SCHOOL OF ECONOMICS AND MANAGEMENT

To Spin or Not to Spin?

Carbon Exposure and Parent Firm Credit Risk after Spin-Offs

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By

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Abstract

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Key words: Spin-Off, Transition Risk, Carbon Intensity, Credit Default Swap Spread, Probability of Default.

Purpose: This paper examines how spin-offs affect the parent firm's credit default swap spread and probability of default, and whether this effect depends on the relative size and carbon exposure of the divested entity.

Methodology: Panel regressions are estimated on parent–spin-off pairs around the spin-off event, with credit risk measured through the five-year credit default swap spread and probability of default. Three hypotheses are tested, the baseline effect of spin-offs on credit risk and the moderating effects of the relative size and carbon exposure of the divested entity.

Theoretical perspectives: Coinsurance Hypothesis, Information Asymmetry, Wealth Expropriation Hypothesis, Environmental Management Model, Stakeholder Theory.

Empirical foundation: The sample consists of completed international spin-offs from Capital IQ Pro from 2004 onward, with separate CDS and PD samples constructed after applying sample restrictions and requiring Scope 1 and 2 emissions data for both the parent and divested entity.

Conclusions: Spin-offs are associated with an increase in the parent firm's structural default probability concentrated in the fiscal year of separation, while producing no detectable response in market-priced CDS spreads. The increase is concentrated in larger transactions and the carbon profile of the divested entity operates in the direction predicted by environmental finance theory, though statistical significance is marginal.

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Keywords and Concepts

Keyword / Concept	Description
Spin-Off	A corporate divestiture where a parent firm distributes shares of a subsidiary to its shareholders, creating a new, independent entity.
Carbon Intensity	Refers to the level of greenhouse gas emissions, Scope 1 and Scope 2, generated by a firm's operations.
Credit Default Swap	A derivative contract in which one party buys protection against the default of a reference entity, such as a company or sovereign borrower.
Credit Default Swap Spread	The annual premium paid for this protection, quoted in basis points, reflecting the market’s assessment of the borrower’s credit risk.
Probability of Default	A market-based measure of credit risk representing the likelihood that a firm’s asset value will fall below its total debt obligations at maturity.
CarbonShare	The paper’s primary explanatory variable, measuring the share of combined parent and divested entity Scope 1 and Scope 2 emissions represented by the divested entity.
Relative Size	The share of combined parent and divested entity total assets represented by the divested entity, capturing the scale of the spin-off relative to the parent firm.

Table of Contents

1. Introduction

Chapter 1 introduces the background and problematization of the paper, presents its purpose and research questions, and concludes with the main findings, contribution, and structure of the paper.

1.1 Background

A spin-off is a form of divestiture where a parent firm distributes shares of a subsidiary to its existing shareholders on a pro rata basis, creating a separate and independent firm (Schipper & Smith, 1983). Spin-offs are commonly undertaken with the expectation that separation can improve managerial focus, reduce organizational complexity, and allow capital markets to value the entity independently of the parent (John & Ofek, 1995; Owers & Sergi, 2021). They have also become an increasingly prominent feature of the international corporate restructuring landscape. Wachtell, Lipton, Rosen and Katz (2025) report that international spin-off activity reached a peak of 100 completed transactions with a total volume of $226 billion in 2021, a year that saw record-breaking M&A activity. They also report that activity was reduced to 78 completed spin-offs valued at $101 billion in 2022, remained steady at 81 transactions with a higher total value of $147 billion in 2023, and declined to 54 spin-offs valued at $100 billion in 2024.

The significance of spin-offs extends beyond shareholder value creation to the broader question of how corporate restructurings affect the credit risk of the firms involved. Prior research establishes that spin-offs alter the risk profile of the parent firm by removing diversification benefits and redistributing risk between the parent and the newly independent entity (Lewellen, 1971; Maxwell & Rao, 2003). This loss of coinsurance, combined with the strategic reallocation of debt documented by Mehrotra, Mikkelson and Partch (2003) and the pre-separation repricing of credit terms documented by Hope, Porumb, Rusanescu and Vyas (2023), suggests that spin-offs have material consequences for how creditors assess the parent firm's default risk. Understanding these consequences is important due the scale of spin-off activity internationally, and given that creditors represent a major stakeholder group whose risk exposure is directly affected by corporate restructuring decisions.

These two developments intersect when a parent firm divests a carbon-intensive subsidiary through a spin-off, because the transaction sets two mechanisms in motion at once. On one side, the parent loses diversification benefits and internal capital market support, which may raise its credit risk. On the other hand, the parent sheds exposure to carbon-intensive operations and the transition risks associated with climate policy, regulation, technological change, and shifting investor preferences, which may lower it. How these offsetting forces net out for the parent's creditors is the question this paper addresses. Credit risk is operationalised through two complementary measures, the parent firm's five-year credit default swap (CDS) spread, capturing market-priced credit risk, and its probability of default (PD), estimated using the naïve Bharath and Shumway (2008) approximation of the Merton (1974) structural default model and capturing model-implied default risk.

1.2 Problematization

The existing literature on parent firm credit risk around spin-offs largely treats divestitures as a homogenous corporate event, focusing on the average effect of separation rather than on how the characteristics of the divested asset shape the creditor outcome of the parent. Maxwell and Rao (2003) document negative bond returns following spin-off announcements in a U.S. sample, while Hope et al. (2023) show that loan spreads widen before completion as creditors anticipate the structural change, also in a U.S. setting. In contrast, Veld and Veld-Merkoulova (2008) find positive bond returns in a European sample, illustrating that the literature itself is divided on the direction of the creditor response. However, this disagreement suggests that the parent's post-separation credit risk is not determined solely by the act of divestiture, but also by what is being divested and in what institutional context. The literature has not systematically examined which characteristics of the divested asset determine the magnitude or direction of the parent firm's credit-risk outcome.

A separate empirical literature establishes that the carbon exposure of a firm's operations is a material determinant of credit risk. Chava (2014), Ehlers, Packer and de Greiff (2022) and Caragnano, Mariani, Pizzutilo and Zito (2020) document a significant carbon premium in debt markets across U.S. and international samples. Capasso, Gianfrate and Spinelli (2020) and Kabir, Rahman, Rahman and Anwar (2021) extend this finding to default risk, showing that higher emissions are associated with weaker distance-to-default measures and higher PD. Bolton and Kacperczyk (2021) further establish that carbon exposure is priced as a systematic and non-diversifiable risk factor, meaning that carbon-intensive firms face a risk premium that cannot be diversified away. While the literature has primarily examined carbon exposure at a single point in time, few studies have examined how a discrete change in a firm's carbon profile affects its credit risk in a restructuring setting that actively reshapes that profile.

The intersection of these two literatures defines the gap that this paper aims to address. A spin-off is a corporate event that can simultaneously trigger the credit-risk mechanisms documented in the spin-off literature and a discrete change in the parent's carbon exposure if the divested asset is carbon-intensive. The parent's post-separation credit risk may therefore reflect two competing forces. The first is the increase in risk predicted by the loss of coinsurance, reduced diversification, and potential creditor wealth expropriation. The second is the potential reduction in transition risk when the parent separates a carbon-intensive asset. To the best of the authors' knowledge, no existing study examines whether these forces interact and produce different credit-risk outcomes when the divested entity represents a larger share of combined carbon exposure or a larger share of the parent's pre-separation asset base.

A further gap concerns how credit risk is measured. Most prior work in the spin-off setting relies on bond returns or model-implied default risk derived from PD measures, while studies using CDS spreads remain scarce in this context. PD and CDS spreads capture related but conceptually distinct dimensions of credit risk. PD is a structural measure that responds primarily to the likelihood of severe distress, while CDS spreads are market prices that reflect ongoing investor sentiment, contract liquidity, and broader credit-market conditions, and need not move in tandem with structural default risk. The two measures may therefore respond differently to the same corporate event, and using them in parallel allows the analysis to assess whether the credit-risk consequences of spin-offs depend on how credit risk is measured.

1.3 Purpose and Research Questions

This paper examines how spin-offs affect the parent firm's credit risk, and whether this effect depends on the relative size of the divested entity and on the share of carbon exposure removed through the divestiture. The empirical sample covers public parent firms internationally that have completed spin-offs across a range of countries and industries, exploiting greater variation in parent characteristics, carbon exposure, and institutional environments than would be available in a single-country setting.

The paper is guided by three research questions:

RQ1: How does a spin-off affect the parent firm's credit risk in the post-separation period, and does this effect differ between market-based and model-implied measures of credit risk?

RQ2: How does the relative size of the divested entity moderate the effect of the spin-off on the parent firm's credit risk?

RQ3: How does the share of carbon exposure removed through the spin-off moderate the effect on the parent firm's credit risk?

1.4 Main Findings

The analysis shows that spin-offs are associated with a statistically significant post-separation increase in the parent firm's PD, with the pair fixed effects estimate of 7.2 percentage points concentrated in the fiscal year of separation and roughly 45 percent of the effect persisting beyond the event year. The corresponding effect on the parent firm's five-year CDS spread is positive but does not reach statistical significance, indicating that the structural credit-risk consequences of spin-offs are detectable through model-implied default risk but not, in this sample, through market-priced credit derivatives. The PD response is concentrated in transactions where the spun-off entity represents a larger share of the parent's pre-separation asset base, and the share of carbon exposure removed operates in the direction predicted by environmental finance theory, reaching significance at the 10 percent level once the year of separation is excluded.

1.5 Contribution

The paper contributes to the spin-off and environmental finance literature by showing that the credit-risk consequences of spin-offs depend on how credit risk is measured. By estimating both PD and CDS responses on a common sample of parent–spin-off pairs, it shows that the structural mechanisms documented in the spin-off literature are detectable in PD-based measures but not, in this sample, in market-priced CDS spreads, offering a measurement-based reading of why the prior literature disagrees on the direction of the creditor response. The paper also connects the spin-off literature to the environmental finance literature on the carbon premium by examining how a discrete change in a firm's carbon profile affects its credit risk in a restructuring setting, and by elevating the relative size of the divested entity to an explicit moderator of the parent's creditor outcome.

1.6 Structure of the Paper

Chapter 2 presents the theoretical background, followed by the literature review in Chapter 3 and the hypothesis development in Chapter 4. Chapter 5 outlines the methodology, Chapter 6 describes the data and reports descriptive statistics, and Chapter 7 presents the empirical analysis. Chapter 8 concludes.

2. Theoretical Background

Chapter 2 presents the theoretical background in three sections, covering theories regarding spin-offs, theories regarding carbon intensity, and the distinction between the two credit-risk measures used in this paper.

2.1 Theories Regarding Spin-Offs

2.1.1 Coinsurance Hypothesis

The coinsurance hypothesis, developed by Lewellen (1971), provides a central framework for understanding how spin-offs affect parent firm credit risk. Diversified firms benefit from combining imperfectly correlated cash flows across business units, which stabilises overall firm performance and reduces the likelihood of default. Diversification therefore increases debt capacity and lowers creditor risk, since negative shocks to one unit can be partly offset by more stable performance in another. Subsequent work supports this logic through bankruptcy probability (Higgins & Schall, 1975) and option pricing frameworks (Galai & Masulis, 1976), where lower firm value volatility reduces the probability that the firm's asset value falls below the value of outstanding debt. The mechanism is also linked to internal capital markets, where diversified firms can reallocate resources across units, allowing stronger segments to support weaker ones during periods of temporary distress (Gertner, Scharfstein & Stein, 1994; Stein, 1997).

A spin-off weakens this coinsurance effect. After the separation, the parent retains a narrower set of operations, loses the stabilising effect of the divested unit's earnings, and can no longer draw on its cash flows to support the remaining business. The strength of this loss should depend on how much of the parent's operations are separated. A small spin-off leaves most of the parent's diversification intact, while a large spin-off removes a meaningful portion of it and weakens internal financing flexibility more substantially. The coinsurance hypothesis therefore predicts that spin-offs increase parent firm credit risk, and that this increase is more pronounced when the divested entity represents a larger share of the parent's pre-separation asset base.

2.1.2 Information Asymmetry

Information asymmetry theory provides a second mechanism through which spin-offs may affect parent firm credit risk. The consolidated financial statements of a diversified parent combine the performance, risk, and cash flows of several business units, and shared costs, intercompany transactions, and internal financing flows can obscure each unit's contribution to total firm risk even when segment reporting is available (Lang & Stulz, 1994; Berger & Ofek, 1995). Akerlof (1970) shows that when one party cannot observe the quality of what it is pricing, adverse selection and mispricing may arise, and Myers and Majluf (1984) extend this logic to corporate financing by arguing that external capital providers demand compensation when they cannot accurately assess a firm's risk profile. In a conglomerate setting, this uncertainty can increase perceived credit risk because creditors cannot fully separate the risk of the parent's remaining business from the risk of the embedded subsidiary.

