings remain unchanged or the probability of default is very low. While credit spreads may experience swift fluctuations in the short term due to market events, ratings are designed to be stable and oriented towards the long term. Cantor and Packer[47] assert that "the contrast between the dynamic nature of credit spreads and the stability of ratings underscores the necessity for an integrated approach to credit risk assessment, incorporating both quantitative and qualitative factors." For instance, following the 2008 crisis, numerous issuers retained high ratings yet experienced a surge in spreads due to a segment of the investor base losing confidence amid unfavorable market conditions.

A significant factor influencing credit spreads is market liquidity. In liquid markets, as per a report by the European Central Bank (ECB, 2023)[48], investors

[46] Campbell, J. Y., & Taksler, G. B. 2003. "Equity Volatility and Corporate Bond Yields." *The Journal of Finance*, 58(6), 2321–2350.
[47] Cantor, R., & Packer, F. 1996. "Determinants and Impact of Sovereign Credit Ratings." *FRBNY Economic Policy Review*, 2(2), 37–54.
[48] European Central Bank (ECB). 2023. "Market Liquidity and Credit Spreads: An Analysis of Current Trends." *ECB Financial Stability Review*. European Central Bank, Frankfurt.

can readily transact bonds with minimal transaction costs, consequently requiring a lower risk premium for holding securities with elevated risk profiles. In contrast, in less liquid markets, spreads typically expand considerably to reflect the heightened risk linked to trading challenges. Nonetheless, bonds issued by firms with lower trading volumes exhibit a higher credit spread, even when ratings are comparable to those of companies with highly active secondary markets (FED, 2022)[49].

The macroeconomic environment and monetary policies are crucial in influencing credit spreads. During the COVID-19 pandemic, central banks intervened by implementing corporate bond purchase programs and reducing interest rates, which mitigated the widening of spreads despite the heightened probability of default forecast. However, following the gradual dismantling of those stimulus measures, the spreads ultimately reverted to their previous wide levels. Consequently, these instances demonstrate that investor expectations and the cost of capital fluctuate due to market changes. Enhanced regulatory reforms, partially originating from the Basel Committee, have similarly underscored the importance of credit risk management. Consequently, Basel III established new rigorous capital requirements concerning market risks, especially those associated with credit risk. This has significantly reduced the volatility of credit spreads over time, as banks, essential investors in corporate bonds, are considerably better equipped to endure market fluctuations (Basel Committee, 2024)[50].

Credit rating agencies play a vital role in establishing credit spreads, yet their influence is not without constraints. While ratings are essential instruments for mitigating informational asymmetry, they do not consistently reflect alterations in an issuer's risk profile promptly (Partnoy, 1999)[51]. This delay can result in considerable divergence between credit spreads, which respond swiftly to market conditions, and ratings, which tend to remain relatively unchanged. The probability of default, ratings, and bond spreads constitute a complex relationship influenced by numerous qualitative and quantitative factors. While ratings offer a standardized evaluation of credit risk, they do not consistently encompass the

[49] Federal Reserve (FED). 2022. "Credit Spreads and Market Liquidity: Lessons from Recent Developments." *Federal Reserve Economic Research Report*. Federal Reserve Board, Washington D.C.
[50] Basel Committee on Banking Supervision. 2024. "Basel III and Market Risk: A Comprehensive Approach to Strengthen Financial Stability." Bank for International Settlements, Basel.
[51] Partnoy, F. 1999. "The Siskel and Ebert of Financial Markets? Two Thumbs Down for the Credit Rating Agencies." *Washington University Law Quarterly*, 77(3), 619–712.

complete subtleties of risk as recognized by the markets. In contrast, credit spreads represent a more dynamic quantitative metric influenced not only by probability of default and ratings but also by market conditions such as liquidity and idiosyncratic volatility.

Individual volatility affects credit spreads (Campbell & Taksler, 2003)[52]. Investors may demand a higher premium because it reflects issuer variability that cannot be diversified away by market movements. Bond spreads rise when idiosyncratic volatility indicates uncertainty. This shows the importance of evaluating more variables than traditional risk indicators to understand financial risk dynamics. Modigliani and Miller's theories redefined capital structure and cost. They assumed that capital structure did not affect firm value in their no-tax model in a perfect market. Taxes, bankruptcy costs, and other market imperfections make debt-equity ratios important. Leverage increases bankruptcy costs, which must be balanced against debt's interest deductibility tax benefit. Legal fees and reputation damage are examples. Higher bond spreads indicate higher perceived risk for firms with excessive debt-oriented capital structures. Myers[53] examined the "capital structure puzzle," which showed that firms must weigh debt's pros and cons. The pecking order theory, developed by Myers and Majluf [54], states that firms use internal resources to finance investments before considering debt or equity due to informational asymmetry between managers and investors. This affects investors' risk perception and credit spreads. Companies with an ideal debt-to-equity ratio reduce market risks, keeping spreads low (Standard & Poor's, 2024)[55]. However, status changes from investment grade to junk or vice versa tend to disproportionately increase or decrease capital costs. Credit ratings are essential for reducing debt market uncertainty.

The sectoral context is paramount for financial risk assessment. The "Sector-Specific Corporate Methodology" of S&P Global Ratings[55] stipulates that competitive advantage, geographical diversification, and operational efficiency are essential factors in determining a company's financial strength. The methodology emphasizes that industries characterized by intense competition or stringent

[52] Campbell, J. Y., & Taksler, G. B. 2003. "Equity Volatility and Corporate Bond Yields." *The Journal of Finance*, 58(6), 2321–2350.
[53] Myers, S. C. 1984. "The Capital Structure Puzzle." *The Journal of Finance*, 39(3), 575–592.
[54] Myers, S. C., & Majluf, N. S. 1984. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics*, 13(2), 187–221.
[55] Standard & Poor's. 2024. "Sector-Specific Corporate Methodology: Assessing Competitive Position and Financial Resilience." *S&P Global Ratings Report*. S&P Global, New York.

regulations may significantly influence ratings and, consequently, credit spreads. Furthermore, macroeconomic fluctuations, exemplified by the financial cycle in China as noted by Liu et al., illustrate how economic conditions reshape corporate financial structures, thereby affecting PD and ratings. It is essential to integrate sector-specific viewpoints into financial risk evaluation. The S&P Global Ratings' document[55] emphasizes that competitive positioning, cash flow generation, and financial leverage are critical factors in assessing a company's risk. This method facilitates comprehensive sector analyses and evaluates the operational resilience and financial stability of a company. Competitive advantages, geographic diversification, and operational efficiency are assessed to determine a company's relative strength within its industry. Secondly, Competitive Positioning Group Profiles are utilized to assess the weight of each factor, considering sector characteristics and the significance of competitive and regulatory dynamics in evaluating overall risk.

This relationship has significant practical ramifications for both investors and corporations. The interaction among PD, ratings, and bond spreads is crucial for investors in creating a well-diversified portfolio that enhances risk-adjusted returns. Credit ratings and spreads influence the cost of capital for companies, thereby affecting their access to financial markets. A company with a high credit rating can benefit from reduced financing costs and enhanced investor confidence, whereas a low rating may limit funding opportunities and elevate debt expenses. This underscores the significance of sustaining a robust credit profile to enhance access to financial markets for long-term growth.

The COVID-19 pandemic emphasized the significance of comprehending the intricate relationship among default probability, credit ratings, and bond spreads. During a crisis, disparities among these variables tend to amplify due to heightened market volatility and economic uncertainty. Many issuers encountered credit rating downgrades in 2020, despite their probability of default remaining relatively stable. This resulted in a significant rise in credit spreads, indicating heightened risk perception and investor aversion to risk. The crisis underscored how credit spreads, susceptible to market influences such as liquidity and idiosyncratic volatility, can diverge from ratings and probability of default during periods of turbulence. Idiosyncratic volatility, defined as uncertainty unique to

individual issuers, significantly influences credit spreads (Campbell & Taksler, 2003)[56]. This additional volatility, frequently overlooked by credit ratings, compels investors to seek elevated risk premiums, thereby exacerbating bond spreads.

During the pandemic, bond market dynamics have been profoundly affected by governmental and monetary support initiatives. While the expansionary policies of central banks stabilized markets, they failed to eliminate solvency concerns for numerous companies. Standard & Poor's indicates that credit rating downgrades often precede significant increases in credit spreads, highlighting the essential function of ratings as indicators of perceived risk. Moreover, sectoral and geographical contexts exacerbated these discrepancies. The heightened economic volatility in specific regions and sectors necessitated a reassessment of risks, disproportionately affecting credit spreads. The pandemic highlighted the necessity for an integrated and dynamic approach to credit risk management. The current methodologies, primarily based on historical data, should be enhanced with tools that facilitate the capture of changing market conditions and future-oriented insights. This perspective highlights that the interaction between ratings, probability of default, and credit spreads presents both a challenge and an opportunity to enhance transparency and resilience in financial markets.

2.3 OAS: Decoding Credit Risk and Bond Market Dynamics

The Option-Adjusted Spread is a critical instrument for evaluating pure credit risk in bond markets by isolating it from other market factors. Bond spreads indicate a confluence of factors, encompassing credit risks, liquidity conditions, and overarching market dynamics (Elton et al., 2001)[57]. Among the available measures, the OAS uniquely isolates default risk, thereby offering a clearer and more precise assessment of the inherent risk associated with a security. This characteristic is essential for enabling investors to accurately assess the unique risks linked to bond issuers. The determinants of credit spreads encompass a multifaceted and interconnected array of factors extending beyond mere credit risk. Systemic factors such as interest rate fluctuations, market volatility, and overall liquidity conditions

[56] Campbell, J. Y., & Taksler, G. B. 2003. "Equity Volatility and Corporate Bond Yields." *The Journal of Finance*, 58(6), 2321–2350.
[57] Elton, E.J., Gruber, M.J., Agrawal, D., & Mann, C. 2001. *Explaining the Rate Spread on Corporate Bonds*. Journal of Finance, 56(1), 247-277.

significantly affect bond spread behavior (Collin-Dufresne et al., 2001)[58]. These factors, frequently undervalued in cursory evaluations, underscore the significance of contextualized methodologies that consider macroeconomic conditions and the global environment.

The critical element in analyzing bond spreads is the OAS, which effectively isolates pure credit risk from other factors, thereby offering a more precise assessment of a bond's inherent risks. This measure is not static; it is responsive to market volatility and alterations in economic fundamentals, rendering it dynamic and contextually relevant. Recent research (Davidson & Levin, 2014)[59] indicates that the OAS gains significant importance during times of economic instability, when the interplay between systemic and specific risks is heightened. During volatile periods, the OAS can elucidate how variations in interest rates or economic growth projections affect bond spreads, offering essential insights for risk management and investment strategies.

An intriguing application of OAS relates to callable bonds, wherein the bondholder possesses the option to redeem the bond when the interest rate declines below the bond's yield-to-maturity. The risk of a call option bond is contingent not only upon the issuer's credit standing but also on the likelihood of early redemption. This situation arises particularly when declining interest rates incentivize issuers to refinance their debt at a reduced cost. In this context, OAS is essential as a valuation instrument for yield adjustments related to risks associated with call options, effectively isolating it from pure credit risk (Huang & Kong, 2003)[60]. This facility is particularly advantageous for bonds issued by low-rated companies or those in highly volatile sectors, as the interplay between credit risk and option risk becomes more complex and evident.
Another significant aspect is the predominant influence of global monetary policy on OAS: fluctuations in rates and exceptional measures have been observed to directly impact interest rates and bond spreads. In unfavorable economic conditions, the expansion of OAS spreads indicated investors' perception of systemic risk and potential credit deterioration. Nonetheless, accommodative

[58] Collin-Dufresne, P., Goldstein, R.S., & Martin, J.S. 2001. *The Determinants of Credit Spread Changes*. Journal of Finance, 56(6), 2177-2207.
[59] Davidson, A., & Levin, A. 2014. *The Concept of Credit Option-Adjusted Spread*. Research Paper, Mortgage Research Institute, New York.
[60] Huang, J.-Z., & Kong, W. 2003. *Explaining Credit Spread Changes: Some New Evidence from Option-Adjusted Spreads of Bond Indices*. Review of Financial Studies, 16(4), 1013-1038. doi:10.1093/rfs/hhg042.

monetary policies such as quantitative easing can momentarily narrow spreads, enhancing investor confidence and elevating demand for bonds (Robeco Italia, 2025)[61]. This effect is especially evident in corporate and high-yield bonds, where central bank interventions mitigate liquidity pressures, thereby indirectly enhancing credit conditions.

Various advanced quantitative models, including those developed by Duan et al.[62], demonstrate that the OAS serves as a highly dependable indicator of credit risk. When integrated with conventional credit rating systems, it offers a significantly more dynamic and comprehensive assessment of bond risk. The latter is crucial in instances where the static characteristics of ratings and their inherently delayed methodology led to the oversight of evolving trends of the issuer. This approach is significantly more reactive and informative, as perceptions regarding changes in the bond market directly influence shifts in OAS. The calculation of an OAS necessitates the application of sophisticated quantitative methodologies. The predominant techniques utilized are Monte Carlo simulations and binomial tree models, both of which are essential for differentiating credit risk from interest rate risk and assessing the effects of embedded options. Monte Carlo simulations facilitate the modeling of complex scenarios by accounting for various trajectories of interest rates and their interplay with credit and market risks. It facilitates the capture of the heterogeneity and uncertainty inherent in bond markets, generating the probability distribution for OAS, encompassing extreme and nonlinear events. The binomial tree models have been extensively utilized for pricing bond options, including callable and puttable embedded options, while accounting for option risks in the net OAS calculations. These models serve as powerful instruments for deciphering diverse risk elements and offering a comprehensive analysis of the structural attributes of bonds. Advanced econometric models examine the relationship between the OAS and credit risk. The methodologies extend beyond traditional analysis by incorporating portfolio rebalancing, ARCH dynamics, and market jump effects. These methodologies more precisely capture the conditional volatility and abrupt shocks affecting bond spreads. Bierens[63] proposed a model that integrated stochastic processes with nonlinear analyses, significantly

[61] Robeco Italia. 2025. *Come Misurare il Valore nel Mercato del Credito?* Robeco Italia.
[62] Duan, J.C., Sun, J., & Wang, T. 2012. *Multiperiod Corporate Default Prediction - A Forward Intensity Approach*. Journal of Econometrics, 170(1), 191-209.
[63] Bierens, H. 2000. *An Econometric Model of Credit Spreads with Rebalancing, ARCH, and Jump Effects*. Journal of Financial Economics, 58(3), 251-293.

enhancing the comprehension of spread behavior under fluctuating market conditions. In times of economic crisis or financial distress, ARCH effects elucidate the enduring volatility of spreads, providing valuable insight into the prediction of extreme fluctuations. Moreover, the incorporation of jump models, such as the Merton Jump-Diffusion Model, has demonstrated efficacy in modeling abrupt variations in spread, frequently resulting from unforeseen occurrences, including rating downgrades, default announcements, and alterations in monetary policy. These enhance the understanding of risk dynamics and facilitate optimality in bond portfolios through appropriate calibration of the risk-return trade-off. The OAS serves not merely as a theoretical construct but also has practical applications in bond portfolio management. Institutional investors utilize the OAS to compare bonds with varying attributes, evaluate arbitrage opportunities, and identify early indicators of credit deterioration. The OAS can aid an investor in assessing whether a substantial spread signifies an investment opportunity or a cautionary indicator of excessive risk in a corporate or high-yield portfolio.

In emerging markets, the Option-Adjusted Spread is crucial for assessing risk premiums, which are typically significantly elevated compared to those in developed markets. This phenomenon arises from a confluence of intrinsic factors in emerging economies, including currency volatility, political risk, macroeconomic uncertainty, and restricted market liquidity. These factors lead to broader bond spreads, elevating the issuer's debt costs and necessitating more comprehensive risk assessments by investors (Hilscher & Nosbusch, 2010; Eichengreen & Hausmann, 1999)[64]. Currency volatility is a principal risk factor in emerging markets. Exchange rate risks, often intensified by volatile domestic monetary policies or external shocks, heighten uncertainty for international investors. The OAS enables the separation of pure credit risk from the effects of currency volatility, thereby providing a clearer perspective on the risk linked to a specific issuer (Longstaff et al., 2005)[65]. Political risk encompasses factors such as governmental changes, political instability, and erratic regulations, which can directly affect an issuer's ability to fulfill a financial obligation. The OAS facilitates the measurement of the influence of these risks on bond spreads, enabling

[64] Hilscher, J., & Nosbusch, Y. 2010. *Determinants of Sovereign Risk: Macroeconomic Fundamentals and the Pricing of Sovereign Debt*. Review of Financial Studies, 23(5), 1624-1661.
Eichengreen, B., & Hausmann, R. 1999. *Exchange Rates and Financial Fragility*. National Bureau of Economic Research Working Paper No. 7418.
[65] Longstaff, F.A., Mithal, S., & Neis, E. 2005. *Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market*. Journal of Finance, 60(5), 2213-2253.

investors to distinguish risk premiums associated with idiosyncratic factors from those influenced by systemic conditions. Many emerging markets exhibit limited liquidity. In the absence of a robust institutional investor base and with trading volumes lower than those in developed markets, the likelihood of exaggerated fluctuations in the spread increases, particularly during financial crises. In this context, the OAS is a superior indicator of pure credit risk, irrespective of the liquidity conditions. This factor specifically attracts investors seeking to identify value opportunities in comparatively inefficient markets (Acharya & Pedersen, 2005)[66].

The correlation between the OAS and bond spreads is particularly pronounced in the context of corporate high-yield bonds. These instruments exhibit elevated yields and increased credit risk relative to investment-grade bonds and are particularly responsive to economic and market conditions. Consequently, they serve as an exemplary testing ground for comprehending the significance of the OAS as a credit risk indicator. Comprehensive analyses of high-yield spreads illustrate how the OAS can predict fluctuations in bond yields in response to macroeconomic shifts, including alterations in interest rates, economic growth projections, or assessments of systemic risk, as evidenced by Duan et al.[67]. This predictive capability enables investors to identify early indicators of credit decline, allowing them to implement preemptive strategies in portfolio management to enhance the risk-return equilibrium. The OAS plays a crucial role by differentiating between spread widening due to a genuine decline in an issuer's creditworthiness and that induced by transient systemic factors, such as reduced market liquidity or heightened global volatility. This analytical ability allows investors to make more informed strategic decisions, avoiding overreactions to market fluctuations that may not accurately represent a genuine change in underlying credit quality. During economic downturns, such as recessions or global slowdowns, the OAS can indicate whether the widening of high-yield spreads results from an increased risk of default or merely heightened risk aversion among investors. This aids in recognizing investment prospects in bonds that may be momentarily undervalued and offers tangible support for proactive

[66] Acharya, V.V., & Pedersen, L.H. 2005. *Asset Pricing with Liquidity Risk*. Journal of Financial Economics, 77(2), 375-410. doi:10.1016/j.jfineco.2004.06.007.
[67] Duan, J.C., Sun, J., & Wang, T. 2012. *Multiperiod Corporate Default Prediction - A Forward Intensity Approach*. Journal of Econometrics, 170(1), 191-209.

risk management strategies. The implications are significant from a practical perspective for various financial market participants, including investors, corporations, and policymakers. The Option-Adjusted Spread will serve as a crucial instrument for analyzing and managing the intricate dynamics of credit risk, facilitating more informed and strategic decisions in bond investments.

The OAS is a crucial metric for investors to evaluate the credit risk of individual bonds, independent of systemic factors or specific characteristics, such as embedded options. The OAS provides a detailed and precise perspective on pure credit risk, aiding investors in constructing and managing superior bond portfolios. The OAS enables investors to identify when a bond is mispriced by the market due to its risk premium exceeding its credit risk profile. Therefore, it would be particularly relevant in high-yield sectors, such as corporate high-yield bonds or bonds in emerging markets, where perceived risk diverges from actual risk. Moreover, by tracking the progression of the OAS over time, investors can modify their strategies in response to fluctuating market conditions without resorting to hasty decisions driven solely by general or abrupt market shifts. Consequently, the OAS facilitates more rational and data-informed decision-making, thereby improving the overall risk-return profile of the portfolio.

This implies that proactive credit risk management by an issuing company correlates with favorable impacts on the spread, regarded as the cost of financing in debt markets. Improved financial management, increased transparency, and continuous communication with investors can significantly lower spread levels for companies and facilitate a reduction in the cost of capital acquired. A narrower spread not only improves financing conditions but also bolsters investor confidence in the firm's creditworthiness. This can subsequently elevate demand for issued bonds, thereby improving their liquidity and stabilizing prices. Additionally, an enhanced credit profile can draw a wider array of institutional investors, thereby diversifying the funding base and reducing concentration risk.

Policymakers are central to bond market stabilization and economic resilience, and the examination of the Option-Adjusted Spread will significantly contribute valuable insights to them. It enables them to understand how market liquidity factors and monetary policies influence OAS spreads to formulate effective

strategies that could mitigate systemic risk. During periods of financial instability, expansionary monetary policies such as quantitative easing have demonstrated efficacy in the short term by reducing bond spreads and reinstating investor confidence. Such interventions enhance market liquidity, thereby preventing funding crises for companies and facilitating a more rapid economic recovery[68]. Nonetheless, it is crucial to evaluate these policies for their long-term ramifications, including reliance on inexpensive financing or the speculative emergence of bond market bubbles. Through the analysis of the OAS, policymakers can discern real-time fluctuations in market-perceived credit risk and utilize this data to more effectively adjust monetary and fiscal policies in accordance with the economic landscape. This proactive approach can foster market stability and facilitate sustainable economic growth.

2.4 Navigating Bond Market in Times of Crisis

The debt market constitutes a component of the international financial framework, designed to offer firms essential access to capital while providing investors with diverse opportunities for diversification and returns. Regrettably, the exposed significant fragility during periods of economic and financial crises highlights both structural and dynamic deficiencies. Specifically, the corporate sector of the bond market exhibits significantly reduced liquidity during periods of crisis. Reduced liquidity significantly elevates transaction costs for investors. Trading in bonds is challenging due to its significant influence on market prices, which can subsequently create a detrimental cycle. The elevated credit risk, exacerbated during periods of instability, combines with insufficient liquidity to intensify price volatility. This increase in volatility could potentially generate a detrimental cycle wherein forced sales by investors exacerbate price declines. The Bank for International Settlements reported that the corporate bond market encountered a peak in illiquidity during the COVID-19 pandemic, with credit spreads attaining unprecedented levels as investors sought liquid assets (BIS, Quarterly Review, 2020)[69]. An essential factor affecting this was the interplay between investor composition and market conditions. The bond markets exhibit structural heterogeneity, comprising pension funds, insurance companies, central banks, and

[68] FasterCapital. 2025. *Spread Aggiustato per le Opzioni: Comprendere la Volatilità dei Tassi di Interesse*.
[69] Bank for International Settlements (BIS). 2020. The Corporate Bond Market and Liquidity Challenges During COVID-19. *Quarterly Review*. Basel: Bank for International Settlements.

retail investors. During the crisis, most institutional investors adopt a defensive posture by decreasing their exposure, thereby exacerbating liquidity contraction. Simultaneously, liquidity-constrained investors, including mutual funds, may be compelled to liquidate assets to satisfy redemption requests, intensifying market pressure. According to the IMF Global Financial Stability Report [70], it has been disclosed that during the height of the pandemic crisis in March 2020, bond funds experienced significant outflows that intensified instability and contagion. This interaction suggests that the resilience of bond markets during a crisis is contingent not merely on chance, but rather on a complex interplay of market structure, investor demographics, and the attributes of support policies. In the financial crisis of 2008 and the COVID-19 pandemic of 2020, central banks deliberately implemented measures to restore confidence, including direct actions such as purchasing corporate bonds and indirectly enhancing liquidity in the system. The Federal Reserve and the European Central Bank implemented exceptional bond-buying initiatives, including the ECB's Corporate Sector Purchase Program and the Fed's Secondary Market Corporate Credit Facility, which diminished spreads and enhanced liquidity conditions (ECB, Economic Bulletin, 2020)[71].

Equally crucial to the operation of the debt market is a credit rating, which serves as a synthetic measure of corporate bond risk that investors extensively utilize as indicators in their capital allocation decisions. Nonetheless, they are subject to change and exhibit sensitivity to macroeconomic shocks, while fluctuations in the direction of rating migrations during cycles create significant vulnerabilities within the financial system. In expansionary financial cycles, rating agencies often overvalue the creditworthiness of companies, resulting in inflated ratings. The FSB acknowledges this conduct, which may facilitate the formation of speculative bubbles, as credit spreads would be more advantageous than those warranted by economic fundamentals (FSB, 2019)[72]. This can be ascribed to the fundamental interconnection between rating agencies and the corresponding issuing firms during periods of financial expansion. Agencies functioning in competitive markets frequently exhibit a tendency to assign elevated ratings to acquire or maintain

[70] International Monetary Fund (IMF). 2020. Global Financial Stability in the Face of COVID-19. *Global Financial Stability Report*. Washington, D.C.: International Monetary Fund.
[71] European Central Bank (ECB). 2020. Liquidity Measures and Bond Spreads During COVID-19. *Economic Bulletin*. Frankfurt: European Central Bank.
[72] Financial Stability Board (FSB). 2019. Thematic Review of Credit Rating Agencies: Systemic Risks and Conflicts of Interest. Basel: Financial Stability Board.

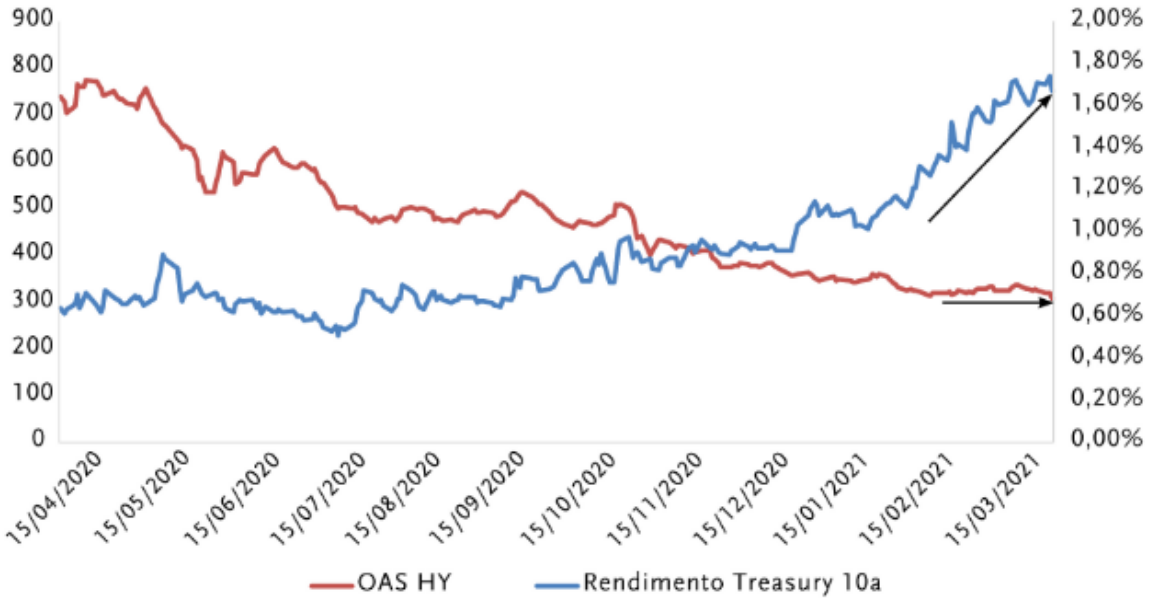
clients, a practice commonly known as rating shopping. The International Organization of Securities Commissions (IOSCO) has emphasized that competition among agencies may compromise the integrity of ratings and intensify systemic risks (IOSCO, 2020)[73]. When economic cycles shift and the financial system experiences turbulence, the repercussions of rating inflation become apparent. Companies with overstated ratings may encounter refinancing disruptions when markets abruptly adjust their risk assessments. Following the global financial crisis of 2008, the G20 identified inflated bonds as a contributing factor and mandated a review of the regulatory frameworks governing credit rating agencies (G20 Communiqué, 2009)[74]. The financing decisions of companies are substantially affected by their strategic relationships with rating agencies. Firms operating in highly volatile sectors, or those that frequently require access to capital markets, may adopt financial strategies that temporarily enhance ratings by augmenting leverage or issuing structured debt. These strategies, however, increase corporate vulnerability to macroeconomic shocks, thereby elevating default risk during crises. These dynamics have become crucial for both investors and regulators. Investors who depend solely on credit ratings to assess risk may make suboptimal investment choices, especially in situations where ratings fail to accurately represent actual risk levels. The European Securities and Markets Authority has reiterated its exhortations for investors to transcend ratings and conduct comprehensive risk analyses to prevent decisions based on potentially misleading information (ESMA, 2022)[75]. Regulators face the challenge of improving the transparency and credibility of the rating assignment process by augmenting oversight of rating agencies and instituting more rigorous standards to guarantee that ratings accurately represent the inherent risks of a security. The Financial Stability Board and IOSCO have proposed measures, including enhanced disclosure of rating models and foundational assumptions, to bolster investor confidence and mitigate conflicts of interest (FSB, 2010; IOSCO, 2020)[76].

The debt markets were significantly affected by monetary policies in the 2022-2023 period, as major central banks implemented a series of interest rate increases

[73] International Organization of Securities Commissions. 2020. Code of Conduct Fundamentals for Credit Rating Agencies. Madrid: International Organization of Securities Commissions.
[74] G20. 2009. Communiqué: Enhancing Regulation of Credit Rating Agencies. Pittsburgh: Group of Twenty.
[75] European Securities and Markets Authority. 2022. Annual Report on Credit Rating Agency Regulation. Paris: European Securities and Markets Authority.
[76] Financial Stability Board. 2010. Principles for Reducing Reliance on CRA Ratings. Basel: Financial Stability Board.
International Organization of Securities Commissions. 2020. Code of Conduct Fundamentals for Credit Rating Agencies. Madrid: International Organization of Securities Commissions.

to address inflation. Monetary surprises are unforeseen decisions or actions that surpass expectations, increasing risk premiums and credit costs, thereby adversely affecting more vulnerable segments of the bond market. The Federal Reserve executed one of the most stringent monetary tightening in decades, elevating rates from a range of 0-0.25% to over 5% between 2022 and 2023.

Figure 2 - OAS HY Evidence from US Curve



Concurrently, the European Central Bank implemented a strategy of incremental hikes, elevating benchmark rates from negative levels to surpass 4% during the corresponding timeframe. This increase inevitably affected OAS due to heightened risk perception among investors and a reduction in secondary market liquidity. Forward guidance was a crucial instrument to mitigate the adverse effects of stringent monetary policies. Central banks, cognizant of the destabilizing consequences of interest rate hikes, employed transparent communication strategies to stabilize investor expectations. The Federal Reserve reaffirmed its dedication to reducing inflation but suggested that the rate of increases may decelerate as 2023 concludes. This strategy exerted a calming influence on markets, resulting in diminished volatility in bond spreads. Nonetheless, the period of 2022–2023 highlighted certain constraints of monetary policy transmission mechanisms. Modest fluctuations in short-term rates prompted significant alterations in risk premiums and long-term credit expenses. The rate increases implemented by the ECB prompted a swift expansion in long-term

corporate bond spreads, particularly for highly leveraged firms. The effect was particularly evident in the energy and commodities sectors, where the interplay of elevated financing costs and geopolitical uncertainties resulted in increased spread widening (ECB Financial Stability Review, 2023)[77]. A significant dynamic during this period was the interaction between developed and emerging markets. Interest rate increases by central banks in advanced economies prompted capital flight from emerging markets, thereby elevating financing costs for domestic issuers. The BIS reported that corporate bond spreads in emerging markets exceeded 600 basis points in 2022, indicating increased risk aversion and diminished liquidity (BIS Quarterly Review, 2023)[78].

Emerging economies, dependent on foreign currency debt, are especially susceptible to the impacts of global monetary tightening, particularly that instigated by the Federal Reserve. Recently, the swift normalization of monetary policy in the United States has resulted in a substantial rise in financing costs for numerous emerging markets, accompanied by marked capital outflows to more secure, developed markets. This phenomenon has intensified challenges in credit access, resulting in a rise in bond spreads and a reduction in liquidity in local markets (BIS Quarterly Review, 2023)[78]. The increase in U.S. interest rates has directly affected local currencies in emerging markets. Emerging markets in regions such as Latin America and Asia have experienced considerable pressure on their currencies, including the Argentine peso, Brazilian real, and Indian rupee, leading to devaluation and increased costs of dollar-denominated debt. Most emerging economies rely on foreign currency financing for public expenditures and infrastructure investments, resulting in significant economic instability and elevated risk. (IMF Global Financial Stability Report, 2023)[79]. This reliance on dollar-denominated debt signifies a structural weakness in numerous economies. In 2023, dollar-denominated U.S. debt held by emerging markets reached $4.5 trillion, as reported by the Bank for International Settlements, rendering these economies significantly susceptible to fluctuations in U.S. interest rates and currency values (BIS Quarterly Review, 2023)[80]. This has resulted in a significant expansion of bond spreads for emerging market issuers, exceeding an average of

[77] European Central Bank (ECB). 2023. Financial Stability Review: Bond Market Trends in the Euro Area. Frankfurt: European Central Bank.
[78] Bank for International Settlements. December 2023. Emerging Market Bond Spreads and Global Liquidity Shifts. *Quarterly Review*. Basel: Bank for International Settlements.
[79] International Monetary Fund. 2023. Sovereign Debt Transparency Framework. Washington, D.C.: International Monetary Fund.
[80] Bank for International Settlements. 2023. Corporate Bond Market Spreads and Liquidity Trends. *Quarterly Review*. Basel: Bank for International Settlements.

200 basis points in corporate bonds relative to the pre-pandemic era. The reduction in global liquidity signifies a shift towards stringent conditions, as evidenced by the significant decrease in foreign currency credit, especially in U.S. dollars. According to the BIS, the volume of international dollar credit diminished by approximately 10% in 2023 relative to the previous year, signifying a new phase in global liquidity. This trend significantly impacts emerging economies by constraining their access to external funding and heightening the risk of debt crises. The International Monetary Fund has noted that the increase in U.S. interest rates and the reduction in global liquidity have resulted in pronounced disparities between advanced and emerging economies: advanced economies have attracted capital inflows, whereas emerging economies have faced "substantial outflows and swiftly worsening financing conditions". The IMF Global Financial Stability Report indicates that portfolio outflows from emerging markets during 2022–2023 exceeded $100 billion, primarily in sovereign and corporate bonds (IMF Global Financial Stability Report, 2023)[81]. These factors contribute to an escalation in the cost of debt servicing. In nations designated by the World Bank as emerging economies, the average expense of external debt increased by more than 30% from 2021 to 2023, posing a potential risk to debt sustainability for both public and private sectors in numerous such countries. Rising costs pose significant challenges to the fiscal stability of countries that were already fragile prior to the escalation, thereby increasing the risk of both sovereign and corporate defaults.

As diverse vulnerabilities increased in the global bond market, enhanced efforts were essential for improving transparency and resilience to ensure financial stability. The years of monetary tightening, coupled with the reliance of emerging economies on foreign currency debt, highlight the systemic risks inherent in the debt markets. In this context, entities like the International Monetary Fund and the Bank for International Settlements emphasize the necessity of augmenting oversight and fostering international collaboration to adequately prepare bond markets for impending financial disruptions (BIS Quarterly Review, 2023)[82]. The IMF advocates for enhanced regulatory oversight of bond markets to increase

[81] International Monetary Fund (IMF). October 2023. Liquidity Constraints and Risk Premiums in Bond Markets. *Global Financial Stability Report*. Washington, D.C.: International Monetary Fund.
[82] Bank for International Settlements (BIS). December 2023. Emerging Market Bond Spreads and Global Liquidity Shifts. *Quarterly Review*. Basel: Bank for International Settlements.

operational transparency, mitigate liquidity risks, and prevent excessive risk concentration. This signifies more stringent regulation of debt issuance practices and thorough assessment of the risks linked to corporate and sovereign debts. The BIS prioritizes enhanced international collaboration to mitigate contagion effects. In periods of stress, cross-border capital flows may exacerbate instability, and substantial outflows from emerging markets could significantly heighten exchange rate pressures and the costs of foreign currency debt. The expansion of foreign currency swap lines by central banks exemplifies improved international cooperation. These arrangements, allowing central banks to access U.S. dollars or other reserve currencies during periods of stress, have been essential instruments for market stabilization. Throughout the COVID-19 pandemic, the Federal Reserve expanded its swap lines to numerous emerging economies, mitigating currency crises and bolstering global liquidity as a result. (IMF, 2022)[83]. Promoting additional diversification in credit markets is a crucial factor in enhancing the resilience of the global financial system. In emerging market nations, the establishment of local bond markets can diminish reliance on foreign currency financing and mitigate risks associated with exchange rate volatility. The IMF asserts that strengthening robust and liquid local bond markets increases the ability of emerging economies to mobilize domestic resources and diminishes their vulnerability to global risks (IMF Global Financial Stability Report, 2023)[84]. The World Bank emphasizes that enhanced access to local credit, underpinned by a transparent regulatory framework and effective market infrastructure, can markedly bolster financial resilience in these economies. Initiatives like the Emerging Markets Bond Index have facilitated transparency in emerging bond markets, thereby attracting an increasing number of international investors to these markets. The World Bank's International Debt Statistics 2023 indicates that transparency will continue to be a primary factor in fostering investor confidence and preventing crises in the future. The BIS and IMF assert that enhanced standardization of data disclosure regarding sovereign and corporate debt is imperative, encompassing contractual terms, currency exposures, and repayment schedules. Moreover, credit rating agencies play a crucial role in delivering dependable evaluations; however, they must be subjected to more rigorous

[83] International Monetary Fund (IMF). 2022. Annual Report on Exchange Arrangements and Exchange Restrictions. Washington, D.C.
[84] International Monetary Fund (IMF). October 2023. Liquidity Constraints and Risk Premiums in Bond Markets. *Global Financial Stability Report*. Washington, D.C.

oversight to prevent conflicts of interest and guarantee that ratings accurately represent the inherent risks.

2.5 Corporate Bond Trends: Focus on Investment Grade and High Yield Spreads

Corporate bonds are a vital investment vehicle in global financial markets, offering opportunities for diversification and appealing returns. Two primary categories exist: investment-grade bonds and high-yield bonds. The fundamental distinctions among these classes are associated with the issuer's risk level, as determined by credit ratings from rating agencies. Investment-grade bonds are issued by entities with a strong credit rating, exhibiting minimal risk of default, and consequently offering lower yields in comparison to high-yield bonds. Investment-grade bonds are classified with credit ratings of "BBB" or higher by Standard & Poor's and Fitch, or "Baa3" or higher by Moody's. Conversely, HY bonds are commonly known as "junk bonds" due to their issuance by entities with comparatively low repayment capacity or heightened vulnerability to economic recessions. They provide a superior return on investment relative to the assumed risk and are rated below "BBB-" or "Baa3" (Standard & Poor's, Moody's, Fitch)[85]. Credit rating agencies, including Standard & Poor's, Moody's, and Fitch, play a crucial role in evaluating risk associated with corporate bonds. These agencies conduct a comprehensive analysis of financial statements, cash flows, and market forecasts to generate ratings that indicate an issuer's capacity to fulfill financial obligations. These ratings reflect different levels of creditworthiness and directly influence the cost of capital for issuing companies as well as the yields required by investors.

In recent years, global bond markets have experienced substantial transformations, influenced by macroeconomic factors, sector-specific dynamics, and central bank policy decisions. The Option-Adjusted Spreads of investment-grade and high-yield bonds have exhibited contrasting trends, indicative of both economic conditions and investor strategies, as well as the inherent attributes of the two segments. The OAS evaluates the yield differential between a corporate bond and a government bond of comparable maturity, modified for the value of embedded options. This metric reflects the perceived risk associated with

[85] Standard & Poor's, Moody's, Fitch. Credit Rating Overview and Methodology [Report]. 2024. Standard & Poor's, Moody's, and Fitch Ratings.

corporate bonds and offers essential insight into the evolving dynamics of bond markets over time (M&G Investments, 2024)[86].

Thus far, 2022 has been exceptionally volatile for the global bond market, marked by significant widening of spreads within the investment-grade category of debt securities. The developments were intricately linked to the stringent monetary policy adopted by global central banks in their efforts to mitigate inflation and elevate corporate default risk. The Bank of Italy's "Financial Stability Report"[87] indicates a significant rise in the spreads between corporate bond yields and risk-free rates, highlighting heightened apprehensions regarding energy expenses and supply chain disruptions for raw materials and intermediate goods. Furthermore, as indicated in the "Annual Report on 2022" by the Bank of Italy[88], the spreads on corporate bonds remained elevated year over year, hindering market access for both companies and banks. In the high-yield sector, primary market activity significantly declined among corporate issuers. The issuance of high-yield bonds significantly decreased following the Russian invasion of Ukraine, whereas investment-grade issuers experienced a more moderate decline. Both trends highlight the overarching market challenges that arose in 2022, as geopolitical tensions and economic uncertainty reshaped investor risk preferences and corporate financing strategies.

As 2023 neared, the economic landscape commenced a notable transformation. Central banks, reacting to indications of diminishing inflation and more stable economic growth, gradually relaxed the stringent policies implemented in prior years. This transition directly affected corporate bond spreads, especially the Option-Adjusted Spreads for Investment Grade and High Yield bonds. In 2024, spreads on investment-grade bonds significantly widened due to macroeconomic uncertainty, persistent inflationary pressures, and declining demand. As sectors recover at moderate rates, both cyclical and structural factors contributed to the increases. Geopolitical tensions significantly influenced the situation; concurrently, investors consistently exhibit risk aversion. The Bank of Italy's Economic Bulletin No. 4 of 2024[89] emphasized that, despite persistent disinflation, economic activity in the euro area fell short of expectations. Simultaneously, the

[86] M&G Investments. 2024. Overview of the Bond Asset Class [Report]. June 2024. M&G Investments, London.
[87] Bank of Italy, Financial Stability Report. 2022. Report on the Financial Stability of Italy [Report]. Bank of Italy, Rome.
[88] Bank of Italy, Annual Report. 2022. Annual Review of Economic and Financial Trends [Report]. Bank of Italy, Rome.
[89] Bank of Italy, Economic Bulletin No. 4, 2024. 2024. Analysis of Economic Trends in the Euro Area [Bulletin]. Bank of Italy, Rome.

rate hikes instituted by central banks in prior periods significantly elevated the financing costs for investment-grade companies. As a result, refinancing debt became costly, increasing perceived credit risk for even those companies with strong fundamentals. In September 2024, the European Central Bank adjusted its monetary policy decisions, resulting in a modest downward revision of economic growth attributed to diminished domestic demand and ongoing credit access limitations. Another factor facilitating the proliferation of IG is the growing appeal of alternative credit instruments, such as private debt. Consequently, in pursuit of enhanced yields, investors allocated diminishing amounts to investment-grade bonds, redirecting their investments towards higher-yielding assets with a more favorable risk-return profile. The Financial Stability Report No. 1 of 2024 highlights that, amidst a precarious macroeconomic environment, certain market dynamics, supported by a strong labor market and decreasing headline inflation, have stabilized perceptions of systemic risk, allowing for pressure in specific market segments such as IG (Bank of Italy, 2024)[90].

Meanwhile, the OAS of the HY bonds exhibited a contractionary trend during these two years. Some reasons are technical, but primarily fundamental, including strong demand due to significantly superior yield values for the segment compared to other classes in a high-interest-rate environment. Furthermore, during this period, the contraction in the global supply of high-yield bonds reduced availability by approximately 18% relative to 2021, indicating that scarcity value bolstered the pre-existing bond prices. The decrease in supply was exacerbated by the improvement in credit quality, leading numerous high-yield issuers to attain investment-grade status—a trend more pronounced than that of issuers downgraded to high-yield, referred to as "rising stars" versus "fallen angels"—thereby further diminishing the high-yield market (M&G Investments, 2024)[91]. The monetary policies enacted by major central banks were a primary factor in the divergence between investment-grade and high-yield markets. The European high-yield market profited from the interest rate reductions declared by the ECB in 2024, whereas U.S. investment-grade spreads were influenced by the Fed's prudence. The policy decisions affected the two segments differently; heightened economic confidence and robust corporate fundamentals bolstered the HY market,

[90] Bank of Italy, Financial Stability Report No. 1, 2024. 2024. Financial Stability Report with Systemic Risk Insights [Report]. Bank of Italy, Rome.
[91] M&G Investments. 2024. Overview of the Bond Asset Class [Report]. June 2024. M&G Investments, London.

whereas the IG market continued to account for risks associated with economic growth and geopolitical uncertainties. In 2024, numerous investors exhibited an increased risk appetite by entering the high-yield market to capitalize on elevated yields. This dynamic is evident in the contraction of high-yield spreads, indicating that demand surpasses supply. The IG market, in contrast, exhibited diminished investor interest as they sought diversification into higher-yielding assets (Olson, Brent and Ross, 2024)[92].The contraction in the high-yield market was exacerbated by private credit's acquisition of debt, particularly in the leveraged buyout sector, while the reduced supply of high-yield bonds in public markets contributed to the compression of spreads. Simultaneously, the majority of high-yield bonds exhibited robust financial health and a minimal perceived likelihood of default, thereby bolstering investor confidence.

In the near term, IG OAS levels may persist at elevated levels due to continued macroeconomic uncertainty and difficulties in refinancing debt at increased interest rates. Conversely, an improvement in global economic conditions and a decrease in geopolitical risks may lead to the stabilization or slight tightening of these spreads. In the high-yield market, OAS levels are expected to exhibit a contractionary trend, bolstered by robust demand and favorable fundamentals. However, a rise in default rates or a decline in economic conditions could alter this trend (U.S. High Yield 2Q2024 Outlook, 2024)[93].

[92] Olson, Brent & Ross, Tom. 2024. Why the Pressure on High-Yield Bonds Is Both Beneficial and Detrimental [Article]. M&G Investments, June 2024.
[93] U.S. High Yield 2Q2024 Outlook, Specialty Fixed Income. 2024. Outlook on U.S. High-Yield Market Dynamics [Report]. Specialty Fixed Income, New York.

Research Questions and Methodology

3.1 Research Questions

This research builds upon the theoretical foundation established in previous studies to examine how changes in the European Central Bank's (ECB) interest rates influence the credit spreads of European listed bonds. Credit spreads, representing the yield differential between corporate bonds and risk-free government securities, are shaped by various macroeconomic factors, with monetary policy playing a pivotal role. Fluctuations in the ECB's key rates can significantly impact borrowing costs, market liquidity, and investor risk perceptions.

To analyze this relationship, the study employs a dataset of European listed bonds collected monthly from January 2022 to June 2024, a period marked by substantial monetary policy shifts in response to inflationary pressures, post-pandemic recovery efforts, and geopolitical uncertainties. The research aims to capture both the immediate and delayed effects of interest rate changes, providing a comprehensive perspective on how bond markets react to monetary tightening or easing.

At the core of this study lie three key research questions:

1. *"How do changes in the European Central Bank's interest rates influence the credit spreads of European listed bonds?"* By examining the evolution of credit spreads in response to interest rate fluctuations, the study seeks to assess the extent to which monetary policy decisions shape market dynamics and investor sentiment.

2. *"To what extent do credit spreads across different sectors exhibit varying sensitivities to ECB interest rate fluctuations?"* A sectoral analysis will explore how industries, classified according to Bloomberg's BICS system, respond differently to monetary policy shifts. Factors such as interest rate sensitivity, capital structure, and market volatility will be considered to determine whether certain sectors are more exposed to central bank interventions.

3. *"How do Investment Grade and High Yield bonds differentially respond to shifts in the ECB's monetary policy?"* Given their contrasting risk profiles, IG and HY bonds are expected to react differently to changes in the interest rate environment. While IG bonds, seen as lower-risk assets, may exhibit more stability, HY bonds, which carry higher credit risk, are likely to show greater sensitivity to rate movements. This distinction will help uncover how investors adjust their risk tolerance in response to changes in the central rate curve.

Ultimately, this study aims to quantify the extent to which ECB rate fluctuations influence the yields of European listed bonds. By deepening the understanding of investor behavior in the debt market, particularly during periods of rising interest rates, the findings will contribute to the broader discourse on monetary policy transmission, highlighting the intricate link between central bank decisions, financial markets, and investment strategies.

3.2 Research Methodology

The study adopts a statistical approach, relying on data sourced from the Bloomberg database, particularly for information related to Option-Adjusted Spreads (OAS) and average credit ratings. These variables are fundamental in capturing market perceptions of credit risk, as the OAS provides an adjusted measure of bond spreads that accounts for embedded options, offering a more accurate reflection of yield differences compared to risk-free securities. This measure is especially valuable in fixed income analysis, as it isolates the credit risk premium from other factors influencing bond yields. As for the independent variables, they were obtained from the ECB data portal, ensuring consistency and reliability in the representation of macroeconomic and monetary policy indicators.

The OAS curves for different sectors serve as indicators of how perceived credit risk evolves over time within specific industries. These curves allow us to trace the market's assessment of creditworthiness under varying economic conditions. By utilizing monthly data, the study achieves a dataset comprising thirty observations for each curve, covering the period from January 2022 to June 2024. This sample size is robust enough to support statistical analyses, providing sufficient variability

to detect meaningful relationships while maintaining consistency with observed market trends. The choice of monthly frequency strikes a balance between capturing timely market reactions to macroeconomic developments and avoiding excessive noise that could arise from higher-frequency data.

Regarding the independent variables, the analysis begins with the risk-free rate curve, represented by the "Compounded euro short-term rate average rate", which serve as the benchmark for evaluating credit spreads. This selection is intentional, as the core objective of the research is to understand how effectively European monetary policy influences the perception of credit risk among investors in listed bonds. The risk-free rate acts as the foundation for pricing in the fixed income market, and any shifts in this curve due to monetary policy decisions are expected to ripple through credit markets, affecting yield spreads across different sectors and credit ratings.

Moreover, considering that sectoral dynamics are shaped by a range of additional factors beyond interest rate movements. Each sector responds differently to macroeconomic conditions due to variations in business models, capital structures, and exposure to external shocks. For this reason, distinct input data curves were selected for each sector to capture these idiosyncratic factors. For instance, sectors like financials may be more sensitive to interest rate changes, while industrial sectors might react more strongly to variables such as commodity prices or global trade flows. This tailored approach allows for a more granular analysis of how different industries are affected by changes in monetary policy and broader economic conditions.

Once the necessary data was collected and the database was complete, the focus shifted to analyzing the relationships between the variables. To achieve this, the study employed advanced data analysis techniques using Python, a versatile programming language widely used in econometrics and financial modeling. This methodological approach allowed for the estimation of complex relationships, accounting for multiple factors simultaneously, and provided a comprehensive understanding of how ECB policies influence credit spreads.