A spin-off may reduce this information problem by separating the business unit into a standalone entity, so that the parent's financial statements reflect only its retained operations and creditors can evaluate its cash flows, debt servicing capacity, and risk profile more directly. The removal of the divested unit therefore improves transparency and may reduce the uncertainty premium associated with the conglomerate structure. Information asymmetry theory therefore predicts a partially offsetting effect relative to the coinsurance hypothesis. While spin-offs may increase parent firm credit risk by reducing diversification, they may also reduce credit risk by making the parent's remaining operations easier to evaluate.

2.1.3 Wealth Expropriation Hypothesis

The wealth expropriation hypothesis, rooted in the agency theory of debt developed by Jensen and Meckling (1976), addresses the conflict between shareholders and creditors when corporate actions redistribute risk. Equity in a levered firm resembles a call option on the firm's assets, where shareholders benefit from upside outcomes while creditors bear more of the downside risk (Myers, 1977). This asymmetric payoff creates incentives for shareholders to support actions that increase firm risk after debt has been issued, since the gains accrue mainly to equity holders while creditors are not necessarily compensated for the higher risk exposure.

A spin-off can represent such a risk-shifting event. When a parent firm separates a business unit, the asset base that previously supported creditor claims is divided into two smaller and less diversified entities, leaving creditors exposed to a structurally different parent firm than the one against which their claims were originally priced. If existing covenants and contractual protections do not fully account for the post-separation risk profile, creditors may absorb a change in risk without receiving corresponding compensation, creating a potential wealth transfer from creditors to shareholders. The scope for this transfer should depend on how materially the parent's asset base changes. A small spin-off leaves the asset pool largely intact and existing covenants are more likely to remain adequate, while a large spin-off can materially shrink the asset pool and leave creditors exposed to a substantially different borrower. The wealth expropriation hypothesis therefore predicts a larger increase in parent firm credit risk when the divested entity represents a larger share of the parent's pre-separation asset base. In this paper, the wealth expropriation mechanism implies that the post-separation increase in parent firm credit risk should be concentrated in larger transactions, where the reduction in the asset pool backing creditor claims is most pronounced and existing covenants are least likely to remain adequate.

2.2 Theories Regarding Carbon Intensity

2.2.1 The Environmental Management Model

Klassen and McLaughlin (1996) develop a model linking environmental management quality to firm performance through financial and reputational channels. Firms with strong environmental management reduce their exposure to regulatory penalties, litigation costs, cleanup liabilities, and operational inefficiencies, while improving their reputation among key stakeholders. Firms with poor environmental management face the opposite effect, as environmental problems can reduce profitability, damage reputation, and increase perceived risk. A central implication of the model is that financial markets place particular weight on the downside risk of poor environmental management, so that the costs of weak environmental performance are asymmetric and larger than the rewards for strong performance (Klassen & McLaughlin, 1996).

Applied to carbon exposure, the model predicts that carbon-intensive firms face higher credit risk because they are more exposed to regulatory, operational, and reputational pressures. Carbon pricing, emissions trading schemes, compliance requirements, and potential environmental liabilities can reduce profitability and weaken debt-servicing capacity, while key stakeholders may react negatively to carbon-intensive activities, increasing uncertainty around future cash flows. In the context of spin-offs, divesting a carbon-intensive subsidiary may reduce the parent firm's exposure to these risks. This does not imply that spin-offs always reduce credit risk, since the parent may still lose diversification benefits and internal capital market support. Rather, the model suggests that the credit-risk increase predicted by the spin-off theories may be smaller when the divested asset represents a larger share of the parent's carbon exposure.

2.2.2 Stakeholder Theory

Freeman (1984) develops stakeholder theory as a framework for understanding firm performance and long-term viability. The central argument is that firms must manage relationships with stakeholders whose interests affect and are affected by the firm's activities, including regulators, customers, employees, institutional investors, suppliers, and communities. Strong stakeholder management can support financial performance through stable revenue, access to capital, regulatory cooperation, and lower operating costs, while poor stakeholder management may damage firm value through penalties, customer attrition, restricted financing access, and reputational harm. This framework has direct implications for credit risk because creditors are exposed to the financial consequences of stakeholder pressure. Firms that manage these relationships poorly may face higher uncertainty around future cash flows, weaker profitability, and greater exposure to regulatory or reputational shocks.

In the context of carbon exposure, stakeholder theory predicts that carbon-intensive firms face pressure from several groups at once. Regulators may impose carbon pricing, emissions caps, and compliance requirements, customers may shift toward lower-carbon alternatives, institutional investors may screen portfolios for climate exposure or pressure firms to reduce emissions, and employees, communities, and non-governmental organisations may respond negatively to carbon-intensive operations. These pressures are cumulative rather than isolated, meaning that carbon exposure can affect credit risk through several stakeholder channels simultaneously. When a parent firm divests a carbon-intensive subsidiary through a spin-off, part of this pressure may be transferred away from the parent, and the parent's remaining operations may become less exposed to carbon regulation, reputational criticism, and investor concerns related to the divested asset. Stakeholder theory therefore supports the expectation that the carbon profile of the divested entity moderates the parent firm's post-separation credit risk, with the moderating effect being stronger when the divested entity carries a larger share of carbon-related stakeholder pressure.

2.3 Structural Default Risk and Market-Priced Credit Risk

Credit risk is not a single observable quantity, and the two measures used in this paper capture conceptually distinct dimensions of it. The PD derived from the Merton (1974) structural framework is an equity- and balance-sheet-based measure of the likelihood that a firm's asset value falls below its debt obligations at maturity. It responds primarily to the firm's asset base, leverage, and asset volatility, and rises most sharply as a firm approaches severe distress (Merton, 1974; Bharath & Shumway, 2008). A spin-off that reshapes the parent's asset base and the volatility supporting its debt therefore feeds directly into the structural PD measure at the point of separation.

The CDS spread, by contrast, is a market price, the premium paid to insure against the reference entity's default. A substantial body of evidence shows that it reflects more than structural default risk alone, being driven by liquidity, investor sentiment, equity-market volatility, and broader macroeconomic conditions in addition to firm fundamentals (Longstaff, Mithal & Neis, 2005; Bongaerts, de Jong & Driessen, 2011). A high CDS spread therefore signals that the market requires greater compensation for bearing default risk, but need not indicate imminent distress in the way a high PD does. The two measures are accordingly treated throughout as complementary indicators that may diverge, a divergence that is itself informative about the credit-risk consequences of spin-offs.

3. Literature Review

The literature review is divided into two subheadings. The first examines how spin-offs affect parent credit risk. The second establishes the empirical relationship between carbon intensity and credit risk.

3.1 Spin-Offs and Parent Firm Credit Risk

A substantial body of empirical literature documents that spin-offs create value for parent firm shareholders, with early studies finding positive equity market reactions around spin-off announcements (Schipper & Smith, 1983; Miles & Rosenfeld, 1983; Cusatis, Miles & Woolridge, 1993; Desai & Jain, 1999; Chemmanur & Yan, 2004), evidence that extends to European markets (Veld & Veld-Merkoulova, 2004) and persists in more recent U.S. data (Owers & Sergi, 2021). These gains are commonly attributed to reduced organisational complexity, improved capital allocation, and stronger post-divestiture operating performance (John & Ofek, 1995). This shareholder-value literature provides the starting point for this paper, but it does not directly answer whether the same restructuring benefits extend to creditors or whether parent firm credit risk increases after separation.

The creditor perspective has produced more mixed findings. Maxwell and Rao (2003) examine U.S. bond market data for 155 spin-offs between 1970 and 1996 and find negative abnormal bond returns of approximately 0.9 percent around spin-off announcements, which they attribute to the loss of coinsurance and an increase in default risk that redistributes value from creditors to shareholders. Parrino (1997) provides more detailed evidence from the Marriott spin-off in 1993, showing how the allocation of debt and assets in a spin-off can be structured in a way that harms bondholders. The Marriott case illustrates the wealth expropriation mechanism in practice, since creditor outcomes depend not only on whether a spin-off occurs but also on how liabilities and assets are allocated across the separated entities.

By contrast, Veld and Veld-Merkoulova (2008) examine 156 European and U.S. spin-offs between 1987 and 2000 and report positive abnormal bond returns for parent firms. They conclude that value-enhancing effects may outweigh the loss of coinsurance when the divested unit is a source of risk rather than stability. The disagreement between Maxwell and Rao (2003) and Veld and Veld-Merkoulova (2008) is central for this paper because it suggests that creditor outcomes are not determined by spin-offs as a uniform event. Instead, the effect appears to depend on the characteristics of the divested asset, the structure of the transaction, and the credit-market environment. Boreiko and Murgia (2016) add further nuance by studying European spin-offs, where bank debt is more important and creditor protections differ from the U.S. Their findings suggest that the bondholder wealth-transfer mechanism may vary across institutional and debt-market settings.

A related strand of literature shows that firms actively adjust capital structure around spin-offs. Mehrotra et al. (2003) examine 91 U.S. spin-offs between 1975 and 1998 and find that firms deliberately redesign capital structures around separation, often increasing leverage in the divested entity while restructuring parent debt at the same time. This is important for this paper because changes in parent credit risk after a spin-off may reflect both the loss of diversification and the financial structure chosen at separation. Hope et al. (2023) extend the creditor perspective by analysing U.S. syndicated loan data for 1,191 spin-offs between 1996 and 2018, finding that loan spreads widen substantially before completion. This indicates that creditors begin pricing anticipated restructuring risk before legal separation takes place, and that credit-market reassessment may begin even before the parent and divested entity are formally separated.

The literature thus shows that spin-offs often benefit shareholders while creditor outcomes remain ambiguous, with some studies documenting losses consistent with coinsurance loss and wealth expropriation and others finding gains when the divested unit carries disproportionate risk. Three gaps motivate this paper. First, existing creditor studies are concentrated in U.S. samples and rely largely on bond returns or model-implied default risk, leaving open whether the structural effects documented in prior work are also reflected in market-priced CDS spreads. Second, most evidence relates to announcement-period or pre-completion responses, with less known about how parent firm credit risk develops over multiple post-separation years. Third, the carbon profile of the divested asset has not, to the best of the authors' knowledge, been examined as a determinant of variation in parent firm credit risk after spin-offs.

3.2 Carbon Intensity and Credit Risk

A central contribution to the environmental finance literature is Chava (2014), who examines the relationship between environmental concerns and cost of capital for U.S. firms between 1991 and 2007. Using cross-sectional regressions of equity returns and loan spreads on firm environmental characteristics, Chava finds that firms in carbon-intensive industries face a significant financing premium, which he attributes to regulatory exposure, litigation risk, and potential deterioration in future cash flows. Goss and Roberts (2011) provide related evidence from the bank loan market, showing that firms with poor environmental performance face higher loan spreads. Together, these studies establish that environmental risk is relevant for creditors because it affects expected cash flows, downside risk, and the uncertainty surrounding debt repayment.

This evidence has since been extended beyond the U.S. setting. Kleimeier and Viehs (2016) study international syndicated loan data between 2003 and 2013 and find that higher carbon intensity is associated with higher loan spreads, while greater carbon disclosure is associated with lower spreads. Ehlers et al. (2022) combine syndicated loan data with carbon intensity data across industries and countries, documenting a substantial carbon premium in debt pricing and suggesting that creditors price carbon exposure as a general source of transition risk rather than only as a sector-specific stranding risk. Caragnano et al. (2020) find similar evidence for EuroStoxx 600 firms between 2010 and 2017, and Ho and Wong (2023) extend the literature to emerging markets, finding that banks price transition risk through both higher loan spreads and stricter non-pricing terms.

A more recent strand of literature links carbon exposure directly to default risk. Capasso et al. (2020) examine 458 international investment-grade firms and find that higher Scope 1 emissions are associated with lower Merton distance to default, implying higher PD. Kabir et al. (2021) confirm and extend this relationship using firm-level data from 42 economies between 2004 and 2018, showing that carbon emissions have a positive effect on default risk measured through Merton's distance to default. Their results are stronger for firms in carbon-intensive industries and remain robust across alternative definitions of emissions and default risk. These studies are directly relevant for this paper because they show that carbon exposure affects not only financing costs but also model-implied default risk.