Through these regression analyses, it's possible to identify patterns and quantify the extent to which monetary policy decisions impact credit risk perceptions across

different sectors and credit ratings. The final step involves interpreting the output data, drawing conclusions that reflect not only the statistical results but also their economic significance. This comprehensive approach ensures that the findings are not only statistically robust but also relevant for understanding the broader implications of monetary policy on the European bond market.

3.3 Research Structure

In this section, the aim is to clarify how the variables are selected and structured, as well as the theoretical model adopted to support the empirical analysis and findings. The framework of the model is based on the identification and classification of three key categories of variables: dependent variables, independent variables, and control variables. Each category plays a specific role in the analysis, contributing to a comprehensive understanding of the relationship between monetary policy and credit spreads in different market conditions.

Starting with the dependent variable, it is the average OAS of a carefully selected panel of listed bonds. To capture variations in credit risk perception, the bonds are classified based on both credit rating, separating High Yield from Investment Grade securities, and sector, as different industries respond differently to macroeconomic conditions and monetary policy shifts. This distinction allows for the observation of whether sensitivity to changes in interest rates and economic conditions varies across credit qualities and industry sector.

Regarding the independent variable, the focus is on the monthly compounded risk-free rate curve published by the European Central Bank. This curve serves as a fundamental reference in the assessment of credit spreads, representing the baseline cost of capital in the economy, free from credit risk. The risk-free rate acts as a benchmark against which the additional yield required for credit risk is measured, enabling the isolation of the effect of monetary policy changes on the cost of corporate debt.

For the control variables, the selection process is more nuanced, requiring careful consideration of the unique characteristics and dynamics of each sector. These variables are chosen based on their relevance to sector-specific risk factors, aiming to control for external influences that could otherwise distort the relationship

between the independent and dependent variables. In some cases, the control variables relate to production indicators, such as industrial output, which is particularly relevant for the industrial sector, where production cycles and supply chain dynamics significantly influence financial performance. In other sectors, especially those more sensitive to macroeconomic fluctuations, the model incorporates variables reflecting price level changes, such as inflation rates or commodity price indices, which can substantially impact profit margins, cost structures, and ultimately credit risk. For instance, in sectors exposed to raw materials, fluctuations in commodity prices directly affect the financial health of companies, influencing both their ability to service debt and the market's perception of their creditworthiness.

For the Technology sector, a different approach is adopted by using a control variable linked to equity market performance, specifically a stock market index that tracks the performance of major European technology companies. This choice is driven by the fact that technology firms often rely heavily on market valuations, investor sentiment, and equity financing conditions, which are closely tied to stock market trends. Including this variable accounts for the influence of broader market dynamics on credit spreads within the technology sector, beyond the effects of monetary policy alone.

Once the variables are defined and the dataset is constructed, the next phase involves conducting rigorous statistical analyses to explore the relationships between these variables. The inclusion of sector-specific control variables enhances the robustness of the results, ensuring that the observed effects can be more confidently attributed to changes in monetary policy rather than confounding factors. This methodological approach provides a more detailed and accurate interpretation of the data, shedding light on the complex mechanisms through which monetary policy influences credit risk perceptions across different segments of the bond market.

3.3.1 Dependent Variable

The Option-Adjusted Spread is a fundamental measure used in bond markets to assess credit risk, and the risk premium associated with a debt security relative to a

risk-free asset, such as government bonds. The OAS represents the spread, or the difference in yield, between a bond and the risk-free benchmark rate, adjusted for the impact of any embedded options within the bond. This adjustment is particularly relevant because many bonds include features such as callable options, allowing for early redemption, or puttable options, which grant the holder the right to sell the bond back to the issuer. By removing the influence of these options, the OAS provides a clearer measure of pure credit risk, isolating the additional yield required by investors to compensate for the issuer's creditworthiness.

Bloomberg calculates the OAS using advanced quantitative models that consider several key factors. Among these, the risk-free rate curve—typically constructed from swap rates or sovereign bond yields—serves as the primary benchmark. Additionally, Bloomberg incorporates the current market price of the bond, future cash flows from coupon payments and principal repayment, and implied volatility, which is particularly important for bonds with embedded options. To model the evolution of future yields, Bloomberg relies on term structure models of interest rates. The price of a bond is thus calculated as the sum of discounted future cash flows, where the discount rate is the risk-free rate plus the OAS, reflecting both credit and liquidity premiums. In our analysis, the OAS has been instrumental in illustrating how debt market investors responded to the monetary policies implemented by the ECB. The Bloomberg prompt used to ensure the consistency of the panels is shown in the figure below, highlighting the observation point as of January 1, 2022, for the Investment Grade category within the Financials sector.

Figure 3 - Prompt Bloomberg OAS Financial IG

This specific case serves as an example to demonstrate the structure of the Bloomberg prompt, which remained consistent across the various panels. The fields shown in the figure that remained unchanged include Maturity, Issue Date, and Currency. The maturity was set with a maximum of ten years from the date the panel was extracted, which took place in December 2024. This constraint ensures

that the bonds analyzed have comparable durations, facilitating robust yet coherent panel construction. The Issue Date was fixed on January 1, 2020, to include bonds issued around the same period, thus avoiding older bonds that could skew the results due to differing market conditions at the time of issuance. Regarding the Currency, only bonds denominated in euros and issued within the European market were considered, to maintain a focus on a strictly European context. Other variables visible in the figure, specifically the BICS Classification and the BBG Composite, were adjusted for each panel to reflect the characteristics of different sectors and rating categories. Below, we present an example of the High Yield panel for the Energy sector, illustrating how these fields can be modified to suit the specific requirements of each dataset.

Figure 4 - Prompt Bloomberg OAS Energy HY

The observations discussed in this paragraph are detailed in Appendix 1, categorized by sector and rating.

3.3.2 Independent Variable

The independent variable in this analysis is the Compounded Euro Short-Term Rate Average (€STR), 1-month tenor, daily – Businessweek, a key reference in assessing the cost of capital within the euro area. Published by the European Central Bank, this rate represents a risk-free benchmark that reflects the cost at which banks borrow unsecured funds in the short-term money market. Given its compounded nature over a one-month period, it captures evolving liquidity conditions and the stance of monetary policy more comprehensively than a simple overnight rate.

The decision to use the €STR compounded rate instead of the German risk-free curve stems from several critical considerations. While German government bond yields are often used as a proxy for the risk-free rate in euro-denominated financial

markets, they are influenced by country-specific factors, such as sovereign credit risk, fiscal policy, and supply-demand imbalances in the German bond market. In contrast, the €STR provides a neutral and purely market-driven measure of risk-free borrowing costs across the euro area, responding directly to ECB monetary policy decisions without distortions related to individual sovereign debt markets. More importantly, the €STR represents the most suitable risk-free curve for estimating the relationship with the Option-Adjusted Spread (OAS) of our panel of European listed bonds.

This choice is based on several key factors:

- Direct Reflection of ECB Monetary Policy
  The €STR is purely driven by the European Central Bank's interest rate decisions and short-term liquidity conditions, ensuring that changes in the risk-free rate are directly linked to monetary policy. This makes it the most accurate measure for assessing how interest rate fluctuations influence corporate credit spreads.

- Neutrality and Euro-Area-Wide Representativeness
  Unlike the German Bund curve, which reflects Germany-specific fiscal dynamics and safe-haven demand, the €STR is not subject to sovereign credit risk and represents a uniform measure of risk-free borrowing costs across the euro area. This ensures a more consistent and unbiased benchmark when analyzing bonds issued by corporations from different countries.

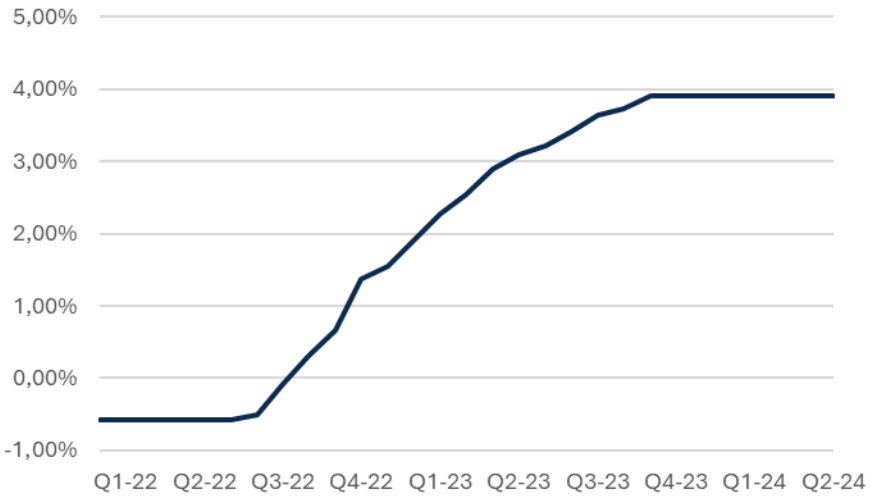
- Alignment with Corporate Borrowing Costs
  Since corporate bond spreads are measured against a risk-free benchmark that reflects the true cost of capital in the financial system, it is crucial to use a rate that aligns with the financing conditions available to firms. The €STR closely mirrors the funding costs faced by European financial institutions, making it the most relevant benchmark for assessing credit spreads in the corporate bond market.

- Dynamic and Market-Driven Nature
  The compounded €STR integrates daily fluctuations in short-term rates,

providing a smoother and more responsive measure of the risk-free cost of capital than static sovereign yield curves. It effectively captures liquidity conditions and market expectations regarding future rate movements without distortions from long-term sovereign debt issuance dynamics.

- Consistency Across Different Bond Types and Sectors
  Since the OAS is calculated as a spread over a theoretical risk-free rate, it is crucial to pair it with a risk-free benchmark that applies uniformly to different types of bonds. The €STR serves as a neutral reference point across sectors and credit ratings, ensuring consistency when comparing IG and HY bonds without the bias of country-specific sovereign yield movements.

Figure 5 - Compounded Euro Short-Term Rate Average



Source: ECB Portal Data

Above is presented the monthly observations curve between January 2022 and June 2024; it is easy to see how the behavior of the curve is consistent with the bullish European monetary policy decisions regarding reference rates. The time frame shown is aligned with the monthly observations of the different bond panels, ensuring their comparability and effectiveness for the analysis presented.

3.3.3 Control Variables

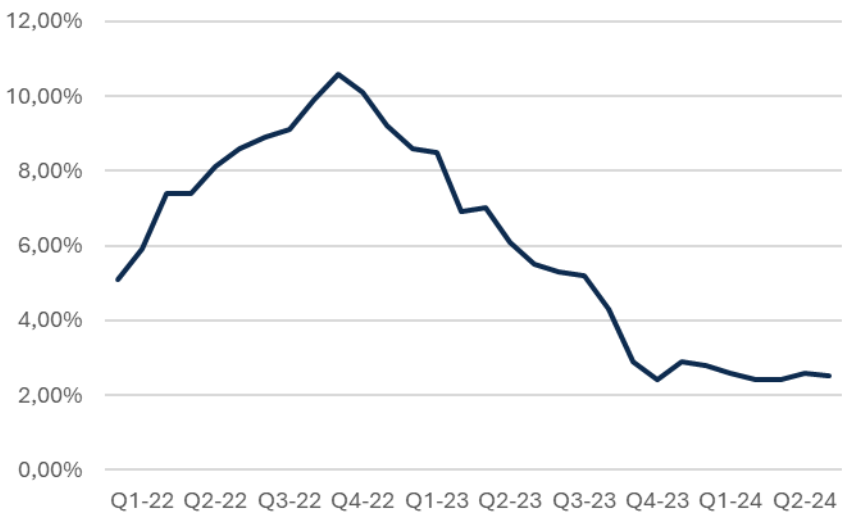
The selection of control variables in this study is guided by their sectoral relevance and their ability to isolate the impact of monetary policy on credit spreads. As

credit risk is influenced by a combination of macroeconomic conditions and sector-specific dynamics, the incorporation of well-targeted control variables ensures a more accurate estimation of the relationship between monetary policy decisions and credit spreads. Each variable was chosen to account for fundamental economic forces (such as inflation, production cycles and market sentiment) that can influence the financial health of firms. By controlling for these external influences, the analysis reduces potential bias, allowing a clearer identification of the extent to which monetary policy drives changes in OAS across sectors. For each of these variables, the graph showing the trend for the range of interest of the study is shown in the respective paragraph; for all of them, data are provided by the "European Central Bank data portal".

Harmonized Index of Consumer Prices (HICP) – Overall Index

The "HICP – Overall Index" is the primary measure of inflation in the Euro area, reflecting the average price level changes of a broad basket of goods and services consumed by households. This Index has been chosen for the Financials, Health Care, and Materials sectors, as general inflation trends significantly impact these industries. In the Financial sector, inflation directly influences ECB monetary policy, shaping liquidity conditions, interest rates, and the profitability of financial institutions. For Health Care, price levels affect procurement costs for medical equipment and pharmaceuticals, potentially eroding corporate margins. In Materials, rising raw material prices and production costs can reduce profitability and alter financing conditions for companies operating in this industry.

Figure 6 - HICP Overall Index

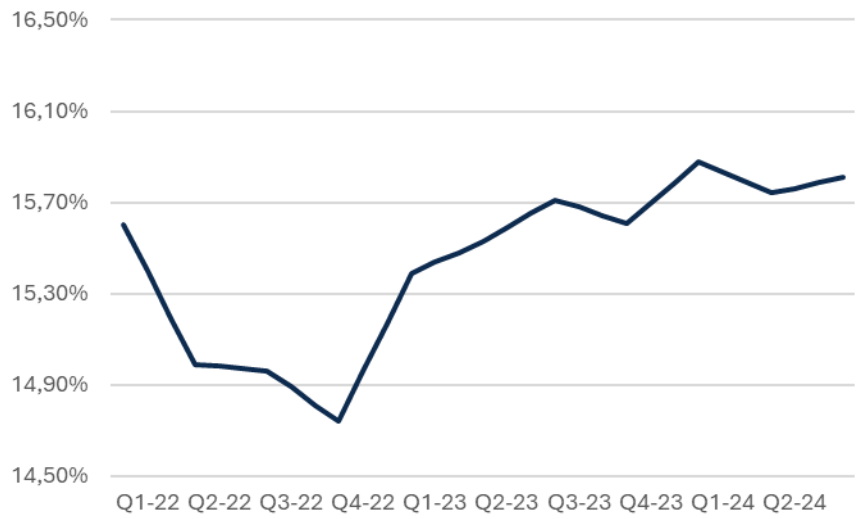


Source: ECB Data Portal

Common Equity Tier 1 Ratio

For the Financials sector, the Common Equity Tier 1 Ratio (CET1) has been included as an additional control variable. This key indicator of banking sector solvency measures a financial institution's ability to absorb losses and meet regulatory requirements. Since the CET1 ratio is published on a quarterly basis, it has been interpolated to obtain monthly observations, ensuring consistency with the rest of the dataset and improving the accuracy of econometric estimates.

Figure 7 - CET1 Ratio

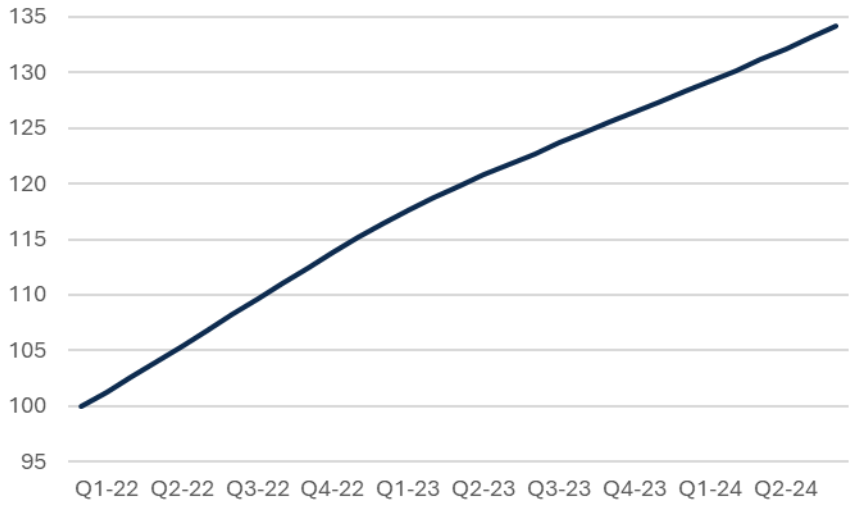


Source: ECB Data Portal

HICP – Energy

For the Energy sector, the HICP – Energy variable has been selected, representing energy price fluctuations in the euro area. This sector is directly influenced by changes in energy prices, which impact corporate profitability for both energy producers and utility companies. Rising energy costs can affect investment sustainability and credit risk exposure, making this variable crucial in capturing the sector's sensitivity to inflationary pressures.

Figure 8 – HICP Energy

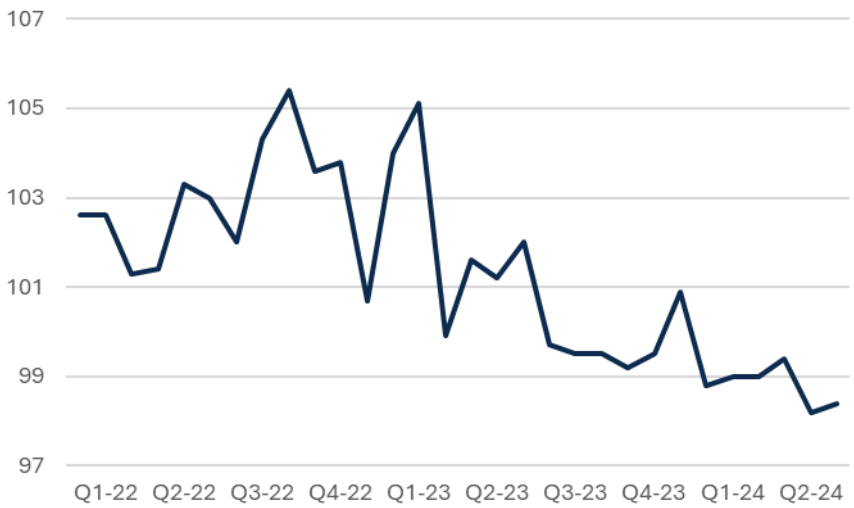


Source: ECB Data Portal

Industrial Production Index

For the Industrials sector, the selected control variable is the monthly Industrial Production Index, a fundamental indicator of economic activity and demand in the manufacturing sector. The relevance of this variable stems from the fact that industrial firms are highly cyclical and respond to variations in aggregate demand. Changes in production levels significantly impact corporate revenues and their ability to meet debt obligations, making this index a key determinant of credit risk fluctuations.

Figure 9 - Industrial Production Index

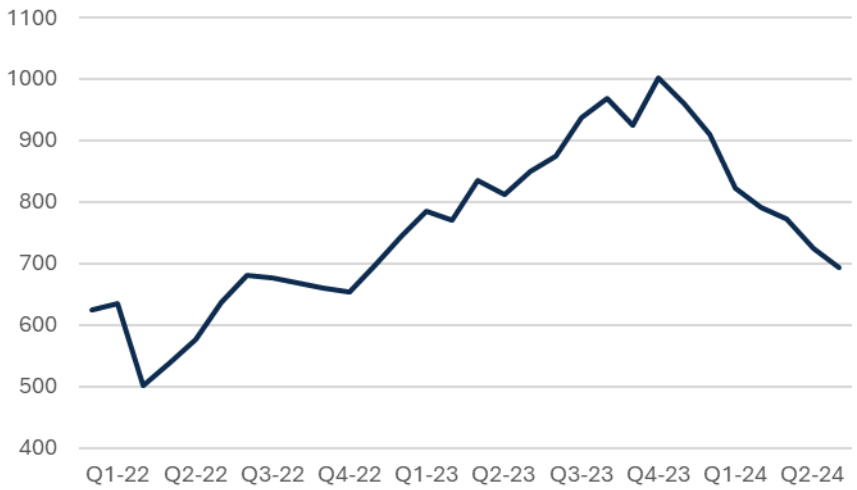


Source: ECB Data Portal

EURO STOXX Technology Index

For the Technology sector, the chosen control variable is the EURO STOXX Technology Index, which tracks the performance of major European technology companies. The technology industry is particularly affected by market liquidity conditions and interest rate fluctuations, as many firms rely heavily on equity financing rather than traditional debt markets. A rising stock market generally indicates favorable conditions for the sector, reducing perceived credit risk and influencing corporate financing strategies.

Figure 10 – EURO STOXX Technology Index

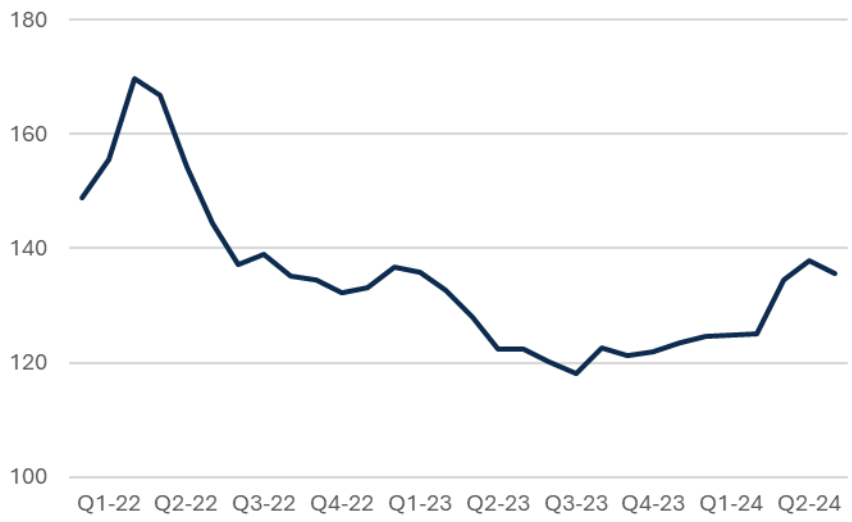


Source: ECB Data Portal

ECB Commodity Price Index

For the Materials sector and companies linked to commodities, the ECB Commodity Price Index, import-weighted has been selected. This index is essential for tracking price fluctuations in raw materials, which directly affect profit margins and financial stability in the sector. Given the strong correlation between commodity price movements and corporate balance sheets, this control variable ensures that the analysis captures market dynamics that could otherwise distort the interpretation of credit spread changes.

Figure 11 – ECB Commodity Price Index



Source: ECB Data Portal

3.3.4 Theoretical Model

The theoretical model underlying this regression is a multiple linear regression (MLR) estimated using the ordinary least squares (OLS) method. This approach is widely applied in econometrics to analyze the relationship between a dependent variable and multiple independent variables, aiming to quantify the extent to which each explanatory factor influences the outcome variable.

The general specification of the multiple linear regression model is:

$$y_i = \beta_0 + \beta_1 x_{\{1i\}} + \beta_2 x_{\{2i\}} + \ldots + \beta_k x_{\{ki\}} + \epsilon_i$$

Where:

- $\boldsymbol{y_i}$ is the dependent variable for observation i, representing the outcome to be explained.
- $\boldsymbol{x_{1i}, x_{2i}, \ldots, x_{ki}}$ are the independent variables assumed to influence y_i, while β_o is the intercept, indicating the expected value of y_i when all explanatory variables are zero.
- $\boldsymbol{\beta_1, \beta_2, \ldots, \beta_k}$ are the coefficients that quantify the marginal effect of each independent variable on y_i, holding other factors constant.

- ϵ_i is the error term that captures unobserved influences on y_i that are not included in the model.

This regression model is based on a set of key assumptions to ensure the validity of the estimates:

- The first assumption is **linearity**, meaning that the relationship between the dependent and independent variables is linear in parameters.
- Additionally, the expectation of the error term given the independent variables must be zero, ensuring that the **explanatory variables are not correlated** with the residuals.
- Another crucial assumption is **homoscedasticity**, implying that the variance of the error term is constant across observations.
- Furthermore, the model assumes **no autocorrelation**, meaning that the residuals are not systematically related over time or across observations.
- The absence of **multicollinearity** is required to ensure that the independent variables are not highly correlated with each other, which would make individual coefficient estimates unreliable.

If these assumptions hold, the OLS estimator provides Best Linear Unbiased Estimates (BLUE), meaning that the estimated coefficients are unbiased and have the minimum variance among all linear estimators.

Empirical and Statistical Analysis

This chapter delineates the findings of the analysis, commencing with an overview of the economic context, succeeded by a comprehensive literature review, and culminating in a precise elucidation of the refinement of specific research methodologies. The objective is to establish a framework for comprehending the dynamics of the public debt market during crises, emphasizing the impact of international monetary policies.

The study provides a comprehensive analysis of the selected variables and characteristics of the examined bond panels, elucidating the effects of monetary policy decisions across the seven identified sectors, with an emphasis on rating implications. This comprehensive analysis evaluates the impact of increasing interest rates across various sectors and rating categories, emphasizing their structural distinctions and providing insights for investors and policymakers. Appendix 2 provides graphs illustrating the observed curve and the curve predicted by the model's input data, demonstrating a correlation between the results discussed in this chapter and the graphical representations (the division will be based on sectors and ratings).

4.1 Sectoral Impact of Monetary Policy

The impact of monetary policy on the examined sectors was inconsistent, primarily shaped by the prevailing market dynamics. It is imperative to recognize that investors, the principal actors in public markets, do not invariably base their decisions solely on risk evaluations. Thus, a contraction in monetary policy may result in extensive price modifications that do not necessarily correspond to sector-specific fundamentals but instead reflect a general rise in perceived risk.
Crisis periods exacerbate this phenomenon, as investors exhibit heightened sensitivity to the extensive information accessible to the public. This heightened sensitivity complicates the establishment of a consistent trajectory across all sectors and, more broadly, among various rating classes. This section aims to address the second question in our analysis, specifically identifying the sectors that demonstrate the highest variability in response to heightened risk perception.