Bolton and Kacperczyk (2021) provide an important bridge between the carbon premium literature and the divestiture setting. Using international firm-level emissions data from 2005 to 2017, they show that carbon-intensive firms are exposed to systematic transition risk related to regulation, technological change, and shifting investor preferences. Because this risk is systematic, it cannot be fully diversified away within a conglomerate. A parent firm that retains a carbon-intensive subsidiary therefore continues to carry transition-risk exposure even if its other operations are less carbon-intensive. A spin-off of the carbon-intensive asset may reduce this exposure, but prior literature has not tested this mechanism in a restructuring setting. This paper addresses that gap by examining whether the carbon profile of the divested entity helps explain changes in parent firm credit risk after separation.

4. Hypothesis Development

Chapter 4 develops the hypotheses of the paper based on the theoretical and empirical discussions in previous chapters.

4.1 The Effect of Spin-Offs on Credit Risk

The coinsurance hypothesis predicts that spin-offs increase parent firm credit risk because the parent loses the stabilising effect of the divested unit's earnings and the flexibility to reallocate resources across business units (Lewellen, 1971; Gertner, Scharfstein & Stein, 1994; Stein, 1997). The wealth expropriation hypothesis points in the same direction. When a spin-off divides the asset base into two smaller and less diversified entities, creditors who originally priced their claims against the consolidated firm may be left with exposure to a structurally different parent, and the limits of existing covenants can allow shareholders to capture value at their expense (Jensen & Meckling, 1976; Myers, 1977). Information asymmetry theory provides a partially offsetting argument, since the parent's standalone financial statements may make its operations easier to evaluate after separation (Akerlof, 1970; Myers & Majluf, 1984), but this improvement does not eliminate the loss of diversification.

The empirical evidence is broadly consistent with this prediction but varies across markets. The coinsurance and wealth-expropriation channels are reflected in the U.S. bond-market losses documented by Maxwell and Rao (2003) and Parrino (1997), while Hope et al. (2023) show that loan spreads begin to widen before completion, indicating that creditors price the anticipated restructuring ahead of the legal separation, while the positive European bond returns in Veld and Veld-Merkoulova (2008) indicate that the direction of the creditor response is not uniform across institutional settings.

The first hypothesis therefore predicts that spin-offs increase parent firm credit risk in the post-separation period, reflecting the combined effects of coinsurance loss and the potential for wealth expropriation, partly offset by improved transparency. Because credit risk is operationalised through two complementary measures, the framework set out in Section 2.3 also bears on how this prediction is tested. The PD measure responds mechanically to changes in the parent's asset base, leverage, and asset volatility, all of which a spin-off alters at the point of separation, while the CDS spread is a market price that incorporates liquidity, investor sentiment, and broader credit-market conditions alongside fundamental default risk (Longstaff et al, 2005). The two measures may therefore respond differently to the same corporate event, and any divergence between them is informative about whether credit-risk consequences of spin-offs are reflected in market-priced credit derivatives over the event window.

H1: A spin-off increases the parent firm's credit risk in the post-separation period.

4.2 The Moderating Effect of Relative Size

While the average effect of spin-offs on parent credit risk has been examined before, prior evidence is concentrated in single-country, largely U.S. samples and relies predominantly on a single credit-risk measure. H1 treats spin-offs as a uniform event without distinguishing between transactions of different scale, yet the theoretical mechanisms underlying it are not immune to scale. The coinsurance hypothesis implies that the loss of diversification benefits should be larger when more of the parent's pre-separation operations are removed, because the parent retains less of the imperfectly correlated cash flow base that previously stabilised performance and supported debt capacity (Lewellen, 1971). Internal capital market flexibility is also more meaningfully reduced when a larger share of the parent's asset base is divested (Stein, 1997).

The wealth expropriation mechanism operates similarly. A small spin-off leaves the asset pool supporting creditor claims largely intact and existing covenants are more likely to remain adequate, while a large spin-off can materially shrink the asset pool and leave creditors exposed to a substantially different borrower (Jensen & Meckling, 1976; Myers, 1977). Mehrotra et al. (2003) provide empirical support by documenting that firms actively redesign capital structures around spin-offs, with these redesigns being more likely to be material when the separation involves a larger share of the parent's asset base. The credit-risk consequences of spin-offs should therefore be concentrated in transactions where the divested entity represents a larger share of the parent's pre-separation operations.

H2: The post-divestiture increase in parent firm credit risk is larger when the divested entity represents a larger share of the parent's pre-separation assets.

4.3 The Moderating Effect of Carbon Exposure Removed

H1 and H2 treat the spin-off as an event neglecting the environmental characteristics of the divested unit. The environmental management model and stakeholder theory imply, however, that the carbon profile of the divested entity should also matter. Carbon-intensive operations expose firms to regulatory tightening, carbon pricing, compliance costs, potential asset stranding, and reputational pressure from key stakeholders (Klassen & McLaughlin, 1996; Freeman, 1984). These pressures can reduce profitability and increase the uncertainty around future cash flows, both of which directly affect the parent's debt-servicing capacity.

The empirical literature confirms that this carbon-related risk is priced. Chava (2014), Ehlers et al. (2022), Caragnano et al. (2020), and Kleimeier and Viehs (2016) document a carbon premium in debt markets across U.S. and international samples, while Capasso et al. (2020) and Kabir et al. (2021) show that higher emissions are associated with higher PD. Bolton and Kacperczyk (2021) further show that carbon exposure is priced as a systematic risk factor that cannot be diversified away within a conglomerate.

When a parent firm divests a carbon-intensive subsidiary, it removes part of this exposure to regulatory tightening, carbon pricing, and reputational pressure. This reduction in carbon-related risk may partly offset the increase in credit risk predicted by H1, and the magnitude of this offsetting effect should depend on how much of the combined carbon exposure is represented by the divested entity. The third hypothesis therefore predicts that the post-divestiture increase in parent firm credit risk is smaller when the divested entity represents a larger share of combined carbon exposure. H3 is framed as a moderation of the H1 effect rather than as a separate test of a net reduction, because the structural mechanisms underlying H1 operate on every spin-off in the sample while the carbon channel only operates to the extent that the divested entity carries meaningful carbon exposure. A sufficiently large negative interaction coefficient would in any case capture the net-reduction case as a limiting outcome, so framing H3 as a moderation does not rule it out.

H3: The post-divestiture increase in parent firm credit risk is smaller when the divested entity represents a larger share of combined parent and divested carbon exposure.

5. Methodology

Chapter 5 presents the methodological framework of the paper, covering the data sources and sample construction, data treatment, variable measurement, econometric methodology, and the statistical tests used in the empirical analysis.

5.1 Data Sources and Sample Construction

5.1.1 Data Sources and Sample Universe

The empirical dataset is constructed using Capital IQ Pro. Spin-off transaction data are used to identify completed spin-offs, parent firms, divested entities, and completion dates. Accounting data are used to construct firm-level control variables, market data are used to estimate PD and equity beta, CDS data are used to measure market-based credit risk through five-year CDS spreads, and greenhouse gas (GHG) emissions data are used to construct the carbon exposure measure for the divested entity relative to the parent firm.

The initial transaction universe consists of completed spin-off transactions with public parent firms and completion dates from 2004 onward, comprising 1,695 parent–spin-off pairs. The 2004 start date corresponds to the publication of the GHG Protocol Corporate Standard (WBCSD & WRI, 2004), after which firm-level Scope 1 and Scope 2 emissions data become systematically available and comparable, which is required to construct the carbon exposure measure central to the analysis. The analysis focuses on public parent firms because the dependent variables and control variables require market and accounting data. A parent–spin-off pair is defined by the parent firm, the divested entity, and the spin-off completion date. If the same parent firm completes more than one spin-off during the sample period, each transaction is treated as a separate pair

5.1.2 Event Window

The dataset is structured as an event-time panel covering seven fiscal years around each spin-off. Event year 0 is the fiscal year in which the spin-off is completed. Event years −3 to −1 represent the pre-spin-off period and event years 0 to +3 represent the post-divestiture period. Event year 0 is included in the post period because the spin-off is completed within that year and any structural change to the parent firm's risk profile takes effect from that point onward. This treatment also preserves the sample size, which is important given the limited number of transactions for which the required credit-risk and emissions data are jointly available.

5.1.3 Sample Restrictions

Several restrictions are applied before estimating the regressions. Financial firms are excluded by removing observations with SIC codes between 6000 and 6999, because financial firms have balance sheets, leverage structures, regulatory requirements, and credit-risk determinants that differ substantially from non-financial firms. Observations with economically implausible values, such as negative total assets, non-positive debt inputs in the PD calculation, or invalid emissions values, are set to missing.

The main analysis requires Scope 1 and Scope 2 emissions data for both the parent firm and the divested entity, since the carbon-moderation hypothesis is the central contribution of the paper and the same sample is used throughout for comparability across hypotheses. The empirical analysis is therefore conducted on two estimation samples, one for each dependent variable. The CDS sample is restricted to parent–spin-off pairs with available five-year CDS spreads, control variables, and emissions data, while the PD sample is restricted to pairs with sufficient accounting and market data to estimate default risk, together with the same control variables and emissions requirement. The samples differ in size because traded CDS contracts are available primarily for larger and more actively followed firms, while PD can be estimated for a broader set of public firms.

5.2 Data Treatment

Variables imported from Capital IQ Pro are reviewed to ensure that accounting, market, credit-risk, and emissions variables are stored in a consistent numeric format. The dependent variables and the two main explanatory variables are reported in raw form. Continuous variables used in the regressions are winsorized by fiscal year at the 1st and 99th percentiles to reduce the influence of extreme observations while preserving the number of observations in the event-time panel.

5.3 Variable Measurement

5.3.1 Dependent Variables

5.3.1.1 Credit Default Swap Spread

The first dependent variable is the parent firm's five-year credit default swap spread ($CDS_{i,t}$). A CDS is a derivative contract that transfers default risk from the protection buyer to the protection seller, and the CDS spread is the annual premium paid for this protection, quoted in basis points. The CDS spread is a market-based measure of credit risk in which higher spreads indicate that market participants require greater compensation for bearing the firm's default risk. The variable is taken from Capital IQ Pro and used in levels, so that coefficient estimates can be interpreted directly in basis points. The main limitation of the CDS measure is data availability, since traded CDS contracts are mainly available for larger and more actively followed firms.

5.3.1.2 Probability of Default

The second dependent variable is the parent firm's PD ($PD_{i,t}$), estimated using the naïve approximation of the Merton (1974) structural default model proposed by Bharath and Shumway (2008). Bharath and Shumway show that this naïve measure forecasts default at least as well as the more complex iterative solution of the Merton model, and the approximation has since become widely used in the default-risk literature (Campbell, Hilscher & Szilagyi, 2008; Vassalou & Xing, 2004; Capasso et al. 2020). The measure is therefore well suited to a large international panel as it retains the structural logic of the Merton framework while avoiding the iterative estimation that is difficult to apply consistently across firms and years, and it does not require country-specific risk-free rates that are not uniformly available across the international sample. The naïve PD measure is known to produce a strongly right-skewed, zero-concentrated distribution, with most firm-years close to zero and a thin tail approaching one, reflecting the cumulative normal transformation at the extremes of the asset-value distribution (Bharath & Shumway, 2008; Campbell et al. 2008). Estimated PD coefficients should therefore be read as average shifts driven primarily by a subset of firm-years moving out of the near-zero region, rather than as uniform movements along a smoothly distributed scale.

The face value of debt is defined as short-term debt plus one half of long-term debt:

$$F_{i,t} = STD_{i,t} + 0.5 * LTD_{i,t} \qquad \textit{(Eq. 1)}$$

The market value of assets is approximated as the sum of the market value of equity and the face value of debt:

$$V_{i,t} = E_{i,t} + F_{i,t} \qquad \textit{(Eq. 2)}$$

Asset volatility is estimated using the naïve Bharath and Shumway approximation:

$$\sigma_{V,i,t} = \frac{E_{i,t}}{E_{i,t}+F_{i,t}} \sigma_{E,i,t} + \frac{F_{i,t}}{E_{i,t}+F_{i,t}} (0.05 + 0.25\sigma_{E,i,t}) \qquad \textit{(Eq. 3)}$$

where $\sigma_{E,i,t}$ is annualised equity volatility, estimated from daily stock returns over the preceding 252 trading days. Distance to default is then calculated as

$$DD_{i,t} = \frac{ln(V_{i,t}/F_{i,t}) + (\mu_{i,t-1} - 0.5\sigma^2_{V,i,t})T}{\sigma_{v,i,t}\sqrt{T}} \qquad \textit{(Eq. 4)}$$

where $\mu_{i,t-1}$ is proxied by the parent firm's prior-year stock return and T is set to one year. Using the prior-year return as the drift proxy is standard in the naïve implementation but introduces a known limitation, since years preceded by negative parent returns mechanically receive a lower drift and therefore a lower distance-to-default. To the extent that spin-offs follow periods of parent underperformance, this could generate a correlation between divestiture timing and estimated PD independent of structural changes in default risk, although the absence of pre-trends documented in Section 7.4.2 mitigates this concern at the event-window level. PD is then given by the cumulative normal distribution of negative distance to default:

$$PD_{i,t} = N(-DD_{i,t}) \qquad \textit{(Eq. 5)}$$

5.3.2 Independent Variables

5.3.2.1 Relative Size of the Spin-off

The first moderator is the relative size of the divested entity ($RelSize_i$), which captures the share of combined parent and divested entity total assets represented by the divested entity. The parent firm's total assets are measured in event year −1, the final fiscal year before the spin-off, while the divested entity's total assets are measured as the average across the available post-separation fiscal years to reduce the influence of one-off accounting items in the first reported year of the new entity. $RelSize_i$ is computed as:

$$RelSize_i = Assets_t^{SO,i} / (Assets_{t-1}^{Parent,i} + Assets_t^{SO,i}) \qquad (Eq.\ 6)$$

where $Assets_t^{SO,i}$ denotes the divested entity's average post-separation total assets and $Assets_{t-1}^{Parent,i}$ denotes the parent firm's total assets in event year −1. The variable ranges from 0 to 1. A value close to 0 indicates that the divested entity is small relative to the parent firm, while a value closer to 1 indicates that the divested entity represents a large share of the combined asset base. $RelSize_i$ is time-invariant within each parent–spin-off pair. The construction is subject to measurement error, since the parent's event year −1 total assets include the assets of the subsidiary that will be divested, while the divested entity's post-separation total assets reflect the carved-out balance sheet after debt allocation and working capital adjustments, so the numerator and denominator are not measured on a fully consistent basis.

5.3.2.2 Carbon Share Removed

The second moderator is $CarbonShare_i$, which measures the share of combined parent and divested entity carbon emissions represented by the divested entity. The variable is constructed using absolute Scope 1 and Scope 2 GHG emissions for both the parent firm and the divested entity, sourced from Capital IQ Pro. The parent firm's emissions are measured in event year −1, the final fiscal year before the spin-off, while the divested entity's emissions are measured in event year 0, the fiscal year of the spin-off. The asymmetry in timing reflects data availability, where the divested entity does not report standalone emissions until it becomes independent at separation, so its first observable Scope 1 and 2 figures are those for event year 0, while the parent's pre-separation emissions are measured in the last full fiscal year before the transaction. This introduces a potential measurement error. The parent's event year −1 figure includes the subsidiary that will subsequently be divested, mechanically understating *CarbonShare*, while the divested entity's event year 0 figure may reflect only a partial year of independent operation or carve-out accounting, with an ambiguous direction of bias. Both errors are most material for transactions completed late in the fiscal year and are difficult to address without standalone pre-separation emissions for the divested unit, which are not consistently reported. $CarbonShare_i$ is computed as:

$$CarbonShare_i = \frac{GHG_{i,t=0}^{SO}}{GHG_{i,t=-1}^{Parent} + GHG_{i,t=0}^{SO}} \qquad (Eq.\ 7)$$

where $GHG^{SO}_{i,t=0}$ denotes the divested entity's combined Scope 1 and Scope 2 emissions in event year 0, and $GHG^{Parent}_{i,t=-1}$ denotes the parent firm's combined Scope 1 and Scope 2 emissions in event year −1. The variable ranges from 0 to 1. A value close to 0 indicates that the divested entity represents only a small share of combined emissions, while a value closer to 1 indicates that it represents a large share. $CarbonShare_i$ is time-invariant within each parent–spin-off pair.

The emissions data used in this paper are Scope 1 and Scope 2 GHG emissions, which respectively capture direct emissions from sources owned or controlled by the firm and indirect emissions from purchased electricity, steam, heating, and cooling, as defined by the GHG Protocol Corporate Standard (WBCSD & WRI, 2004). Scope 3 emissions are excluded because they are subject to greater measurement error, inconsistent reporting practices, and lower comparability across firms, particularly in an international sample. This focus is also consistent with prior evidence that Scope 1 and Scope 2 emissions are priced in syndicated loan spreads (Ehlers et al. 2022) and as systematic risk factors in capital markets (Bolton & Kacperczyk, 2021).

5.3.2.3 Control Variables

The regression specifications include a vector of firm-level control variables, $X_{i,t}$, selected based on prior corporate finance, spin-off, and environmental finance literature (Chava, 2014; Hope et al. 2023; Caragnano et al. 2020). *Firm Size* is controlled as the natural logarithm of total assets, since larger firms tend to have more diversified operations, more stable cash flows, and better access to capital markets. Return on assets (*ROA*) is measured as EBITDA divided by total assets and proxies for profitability and internal cash generation (Myers & Majluf, 1984). *Leverage* is measured as total debt divided by total assets and captures capital structure as a direct determinant of credit risk (Jensen & Meckling, 1976). *Tangibility* is measured as net property, plant, and equipment divided by total assets, capturing both collateral value (Berger & Udell, 1990) and the asset-heavy character of carbon-intensive firms.

Current Ratio is measured as current assets divided by current liabilities and captures short-term liquidity (Myers, 2001). *Tobin's Q* is measured as the market value of total assets divided by the book value of total assets and proxies for growth opportunities and intangible value (Tobin, 1969; Lang, Ofek & Stulz, 1996). *Equity Beta* is measured as the parent firm's five-year equity beta and proxies for systematic risk. *Institutional Ownership* is measured as the percentage of shares outstanding held by institutional investors and proxies for external monitoring and governance quality (Jensen & Meckling, 1976), and is also included given the documented role of institutional investors in climate-risk pricing. (Dyck et al. 2019; Krueger, Sautner & Starks, 2020).

5.4 Econometric Methodology

The empirical analysis estimates panel regressions around the spin-off event. The four specifications below test the three hypotheses developed in Chapter 4 and assess the timing of credit-risk changes around completion. Each specification is estimated separately for the two dependent variables, CDS spread and PD. Standard errors are clustered at the parent–spin-off pair level in all regressions to account for serial correlation in residuals within the same transaction over the event window.

5.4.1 Baseline Specification

To test the average effect of spin-offs on parent credit risk, the following baseline specification is estimated:

$$y_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 X_{i,t} + u_i + \gamma_t + \varepsilon_{i,t} \qquad \textit{(Eq. 8)}$$

In Equation 8, $y_{i,t}$ is the credit-risk outcome for parent–spin-off pair *i* in fiscal year *t*. The dependent variable is either the parent firm's CDS spread or its PD. $Post_{i,t}$ equals one in event years 0 to +3 and zero in event years −3 to −1, in line with the standard convention that the post period begins in the year of the event. β_1 captures the average post-divestiture change in parent firm credit risk. $X_{i,t}$ is the vector of firm-level control variables defined in Section 5.3.2.3. u_i denotes pair fixed effects, which absorb all time-invariant characteristics of each transaction, including parent country, industry, and baseline risk profile. γ_t denotes fiscal-year fixed effects, which control for shocks that affect all firms in a given year. Equation 8 is estimated across an escalating set of fixed-effects structures, including pooled OLS, industry and fiscal-year fixed effects, pair and fiscal-year fixed effects, so that the robustness of the estimated effect to progressively more demanding controls for unobserved heterogeneity can be assessed. Pooled OLS is reported alongside the fixed-effects specifications because time-invariant regressors, including the moderators introduced below and *Institutional Ownership*, are absorbed under pair fixed effects and can only be identified in the less restrictive specifications.

5.4.2 Relative Size Specification

To test whether the post-divestiture change in credit risk depends on the relative size of the divested entity (H2), the baseline specification is extended with an interaction between *Post* and the mean-centred continuous *RelSize* measure:

$$y_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 (Post_{i,t} * RelSize_i) + \beta_3 X_{i,t} + u_i + \gamma_t + \varepsilon_{i,t} \qquad \textit{(Eq. 9)}$$

Because $RelSize_i$ is time-invariant within each pair, its standalone effect is absorbed by the pair fixed effects, and the interaction is identified through within-pair variation in $Post_{i,t}$. The coefficient β_2 captures whether the post-divestiture change in credit risk scales with the relative size of the divested entity. A positive β_2 would be consistent with H2. As a robustness check, the baseline specification is also estimated separately on subsamples split at the median of $Relsize$, providing a non-parametric complement to the continuous interaction.

5.4.3 Carbon Moderation Specification

To test whether the post-divestiture change in credit risk depends on the carbon exposure represented by the divested entity (H3), the baseline specification is extended with an interaction between *Post* and *CarbonShare*. Because $CarbonShare_i$ is time-invariant within each parent–spin-off pair, its standalone effect cannot be identified together with pair fixed effects. The main specification is therefore estimated using ordinary least squares with industry and fiscal-year fixed effects:

$$y_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 CarbonShare_i + \beta_3 (Post_{i,t} * CarbonShare_i) + \beta_4 X_{i,t} + \delta_j + \gamma_t + \varepsilon_{i,t}$$

(Eq. 10)

δ_j denotes industry fixed effects. β_3 captures whether the post-divestiture change in credit risk differs depending on the carbon exposure represented by the divested entity. A negative coefficient is consistent with H3, since it indicates that the increase in credit risk is smaller when a larger share of combined carbon exposure is divested. To assess the robustness of the carbon moderation, the specification is also estimated with parent firm fixed effects and with parent–spin-off pair fixed effects. The pair fixed-effects version absorbs the standalone $CarbonShare$ term but retains the interaction.

5.4.4 Event-Time Specification

To examine the timing of credit-risk changes around the spin-off and assess whether the post-divestiture results are preceded by observable pre-trends, an event-study specification is estimated using event-year indicators:

$$Y_{i,t} = \alpha + \sum_{r \neq -2} \delta_T D^T_{i,t} + \beta X_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t} \qquad \textit{(Eq. 11)}$$

$D^T_{i,t}$ is an indicator equal to one when parent–spin-off pair i is observed in event year T. Event year −3 is omitted as the reference category. The coefficients δ_T measure the difference in credit risk in each event year relative to three years before the spin-off. The coefficients for event years −2 and −1 serve as pre-trend tests. If they are statistically indistinguishable from zero, this suggests that credit risk was not already changing systematically before the spin-off. The coefficients for event years 0 to +3 then show how credit risk develops during and after the transaction.

5.5 Statistical Tests and Inference

Several diagnostics inform the inference strategy. Variance inflation factors (VIF) are computed to check for multicollinearity among the control variables, White's test is used to assess heteroskedasticity, and a skewness-kurtosis test is used to assess residual normality (Bailey, 2016). Because the panel structure and the wide dispersion in firm size and credit risk make heteroskedasticity and within-pair serial correlation likely, all regressions report standard errors clustered at the parent–spin-off pair level, which remain valid under heteroskedasticity, within-cluster dependence, and non-normal residuals (Bailey, 2016).

6. Data and Descriptive Statistics

This chapter describes the data underlying the empirical analysis and establishes its structure and quality before the results are presented in Chapter 7.

6.1 Sample Composition

The empirical sample is constructed in six steps, summarised in Appendix B, which reports the pair-year counts for the PD and CDS samples in parallel. The starting universe consists of 1,695 completed parent–spin-off pairs identified in Capital IQ Pro with completion dates from 2004 onward, structured as an event-time panel covering event years −3 to +3 and yielding 11,865 pair-year observations. Step 1 removes financial firms with parent SIC codes between 6000 and 6999, and Step 2 sets economically implausible values to missing without dropping any pairs, leaving 10,118 pair-years. Step 3 requires non-missing parent firm Scope 1 and Scope 2 emissions in event year −1, reducing the count to 4,347. Step 4 additionally requires the divested entity's emissions, so that *CarbonShare* can be constructed, together with non-missing relative size, which is the central requirement of the analysis and the point at which the two samples diverge, leaving 1,400 PD and 672 CDS pair-years. Step 5 applies the dependent-variable availability requirement, leaving 1,203 PD and 495 CDS pair-years, the smaller CDS figure reflecting that traded five-year CDS contracts are concentrated in larger and more actively followed firms. After singleton removal in Step 6, the final PD sample contains 1,201 pair-year observations across 198 parent–spin-off pairs and the final CDS sample 490 across 91 pairs.