4.1.1 Financial Sector

The multivariate regression analysis conducted on two panels of European financial market bonds indicated substantial differences between the two market segments, as demonstrated by the accompanying graphs. The coefficient of determination (R^2) for the OAS of investment-grade bonds is 0.157, whereas for high-yield bonds it is considerably greater at 0.638. This suggests that the selected explanatory variables (risk-free rate, inflation and CET1) can elucidate variations in HY spreads more precisely than in IG spreads. Moreover, the importance of the variables varies considerably: for IG bonds, no variable is significant at the 5% level, while for HY bonds, both the risk-free rate and CET1 exhibit a stronger correlation with spreads. The Durbin-Watson statistic for IG bonds is 1.1296, signifying a greater level of autocorrelation in the residuals compared to HY bonds, which is 1.78.

Figure 12 - Financial Sector IG

OLS Regression Results

Dep. Variable:	y	R-squared:	0.157
Model:	OLS	Adj. R-squared:	0.059
Method:	Least Squares	F-statistic:	1.609
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	0.211
Time:	16:09:40	Log-Likelihood:	241.04
No. Observations:	30	AIC:	-474.1
Df Residuals:	26	BIC:	-468.5
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0048	0.002	2.492	0.019	0.001	0.009
x1	-1.82e-05	1.64e-05	-1.113	0.276	-5.18e-05	1.54e-05
x2	1.51e-05	1.3e-05	1.158	0.257	-1.17e-05	4.19e-05
x3	0.0003	0.000	2.063	0.049	8.97e-07	0.001

Omnibus:	1.764	Durbin-Watson:	1.130
Prob(Omnibus):	0.414	Jarque-Bera (JB):	1.619
Skew:	-0.491	Prob(JB):	0.445
Kurtosis:	2.424	Cond. No.	2.08e+03

Breusch-Pagan p-value: 0.5319
Durbin-Watson statistic: 1.1296

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	15496.375531
1	Risk_Free	3.883657
2	Inflation	5.277490
3	Cet_1	7.684747

Figure 13 - Financial Sector HY

OLS Regression Results

Dep. Variable:	y	R-squared:	0.638
Model:	OLS	Adj. R-squared:	0.596
Method:	Least Squares	F-statistic:	15.27
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	6.27e-06
Time:	16:22:08	Log-Likelihood:	138.43
No. Observations:	30	AIC:	-268.9
Df Residuals:	26	BIC:	-263.3
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-0.0391	0.059	-0.668	0.510	-0.159	0.081
x1	-0.0030	0.001	-6.038	0.000	-0.004	-0.002
x2	-0.0006	0.000	-1.551	0.133	-0.001	0.000
x3	0.0056	0.004	1.518	0.141	-0.002	0.013

Omnibus:	11.275	Durbin-Watson:	1.781
Prob(Omnibus):	0.004	Jarque-Bera (JB):	10.995
Skew:	-1.069	Prob(JB):	0.00410
Kurtosis:	5.055	Cond. No.	2.08e+03

Breusch-Pagan p-value: 0.2961804017940157
Durbin-Watson statistic: 1.7808176487205944

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	15496.375531
1	Risk_Free	3.883657
2	Inflation	5.277490
3	Cet_1	7.684747

Indicating that in the IG model, the errors exhibit correlation, whereas in the HY model, the residuals are more dispersed, suggesting greater independence of the errors. This may indicate that the model for HY is more accurately defined or that HY bonds, due to their greater volatility, react more unpredictably to market influences than IG. (See Appendix 3)

The risk-free rate exerts a minimal and statistically insignificant influence on investment-grade bonds, whereas for high-yield bonds, the coefficient is -0.0030 with considerable significance, indicating that an increase in risk-free rates correlates with a decrease in high-yield spreads. Inflation exerts a positive yet statistically insignificant influence on investment-grade bonds, whereas it demonstrates a negative and significant correlation with high-yield bonds, suggesting that elevated inflation levels are associated with a decrease in high-yield spreads. The CET1 ratio appears to exert a negligible impact on IG bonds, whereas it demonstrates a positive and significant effect on HY bonds, indicating that enhancing bank capital slightly increases HY spreads.

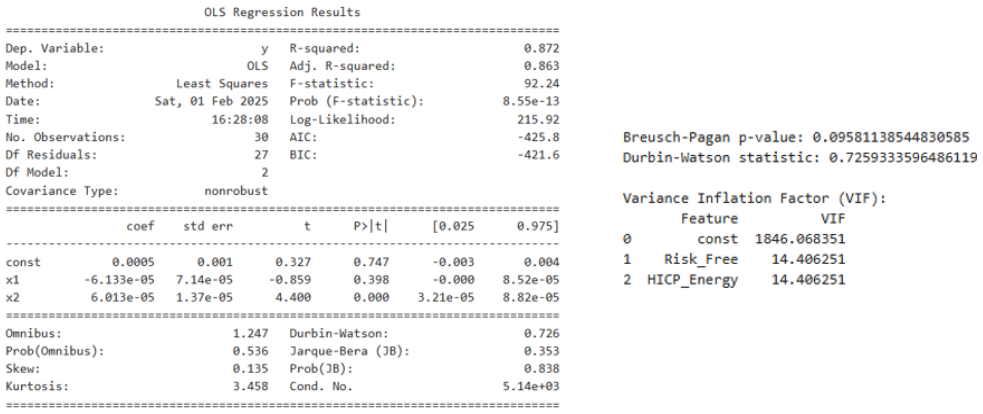
The multicollinearity analysis employing the variance inflation factor (VIF) indicates elevated values for CET1 (7.68) and inflation (5.28), suggesting potential redundancy between these variables in the model. During the examined period (2022-2024), monetary tightening elevated risk-free rates. Nonetheless, high-yield spreads contracted, signifying an enhancement in market sentiment regarding credit risk or an augmented capacity of high-yield issuers to fulfill financial obligations. This trend likely reflects investors' risk appetite and the regulatory measures enacted by the ECB. The reduction in inflation appears to have influenced this contraction, although its effect on investment-grade bonds is negligible.

4.1.2 Energy Sector

The multivariate regression analysis of European energy sector bonds reveals clear distinctions between the investment-grade and high-yield segments. The coefficient of determination for the OAS of IG bonds is 0.872, indicating that the model accounts for a significant portion of the spread variations. For high-yield

bonds, the R^2 diminishes marginally to 0.808, yet retains considerable explanatory capacity.

Figure 14 – Energy Sector IG



OLS Regression Results

Dep. Variable:	y	R-squared:	0.872
Model:	OLS	Adj. R-squared:	0.863
Method:	Least Squares	F-statistic:	92.24
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	8.55e-13
Time:	16:28:08	Log-Likelihood:	215.92
No. Observations:	30	AIC:	-425.8
Df Residuals:	27	BIC:	-421.6
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0005	0.001	0.327	0.747	-0.003	0.004
x1	-6.133e-05	7.14e-05	-0.859	0.398	-0.000	8.52e-05
x2	6.013e-05	1.37e-05	4.400	0.000	3.21e-05	8.82e-05

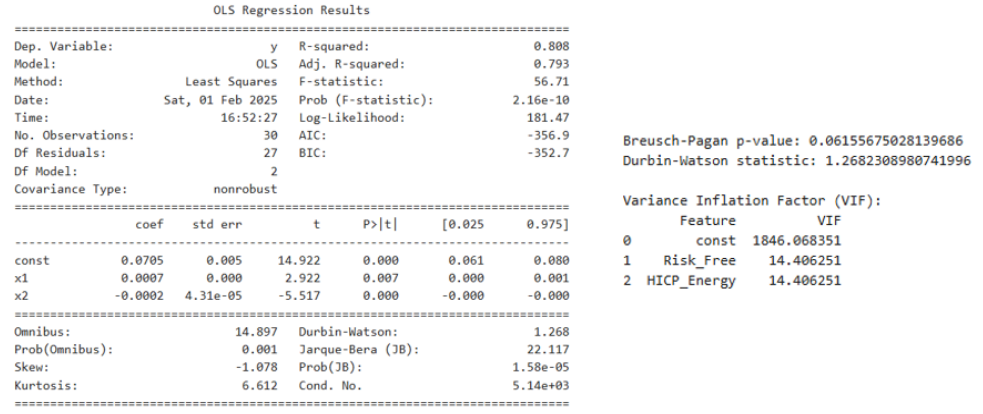
Omnibus:	1.247	Durbin-Watson:	0.726
Prob(Omnibus):	0.536	Jarque-Bera (JB):	0.353
Skew:	0.135	Prob(JB):	0.838
Kurtosis:	3.458	Cond. No.	5.14e+03

Breusch-Pagan p-value: 0.09581138544830585
Durbin-Watson statistic: 0.7259333596486119

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	1846.068351
1	Risk_Free	14.406251
2	HICP_Energy	14.406251

Figure 15 – Energy Sector HY



OLS Regression Results

Dep. Variable:	y	R-squared:	0.808
Model:	OLS	Adj. R-squared:	0.793
Method:	Least Squares	F-statistic:	56.71
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	2.16e-10
Time:	16:52:27	Log-Likelihood:	181.47
No. Observations:	30	AIC:	-356.9
Df Residuals:	27	BIC:	-352.7
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0705	0.005	14.922	0.000	0.061	0.080
x1	0.0007	0.000	2.922	0.007	0.000	0.001
x2	-0.0002	4.31e-05	-5.517	0.000	-0.000	-0.000

Omnibus:	14.897	Durbin-Watson:	1.268
Prob(Omnibus):	0.001	Jarque-Bera (JB):	22.117
Skew:	-1.078	Prob(JB):	1.58e-05
Kurtosis:	6.612	Cond. No.	5.14e+03

Breusch-Pagan p-value: 0.06155675028139686
Durbin-Watson statistic: 1.2682308980741996

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	1846.068351
1	Risk_Free	14.406251
2	HICP_Energy	14.406251

The analysis reveals that the risk-free rate is statistically non-significant for investment-grade bonds (p-value 0.398), indicating that fluctuations in risk-free rates do not directly affect investment-grade spreads. Conversely, for high-yield bonds, the effect is significant and advantageous (p-value 0.007), suggesting that elevated risk-free rates result in broader high-yield spreads. The Energy HICP exhibits contrasting effects: it is positively and significantly correlated with IG bonds (p-value < 0.001), indicating that energy inflation substantially impacts the widening of IG spreads, whereas it is negatively and significantly correlated with HY bonds (p-value < 0.001), signifying that elevated energy prices result in a narrowing of HY spreads.

In the IG model, residuals display a distinct pattern, indicating autocorrelation and

implying that certain systematic factors remain inadequately accounted for. This suggests that IG spreads may be affected by enduring macroeconomic trends. Conversely, the HY model exhibits more dispersed residuals, signifying increased independence of errors. This implies a more precisely defined model or that high-yield bonds, owing to increased volatility, respond more erratically to market fluctuations. (See Appendix 3)

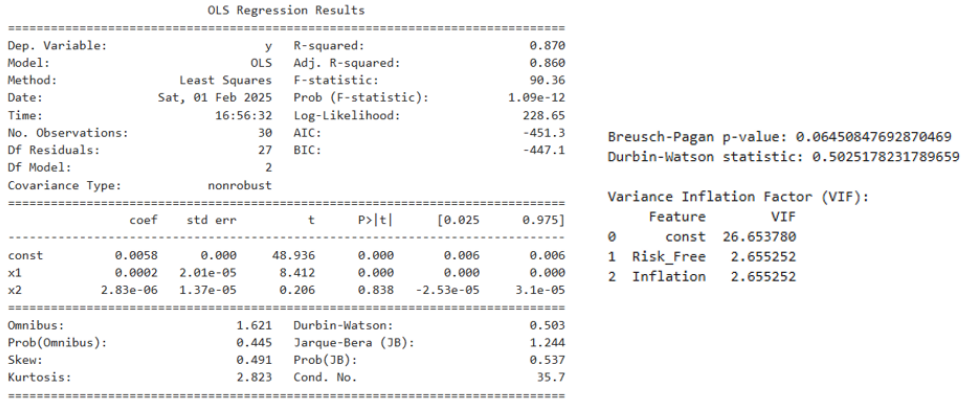
Multicollinearity analysis utilizing the VIF reveals elevated values for both the risk-free rate and the Energy HICP (approximately 14.4), signifying a robust correlation between these macroeconomic variables, suggesting that external economic factors affect both.

From a macroeconomic standpoint, increasing risk-free rates exert a greater impact on high-yield spreads compared to investment-grade spreads, highlighting that robust firms are less vulnerable to adverse financial conditions. Simultaneously, energy inflation exerts dual effects: it leads to the widening of investment-grade spreads, likely due to cost pressures, while concurrently narrowing high-yield spreads, possibly signifying improved earnings outlooks for energy firms. These disparities underscore the disproportionate impact of macroeconomic factors on the different credit segments within the energy sector.

4.1.3 Health Care Sector

The coefficient of determination for IG spreads is 0.870, indicating the model's robust capacity to elucidate variations in this segment. Conversely, HY bonds exhibit a diminished R^2 of 0.485, signifying that additional factors influence spread variations within this category. The charts below depict the data corroborating these findings.

Figure 16 – Health Care IG



OLS Regression Results

Dep. Variable:	y	R-squared:	0.870
Model:	OLS	Adj. R-squared:	0.860
Method:	Least Squares	F-statistic:	90.36
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	1.09e-12
Time:	16:56:32	Log-Likelihood:	228.65
No. Observations:	30	AIC:	-451.3
Df Residuals:	27	BIC:	-447.1
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0058	0.000	48.936	0.000	0.006	0.006
x1	0.0002	2.01e-05	8.412	0.000	0.000	0.000
x2	2.83e-06	1.37e-05	0.206	0.838	-2.53e-05	3.1e-05

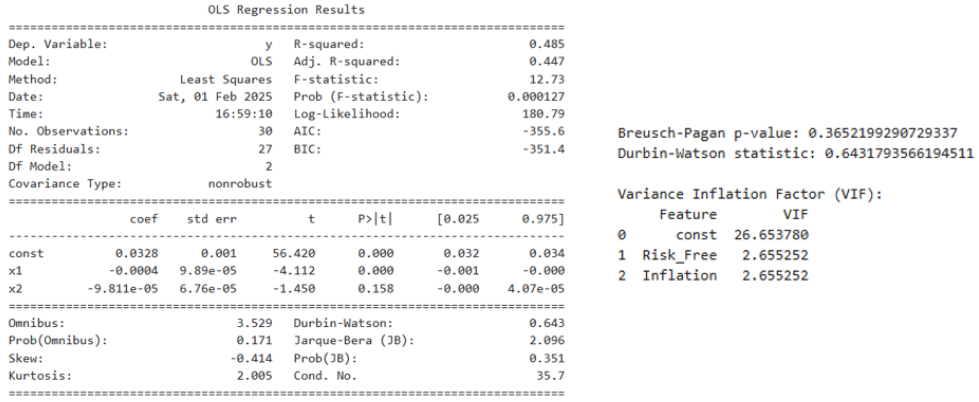
Omnibus:	1.621	Durbin-Watson:	0.503
Prob(Omnibus):	0.445	Jarque-Bera (JB):	1.244
Skew:	0.491	Prob(JB):	0.537
Kurtosis:	2.823	Cond. No.	35.7

Breusch-Pagan p-value: 0.06450847692870469
Durbin-Watson statistic: 0.5025178231789659

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	26.653780
1	Risk_Free	2.655252
2	Inflation	2.655252

Figure 17 – Health Care HY



OLS Regression Results

Dep. Variable:	y	R-squared:	0.485
Model:	OLS	Adj. R-squared:	0.447
Method:	Least Squares	F-statistic:	12.73
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	0.000127
Time:	16:59:10	Log-Likelihood:	180.79
No. Observations:	30	AIC:	-355.6
Df Residuals:	27	BIC:	-351.4
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0328	0.001	56.420	0.000	0.032	0.034
x1	-0.0004	9.89e-05	-4.112	0.000	-0.001	-0.000
x2	-9.811e-05	6.76e-05	-1.450	0.158	-0.000	4.07e-05

Omnibus:	3.529	Durbin-Watson:	0.643
Prob(Omnibus):	0.171	Jarque-Bera (JB):	2.096
Skew:	-0.414	Prob(JB):	0.351
Kurtosis:	2.005	Cond. No.	35.7

Breusch-Pagan p-value: 0.3652199290729337
Durbin-Watson statistic: 0.6431793566194511

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	26.653780
1	Risk_Free	2.655252
2	Inflation	2.655252

The examination of variable importance underscores the risk-free rate's pivotal influence on investment-grade bonds, demonstrating a positive and statistically significant impact (p-value < 0.001). This indicates that as risk-free rates rose, investment-grade spreads expanded, supporting the notion that higher-yielding government securities gained appeal, resulting in diminished demand for investment-grade corporate bonds. Conversely, for high-yield bonds, the risk-free rate exerted a substantial negative influence (p-value < 0.001), suggesting that increasing interest rates led to a contraction of spreads, possibly indicative of enhanced credit conditions or a heightened investor demand for higher-risk assets. Inflation was not a substantial factor for either IG (p-value 0.838) or HY (p-value 0.158), underscoring the sector's defensive traits, as demand for healthcare products and services remains consistent irrespective of inflationary fluctuations. Analyzing the coefficients yields further insights. Investment-grade spreads widened as risk-free rates rose, indicating a transition by investors towards more secure government bonds in a rising-rate context. In contrast, HY spreads

contracted, indicating that market participants perceived an enhancement in credit conditions within the sector or pursued elevated returns, rendering HY bonds more attractive. The insignificance of inflation in both segments suggests that healthcare companies, recognized for their resilience, were predominantly impervious to escalating costs, probably owing to robust pricing power and consistent demand.

Il modello IG evidenzia una significativa correlazione tra gli errori, con una statistica di Durbin-Watson di 0.5025, suggerendo residui meno dispersivi e una struttura più rigida nei dati. In contrast, the HY model, with a statistic of 0.6431, indicates a greater dispersion of residuals, suggesting a more erratic response to market fluctuations. Questa disparità evidenzia la natura più instabile dei bond ad alto rendimento, i quali rispondono in modo meno sistematico ai fattori macroeconomici rispetto ai bond investment grade. (See Appendix 3)

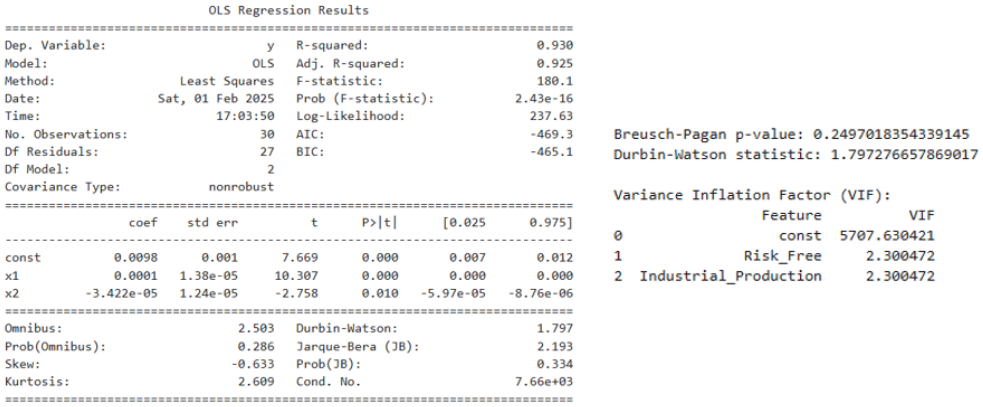
The analysis of multicollinearity through the Variance Inflation Factor (VIF) yielded low values (~2.65 for both variables), suggesting that risk-free rates and inflation do not demonstrate significant correlation, thereby facilitating a more precise interpretation of their individual effects.

From a macroeconomic standpoint, the disparate spread behavior indicates that investment-grade bonds in the healthcare sector operate akin to quasi-government securities, with spreads expanding as interest rates increase. The contraction of high-yield spreads, despite increasing interest rates, underscores the sector's relative stability within the high-yield market, potentially benefiting from enhanced investor sentiment or stronger credit fundamentals.

4.1.4 Industrial Sector

The coefficient of determination for IG bonds stands at 0.930, indicating that the model accounts for a substantial portion of spread variation. In contrast, HY bonds exhibit a lower R^2 of 0.598, suggesting that additional influences shape their spread movements. The data supporting these findings can be seen in the charts below.

Figure 18 – Industrial Sector IG



OLS Regression Results

Dep. Variable:	y	R-squared:	0.930
Model:	OLS	Adj. R-squared:	0.925
Method:	Least Squares	F-statistic:	180.1
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	2.43e-16
Time:	17:03:50	Log-Likelihood:	237.63
No. Observations:	30	AIC:	-469.3
Df Residuals:	27	BIC:	-465.1
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0098	0.001	7.669	0.000	0.007	0.012
x1	0.0001	1.38e-05	10.307	0.000	0.000	0.000
x2	-3.422e-05	1.24e-05	-2.758	0.010	-5.97e-05	-8.76e-06

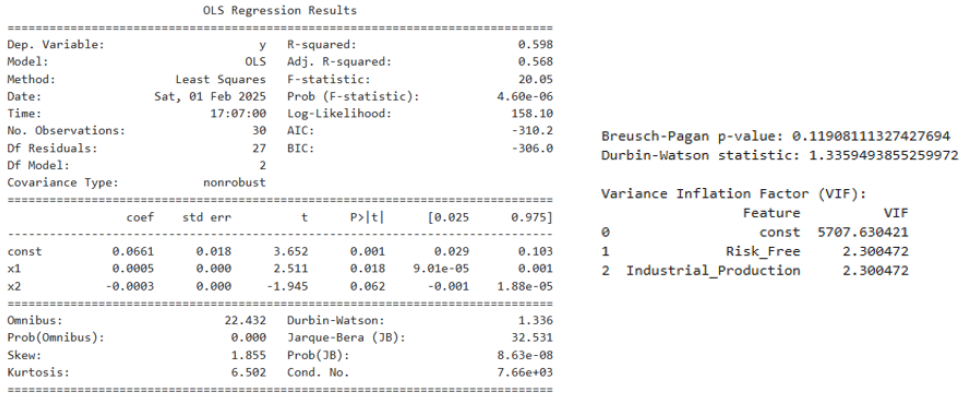
Omnibus:	2.503	Durbin-Watson:	1.797
Prob(Omnibus):	0.286	Jarque-Bera (JB):	2.193
Skew:	-0.633	Prob(JB):	0.334
Kurtosis:	2.609	Cond. No.	7.66e+03

Breusch-Pagan p-value: 0.2497018354339145
Durbin-Watson statistic: 1.797276657869017

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	5707.630421
1	Risk_Free	2.300472
2	Industrial_Production	2.300472

Figure 19 – Industrial Sector HY



OLS Regression Results

Dep. Variable:	y	R-squared:	0.598
Model:	OLS	Adj. R-squared:	0.568
Method:	Least Squares	F-statistic:	20.05
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	4.60e-06
Time:	17:07:00	Log-Likelihood:	158.10
No. Observations:	30	AIC:	-310.2
Df Residuals:	27	BIC:	-306.0
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0661	0.018	3.652	0.001	0.029	0.103
x1	0.0005	0.000	2.511	0.018	9.01e-05	0.001
x2	-0.0003	0.000	-1.945	0.062	-0.001	1.88e-05

Omnibus:	22.432	Durbin-Watson:	1.336
Prob(Omnibus):	0.000	Jarque-Bera (JB):	32.531
Skew:	1.855	Prob(JB):	8.63e-08
Kurtosis:	6.502	Cond. No.	7.66e+03

Breusch-Pagan p-value: 0.11908111327427694
Durbin-Watson statistic: 1.3359493855259972

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	5707.630421
1	Risk_Free	2.300472
2	Industrial_Production	2.300472

The risk-free rate is a critical factor influencing both IG and HY spreads. The correlation for IG bonds is markedly positive (p-value < 0.001), suggesting that increasing risk-free rates result in spread widening, highlighting the sector's sensitivity to borrowing expenses. A comparable trend is noted for high-yield bonds, where the risk-free rate is likewise significant and positive (p-value 0.013), albeit the impact is more subdued. This indicates that although high-yield spreads rise with interest rate increases, their sensitivity is comparatively diminished relative to investment-grade spreads.

Industrial production, conversely, exhibits an inverse correlation with spreads. The coefficient for IG bonds is significantly negative (p-value 0.008), indicating that increased production levels are associated with diminished credit risk perception. In the HY segment, the effect is negative but only marginally significant (p-value 0.062), indicating a weaker yet discernible influence.

The IG model, exhibiting a Durbin-Watson statistic of 1.7972, indicates reduced autocorrelation and a more uniform distribution of residuals compared to the HY model, which, with a statistic of 1.3359, signifies increased error persistence and consequently diminished random dispersion in the data. (See Appendix 3)

Analyzing the coefficients yields additional understanding. The significant influence of the risk-free rate on investment-grade bonds underscores their sensitivity to funding expenses, rendering them less appealing compared to government securities in an environment of increasing rates. Although high-yield bonds demonstrate widening spreads in reaction to increased rates, the effect is less significant, probably because their higher yield mitigates some of the impact. Simultaneously, industrial production serves as a stabilizing influence, aiding in the compression of spreads, especially for investment-grade issuers. This trend supports the notion that investment-grade firms—generally larger and more integrated within industrial supply chains—derive greater advantages from macroeconomic growth compared to their high-yield counterparts, which are usually more vulnerable to firm-specific risks.
The analysis of multicollinearity using the Variance Inflation Factor (VIF) yields low values (~2.30 for both variables), indicating that the risk-free rate and industrial production have independent effects within the model.