6.2 Country and Industry Distribution

6.2.1 Country Distribution

The country distribution of the two estimation samples is reported in Table 1. The PD sample spans 33 countries and the CDS sample 20, with the narrower CDS coverage reflecting the concentration of traded five-year CDS contracts in large, internationally active firms in developed credit markets. Both samples are dominated by the United States, which accounts for roughly 33 percent of the PD sample and close to 59 percent of the CDS sample. Non-US coverage is broader in the PD sample, which is more geographically balanced, while the CDS sample tilts toward Western Europe and the United Kingdom. Mean credit risk and both moderators vary substantially across countries, and this cross-country dispersion provides the variation that the interaction specifications exploit, while the fiscal-year and pair fixed effects in the main specifications absorb persistent country-level differences in credit conditions. The CDS sample is concentrated in developed markets, and the CDS results should be read accordingly.

6.2.2 Industry Distribution

The industry distribution, reported in Table 2 using SIC division groupings, shows that both samples are dominated by manufacturing parent firms, which account for roughly 55 percent of the CDS sample and 52 percent of the PD sample, consistent with manufacturing being the most common industry in international spin-off activity. Outside manufacturing, both samples include transport and utilities, services, wholesale and retail, agriculture and mining, and a residual "other" category, with construction appearing only in the PD sample. Mean credit risk differs across industries, and while *RelSize* is broadly similar across industries, *CarbonShare* shows wider dispersion, being highest in the more emissions-intensive sectors and lowest in services and wholesale and retail. The inclusion of industry fixed effects in the carbon-moderation specification absorbs these persistent industry-level differences in baseline credit risk and emissions intensity.

6.3 Descriptive Statistics

Descriptive statistics for the two estimation samples are reported in Table 3. The CDS sample contains 513 non-missing CDS spreads and the PD sample 1,299 non-missing PD values, with the remaining variables observed for the large majority of each sample. These counts are reported at the sample-definition stage, before singleton pairs are dropped and before listwise deletion on controls. The regression samples are therefore somewhat smaller, at 1,201 and 490 pair-year observations.

The mean CDS spread is 1.482 percent (148 basis points) with a median of 0.842 percent and a maximum of 72.189 percent, indicating a right-skewed distribution with a long upper tail. The mean PD of 0.047 with a median of zero and a maximum of 0.995 shows the same pattern, where most parent firms are far from distress in any given year, while a small number of observations drive the upper tail. Mean *Firm Size* is 10.185 in the CDS sample and 9.045 in the PD sample, reflecting the larger and more actively followed firms for which CDS contracts are traded. The remaining controls are comparable across samples, with mean *Leverage* of 0.276 and 0.267, mean *ROA* of 0.110 and 0.093, and mean *Equity Beta* close to one in both. Mean *Institutional Ownership* is 62.7 percent in the CDS sample against 47.4 percent in the PD sample, again reflecting the selection toward larger firms in the CDS sample.

Mean *RelSize* is 0.210 in the CDS sample and 0.251 in the PD sample, indicating that the typical spin-off represents around one fifth to one quarter of the combined post-separation asset base, with maxima of 0.568 and 0.913 respectively. Mean *CarbonShare* is 0.224 and 0.256, with maxima of 0.933 and 0.974, confirming that the samples span the full range of *RelSize* and *CarbonShare* configurations. This dispersion provides the variation that the moderation specifications exploit.

6.4 Correlation Matrices

Pairwise Pearson correlations are reported in Table 4. In both samples the credit-risk measures correlate with the controls in the directions predicted by the credit-risk literature, with PD and the CDS spread negatively related to *Firm Size*, *Tobin's Q*, and *Institutional Ownership* and positively related to *Leverage* and *Equity Beta*. The consistency of these signs across samples supports the validity of the control vector.

Correlations among the controls are modest. The strongest is between *ROA* and *Tobin's Q* (0.509 in the CDS sample, 0.305 in the PD sample), reflecting their joint role in capturing profitability and growth, while no other pair exceeds 0.30. The correlation between *RelSize* and *CarbonShare* is 0.441 in the CDS sample and 0.474 in the PD sample, the most relevant pattern given that both enter the moderation specifications. These magnitudes are moderate, and because H2 and H3 are tested in separate specifications, the correlation does not threaten identification. The joint specification reported in Section 7.5 includes both interactions simultaneously and confirms that the two channels retain their predicted signs.

6.5 Regression Diagnostics

6.5.1 Multicollinearity

VIFs are reported in Table 5. In the PD sample, no individual VIF exceeds 1.334, and the mean VIF is 1.166. The highest values are *ROA* (1.334), *Tobin's Q* (1.297), and *Tangibility* (1.247), all well below thresholds typically used to indicate problematic multicollinearity. In the CDS sample, the highest VIF is *Tobin's Q* at 2.202, followed by *ROA* (1.659) and *Leverage* (1.521), with a mean of 1.359. The somewhat higher values in the CDS sample reflect the smaller sample size and the stronger pairwise correlations among *ROA*, *Tobin's Q*, and *Leverage* documented in Section 6.4, but all VIFs remain well below the common threshold of five. The VIFs therefore confirm the conclusion drawn from the correlation matrices, namely that multicollinearity is not a material concern in either sample.

6.5.2 Heteroskedasticity

White's test, reported in Table 6, rejects the null hypothesis of homoskedasticity in both samples at the 1 percent level ($\chi^2 = 378.43$, $p < 0.001$ in the PD sample; $\chi^2 = 150.62$, $p < 0.001$ in the CDS sample). This is expected given the cross-sectional and time-series structure of the panel and the wide dispersion in *Firm Size*, *Leverage*, and credit risk across observations. To accommodate this, all regressions reported in Chapter 7 use standard errors clustered at the parent–spin-off pair level, which is robust to both heteroskedasticity and within-pair serial correlation in the residuals.

6.5.3 Residual Normality

The skewness-kurtosis test reported in Table 7 rejects the null hypothesis of residual normality in both samples (adjusted $\chi^2 = 655.36$, $p < 0.001$ for the PD sample; adjusted $\chi^2 = 688.18$, $p < 0.001$ for the CDS sample). The rejections are unsurprising given the skewed distributions of the dependent variables documented in Section 6.3. Non-normality of residuals does not bias OLS coefficient estimates, and the pair-clustered standard errors used in the empirical analysis remain valid under heteroskedasticity, within-cluster dependence, and non-normal residuals (Bailey, 2016). The main inferential concern across the diagnostics is therefore heteroskedasticity rather than multicollinearity or non-normality, and this concern is addressed through the pair-clustered standard errors applied throughout Chapter 7.

7. Empirical Analysis

Chapter 7 presents the empirical results. The chapter is organised by hypothesis, with the baseline effect of spin-offs on credit risk in Section 7.1, the moderating effect of relative size in Section 7.2, and the moderating effect of carbon share in Section 7.3, followed by event-time evidence and robustness checks.

7.1 Baseline Effect of Spin-Offs on Credit Risk

7.1.1 CDS Results

Table 8 reports the baseline results for the CDS sample. The coefficient on *Post-Spinoff* is positive across all three specifications but does not reach statistical significance. The pooled OLS estimate in column (1) is 0.330, the industry and year fixed effects estimate in column (2) is 0.294, and the pair and year fixed effects estimate in column (3) is 0.427. The signs are uniformly positive, indicating that parent firm CDS spreads are on average higher in the post-separation period, but the magnitudes are not statistically distinguishable from zero. The pair fixed effects point estimate corresponds to a 42.7 basis point widening of the five-year CDS spread following the spin-off, which is economically meaningful relative to the sample mean of 148 basis points reported in Table 3, but the wide standard errors do not allow this magnitude to be inferred with confidence.

These results indicate that the structural credit-risk effect predicted by the coinsurance and wealth expropriation mechanisms is not detected when credit risk is measured through market-priced CDS spreads. The absence of a statistically significant effect is consistent with the conceptual distinction drawn in Chapter 2 between PD as a structural measure of distress and CDS spreads as market prices that respond to investor sentiment, contract liquidity, and broader credit-market conditions in addition to firm fundamentals. A spin-off that reshapes the parent's structural risk profile may not generate a corresponding repricing in the CDS market if the change in structural risk is gradual, anticipated, or offset by other factors in credit markets. The result is also consistent with evidence that creditor outcomes around spin-offs are not uniform but depend on the institutional environment and the characteristics of the divested asset (Veld & Veld-Merkoulova, 2008).

7.1.2 PD Results

Table 8 also reports the baseline results for the PD sample. The coefficient on *Post-Spinoff Effect* is positive and statistically significant in all three specifications. 0.025 ($p < 0.01$) in column (4), 0.020 ($p < 0.05$) in column (5), and 0.072 ($p < 0.01$) in column (6). The robustness of the estimate across specifications, and in particular the persistence of statistical significance in the most demanding pair fixed effects specification, indicates that the post-divestiture increase in PD is driven by within-pair variation rather than by unobserved differences between parent–spin-off pairs. The pair fixed effects coefficient corresponds to a 7.2 percentage point increase in the model-implied PD, which is large in absolute terms relative to the sample mean PD of 0.047. The control variables behave as expected, where *Leverage* is positive and significant across all three columns, *Tobin's Q* and *Current Ratio* are negative and significant, and *Firm Size* enters negatively in the less restrictive columns.

These results support H1 when credit risk is measured through structural default probability. The post-separation increase in PD is consistent with the coinsurance mechanism (Lewellen, 1971), the wealth expropriation mechanism (Jensen & Meckling, 1976; Myers, 1977), and prior U.S. evidence on creditor outcomes around spin-offs (Maxwell & Rao, 2003; Parrino, 1997; Hope et al. 2023). The pair fixed effects estimate in column (6), which absorbs all time-invariant characteristics of each transaction including parent country, industry, and baseline risk profile, indicates that the structural credit-risk effect is identified within parent–spin-off pairs over the event window and is not an artefact of selection into spin-off activity. Given the bimodal structure of the PD measure, the 7.2 percentage point coefficient should be read as an average shift driven primarily by a subset of parent–spin-off pairs moving out of the near-zero region of the distribution rather than as a uniform shift across all observations, with the event-study coefficient of 0.056 in event year 0 reported in Table 11 consistent with this reading.

7.1.3 Comparison and Discussion

H1 predicts a post-separation increase in parent firm credit risk and receives clear support in the PD sample, where the effect is robust across specifications, but is not supported in the CDS sample. This divergence between the two measures is consistent with the framework developed in Section 2.3, which treats PD and CDS spreads as capturing related but conceptually distinct dimensions of credit risk, and suggests that the credit-risk consequences of spin-offs documented in the prior literature are sensitive to the measurement choice.

Two interpretations are consistent with this pattern, which the present design cannot separately identify. First, the divergence may reflect what each measure captures. PD is sensitive to changes in the parent's asset base and asset volatility, both of which are directly affected by a spin-off, while CDS spreads need not respond mechanically to structural changes unless the market reassesses default risk concurrently. The PD result on this reading indicates that the structural risk of the parent firm increases after separation, while the CDS result indicates that this structural change is not fully priced into the credit-derivative market over the event window. Second, the CDS market may have priced the separation before completion. Hope et al. (2023) show that loan spreads widen ahead of legal separation as creditors anticipate the restructuring, and if CDS spreads behave similarly, the structural change is already embedded in the pre-separation spread, muting the post-versus-pre difference that the Post indicator measures. Distinguishing these readings would require an announcement-window event study, beyond the scope of the present design.

7.2 Relative Size Moderation

7.2.1 CDS Results

Table 9 reports the *RelSize* moderation results for the CDS sample. The coefficient on the *Post* × *RelSize* interaction is negative across all three specifications but statistically insignificant. -3.960 in column (1), -4.122 in column (2), and -4.422 in column (3). The magnitudes are large in absolute terms but the standard errors are equally large, so no individual coefficient is statistically distinguishable from zero. The *Post-Spinoff* main effect is similarly insignificant across all columns. The subsample-split robustness check in Table 13A confirms this pattern, which is that the *Post-Spinoff* coefficient is 0.002 in the above-median *RelSize* subsample and 0.261 in the below-median subsample, neither significant.

These results indicate that the relative size of the divested entity does not generate a detectable moderating effect on parent firm CDS spreads. The structural prediction underlying H2, which is that the loss of diversification and the wealth expropriation channel should be more pronounced when a larger share of the parent's pre-separation asset base is divested, is not borne out in the CDS market. As with the baseline result, this absence of a detectable effect is consistent with the broader CDS pattern in which structural changes in the parent's risk profile do not translate into measurable repricing in the credit-derivative market, and is also consistent with the limited statistical power of the CDS sample, particularly when split into subsamples where the above-median subsample contains only 189 observations.

7.2.2 PD Results

Table 9 also reports the *RelSize* moderation results for the PD sample. The coefficient on the *Post* × *RelSize* interaction is positive across all three specifications. 0.032 in column (4), 0.034 in column (5), and 0.036 in column (6). The *Post-Spinoff* main effect remains positive and statistically significant across all columns, with values ranging from 0.021 to 0.074. The interaction coefficients point in the direction predicted by H2 but do not reach statistical significance.

The subsample-split robustness check in Table 13A sharpens the picture. The *Post-Spinoff* coefficient is 0.088 ($p < 0.01$) in the above-median subsample and 0.027 ($p < 0.10$) in the below-median subsample, with the effect on PD approximately three times larger in transactions where the divested entity represents an above-median share of the parent's pre-separation asset base. The subsample evidence therefore provides clearer support for the H2 prediction than the continuous interaction specification, and two readings are consistent with this combined evidence. First, the structural mechanism underlying H2 is operative but the continuous interaction specification is underpowered, with the subsample comparison picking up the effect that the interaction term cannot identify with sufficient precision. Second, the relationship between relative size and the post-divestiture credit-risk increase may be non-linear or threshold-based, in which case a median-split comparison would capture it more cleanly.

7.2.3 Comparison and Discussion

The pre-specified continuous *Post* × *RelSize* interaction is insignificant in both samples, while the subsample-split evidence in Table 13 shows a *Post-Spinoff* coefficient roughly three times larger in the above-median *RelSize* subsample of the PD sample. The continuous specification is therefore the more conservative test, and the subsample evidence the more supportive one. Two readings are consistent with this combination. The relationship between relative size and the post-divestiture credit-risk increase may be non-linear or threshold-based, in which case the median-split comparison captures it more cleanly than the linear interaction. Alternatively, the continuous specification may be underpowered relative to the median split. The present design cannot separate these readings, and H2 is best read as receiving qualified support from the PD sample, conditional on the threshold interpretation, and no support from the CDS sample.

The PD subsample evidence is consistent with the structural mechanisms developed in Chapter 2. A spin-off that removes a larger share of the parent's pre-separation operations should generate a larger loss of coinsurance benefits (Lewellen, 1971; Stein, 1997), and the wealth expropriation mechanism (Jensen & Meckling, 1976; Myers, 1977) similarly predicts that larger divestitures leave creditors exposed to a more substantially different borrower. Mehrotra et al. (2003) provide complementary evidence that firms actively redesign capital structures around spin-offs, with these redesigns being more material when the separation involves a larger share of the parent's asset base. The absence of a corresponding CDS result is consistent with the broader divergence documented in Section 7.1.3, which is if market-priced CDS spreads do not respond mechanically to structural changes in the parent's risk profile, the cross-transaction variation captured by *RelSize* would not be expected to generate a detectable moderating effect either. The results in Tables 9 and 13 therefore provide qualified support for H2.

7.3 Carbon Share Moderation

7.3.1 CDS Results

Table 10 reports the carbon-share moderation results for the CDS sample. The *Post* × *CarbonShare* interaction is negative across all three specifications. -3.109 in column (1), -2.488 in column (2), and -2.763 in column (3). The signs are directionally consistent with H3, indicating that the post-separation change in the CDS spread is on average smaller when the divested entity represents a larger share of combined parent and spin-off emissions, but the magnitudes are not statistically distinguishable from zero. The standalone *CarbonShare* term is positive but insignificant in both the OLS and industry-and-year fixed effects columns (0.829 and 1.668), and the *Post-Spinoff* main effect is small and insignificant throughout, consistent with the baseline CDS result.

These results indicate that the carbon profile of the divested entity does not generate a detectable moderating effect on parent firm CDS spreads. The wide standard errors do not allow the negative direction to be inferred with confidence, and the limited statistical power of the CDS sample also constrains the ability to detect a moderate-magnitude interaction effect.

7.3.2 PD Results

Table 10 also reports the carbon-share moderation results for the PD sample. The *Post* × *CarbonShare* interaction is negative across all three specifications. -0.039 in column (4), -0.047 in column (5), and -0.056 in column (6). The signs are consistent with the direction predicted by H3, indicating that the post-separation increase in PD is on average smaller when a larger share of combined carbon exposure is divested. The standalone *CarbonShare* term is close to zero and insignificant in both the OLS and industry-and-year fixed effects columns (0.001 and -0.017), suggesting that *CarbonShare* does not have a direct level effect on PD outside the spin-off context. The *Post-Spinoff* main effect remains positive and statistically significant in the pooled OLS, industry-and-year fixed effects columns (0.025 and 0.020) , and in the pair fixed effects column (0.071).

Interpreted at face value, the column (6) coefficient of −0.056 implies that a one-standard-deviation increase in CarbonShare (0.231 in the PD sample, per Table 3) is associated with roughly a 1.3 percentage point reduction in the post-divestiture increase in PD . The directional consistency across the three columns, combined with the absence of statistical significance, suggests that the carbon-related moderating channel may operate but cannot be identified with confidence given the sample size and the limited within-sample variation in *CarbonShare* available for the interaction. The near-zero standalone *CarbonShare* coefficient indicates further that the effect, where present, operates through the interaction with the spin-off event rather than as a level relationship between carbon exposure and credit risk.

7.3.3 Comparison and Discussion

The results in Table 10 are directionally consistent with H3 in both samples but do not reach statistical significance in either. The interaction coefficients are negative across all six specifications, the sign predicted by the environmental finance literature, but the standard errors are too wide to allow confident inference. The carbon-share moderation channel therefore receives weak directional support without strong statistical confirmation.

This pattern can be read alongside the H1 and H2 results in two complementary ways. First, the directional consistency across all specifications in both samples suggests that the divestiture of carbon-intensive operations does, on average, attenuate the post-separation increase in credit risk, consistent with the environmental management model (Klassen &

McLaughlin, 1996), stakeholder theory (Freeman, 1984), and prior evidence that carbon exposure is priced in debt markets (Chava, 2014; Ehlers et al. 2022; Capasso et al. 2020; Kabir et al. 2021) and as a systematic risk factor (Bolton & Kacperczyk, 2021). The absence of statistical significance does not contradict this literature but indicates that the moderating effect, if present, is not large enough to be identified with confidence in the available samples. Second, the absence of significance in the PD sample is informative in its own right. The structural credit-risk increase documented in Section 7.1.2 is robust across specifications, and the *RelSize* moderation evidence in Section 7.2.2 indicates that this increase is concentrated in larger spin-offs, while the *CarbonShare* moderation does not generate the same statistical signal. One interpretation is that the structural mechanisms operating through *RelSize* are quantitatively more important than the carbon-related mechanisms operating through *CarbonShare* in the available sample.

An alternative interpretation is that the 0.474 correlation between *RelSize* and *CarbonShare* documented in Table 4 limits independent identification of the carbon channel, sharpened by the fact that the two moderators carry opposite predicted signs, positive for *Post* × *RelSize* and negative for *Post* × *CarbonShare*, so their positive empirical correlation mechanically offsets each interaction against the other. The joint specification in Table 14 confirms this, with both interactions retaining their predicted signs but neither reaching significance, the pattern expected when correlated regressors with opposing effects are entered together. The construction of *CarbonShare* introduces a further attenuation, as discussed in Section 5.3.2.2.

7.4 Event-Time Evidence

7.4.1 CDS Results

Table 11 reports the event-year coefficients for the CDS sample. None of the event-year coefficients are statistically significant. The pre-event coefficients in year -2 (-0.226) and year -1 (-0.008) are close to zero, providing no evidence of a pre-trend in CDS spreads before the spin-off. The post-event coefficients are positive in years 0, +1, and +2 (0.113, 0.378, and 0.906 respectively), reach their maximum in year +2, and decline to 0.023 in year +3. The standard errors are large relative to the coefficients across all post-event years. The pattern is consistent with a gradual and noisy widening of CDS spreads in the post-separation period that does not produce a statistically identifiable spike in any single event year, reinforcing the conclusion that the CDS market does not produce a detectable repricing in response to the spin-off.

7.4.2 PD Results

Table 11 also reports the event-year coefficients for the PD sample. The pre-event coefficients in year -2 (-0.012) and year -1 (-0.010) are close to zero and statistically insignificant, providing no evidence of a pre-trend in PD before the spin-off. The coefficient on event year 0 is 0.056 ($p < 0.01$), the only event-year coefficient that reaches statistical significance, and the post-event coefficients decline thereafter to 0.019, 0.014, and 0.004 in years +1, +2, and +3. The pattern indicates that the post-separation increase in PD documented in Section 7.1.2 is concentrated in the fiscal year of the spin-off itself, after which PD reverts toward the pre-event baseline. The increase in structural default risk therefore appears immediately at separation rather than emerging gradually, consistent with the spin-off being a discrete structural event that reshapes the parent's asset base and asset volatility from the moment of completion. The subsequent decline is consistent with the parent firm partially adjusting to its post-separation structure over time through capital structure adjustments, operational changes, or creditor renegotiation, although the specification does not separately identify these mechanisms.

7.4.3 Comparison and Discussion

The event-time evidence confirms the divergence between the two credit-risk measures, and qualifies the H1 result reported in Section 7.1.2. The PD response is sharply concentrated in event year 0, the only event year in which the coefficient reaches statistical significance, while the CDS response does not show a comparable spike in any single event year. The concentration in event year 0 indicates that the headline pair fixed effects estimate of 7.2 percentage points should be read primarily as a year-of-separation effect rather than as a uniform shift over the post-period. This concentration is consistent with two readings that the main specification cannot separately identify. The first is that the spin-off generates a persistent structural change that is partly offset over subsequent years through capital structure adjustments or creditor renegotiation, leaving the year of separation as the cleanest reflection of the structural shock. The second is that the year 0 spike reflects, at least in part, a transitory measurement effect, with the parent's reported assets and equity mid-restructuring and asset volatility estimated from the preceding 252 trading days incorporating elevated return volatility around the corporate event itself. The robustness check in Table 12 addresses this distinction directly by excluding event year 0 from the sample, and shows that approximately 45 percent of the headline PD effect persists beyond the year of separation. The absence of pre-trends in both samples also strengthens the causal interpretation of the baseline results, since credit risk was not already changing in the years before the spin-off in either sample.

7.5 Robustness

7.5.1 Event-Year 0 Excluded

Table 12 reports the main specifications with event year 0 excluded, addressing the concentration of the PD response in the year of separation documented in Section 7.4. The *Post-Spinoff* coefficient on PD remains positive and significant at roughly 45 percent of the main pair fixed effects estimate in Table 8, indicating that the structural credit-risk increase persists beyond the event year while a meaningful share of the headline effect is concentrated in it. This is consistent either with a discrete structural shock that the parent partially absorbs over subsequent years or with a transitory measurement effect the data cannot fully separate. The CDS coefficient remains insignificant. The *Post* × *CarbonShare* interaction on PD is larger in magnitude than the main estimate in Table 10 and significant at the 10 percent level, so the carbon-moderation channel is more clearly identified once the event-year component is removed, providing weak but identifiable support for H3, while the CDS interaction remains insignificant.

7.5.2 Subsample Split for Relative Size

Table 13A reports the H2 result as a subsample split on above-median (Large) and below-median (Small) *RelSize*. The *Post-Spinoff* coefficient on PD is roughly three times larger in the large subsample, while the CDS subsamples are insignificant in both. The PD evidence strengthens H2 and identifies the relationship more cleanly than the continuous interaction in Table 9, suggesting it may be threshold-based rather than strictly linear. Table 13B replicates the split with event year 0 excluded, where the effect remains significant in the large subsample but disappears in the small one, cleanly isolating the post-separation increase in structural default risk to transactions where the divested entity represents an above-median share of the parent's pre-separation asset base. The CDS subsamples remain insignificant.

7.5.3 Joint Specification with Both Interactions

Table 14 reports a combined specification including both interactions simultaneously, addressing the 0.474 correlation between the two moderators. The *Post-Spinoff* main effect on PD remains positive and significant, the *Post* × *RelSize* interaction stays positive but insignificant in line with the H2 main result, and the *Post* × *CarbonShare* interaction stays negative and close in magnitude to the standalone H3 estimates in Table 10 but also insignificant. Both interactions retain their predicted signs when estimated jointly, reinforcing the interpretation that *RelSize* and *CarbonShare* capture conceptually distinct mechanisms despite their empirical correlation.