From a macroeconomic viewpoint, the results indicate that increasing interest rates pose difficulties for the industrial sector by expanding spreads in both investment-grade and high-yield bonds. Nevertheless, economic growth, as indicated by industrial production, mitigates credit risk apprehensions, exerting a more pronounced impact on investment-grade issuers. This contrast signifies that although investment-grade bonds are closely linked to overall economic conditions, high-yield spreads are influenced by a broader array of financial and market factors beyond mere industrial output.

4.1.5 Technology Sector

The regression analysis for the Technology sector highlights key differences between Investment Grade and High Yield bonds in terms of spread dynamics. The coefficient of determination for IG bonds is exceptionally low at 0.040, indicating

that the selected variables—Risk-Free Rate and Eur STOXX Technology—offer minimal explanatory power for IG spread movements. For HY bonds, R^2 is slightly higher at 0.177, but still relatively weak, suggesting that other factors play a dominant role in determining spreads. The data supporting these findings can be seen in the charts below.

Figure 20 – Technology Sector IG

OLS Regression Results

Dep. Variable:	y	R-squared:	0.040
Model:	OLS	Adj. R-squared:	-0.032
Method:	Least Squares	F-statistic:	0.5566
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	0.580
Time:	17:11:55	Log-Likelihood:	222.67
No. Observations:	30	AIC:	-439.3
Df Residuals:	27	BIC:	-435.1
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0074	0.000	22.226	0.000	0.007	0.008
x1	2.457e-06	3.42e-05	0.072	0.943	-6.77e-05	7.26e-05
x2	-2.262e-07	4.29e-07	-0.527	0.602	-1.11e-06	6.54e-07

Omnibus:	5.116	Durbin-Watson:	0.400
Prob(Omnibus):	0.077	Jarque-Bera (JB):	3.788
Skew:	0.854	Prob(JB):	0.150
Kurtosis:	3.339	Cond. No.	1.09e+04

Breusch-Pagan p-value: 0.07539119706587019
Durbin-Watson statistic: 0.4002171878073812

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	141.334082
1	Risk_Free	5.170468
2	Eur_STOXX_Technology	5.170468

Figure 21 – Technology Sector HY

OLS Regression Results

Dep. Variable:	y	R-squared:	0.177
Model:	OLS	Adj. R-squared:	0.116
Method:	Least Squares	F-statistic:	2.908
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	0.0718
Time:	17:18:04	Log-Likelihood:	146.43
No. Observations:	30	AIC:	-286.9
Df Residuals:	27	BIC:	-282.7
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0185	0.004	4.403	0.000	0.010	0.027
x1	-0.0001	0.000	-0.314	0.756	-0.001	0.001
x2	7.259e-06	5.44e-06	1.334	0.193	-3.91e-06	1.84e-05

Omnibus:	6.113	Durbin-Watson:	0.494
Prob(Omnibus):	0.047	Jarque-Bera (JB):	4.421
Skew:	-0.867	Prob(JB):	0.110
Kurtosis:	3.727	Cond. No.	1.09e+04

Breusch-Pagan p-value: 0.5190541017240398
Durbin-Watson statistic: 0.4942073429509004

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	141.334082
1	Risk_Free	5.170468
2	Eur_STOXX_Technology	5.170468

The analysis of the variables indicated that the risk-free rate had no significant effect on IG bonds (p-value 0.943), implying that variations in interest rates did not substantially influence spreads in this category. The Eur STOXX Technology index was also non-significant (p-value 0.602), suggesting that the overall sector performance had a negligible impact on IG spreads. Conversely, in the HY segment, the risk-free rate exerted a substantial negative impact (p-value < 0.001), indicating that increasing rates correlated with a contraction of HY spreads. The Eur STOXX Technology index was insignificant (p-value 0.193), supporting the

idea that broader sector trends were not a principal factor influencing HY spread movements.

Analyzing these coefficients yields additional insights. The IG segment seems predominantly detached from macroeconomic indicators like interest rates and sector indices, suggesting that credit spreads in this domain may rely more on firm-specific fundamentals than on overarching market trends. Simultaneously, the inverse correlation between the risk-free rate and high-yield spreads indicates that, contrary to traditional assumptions, elevated interest rates were associated with a contraction of high-yield spreads. This may suggest sustained investor commitment to technology high-yield bonds despite increasing interest rates, possibly influenced by confidence in the sector's growth prospects or a reevaluation of risk exposure.

The IG model, exhibiting a Durbin-Watson statistic of 0.4002, indicates a significant positive autocorrelation among the errors, implying restricted variability and a rigid configuration in the residuals. The HY model, valued at 0.4942, exhibits marginally greater independence in the residuals, yet it confirms the persistence of errors and a less random distribution, indicating that both models experience correlation in the residuals. (See Appendix 3)

Variance Inflation Factor analysis for multicollinearity indicated a moderate correlation between the risk-free rate and the Eur STOXX Technology index (approximately 5.17 for both), yet not at a magnitude that would substantially skew model outcomes.

From a macroeconomic standpoint, the discerned disconnection between investment-grade spreads and interest rates indicates that investment-grade credit within the technology sector is regarded as comparatively shielded from macroeconomic volatility. The contraction of high-yield spreads due to increasing risk-free rates indicates that investors continued to invest in riskier technology debt despite monetary tightening, possibly signifying optimism about the sector's long-term fundamentals.

4.1.6 Consumer Sector

The regression analysis of the Consumer sector reveals significant disparities in spread behavior between Investment Grade and High Yield bonds. The coefficient of determination for IG bonds is 0.761, signifying that the model accounts for a substantial portion of spread variations. Conversely, for HY bonds, R^2 is elevated at 0.838, indicating that the chosen variables provide a robust explanatory framework for HY spread fluctuations. The accompanying data is shown in the charts below.

Figure 22 – Consumer Sector IG

OLS Regression Results

Dep. Variable:	y	R-squared:	0.761
Model:	OLS	Adj. R-squared:	0.743
Method:	Least Squares	F-statistic:	42.94
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	4.10e-09
Time:	17:26:08	Log-Likelihood:	230.08
No. Observations:	30	AIC:	-454.2
Df Residuals:	27	BIC:	-449.9
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0075	0.000	67.170	0.000	0.007	0.008
x1	1.724e-05	1.91e-05	0.901	0.375	-2.2e-05	5.65e-05
x2	-6.474e-05	1.31e-05	-4.949	0.000	-9.16e-05	-3.79e-05

Omnibus:	7.235	Durbin-Watson:	0.872
Prob(Omnibus):	0.027	Jarque-Bera (JB):	6.198
Skew:	0.691	Prob(JB):	0.0451
Kurtosis:	4.747	Cond. No.	35.7

```
Breusch-Pagan p-value: 0.31572863320021033
Durbin-Watson statistic: 0.871533055657095

Variance Inflation Factor (VIF):
     Feature        VIF
0      const  26.653780
1  Risk_Free   2.655252
2  Inflation   2.655252
```

Figure 23 – Consumer Sector HY

OLS Regression Results

Dep. Variable:	y	R-squared:	0.838
Model:	OLS	Adj. R-squared:	0.826
Method:	Least Squares	F-statistic:	70.00
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	2.07e-11
Time:	17:31:19	Log-Likelihood:	126.29
No. Observations:	30	AIC:	-246.6
Df Residuals:	27	BIC:	-242.4
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0790	0.004	22.116	0.000	0.072	0.086
x1	-0.0064	0.001	-10.527	0.000	-0.008	-0.005
x2	-0.0021	0.000	-4.996	0.000	-0.003	-0.001

Omnibus:	2.340	Durbin-Watson:	0.642
Prob(Omnibus):	0.310	Jarque-Bera (JB):	1.853
Skew:	-0.458	Prob(JB):	0.396
Kurtosis:	2.198	Cond. No.	35.7

```
Breusch-Pagan p-value: 0.01839737604784363
Durbin-Watson statistic: 0.641700169264838

Variance Inflation Factor (VIF):
     Feature        VIF
0      const  26.653780
1  Risk_Free   2.655252
2  Inflation   2.655252
```

Upon analyzing variable significance, the risk-free rate exhibited no significant effect on IG bonds (p-value 0.375), indicating that variations in interest rates did not directly influence spreads in this category. Nonetheless, inflation was markedly significant and adverse (p-value < 0.001), suggesting that increasing inflation resulted in a constriction of IG spreads. In the HY segment, both variables were statistically significant, with the risk-free rate demonstrating a negative correlation (p-value < 0.001) and inflation also showing a pronounced negative impact (p-value < 0.001). This indicates that as inflation rose, spreads narrowed for both investment-grade and high-yield bonds, with HY spreads also reacting inversely to fluctuations in the risk-free rate.

The IG model, exhibiting a Durbin-Watson statistic of 0.8715, demonstrates a significant positive autocorrelation among the errors, signifying restricted dispersion and organized residuals. The HY model, with a value of 0.6417, demonstrates a more robust correlation, indicating greater dependency and reduced randomness in error distribution. This disparity indicates a reduced independence of the residuals in high-yield bonds compared to investment-grade bonds. (See Appendix 3)

Analyzing these coefficients yields further insights. The insensitivity of IG spreads to interest rate fluctuations indicates that credit risk in this category is largely shielded from wider macroeconomic variations. The inverse relationship between inflation and IG spreads indicates that companies in this sector successfully navigated price pressures, likely by transferring costs to consumers. The contraction of spreads in high-yield bonds due to increasing interest rates may indicate investor confidence in the sector's robustness or a reallocation of capital towards higher-yielding assets. The pronounced negative correlation between inflation and high-yield spreads indicates that lower-rated firms in the consumer sector may have gained from inflationary trends, potentially owing to pricing power or nominal revenue expansion.

Analysis of multicollinearity via the VIF revealed a low correlation between the risk-free rate and inflation (approximately 2.65 for both), confirming that the variables independently enhance the model's explanatory capacity.

From a macroeconomic perspective, these findings indicate that increasing interest rates had minimal impact on investment-grade spreads but led to a contraction of high-yield spreads, suggesting that investor sentiment towards riskier consumer-sector debt remained favorable despite monetary tightening. Simultaneously, inflationary pressures led to spread compression in both investment-grade and high-yield segments, possibly indicating the sector's capacity to adapt to cost increases without substantial margin erosion.

4.1.7 Materials Sector

The regression analysis of the Materials sector reveals a significant disparity in spread behavior between IG and HY bonds. The coefficient of determination for IG bonds is significantly low at 0.140, suggesting that the chosen variables—Risk-Free Rate and ECB Commodity Price Index—exhibit minimal explanatory capacity in accounting for variations in IG spreads. Conversely, HY bonds exhibit a markedly higher R^2 of 0.833, indicating that these factors exert a considerably greater influence on HY spreads. The accompanying data is depicted in the charts below.

Figure 24 – Materials Sector IG

OLS Regression Results

Dep. Variable:	y	R-squared:	0.140
Model:	OLS	Adj. R-squared:	0.076
Method:	Least Squares	F-statistic:	2.193
Date:	Sat, 01 Feb 2025	Prob (F-statistic):	0.131
Time:	17:35:45	Log-Likelihood:	139.46
No. Observations:	30	AIC:	-272.9
Df Residuals:	27	BIC:	-268.7
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0064	0.005	1.192	0.244	-0.005	0.017
x1	-0.0009	0.001	-1.260	0.218	-0.002	0.001
x2	3.282e-05	5.34e-05	0.614	0.544	-7.68e-05	0.000

Omnibus:	17.516	Durbin-Watson:	0.466
Prob(Omnibus):	0.000	Jarque-Bera (JB):	20.078
Skew:	1.632	Prob(JB):	4.37e-05
Kurtosis:	5.326	Cond. No.	1.52e+03

Breusch-Pagan p-value: 0.0006220008154877495
Durbin-Watson statistic: 0.6109293935771813

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	302.755200
1	Risk_Free	2.457185
2	ECB_Commodity_Price_Index	2.457185

Figure 25 -Materials Sector HY

OLS Regression Results

Dep. Variable:	y	R-squared:	0.833
Model:	OLS	Adj. R-squared:	0.820
Method:	Least Squares	F-statistic:	67.26
Date:	Sun, 09 Feb 2025	Prob (F-statistic):	3.25e-11
Time:	16:05:49	Log-Likelihood:	127.83
No. Observations:	30	AIC:	-249.7
Df Residuals:	27	BIC:	-245.5
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0560	0.008	7.086	0.000	0.040	0.072
x1	-0.0034	0.001	-3.304	0.003	-0.006	-0.001
x2	-5.417e-05	7.87e-05	-0.688	0.497	-0.000	0.000

Omnibus:	15.715	Durbin-Watson:	0.678
Prob(Omnibus):	0.000	Jarque-Bera (JB):	21.997
Skew:	-1.201	Prob(JB):	1.67e-05
Kurtosis:	6.439	Cond. No.	1.52e+03

Breusch-Pagan p-value: 0.47785344107361016
Durbin-Watson statistic: 0.7970908003251076

Variance Inflation Factor (VIF):

	Feature	VIF
0	const	302.755200
1	Risk_Free	2.457185
2	ECB_Commodity_Price_Index	2.457185

Evaluating variable significance, the risk-free rate demonstrated no substantial effect on IG bonds (p-value 0.218), suggesting that variations in interest rates did not significantly influence spreads in this category. Likewise, the ECB Commodity Price Index was not statistically significant (p-value 0.544), indicating that fluctuations in commodity prices exerted minimal direct impact on IG spreads. Conversely, in the HY segment, the risk-free rate exhibited a substantial negative correlation (p-value 0.003), indicating that increasing risk-free rates were linked to a contraction of HY spreads. Nevertheless, the ECB Commodity Price Index exhibited non-significance (p-value 0.497), thereby reinforcing the notion that fluctuations in commodity prices are not a principal factor influencing HY spread behavior.

Analyzing these coefficients provides additional insights. The insensitivity of IG spreads to both variables indicates that elements beyond interest rates and commodity price variations significantly influence credit risk perceptions in this sector. The inverse relationship between the risk-free rate and high-yield spreads indicates that, contrary to conventional expectations, elevated interest rates were associated with a decrease in high-yield spreads. This may suggest persistent investor interest in the sector despite monetary contraction, potentially influenced by sector-specific factors or relative valuations that rendered high-yield materials bonds more appealing in a rising interest rate context.

In the IG model, the Durbin-Watson statistic of 0.6109 signifies substantial autocorrelation among the errors, suggesting that the residuals exhibit restricted dispersion and adhere to a specific pattern. In the instance of HY, with a value of 0.7970, a more stochastic distribution of errors is observed, although some correlation remains. This indicates that the IG model exhibits reduced variability in the residuals compared to the HY model, where the errors are more widely dispersed. (See Appendix 3)

Analysis of multicollinearity via the Variance Inflation Factor revealed a minimal correlation between the risk-free rate and the ECB Commodity Price Index (approximately 2.45 for both), confirming that the variables independently enhance the model's explanatory capacity.

From a macroeconomic perspective, the results indicate that fluctuations in the risk-free rate minimally impacted investment-grade spreads but facilitated a contraction of high-yield spreads, signifying enhanced credit sentiment in the high-yield segment of the Materials sector. Simultaneously, fluctuations in commodity prices did not markedly impact spreads in either category, probably owing to the heterogeneous nature of firms within the sector, each possessing differing degrees of exposure to raw material expenses and supply chain configurations.

4.2 Interest Rate Impact Across Credit Ratings

The analysis of the responsiveness of Investment Grade and High Yield bonds to changes in the monetary policy of the European Central Bank is dependent on the different exposures to credit risk and interest rate sensitivity that each type of bond possesses. IG bonds, which are typically considered to be instruments with a lower level of risk, tend to demonstrate a more measured reaction to fluctuations in interest rates. On the other hand, HY bonds, which have a higher credit risk profile, are typically more volatile and reactive. A comprehensive understanding of these dynamics is necessary to evaluate the way investors adjust their risk preferences and the manner in which the transmission of monetary policy varies across market segments that have distinct risk characteristics. The following analysis examines sector-specific regression results to address the third research question of this thesis. It does so by highlighting key explanatory variables and statistical limitations that may have an impact on the reliability of the predictive models.

4.2.1 Investment Grade Bonds

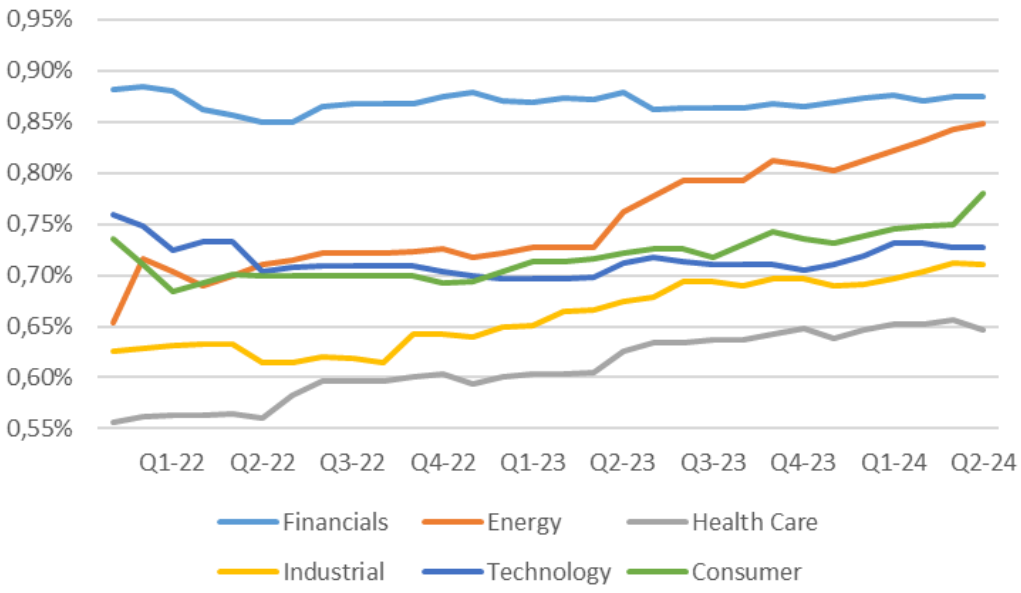
The examination of the regression outcomes for the Investment Grade sectors reveals notable disparities in the models' explanatory power. The Industrial and Energy sectors exhibit the highest predictive capability, with R-squared values of 0.930 and 0.872, respectively, signifying that the variables incorporated in the model predominantly account for the variation in OAS spreads. The Consumer (0.761) and Healthcare (0.485) sectors demonstrate substantial explanatory

power, whereas Financials (0.157), Materials (0.140), and particularly Technology (0.040) exhibit limited capacity to elucidate the variations in the spread.

The examination of the OAS data by sector reveals a distinct growth trajectory over time, with a notable influence of fluctuations in the risk-free rate on the spread dynamics across different sectors. The subsequent graph illustrates the progression of OAS across various sectors, excluding the Materials sector due to issues at the panel level in the initial three observations.

During the initial half of 2022, characterized by a negative risk-free rate of (-0.58%), sector spreads were comparatively modest, with Materials exhibiting the highest spread at 1.62% and Healthcare the lowest at 0.56%. In the third quarter of 2022, as risk-free rates began to ascend, a stabilization or modest increase in spreads across various sectors was evident, indicating an enhanced perception of risk among investors. In the fourth quarter of 2022, the risk-free rate rises substantially, resulting in a slight increase in spreads in the Energy, Industrial, and Materials sectors, while the Financials and Healthcare sectors remain largely unaffected. Beginning in 2023, the robust expansion of the risk-free rate is evidenced by a gradual rise in the Option-Adjusted Spread across nearly all sectors, with the Energy and Materials sectors exhibiting more pronounced increases than their counterparts. This aligns with their heightened sensitivity to economic fluctuations and commodity price instability. In 2024, with a stable risk-free rate at 3.91%, sector spreads exhibit a modest increase, with Energy and Materials attaining 0.85% and 0.84% respectively, while Financials and Healthcare maintain relative stability. This indicates that investors demand a greater risk premium in sectors more susceptible to macroeconomic volatility and global supply and demand influences, whereas sectors like Financials and Healthcare are regarded as more robust. The performance of OAS is influenced by a combination of macroeconomic and sector-specific factors, with a distinct impact from risk-free and sector-specific risk expectations.

Figure 26 – OAS IG Curves



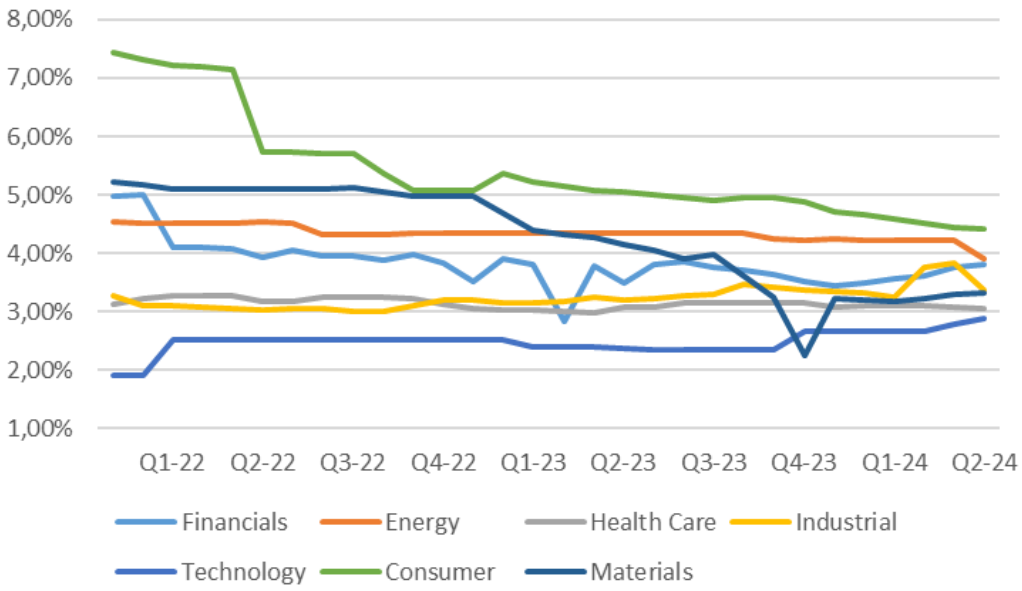
The rise of risk-free rates from 2022 to 2024 has significantly influenced spreads, particularly in sectors more susceptible to macroeconomic volatility. Energy and Materials have experienced the most significant increases, reflecting their susceptibility to economic fluctuations and commodity price volatility, whereas Financials and Healthcare have exhibited relative stability, indicating enhanced resilience. To enhance the analyses, it is advisable to reassess the variable selection in sectors exhibiting low R-squared, mitigate multicollinearity in Energy, and rectify the heteroskedasticity problem in Materials, potentially via robust regression or variable transformation.

4.2.2 High Yield Bonds

The regression analysis of high-yield bonds across sectors demonstrates varied responses to macroeconomic factors. The financial sector exhibits moderate explanatory power, with the risk-free rate, growth, and CET1 ratio as primary determinants, indicating their relationship with systemic risk and the capital robustness of financial institutions. The energy sector exhibits the greatest predictive capability, significantly influenced by the risk-free rate and the HICP Energy index, indicating a reliance on energy prices and financing expenses. The healthcare sector exhibits the least explanatory power, indicating that elements like regulations and earnings projections exert considerable influence. The industrial sector exhibits a moderate reliance on the risk-free rate and industrial

production, underscoring its correlation with the economic cycle. The technology sector exhibits limited predictive capability, suggesting that market volatility and investor sentiment are critical determinants of high-yield spreads. The consumer sector is acutely responsive to market conditions and interest rates, whereas the materials sector is intricately linked to commodity prices, with credit risk significantly influenced by commodity performance.

Figure 27 – OAS HY Curves



The historical analysis of Option-Adjusted Spreads substantiates the primary influence of the risk-free rate on high-yield spreads across various sectors. The chart above illustrates the progression of all seven sectors throughout the observed period. Between Q1-22 and Q2-24, the risk-free rate transitioned from negative values to a stable rate of 3.91% starting in Q4-23, indicative of stricter monetary policies. The financial sector experienced a contraction of the spread, indicating enhanced risk perception. The energy sector exhibited relative stability, signifying reduced interest rate elasticity and increased reliance on commodity prices. The healthcare sector exhibited a stable performance, affirming its defensive function. The industrial sector experienced a minor decline in OAS in 2023, followed by a recovery in 2024, attributed to a potential economic downturn. The technology sector experienced a gradual expansion of spreads, corresponding to the sector's heightened volatility. The consumer sector exhibited a notable contraction of

spreads, affirming its pronounced responsiveness to monetary policy and inflation, whereas the materials sector experienced a consistent reduction of spreads, indicating the substantial impact of commodities on financing expenses.

The comprehensive analysis of regressions and historical OAS data reveals that the risk-free rate is the primary determinant of the HY spread, exerting a notably significant influence in the financial, consumer, and materials sectors. The correlation with sales is evident in the sectors most sensitive to demand, such as finance and consumer goods. The energy sector is notable for its correlation with energy prices, whereas the industrial sector mirrors the economic cycle. The technology sector seems to be less affected by macroeconomic factors and more susceptible to market volatility. The behavior of high-yield markets is heterogeneous, with certain sectors more responsive to macroeconomic conditions while others are influenced by sector-specific dynamics.

Conclusion and Adjustment for Future Research

5.1 Results

Examining how the credit spread of European bonds reacts to shifts in the fixed interest rate set by the European Central Bank offers valuable information about investor sentiment, market dynamics, and the direction of monetary policy. Understanding how spreads have evolved, how they have impacted bond issuer valuations, whether they are investment grade or high-yield, and other macroeconomic issues requires an awareness of these three factors. When the ECB raises interest rates, particularly for high-yield bonds, credit spreads tend to expand. However, investors' assessments of each issuer's default risk also have a significant impact on the market response. One important indicator of the company's financial health and capacity to tolerate debt pressure in this situation is the likelihood of default. Investors will typically sell if they think the default risk has increased. On the other hand, even in a competition of rising rates, a perception of low risk can result in spread compression.

There is no chance of a direct correlation between spreads and macroeconomic indicators when it comes to investment-grade bonds, like those issued by banks and insurance providers. This implies that even if interest rates increase, investors will still consider these bonds to be stable. Businesses in these industries are typically thought to be less vulnerable to a downturn in financial conditions because of their sound capital structures and business plans. Even if interest rates increase, the perception of credit risk is diminished because these issuers have a comparatively low probability of default. As a result, when there are no notable macroeconomic shifts that affect the industry, the spread of these bonds tends to remain constant. Conversely, high-yield bonds—which are issued by businesses that are more likely to default—have reacted more forcefully to interest rate fluctuations. Because rising financing costs can put pressure on high-yield issuers' ability to borrow money, the likelihood of default tends to increase as interest rates rise. Nevertheless, high yield spread compression is seen despite the risk-free interest rate increase. Lower inflation may help the overall state of the economy and lessen the perception of default risk among certain issuers, which is one

reason for this phenomenon. Furthermore, the pursuit of higher yields may allow investors to take on greater risk, which would reduce the high yield spread.

In certain industries, this dynamic is especially noticeable. Investment-grade bonds, for instance, do not respond strongly to changes in interest rates in the energy sector; instead, the spread widens, which causes inflation. This implies that rising energy costs are putting pressure on the margins of businesses in this industry, like utilities and those with high energy intensity, which could raise the likelihood of default and, in turn, the spread. The fiduciary guardians of investors in energy producers who stand to benefit from rising commodity prices, however, can observe spread compression despite rising interest rates due to the high-yield requirements in this sector. This improvement in solvency conditions stops the spread and lowers the perceived default probability.

Because investors see risk-free options as a secure substitute for state-issued bonds, investment-grade obligations in the healthcare sector are particularly vulnerable to them. The major pharmaceutical companies appear to be able to sustain a steady rate of reduction despite cost pressure, as evidenced by their lack of reaction to inflation. In this case, there are no significant fluctuations in the perception of credit risk, and the default probability for these firms remains stable. Conversely, the spread was compressed for high-yield obligations in the healthcare sector, which might suggest that issuers' capacity to fulfill financial commitments is more highly trusted. In contrast to the consequences of a more rigid economic context, the operational stability and profit margins of healthcare businesses may be the reason for the lower default probability in this instance.

IG obligations in the industrial sector are particularly susceptible to interest rate increases because they are highly sensitive to financing costs. Nonetheless, the spread is compressed during the period of industrial expansion, suggesting that economic expansion reduces the issuers' credit profile. As a result, the emitters' predictions improve, which decreases the likelihood that they will default because they are less able to produce cash flows. For high-yield obligations, the response is less evident, but it typically intensifies in the presence of macroeconomic uncertainty or a deterioration in financial conditions. However, the detrimental effect on spread might be mitigated by improving market liquidity and managing

sectoral risks.

In the technology sector, investment-grade bonds demonstrate minimal correlation with risk-free assets, suggesting that investors view them as largely insulated from broader macroeconomic fluctuations. This could be attributed to the increasing influence of company-specific characteristics on credit decisions within this industry. Even amid rising interest rates, high-yield spreads may narrow due to optimistic growth prospects in the technology sector, which could be less affected by competition for higher yields. In such scenarios, the perceived risk is lower as the probability of default is reduced for companies with strong growth potential.

For the consumer goods sector, investment-grade bonds show no strong correlation with interest rate movements, indicating that investors regard these assets as stable, regardless of rate changes. The tightening of IG spreads during inflationary periods supports the notion that these companies are capable of passing increased costs onto consumers without significantly impacting profit margins. This spread compression reflects investor confidence in the resilience and low default risk of these companies, particularly when compared to high-yield bonds within the consumer goods sector.

Investment-grade bonds in the materials sector appear to be largely unaffected by interest rate changes or fluctuations in raw material prices. This suggests that short-term factors play a more significant role in driving market dynamics than overarching macroeconomic conditions. Despite elevated risk-free rates, the tightening of spreads in the high-yield segment may indicate improved cost management within the sector and a shift in liquidity preferences towards more liquid assets.

5.2 Study Limitations and Adjustments for Future Research

This study exhibits specific methodological and analytical limitations that must be recognized to accurately contextualize the findings. A principal constraint pertains to the temporal frequency of observations. The analyzed data are derived from monthly observations gathered from January 2022 to June 2024. This selection facilitates the identification of medium-term trends, but it may compromise the

accuracy of estimates relative to a higher-frequency dataset (e.g., weekly or daily observations). A more detailed time frame could have enhanced the precision of curve estimations and the analysis of relationships among the examined variables.

A crucial element pertains to the choice of input curves. The variables selected to model OAS behavior across various sectors were determined by their overall representativeness for the respective industries. Inflation and energy price trends were utilized for the energy sector, whereas the stock prices of prominent industry participants were applied to the technology sector. This methodological approach may not have completely encompassed all sector-specific dynamics, as each industry is shaped by a distinct amalgamation of macroeconomic, regulatory, and firm-specific factors.

Furthermore, the discrepancies noted in the residual plots indicate possible methodological inconsistencies related to sector studies and rating models. Particularly, distinct atypical patterns manifested at specific time intervals, suggesting that the chosen factors may not consistently suffice to elucidate the variability of credit spreads across the examined sectors. It is essential to acknowledge that the seven examined sectors display unique structural attributes, potentially impacting the results in varied manners. Certain industries may have responded more intensely to specific economic shocks than others, potentially causing distortions in sectoral comparisons. Future research may investigate this issue more comprehensively by employing a segmented methodology that considers a wider array of sector-specific variables and an increased observation frequency.

Appendix 1

Figure 28 - OAS IG Curves

Time Period	Financials	Energy	Health Care	Industrial	Technology	Consumer	Materials
gen-22	0,88%	0,65%	0,56%	0,63%	0,76%	0,74%	1,62%
feb-22	0,88%	0,72%	0,56%	0,63%	0,75%	0,71%	1,62%
mar-22	0,88%	0,70%	0,56%	0,63%	0,72%	0,68%	1,62%
apr-22	0,86%	0,69%	0,56%	0,63%	0,73%	0,69%	0,76%
mag-22	0,86%	0,70%	0,56%	0,63%	0,73%	0,70%	0,74%
giu-22	0,85%	0,71%	0,56%	0,61%	0,70%	0,70%	0,74%
lug-22	0,85%	0,72%	0,58%	0,61%	0,71%	0,70%	0,74%
ago-22	0,87%	0,72%	0,60%	0,62%	0,71%	0,70%	0,75%
set-22	0,87%	0,72%	0,60%	0,62%	0,71%	0,70%	0,77%
ott-22	0,87%	0,72%	0,60%	0,61%	0,71%	0,70%	0,77%
nov-22	0,87%	0,72%	0,60%	0,64%	0,71%	0,70%	0,78%
dic-22	0,88%	0,73%	0,60%	0,64%	0,70%	0,69%	0,78%
gen-23	0,88%	0,72%	0,59%	0,64%	0,70%	0,69%	0,78%
feb-23	0,87%	0,72%	0,60%	0,65%	0,70%	0,70%	0,79%
mar-23	0,87%	0,73%	0,60%	0,65%	0,70%	0,71%	0,80%
apr-23	0,87%	0,73%	0,60%	0,67%	0,70%	0,71%	0,80%
mag-23	0,87%	0,73%	0,61%	0,67%	0,70%	0,72%	0,81%
giu-23	0,88%	0,76%	0,63%	0,67%	0,71%	0,72%	0,81%
lug-23	0,86%	0,78%	0,63%	0,68%	0,72%	0,73%	0,80%
ago-23	0,86%	0,79%	0,63%	0,69%	0,71%	0,73%	0,80%
set-23	0,86%	0,79%	0,64%	0,69%	0,71%	0,72%	0,80%
ott-23	0,86%	0,79%	0,64%	0,69%	0,71%	0,73%	0,80%
nov-23	0,87%	0,81%	0,64%	0,70%	0,71%	0,74%	0,81%
dic-23	0,87%	0,81%	0,65%	0,70%	0,71%	0,74%	0,81%
gen-24	0,87%	0,80%	0,64%	0,69%	0,71%	0,73%	0,82%
feb-24	0,87%	0,81%	0,65%	0,69%	0,72%	0,74%	0,82%
mar-24	0,88%	0,82%	0,65%	0,70%	0,73%	0,75%	0,81%
apr-24	0,87%	0,83%	0,65%	0,70%	0,73%	0,75%	0,82%
mag-24	0,88%	0,84%	0,66%	0,71%	0,73%	0,75%	0,83%
giu-24	0,87%	0,85%	0,65%	0,71%	0,73%	0,78%	0,84%

Figure 29 - OAS HY Curves

Time Period	Financials	Energy	Health Care	Industrial	Technology	Consumer	Materials
gen-22	4,99%	4,53%	3,14%	3,26%	1,90%	7,44%	5,22%
feb-22	5,00%	4,52%	3,21%	3,12%	1,90%	7,33%	5,16%
mar-22	4,10%	4,51%	3,28%	3,11%	2,52%	7,21%	5,11%
apr-22	4,10%	4,51%	3,28%	3,07%	2,52%	7,18%	5,10%
mag-22	4,08%	4,51%	3,28%	3,05%	2,52%	7,13%	5,09%
giu-22	3,94%	4,53%	3,17%	3,03%	2,52%	5,72%	5,09%
lug-22	4,05%	4,52%	3,17%	3,05%	2,52%	5,72%	5,09%
ago-22	3,96%	4,33%	3,24%	3,05%	2,52%	5,72%	5,09%
set-22	3,96%	4,33%	3,24%	3,00%	2,52%	5,71%	5,11%
ott-22	3,88%	4,33%	3,24%	3,00%	2,52%	5,36%	5,04%
nov-22	3,98%	4,34%	3,22%	3,09%	2,52%	5,08%	4,97%
dic-22	3,84%	4,34%	3,13%	3,21%	2,52%	5,08%	4,97%
gen-23	3,51%	4,35%	3,06%	3,20%	2,52%	5,06%	4,97%
feb-23	3,92%	4,35%	3,04%	3,16%	2,52%	5,36%	4,68%
mar-23	3,80%	4,34%	3,02%	3,16%	2,41%	5,22%	4,39%
apr-23	2,84%	4,34%	3,02%	3,18%	2,41%	5,16%	4,33%
mag-23	3,78%	4,34%	2,98%	3,25%	2,41%	5,09%	4,27%
giu-23	3,50%	4,35%	3,08%	3,19%	2,37%	5,04%	4,16%
lug-23	3,80%	4,34%	3,09%	3,23%	2,35%	4,99%	4,05%
ago-23	3,85%	4,34%	3,15%	3,27%	2,35%	4,95%	3,90%
set-23	3,77%	4,34%	3,15%	3,31%	2,35%	4,90%	3,98%
ott-23	3,70%	4,34%	3,15%	3,46%	2,35%	4,96%	3,61%
nov-23	3,64%	4,24%	3,15%	3,41%	2,35%	4,96%	3,26%
dic-23	3,52%	4,21%	3,15%	3,37%	2,66%	4,88%	2,26%
gen-24	3,46%	4,24%	3,07%	3,35%	2,66%	4,71%	3,22%
feb-24	3,50%	4,23%	3,10%	3,33%	2,66%	4,65%	3,19%
mar-24	3,57%	4,21%	3,10%	3,26%	2,66%	4,60%	3,17%
apr-24	3,61%	4,21%	3,10%	3,76%	2,66%	4,52%	3,24%
mag-24	3,77%	4,21%	3,08%	3,85%	2,79%	4,44%	3,30%
giu-24	3,81%	3,91%	3,06%	3,38%	2,89%	4,42%	3,31%

Appendix 2

Figure 30 - Multiple Regression Financials IG

```
Regression coefficients (RF, Inflation, CET1): [-0.00182025  0.00151024  0.02507473]
Intercept (a): 0.47698322837321605
R^2: 0.1565894706256028
```

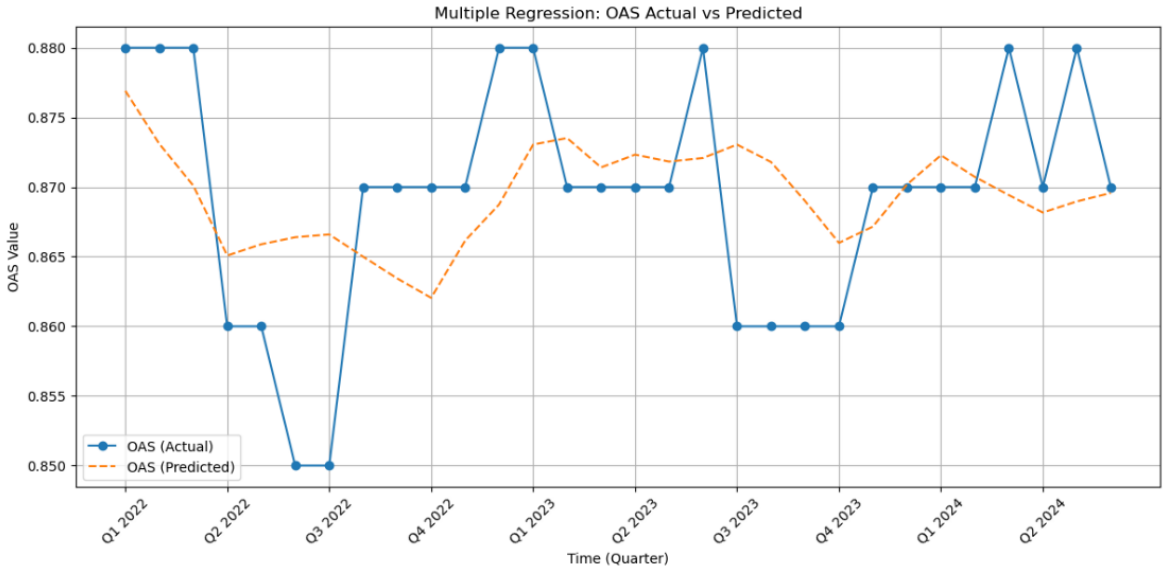


Figure 31 - Multiple Regression Financials HY

```
Regression coefficients (RF, Inflation, CET1): [-0.30197365 -0.06184223  0.56404197]
Intercept (a): -3.907761091705662
R^2: 0.6378898972596418
```

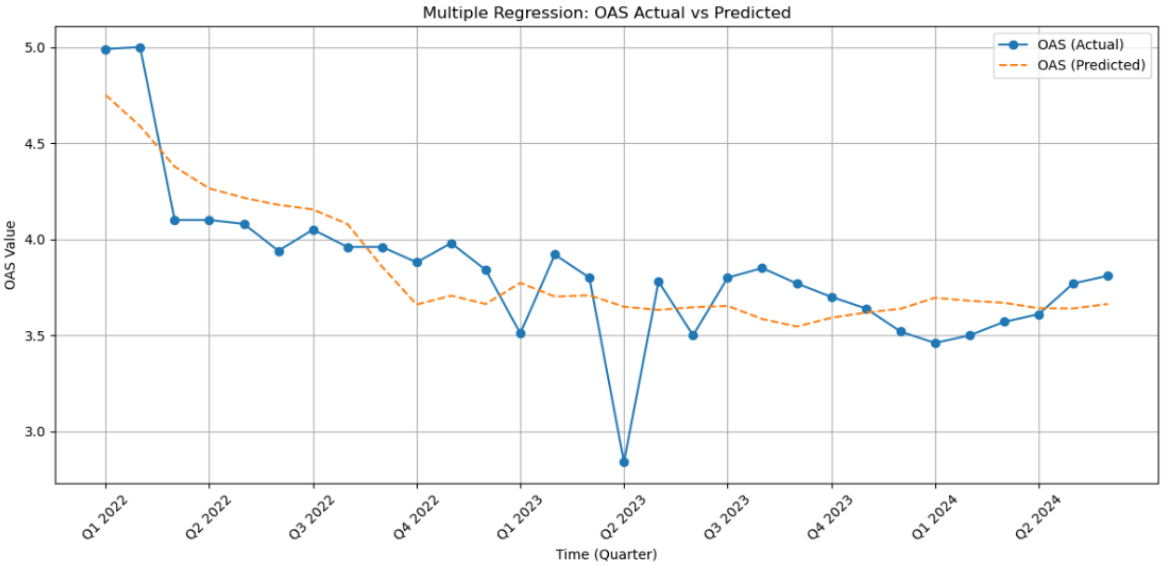


Figure 32 - Multiple Regression Energy IG

```
Regression coefficients (RF, HICP Energy): [-6.13298448e-05  6.01338066e-05]
Intercept (a): 0.0004890664745816542
R^2: 0.8723333996763778
```

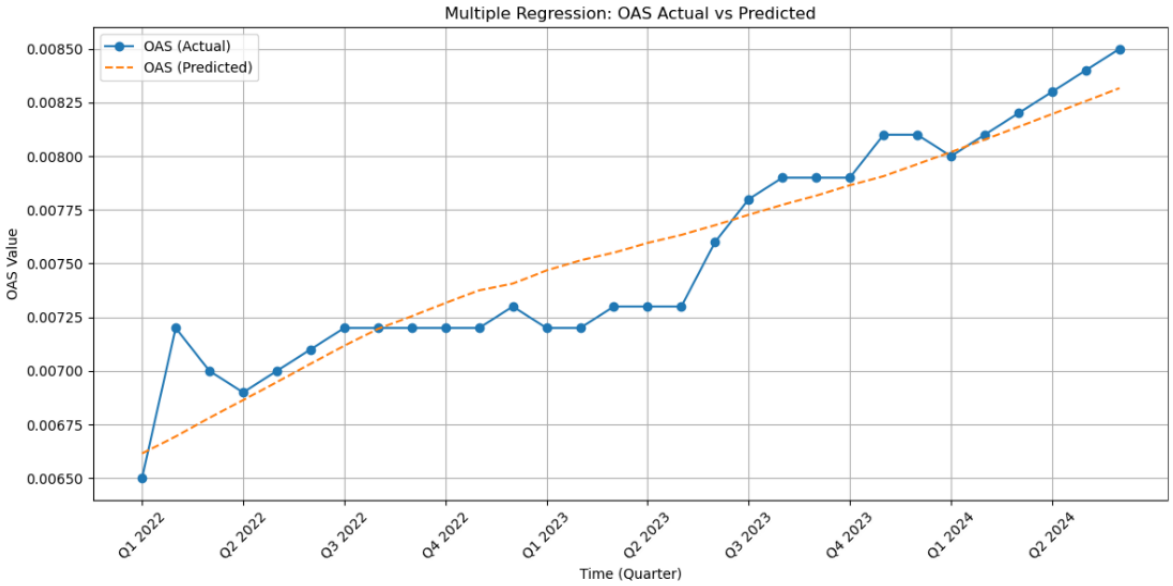


Figure 33 - Multiple Regression Energy HY

```
Regression coefficients (RF, HICP Energy): [ 0.00065811 -0.00023776]
Intercept (a): 0.07046896099106173
R^2: 0.8077087663707944
```

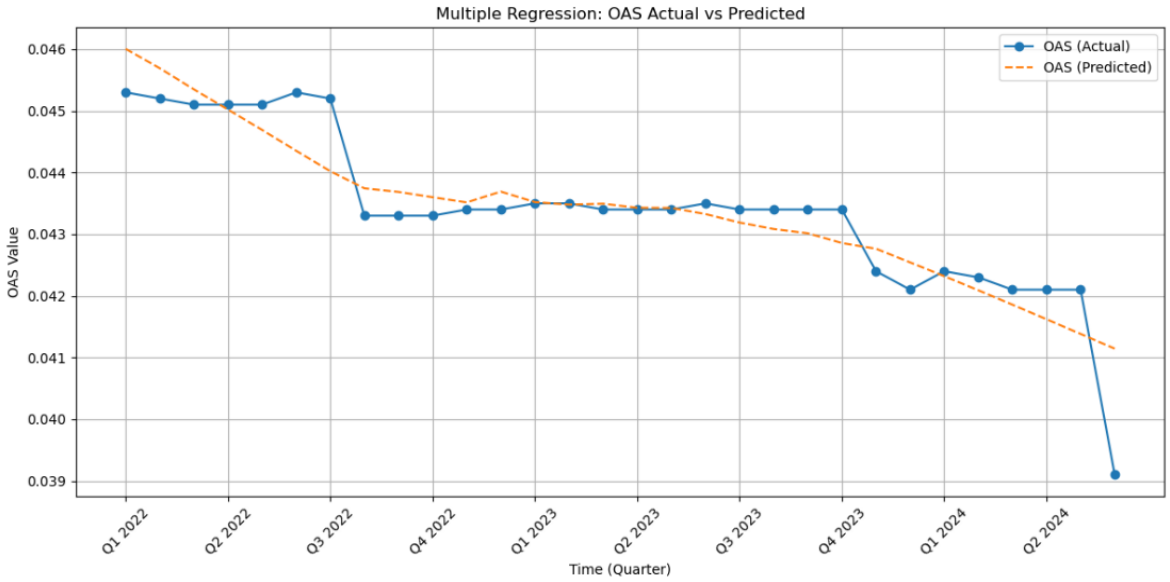


Figure 34 - Multiple Regression Health Care IG

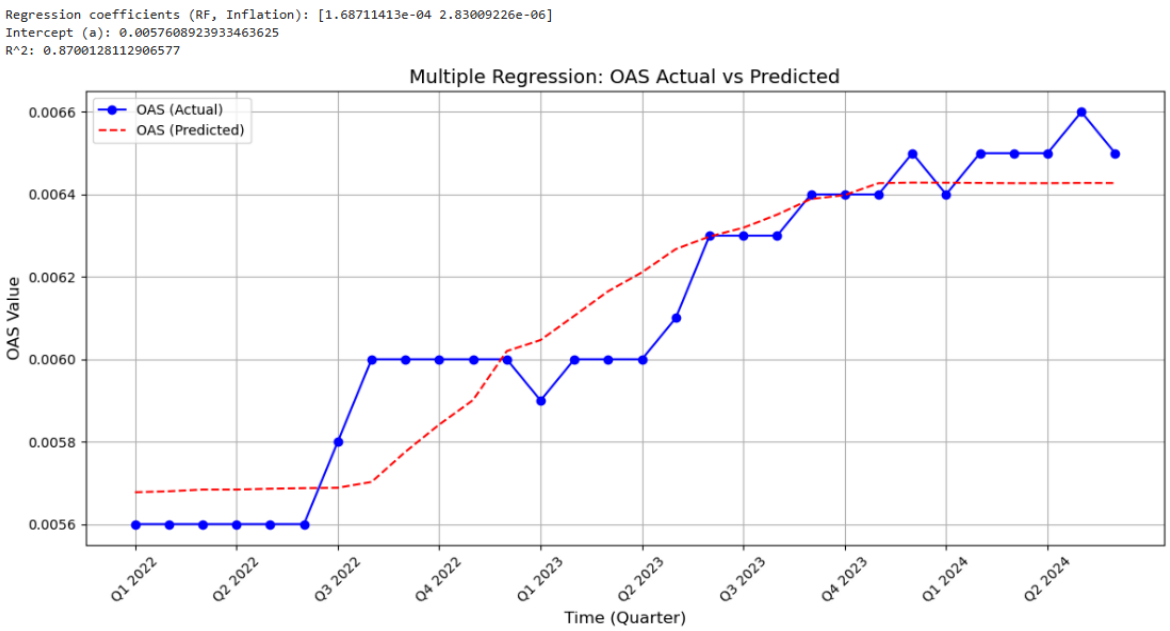


Figure 35 - Multiple Regression Health Care HY

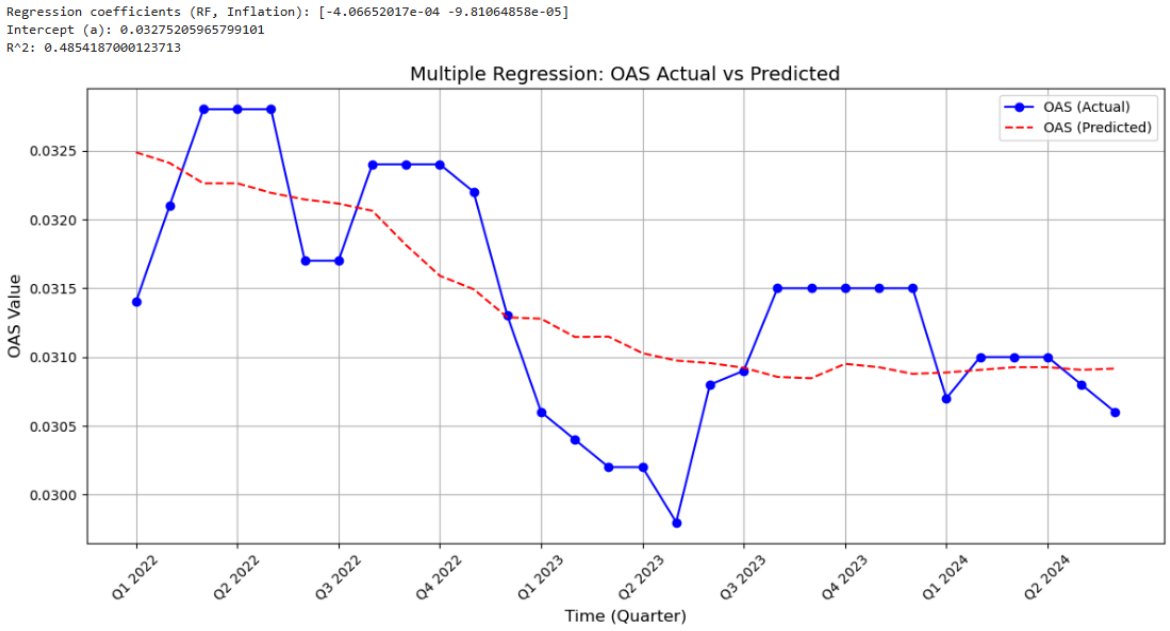


Figure 36 - Multiple Regression Industrial IG

```
Regression coefficients (RF, Industrial Production Index): [ 1.42659700e-04 -3.42248917e-05]
Intercept (a): 0.009794577631705728
R^2: 0.9302713181088633
```