7.5.4 Scope 1 Emissions Only

Table 15 reports the H3 specifications using a *CarbonShare* measure constructed from Scope 1 emissions only. The *Post* × *CarbonShare* interaction is negative and close in magnitude to the main estimates in Table 10 in the PD sample, and directionally consistent in the CDS sample. The directional H3 result is therefore not driven by Scope 2 emissions, supporting the interpretation that the carbon-related moderating channel, where present, operates through direct operational emissions rather than measurement noise.

8. Conclusion

Chapter 8 concludes the paper by summarising the main findings, contributions, and limitations of the analysis, and by outlining directions for future research.

The central empirical finding is that spin-offs are associated with an increase in the parent firm's PD concentrated in the fiscal year of separation, with no detectable response in market-priced CDS spreads. Estimated on a sample of completed international spin-offs from 2004 onward restricted to parent–spin-off pairs with available Scope 1 and Scope 2 emissions data, the post-separation increase in PD is positive and statistically significant across fixed-effects specifications, with a pair fixed effects estimate of 7.2 percentage points. The year-0-excluded specification shows that roughly 45 percent of this effect persists beyond the year of separation, providing the more conservative reading of the structural credit-risk consequences of spin-offs, while the corresponding CDS effect is positive but insignificant throughout. The increase is also concentrated in larger transactions, consistent with the loss of coinsurance benefits and the wealth expropriation channel scaling in the share of operations divested, while the carbon channel operates in the predicted direction and reaches significance at the 10 percent level once the year of separation is excluded. Mapped to the hypotheses, H1 is supported in the PD sample but not in the CDS sample, H2 receives qualified support from the PD subsample evidence conditional on a threshold reading of the relationship, and H3 receives weak but directionally consistent support that strengthens when the year of separation is excluded.

The most important contribution of the paper is the demonstration that the credit-risk consequences of spin-offs are sensitive to the choice of credit-risk measure. Prior studies have used bond returns (Maxwell & Rao, 2003; Veld & Veld-Merkoulova, 2008), syndicated loan spreads (Hope et al. 2023), or model-implied default risk in isolation, and have produced inconsistent findings on the direction of the parent creditor outcome. By estimating both PD and CDS responses on a common sample of parent–spin-off pairs, this paper shows that the structural mechanisms documented in the spin-off literature are identifiable in PD-based measures but not in market-priced CDS spreads, and the disagreement in the prior literature may reflect, in part, that different measures capture different dimensions of credit risk. The paper also connects the spin-off literature to the environmental finance literature on the carbon premium (Chava, 2014; Ehlers et al. 2022; Bolton & Kacperczyk, 2021) by examining how a discrete change in a firm's carbon profile affects credit risk in a restructuring setting. For creditors, the results suggest that structural default models pick up spin-off-induced risk shifts that CDS markets, at least over the event window studied here, do not fully reflect, implying that monitoring frameworks relying solely on market-priced credit derivatives may understate the structural consequences of separation, and the directional carbon evidence indicates that practitioners and rating agencies assessing carbon-intensive divestitures should treat the parent's post-separation carbon profile as a distinct input rather than as a corollary of transaction size.

Several limitations bound the inference these results support. The samples are small relative to the demands of the empirical design, with 198 parent–spin-off pairs in the PD sample and 91 in the CDS sample, and the interaction and subsample specifications rest on correspondingly thin cells, so the absence of detectable CDS responses and the marginal significance of the H3 interaction may reflect limited power as much as a genuine absence of repricing or moderation. The PD effect's concentration in event year 0 is consistent with a discrete structural shock but also with a transitory measurement effect, since the Bharath and Shumway construction uses equity volatility from the preceding 252 trading days and the parent's prior-year return as drift, both of which are affected by the restructuring itself, and because the same drift proxy underlies the pre-trend test, the absence of pre-trends is suggestive rather than independent evidence. The CarbonShare construction introduces structured measurement error, since the parent's event year −1 emissions figure includes the subsidiary that will subsequently be divested, mechanically inflating the denominator and biasing CarbonShare downward most severely in precisely the transactions where it is otherwise largest, attenuating the Post × CarbonShare interaction toward zero, and the timing asymmetry between parent emissions in event year −1 and divested entity emissions in event year 0 adds further measurement error. Selection into spin-off activity is a further concern, since firms that divest carbon-intensive subsidiaries are not a random subset and may act on anticipated regulatory tightening, creditor pressure, or a deteriorating segment outlook, and while pair fixed effects absorb time-invariant differences they cannot address selection on time-varying expectations. The results are therefore best read as descriptive within-pair evidence rather than as identifying a causal effect.

Future work could address these concerns through a propensity-score-matched control sample of non-divesting firms with comparable size, leverage, industry, and pre-period carbon exposure, an alternative CarbonShare construction using the parent's post-separation emissions as the denominator, and an extension to carve-outs and asset sales, where the structural change differs in scale and mechanism from a full spin-off. These findings establish that the credit-risk consequences of spin-offs depend on how credit risk is measured and on what is being divested, and that integrating measurement choice and carbon exposure into the analysis of corporate restructuring is a productive direction for future research.

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Appendix A - Variable Definitions

Variable	Description	Measurement	Source
CDS Spread	Parent firm's five-year credit default swap spread, the annual premium paid for protection against the parent firm's default.	Reported in percentage points (basis points divided by 100); not winsorized.	Capital IQ Pro
PD	Parent firm's probability of default, the model-implied likelihood that the parent firm's asset value falls below its debt obligations at maturity.	Estimated using the naïve Bharath and Shumway (2008) approximation of the Merton (1974) structural default model.	Computed from Capital IQ Pro
Post Spin-Off	Indicator equal to one in the post-separation period and zero in the pre-separation period.	Equals 1 in event years 0 to +3 and 0 in event years −3 to −1. Event year 0 is included in the post period in line with standard event-study practice.	Computed from spin-off completion date
RelSize	Relative size of the divested entity, measured as the share of combined parent and divested entity total assets represented by the divested entity.	Average post-separation total assets of the divested entity, divided by the sum of the parent firm's total assets in event year −1 and the divested entity's average post-separation total assets. Time-invariant within each parent–spin-off pair. Ranges from 0 to 1.	Capital IQ Pro
Large Spin-Off	Indicator equal to one for parent–spin-off pairs with above-median *RelSize* and zero otherwise.	Equals 1 if *RelSize* > sample median; 0 otherwise. Used in the H2 interaction specification (Eq. 9) and the subsample-split robustness check.	Computed from *RelSize*
Carbon Share	Share of combined parent and divested entity Scope 1 plus Scope 2 carbon emissions represented by the divested entity.	Constructed from parent emissions in event year −1 and divested entity emissions in event year 0. Time-invariant within each parent–spin-off pair. Ranges from 0 to 1.	Capital IQ Pro

Firm Size	Natural logarithm of parent firm total assets.	ln(Total Assets).	Capital IQ Pro
Tangibility	Ratio of parent firm net property, plant, and equipment to total assets.	Net PP&E / Total Assets. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
ROA	Parent firm return on assets, capturing profitability and internal cash generation.	EBITDA / Total Assets. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
Leverage	Parent firm leverage, capturing capital structure as a determinant of credit risk.	Total Debt / Total Assets. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
Tobin's Q	Ratio of the market value of parent firm assets to their book value, proxying for growth opportunities and intangible value.	(Total Assets - Book Value of Equity + Market Capitalization) / Total Assets. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
Current Ratio	Parent firm short-term liquidity.	Current Assets / Current Liabilities. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
Equity Beta	Parent firm's five-year equity beta, proxying for systematic risk.	Five-year rolling beta from monthly returns regressed on the local market index. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro
Institutional Ownership	Percentage of parent firm shares outstanding held by institutional investors, proxying for external monitoring and governance quality.	Institutional Holdings / Shares Outstanding × 100. Winsorized by fiscal year at the 1st and 99th percentiles.	Capital IQ Pro

Appendix B - Sample Selection Process

Step	Restriction	PD Pairs	Removed	CDS Pairs	Removed
0	Starting Universe	11,865	-	11,865	-
1	Financial Firms	10,129	-1,736	10,129	-1,736
2	Variable Cleaning	10,118	-11	10,118	-11
3	Parent GHG Availability	4,347	-5,771	4,347	-5,771
4	SO GHG Availability	1,400	-2,947	672	-3,675
5	CDS / PD Availability	1,203	-197	495	-177
6	Singleton Drops	1,201	-2	490	-5

Appendix C - AI Statement

The authors used generative AI tools, specifically OpenAI's ChatGPT and Anthropic's Claude, during the preparation of this paper. The tools helped identify and locate prior research relevant to the spin-off and environmental finance literature. They also assisted with implementing the Stata code and Excel commands that underlie the empirical analysis, with checking the internal consistency of reported figures, tables, and sample statistics, and with improving the clarity, structure, and language of the written text.

The AI tools were not used to generate empirical results or produce original interpretations of the findings. All data collection, regression estimation, and analytical conclusions are the authors' own. The authors are aware of the AI guidelines issued by LUSEM and recognise that AI tools can produce errors, omissions, and inaccurate references. Accordingly, all AI-assisted output, including code, suggested literature, and statistical figures, was subject to thorough manual verification by the authors, who take full responsibility for the final content of this paper.

Tables

Table 1 - Country Distributions

	Panel A : CDS Sample				Panel B : PD Sample			
Country	N	Mean CDS	Mean RelSize	Mean CarbonShare	N	Mean PD	Mean RelSize	Mean CarbonShare
Australia	14	1.075	0.344	0.340	48	0.005	0.256	0.286
Bermuda	-	-	-	-	33	0.047	0.208	0.466
Brazil	-	-	-	-	13	0.142	0.347	0.368
Canada	1	0.478	0.207	0.117	23	0.054	0.211	0.240
Chile	4	1.304	0.278	0.287	7	0.003	0.278	0.287
China	6	0.842	0.146	0.383	20	0.052	0.215	0.174
Colombia	-	-	-	-	4	0.039	0.648	0.002
Denmark	7	1.195	0.096	0.004	14	0.016	0.207	0.117
Finland	1	1.344	0.192	0.177	10	0.007	0.280	0.293
France	36	0.897	0.160	0.276	63	0.119	0.181	0.215
Germany	22	0.788	0.219	0.280	34	0.011	0.260	0.296
Greece	-	-	-	-	7	0.395	0.231	0.378
Hong Kong	14	1.090	0.427	0.462	34	0.032	0.352	0.311
India	8	1.476	0.035	0.000	76	0.060	0.264	0.147
Indonesia	-	-	-	-	7	0.109	0.246	0.144
Ireland	16	0.949	0.248	0.231	28	0.007	0.203	0.195
Israel	-	-	-	-	5	0.040	0.458	0.430
Japan	4	0.213	0.388	0.031	4	0.000	0.388	0.031
Luxembourg	7	4.808	0.047	0.011	7	0.092	0.047	0.011
Malaysia	11	1.289	0.414	0.196	28	0.032	0.328	0.183
Mexico	7	1.352	0.032	0.004	20	0.007	0.116	0.154
Netherlands	11	1.729	0.280	0.438	15	0.058	0.280	0.438
Norway	-	-	-	-	21	0.109	0.164	0.090
Portugal	-	-	-	-	7	0.013	0.079	0.039
Singapore	2	2.444	0.560	0.459	27	0.005	0.307	0.274
South Africa	-	-	-	-	68	0.041	0.330	0.453
South Korea	-	-	-	-	112	0.121	0.436	0.356
Spain	-	-	-	-	7	0.002	0.189	0.040
Sweden	9	0.756	0.328	0.314	63	0.003	0.294	0.419
Switzerland	-	-	-	-	14	0.054	0.119	0.138
Taiwan	-	-	-	-	7	0.001	0.441	0.933
USA	289	1.634	0.200	0.198	401	0.035	0.200	0.195
UK	44	1.636	0.139	0.260	72	0.021	0.151	0.269

N is the number of pair-year observations, not the number of parent–spin-off pairs. Reports N and cross-country means and medians of the dependent variable, *RelSize*, and *CarbonShare*, for the CDS sample (Panel A) and PD sample (Panel B). CDS spreads in percentage points. Countries without traded CDS contracts appear only in Panel B. Means based on few observations should be read with caution.