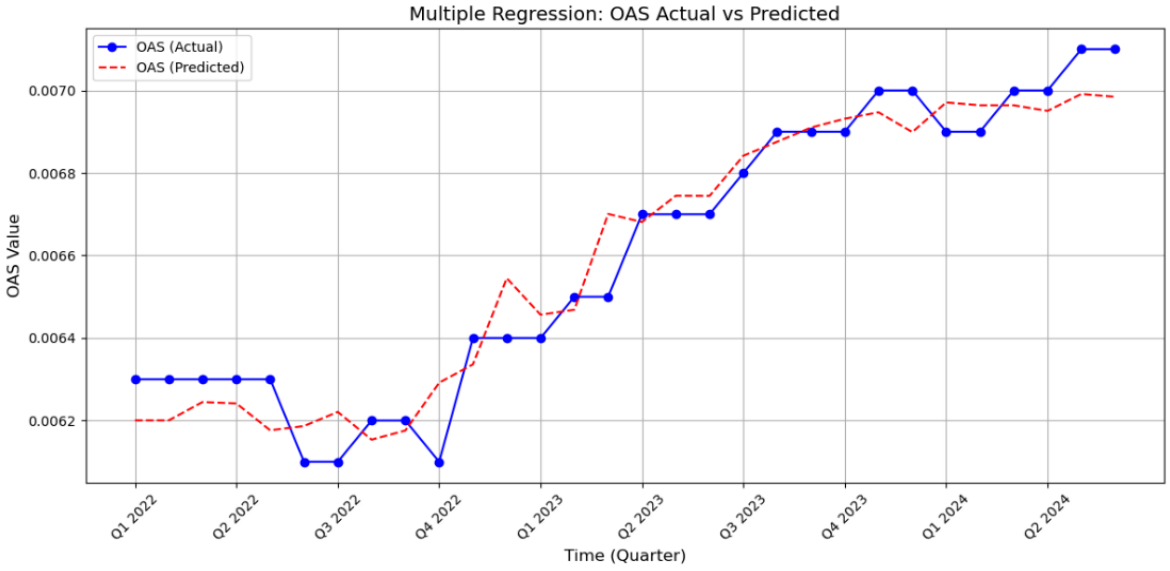


Figure 37 - Multiple Regression Industrial HY

```
Regression coefficients (RF, Industrial Production Index): [ 0.00049244 -0.00034197]
Intercept (a): 0.06608694202681781
R^2: 0.5976182660633087
```

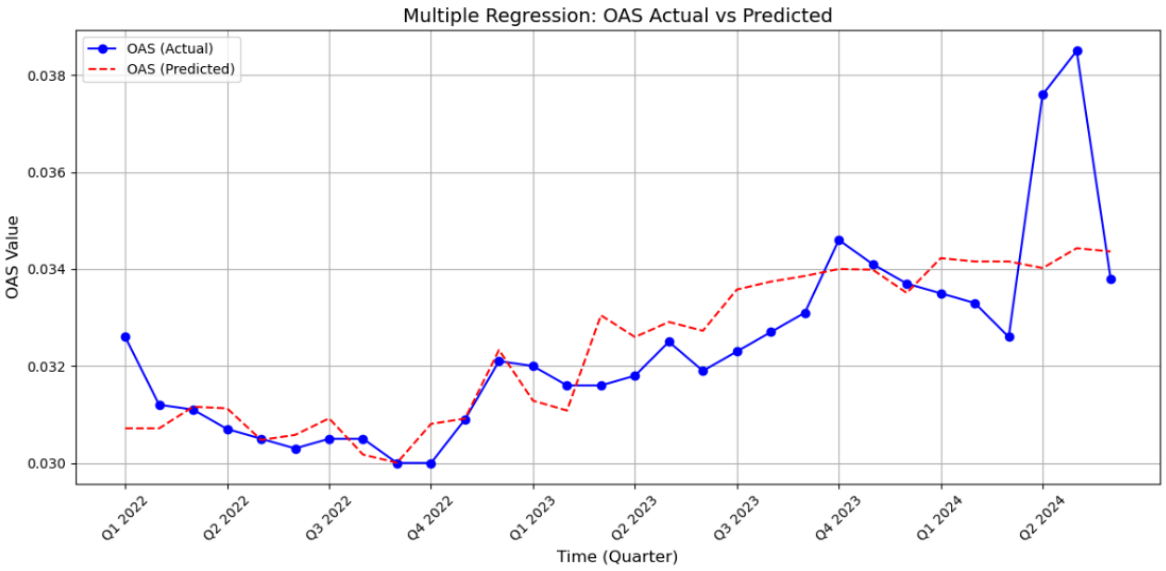


Figure 38 - Multiple Regression Technology IG

```
Regression coefficients (RF, INDEXX Technology): [ 2.45693804e-06 -2.26180038e-07]
Intercept (a): 0.00735617682685731
R^2: 0.03959416967975815
```

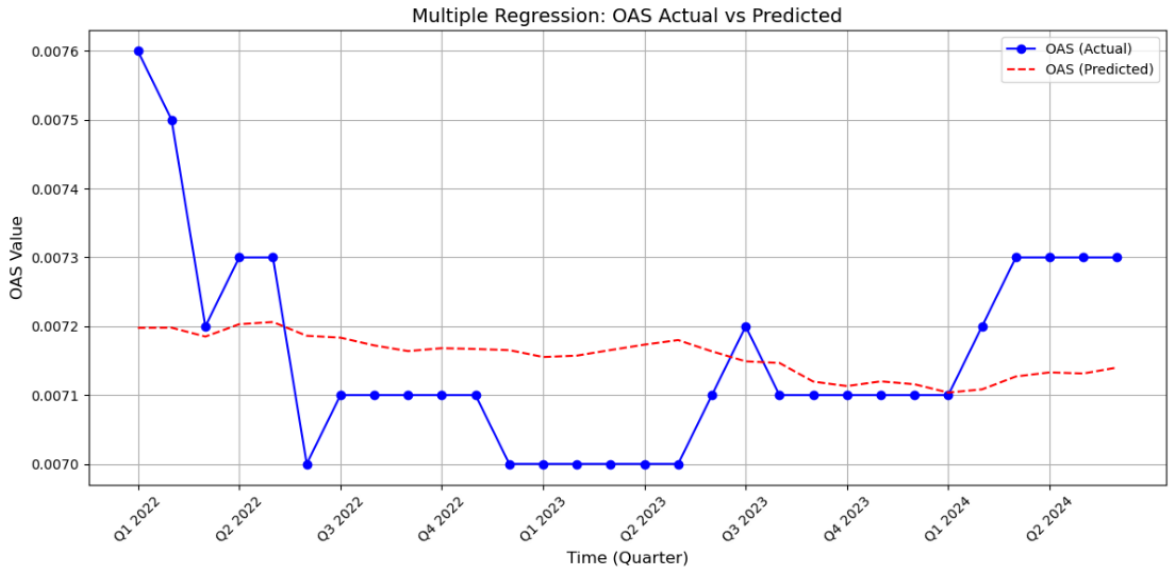


Figure 39 -Multiple Regression Technology HY

```
Regression coefficients (RF, INDEXX Technology): [-1.36253441e-04  7.25877055e-06]
Intercept (a): 0.01849670643189054
R^2: 0.1772066993550797
```

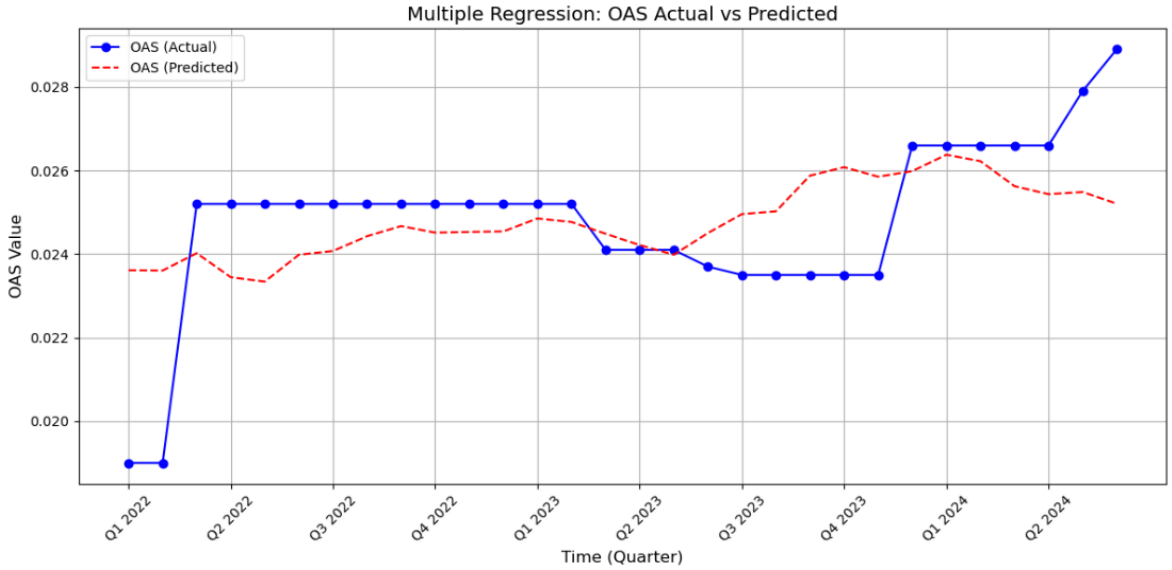


Figure 40 - Multiple Regression Consumer IG

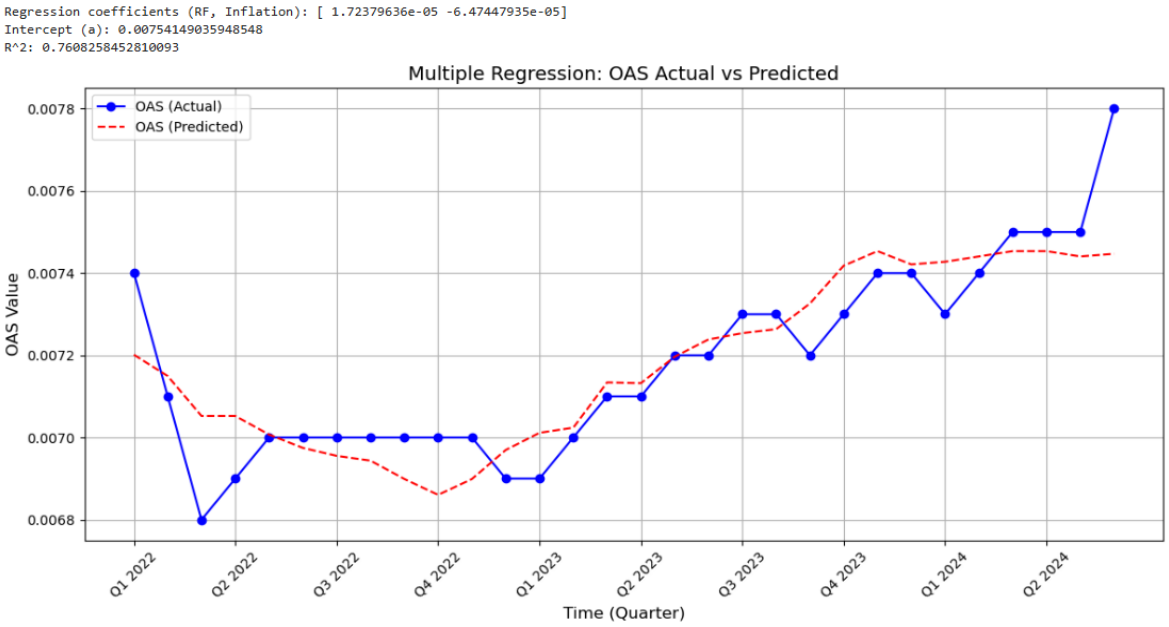


Figure 41 - Multiple Regression Consumer HY

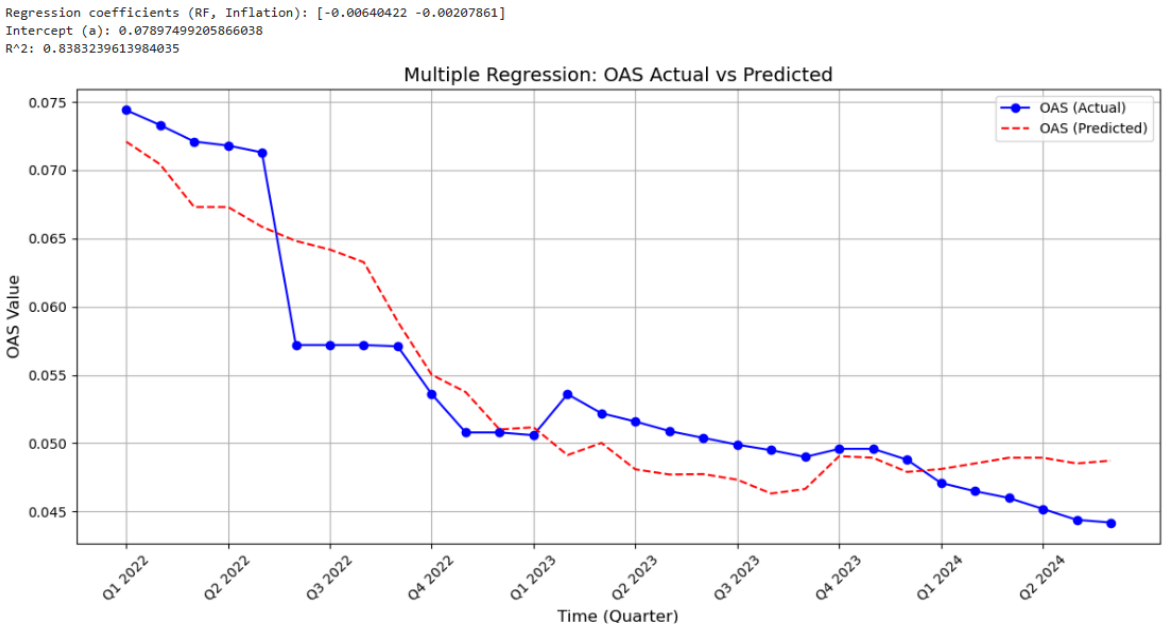


Figure 42 - Multiple Regression Materials IG

```
Regression coefficients (RF, ECB Commodity Price Index): [-8.89146251e-04  3.28245282e-05]
Intercept (a): 0.006394626099090084
R^2: 0.13972606647804287
```

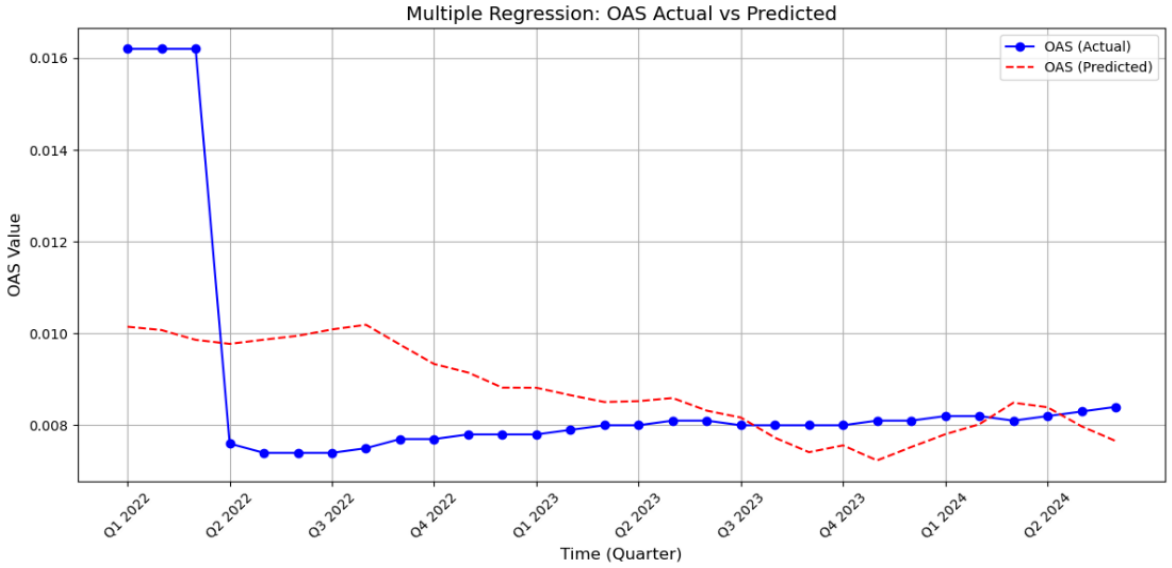
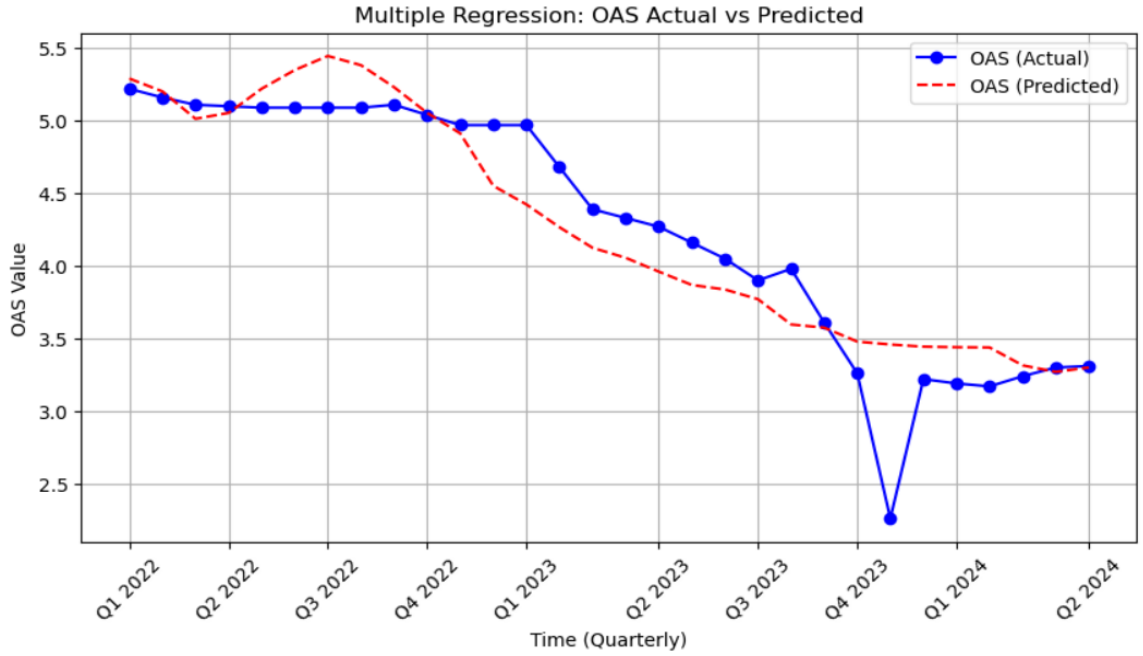


Figure 43 - Multiple Regression Materials HY

```
Regression coefficients (RF, ECB Commodity Price Index): [-0.48259518 -0.01322021]
Intercept (a): 6.978360921510827
R^2: 0.8474506711746633
```



Appendix 3

Figure 44 - Residual Plot Financials IG

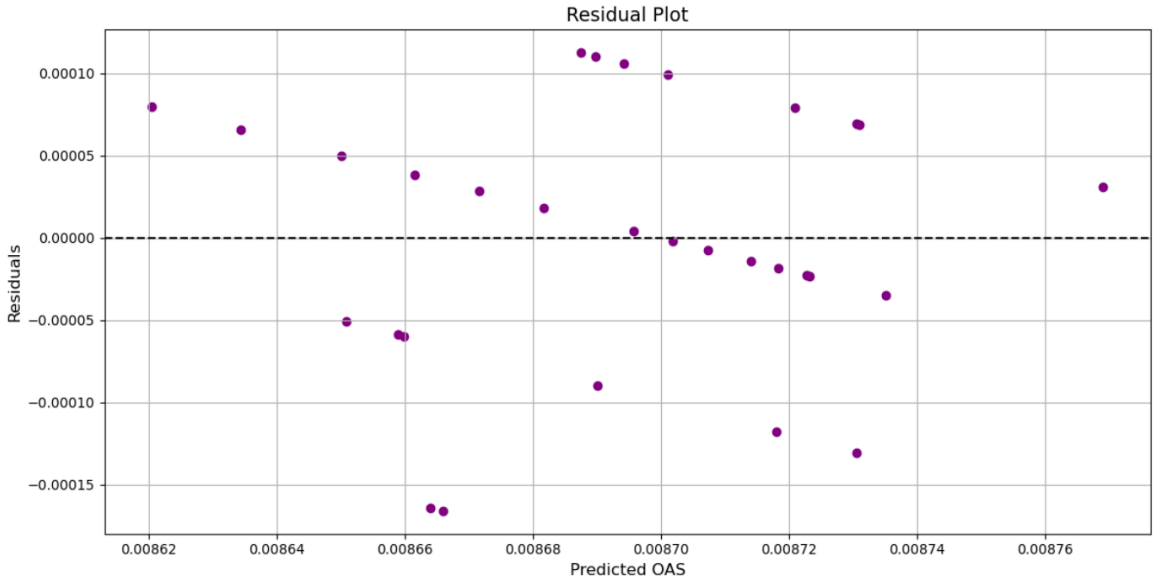


Figure 45 - Residual Plot Financials HY

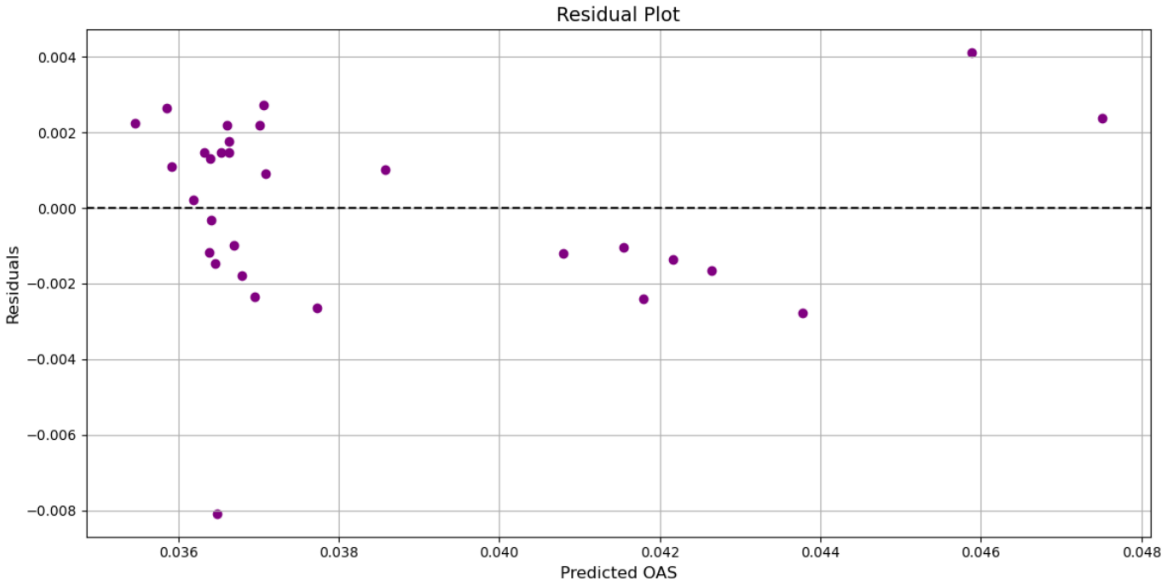


Figure 46 - Residual Plot Energy IG

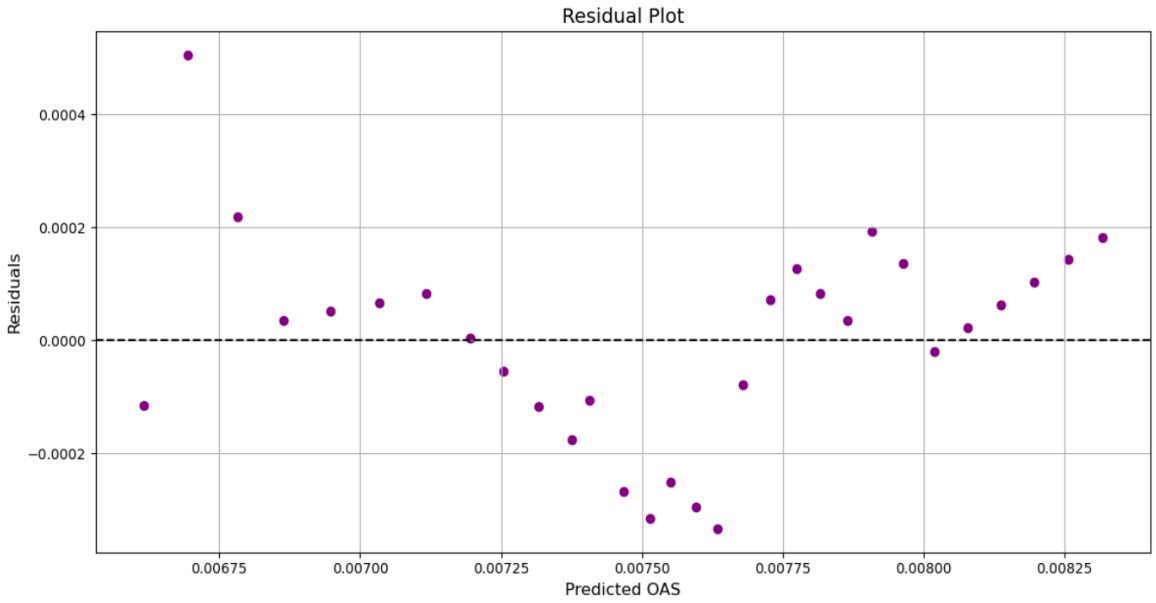


Figure 47 - Residual Plot Energy HY

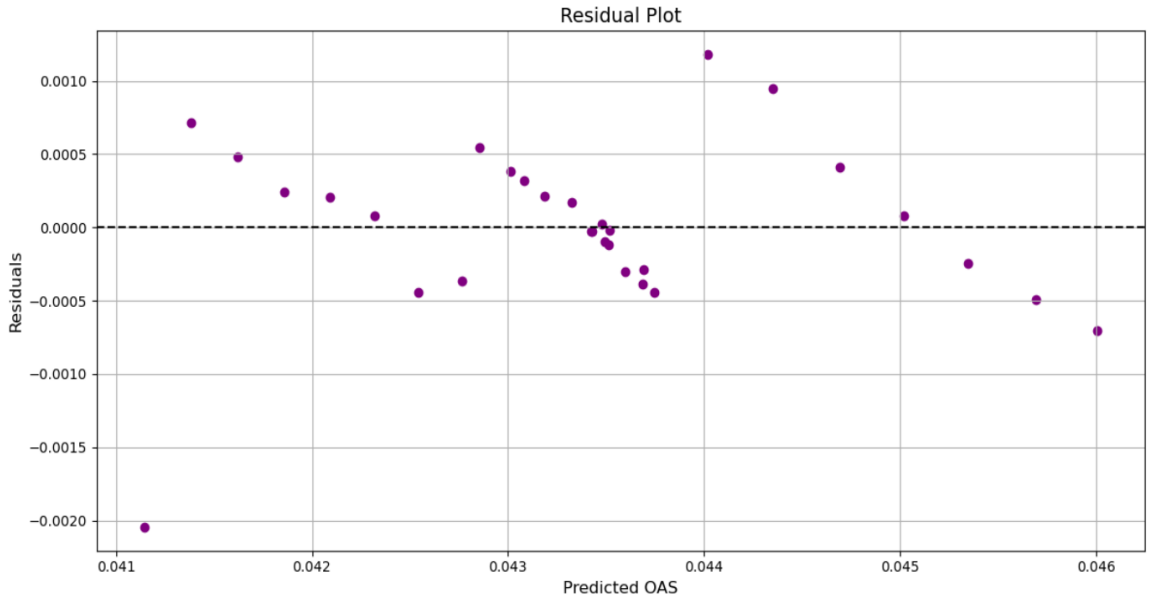


Figure 48 - Residual Plot Health Care IG

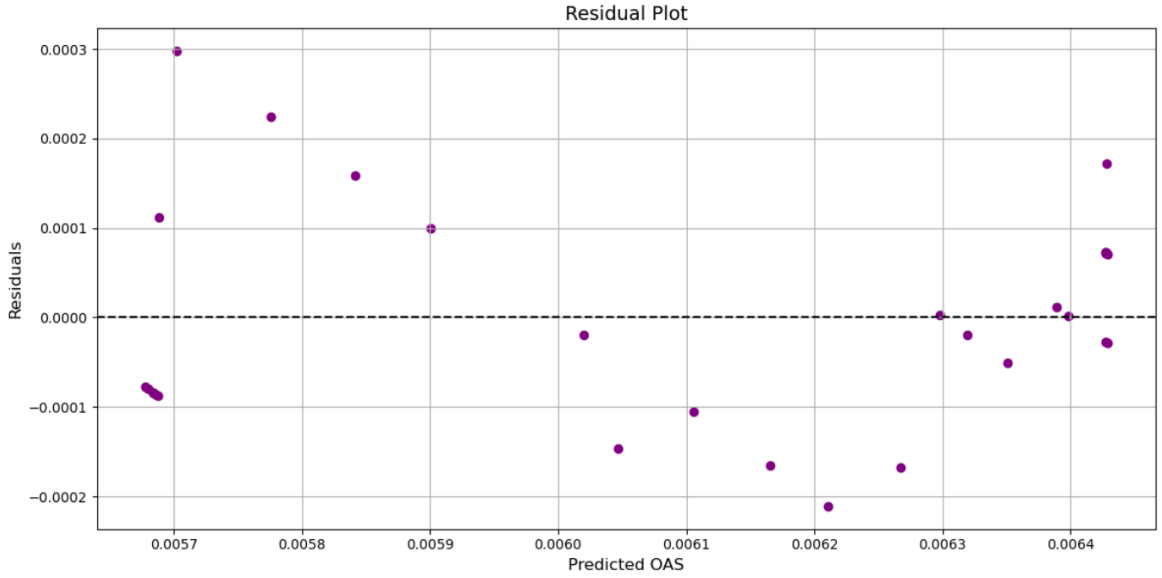


Figure 49 - Residual Plot Health Care HY

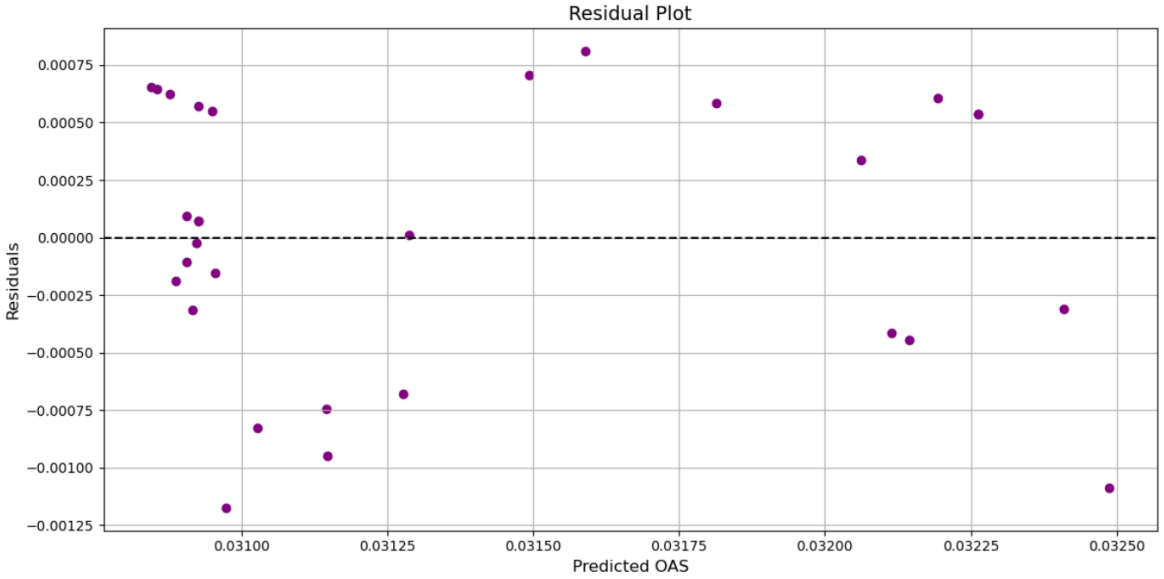


Figure 50 - Residual Plot Industrial IG

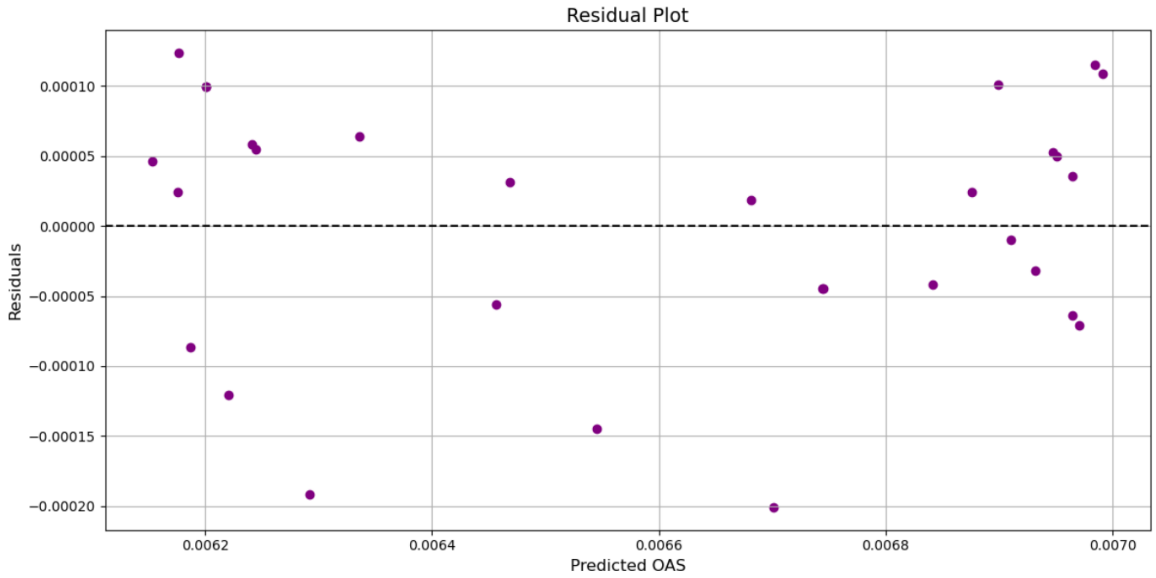


Figure 51 - Residual Plot Industrial HY

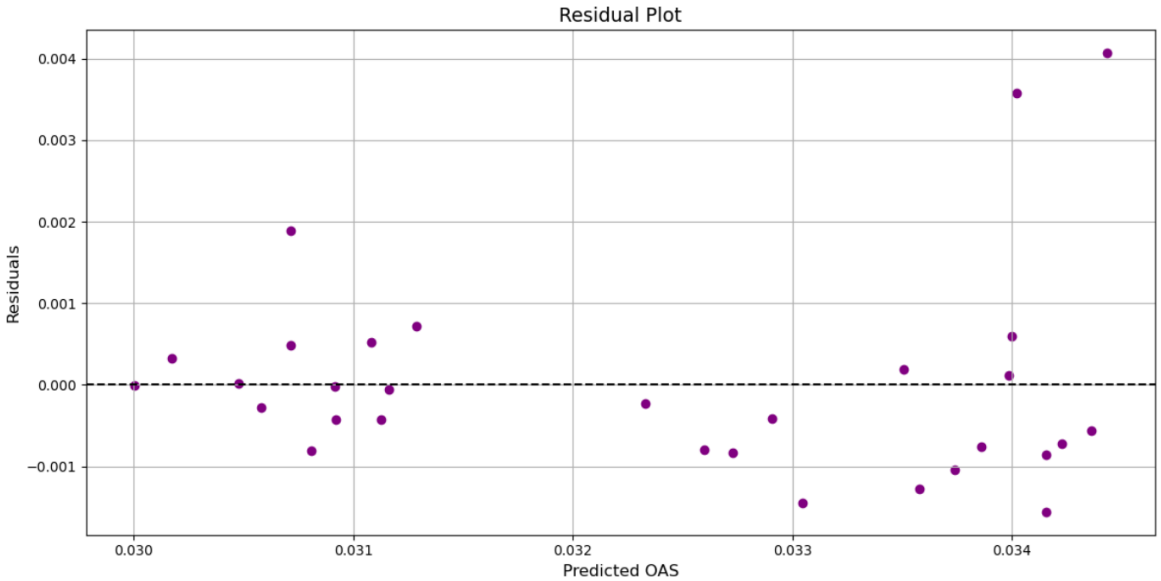


Figure 52 - Residual Plot Technology IG

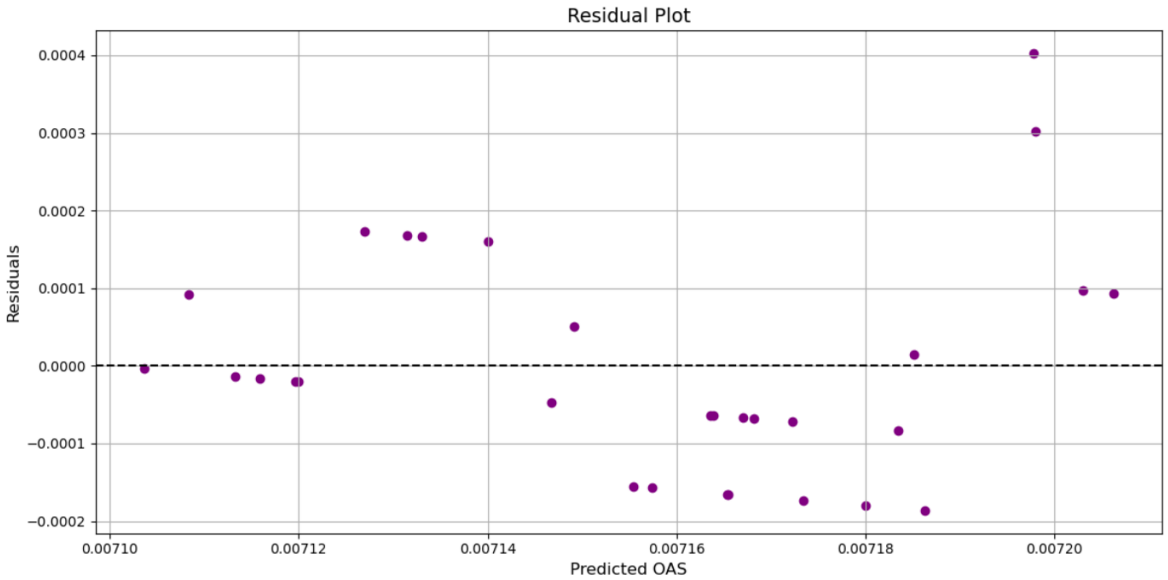


Figure 53 - Residual Plot Technology HY

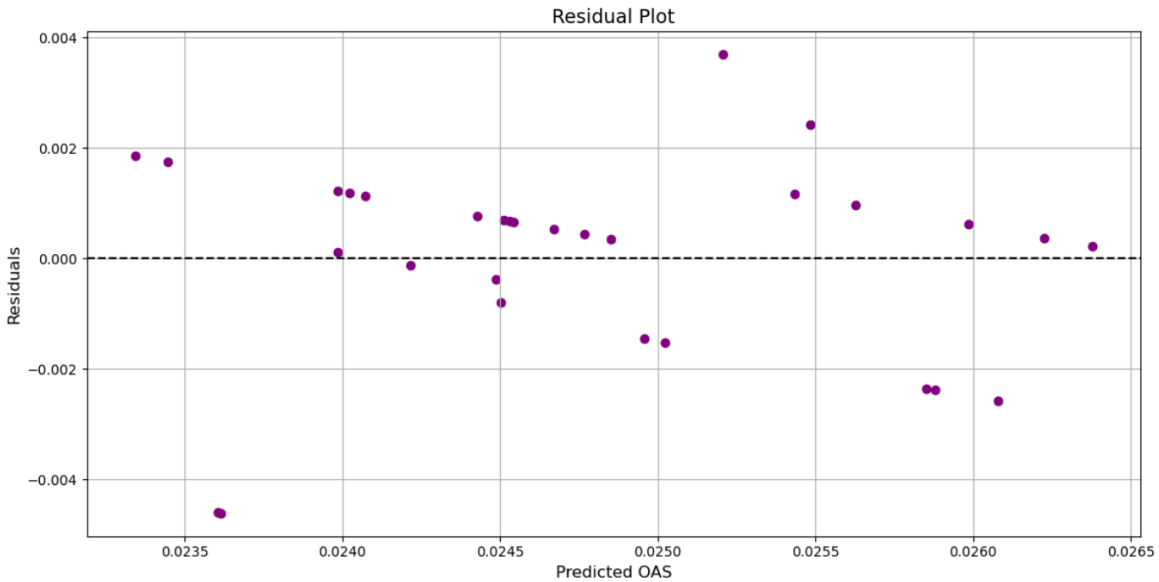


Figure 54 - Residual Plot Consumer IG

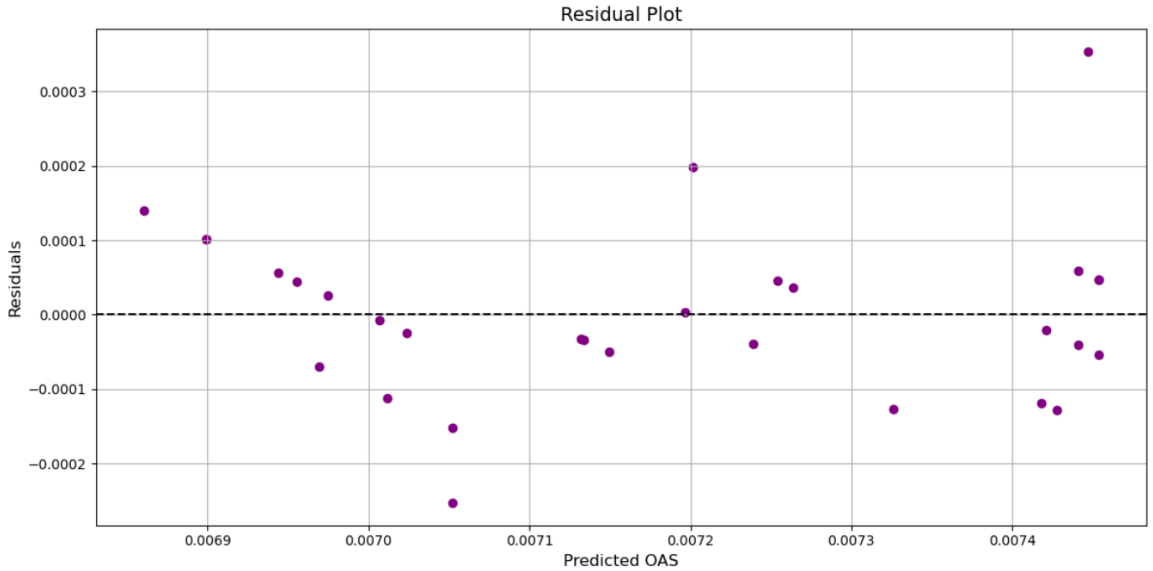


Figure 55 - Residual Plot Consumer HY

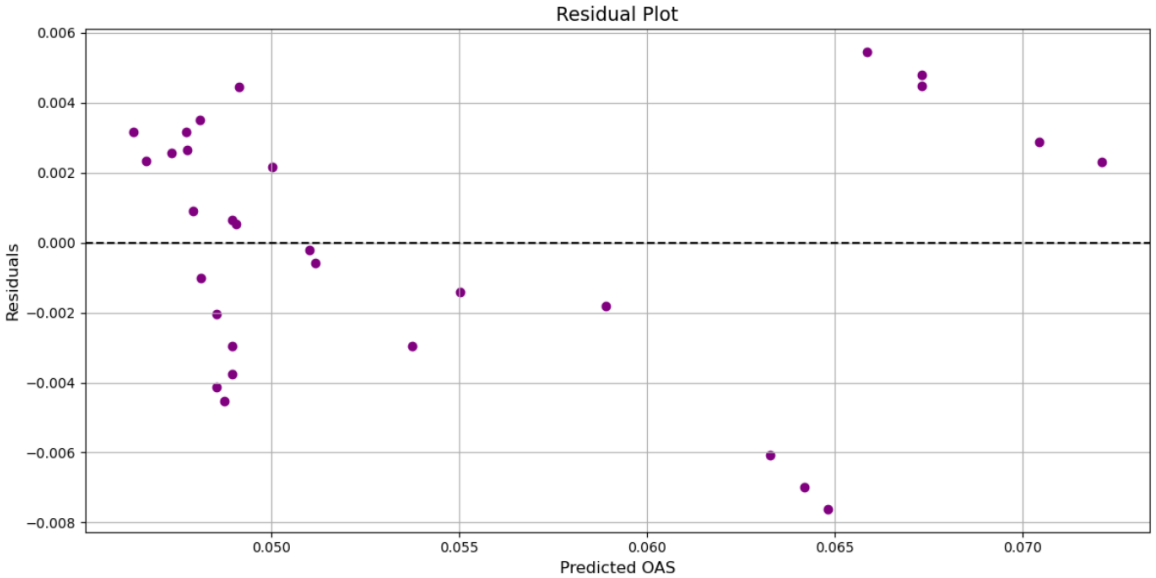


Figure 56 - Residual Plot Materials IG

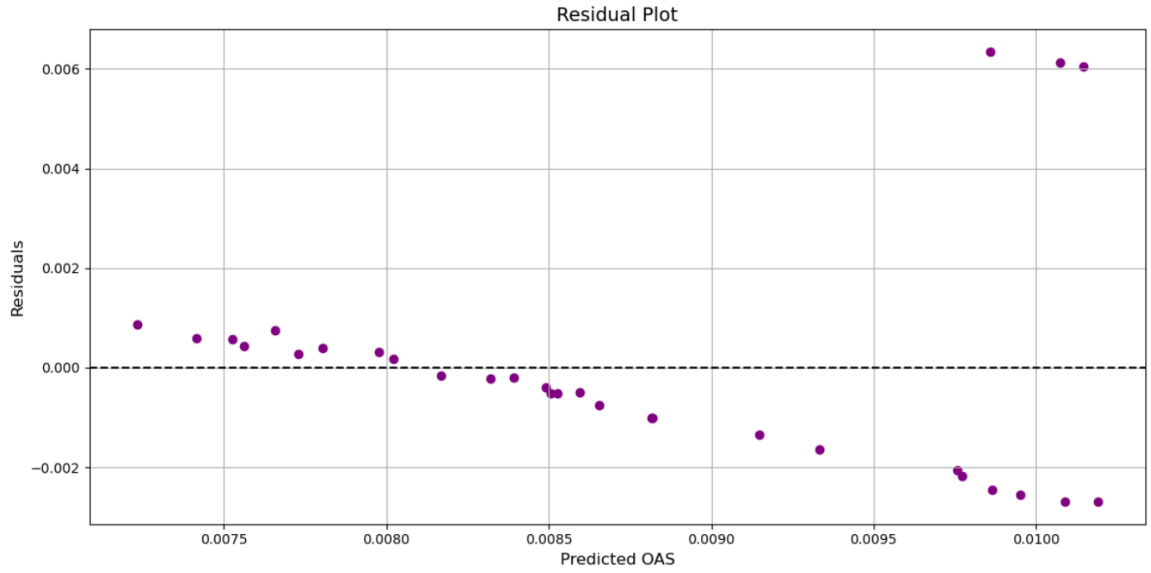
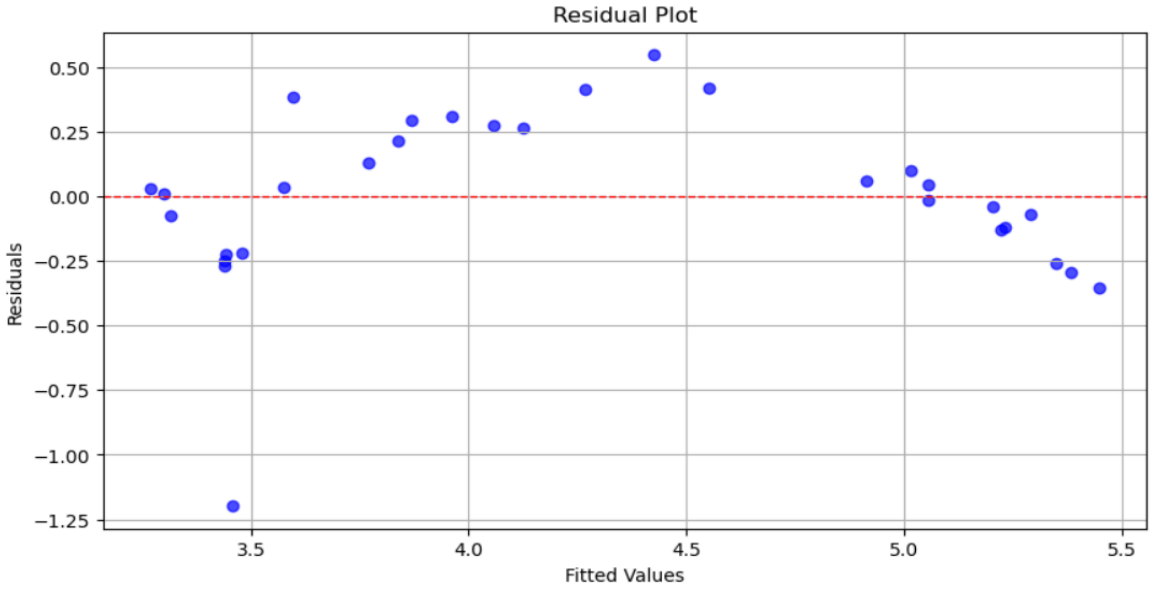


Figure 57 - Residual Plot Materials HY



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List of Figures