Table 2 - Industry Distributions

Panel A : CDS Sample

Industry	N	Mean CDS	Median CDS	Mean RelSize	Median RelSize	Mean CarbonShare	Median CarbonShare
Agriculture/Mining	41	1.811	0.951	0.202	0.228	0.247	0.256
Manufacturing	270	1.171	0.699	0.180	0.169	0.199	0.146
Other	42	0.621	0.505	0.221	0.205	0.278	0.184
Services	48	4.418	1.156	0.242	0.214	0.175	0.130
Transport/Utilities	63	1.161	1.079	0.260	0.275	0.331	0.287
Wholesale/Retail	49	1.194	1.006	0.267	0.304	0.209	0.150

Panel B : PD Sample

Industry	N	Mean PD	Median PD	Mean RelSize	Median RelSize	Mean CarbonShare	Median CarbonShare
Agriculture/Mining	107	0.035	0.000	0.229	0.249	0.326	0.289
Construction	6	0.245	0.062	0.239	0.239	0.514	0.514
Manufacturing	622	0.037	0.000	0.245	0.220	0.229	0.171
Other	135	0.055	0.000	0.325	0.301	0.392	0.435
Services	116	0.092	0.000	0.241	0.214	0.222	0.175
Transport/Utilities	202	0.040	0.000	0.230	0.201	0.252	0.232
Wholesale/Retail	111	0.064	0.000	0.263	0.314	0.219	0.079

N is the number of pair-year observations, not the number of parent–spin-off pairs. Reports N and cross-industry means and medians of the dependent variable, *RelSize*, and *CarbonShare* across SIC divisions, for the CDS sample (Panel A) and PD sample (Panel B). CDS spreads in percentage points. Construction appears only in the PD sample (six observations).

Table 3 - Descriptive Statistics

Panel A : CDS Sample

	N	Mean	Median	SD	Min	Max
CDS Spread (%)	513	1.482	0.842	3.85	.135	72.189
Firm Size	657	10.185	10.208	1.146	6.667	12.61
Tangibility	657	.266	0.180	.23	.014	.901
ROA	657	.11	0.097	.059	-.035	.392
Leverage	657	.276	0.244	.191	0	2.168
Tobin's Q	641	1.76	1.449	1.148	.566	14.665
Current Ratio	657	1.416	1.269	.75	.264	7.578
Equity Beta	648	.992	0.949	.519	-.234	3.271
Institutional Ownership	665	62.739	77.360	32.145	0	100
RelSize	672	.21	0.198	.137	.01	.568
CarbonShare	672	.224	0.151	.209	0	.933

Panel B : PD Sample

	N	Mean	Median	SD	Min	Max
PD	1299	.047	0.000	.162	0	.995
Firm Size	1357	9.045	9.139	1.807	2.22	12.61
Tangibility	1357	.28	0.218	.224	.001	.917
ROA	1351	.093	0.089	.089	-.791	.502
Leverage	1357	.267	0.248	.181	0	2.168
Tobin's Q	1253	1.599	1.343	.998	.506	14.665
Current Ratio	1356	1.668	1.294	2.174	.17	35.937
Equity Beta	1361	.939	0.878	.585	-.848	3.942
Institutional Ownership	1386	47.358	40.055	33.517	0	100
RelSize	1400	.251	0.233	.165	.01	.913
CarbonShare	1400	.256	0.203	.231	0	.974

N is the number of pair-year observations, not the number of parent–spin-off pairs. Reports N, mean, median, standard deviation, minimum, and maximum for the dependent variable, the two main explanatory variables, and the control variables, for the CDS sample (Panel A) and the PD sample (Panel B). Continuous control variables are winsorized by fiscal year at the 1st and 99th percentiles. CDS spreads in percentage points.

Table 4 - Correlation Matrices

Panel A : CDS Sample

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) CDS Spread	1.000										
(2) Firm Size	-0.116*	1.000									
(3) Tangibility	0.092*	-0.004	1.000								
(4) ROA	-0.064	-0.082*	0.233*	1.000							
(5) Leverage	0.232*	-0.234*	0.170*	0.280*	1.000						
(6) Tobin's Q	-0.097*	-0.214*	-0.144*	0.509*	0.456*	1.000					
(7) Current Ratio	0.005	-0.143*	-0.195*	-0.049	-0.066	-0.009	1.000				
(8) Equity Beta	0.221*	-0.052	-0.169*	-0.184*	-0.061	-0.183*	0.131*	1.000			
(9) Inst. Ownership	-0.054	-0.199*	-0.014	0.127*	0.133*	0.192*	0.056	0.043	1.000		
(10) RelSize	-0.046	-0.277*	-0.071	-0.094*	0.041	0.025	0.152*	-0.102*	-0.053	1.000	
(11) CarbonShare	-0.054	-0.037	-0.017	-0.092*	0.012	-0.074	-0.002	-0.114*	-0.090*	0.441*	1.000

Panel B : PD Sample

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) PD	1.000										
(2) Firm Size	-0.176*	1.000									
(3) Tangibility	0.056*	0.048	1.000								
(4) ROA	-0.187*	0.261*	0.192*	1.000							
(5) Leverage	0.206*	0.066*	0.266*	0.062*	1.000						
(6) Tobin's Q	-0.196*	-0.058*	-0.117*	0.305*	0.258*	1.000					
(7) Current Ratio	-0.065*	-0.109*	-0.180*	-0.060*	-0.128*	-0.047	1.000				
(8) Equity Beta	0.177*	0.067*	-0.076*	-0.183*	0.040	-0.142*	-0.014	1.000			
(9) Inst. Ownership	-0.190*	0.308*	-0.119*	0.204*	0.038	0.204*	-0.036	0.056*	1.000		
(10) RelSize	0.016	-0.379*	-0.046	-0.008	-0.124*	-0.017	0.108*	-0.220*	-0.229*	1.000	
(11) CarbonShare	0.010	-0.176*	-0.053	-0.082*	-0.069*	-0.052	0.135*	-0.096*	-0.098*	0.474*	1.000

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Pairwise Pearson correlations between the dependent variable, the two main explanatory variables, and the control variables, reported in Panel A for the CDS sample and Panel B for the PD sample

Table 5 - VIF Scores

Panel A : CDS Sample

Variable	CDS VIF	CDS 1/VIF
Tobin's Q	2.202	.454
ROA	1.659	.603
Leverage	1.521	.658
Firm Size	1.244	.804
Tangibility	1.24	.806
Institutional Ownership	1.16	.862
Equity Beta	1.102	.907
Current Ratio	1.068	.936
Post Spin-Off	1.032	.969
Mean VIF	1.359	.

Panel B : PD Sample

Variable	PD VIF	PD 1/VIF
Tobin's Q	1.334	.75
ROA	1.297	.771
Leverage	1.247	.802
Firm Size	1.168	.856
Tangibility	1.162	.861
Institutional Ownership	1.152	.868
Equity Beta	1.071	.934
Current Ratio	1.061	.943
Post Spin-Off	1.005	.995
Mean VIF	1.166	.

Variance inflation factors and tolerance values for the regressors in the CDS and PD sample baseline specification.

Table 6 - White's Test

Sample	chi2	df	p-value
PD	378.430	53	0.000
CDS	150.620	53	0.000

Test statistics and p-values from White's test of the null hypothesis of homoskedasticity in the CDS and PD samples.

Table 7 - Skewness-Kurtosis Test

Sample	N	Adjusted Chi^2	p-value
PD	1,203	655.36	0.000
CDS	495	688.18	0.000

Adjusted chi-squared statistics and p-values from the joint skewness-kurtosis test of the null hypothesis of residual normality in the CDS and PD samples.

Table 8 - Baseline Effect of Spin-offs

	(1) OLS CDS	(2) IND+YR CDS	(3) PAIR+YR CDS	(4) OLS PD	(5) IND+YR PD	(6) PAIR+YR PD
Post-Spinoff Effect	.33	.294	.427	.025***	.02**	.072***
	(.405)	(.426)	(.305)	(.008)	(.009)	(.017)
Firm Size	-.182	-.446*	-.959	-.015***	-.014***	-.006
	(.176)	(.249)	(.758)	(.004)	(.005)	(.021)
Tangibility	.327	.124	-.069	-.02	.017	.056
	(.622)	(.663)	(1.527)	(.034)	(.058)	(.077)
ROA	-.375	-3.068	-4.261	-.112*	-.127**	-.163*
	(2.68)	(2.786)	(4.194)	(.067)	(.051)	(.09)
Leverage	7.693	3.491*	3.848	.236***	.216***	.197**
	(5.217)	(1.839)	(3.74)	(.061)	(.05)	(.077)
Tobin's Q	-1.115*	-.516**	-.791	-.036***	-.032***	-.038***
	(.621)	(.202)	(.559)	(.01)	(.009)	(.01)
Current Ratio	.01	-.147	-.068	-.008***	-.009***	-.006***
	(.113)	(.1)	(.113)	(.003)	(.003)	(.002)
5Y Equity Beta	1.557*	.585	.597	.045**	.041*	.012
	(.828)	(.531)	(1.473)	(.019)	(.024)	(.015)
Institutional Own.	-.007*	-.003	Omitted	0***	0**	Omitted
	(.004)	(.003)	-	(0)	(0)	-
Constant	1.742	5.909	11.337	.167***	.157***	.062
	(2.924)	(3.566)	(7.034)	(.045)	(.052)	(.207)
Industry Fixed Effects	No	Yes	No	No	Yes	No
Pair Fixed Effects	No	No	Yes	No	No	Yes
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes
Clustering	Pair	Pair	Pair	Pair	Pair	Pair
Observations	495	495	490	1203	1203	1201
R-squared	.183	.484	.51	.2	.322	.532

Estimates of the baseline specification (Eq. 8) with the parent firm's five-year CDS spread (columns 1 to 3) and probability of default (columns 4 to 6) as the dependent variable, each across pooled OLS, industry and year fixed effects, and pair and year fixed effects.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 9 - Relative Size Moderation

	(1) CDS OLS	(2) CDS IND+YR	(3) CDS PAIR+YR	(4) PD OLS	(5) PD IND+YR	(6) PD PAIR+YR
Post Spin-Off Effect	.015	-.076	-.101	.026***	.021**	.074***
	(.234)	(.191)	(.438)	(.009)	(.01)	(.018)
RelSize	-.217	3.063		-.061	-.074	
	(.981)	(1.934)		(.047)	(.061)	
Post × RelSize	-3.961	-4.122	-4.422	.032	.034	.036
	(4.088)	(3.704)	(5.133)	(.058)	(.057)	(.06)
Firm Size	-.297*	-.494**	-1.366	-.016***	-.016**	-.005
	(.153)	(.22)	(1.143)	(.005)	(.006)	(.022)
Tangibility	.272	.296	.617	-.02	.015	.058
	(.651)	(.656)	(1.743)	(.034)	(.056)	(.077)
ROA	-.899	-2.43	-4.108	-.106	-.123**	-.161*
	(2.868)	(2.825)	(4.099)	(.066)	(.052)	(.089)
Leverage	7.947	3.769*	4.542	.233***	.213***	.195**
	(5.289)	(2.004)	(4.355)	(.061)	(.049)	(.077)
Tobin's Q	-1.158*	-.576**	-.907	-.037***	-.032***	-.038***
	(.652)	(.224)	(.686)	(.01)	(.009)	(.01)
Current Ratio	.032	-.178*	-.111	-.008***	-.009***	-.006***
	(.118)	(.091)	(.101)	(.003)	(.003)	(.002)
5Y Equity Beta	1.446*	.504	.462	.043**	.038*	.012
	(.74)	(.494)	(1.339)	(.018)	(.022)	(.015)
Institutional Own.	-.008*	-.001	Omitted	0***	0**	Omitted
	(.004)	(.003)	-	(0)	(0)	-
Constant	3.146	6.597**	15.657	.18***	.174***	.047
	(2.265)	(3.125)	(10.956)	(.049)	(.057)	(.218)
Industry Fixed Effects	No	Yes	No	No	Yes	No
Pair Fixed Effects	No	No	Yes	No	No	Yes
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes
Clustering	Pair	Pair	Pair	Pair	Pair	Pair
Observations	495	495	490	1203	1203	1201
R-squared	.195	.489	.515	.202	.324	.532

RelSize moderation (Eq. 9), with the mean-centred continuous *RelSize* measure interacted with *Post*. Columns 1 to 3 use the CDS spread and columns 4 to 6 use PD as the dependent variable, across pooled OLS, industry and year fixed effects, and pair and year fixed effects. The *Post* × *RelSize* coefficient is the test of H2. The standalone *RelSize* term is absorbed under pair fixed effects, which retain only the interaction.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 10 - Carbon share moderation

	(1) CDS OLS	(2) CDS IND+YR	(3) CDS PAIR+YR	(4) PD OLS	(5) PD IND+YR	(6) PD PAIR+YR
Post Spin-Off Effect	.205	.162	.223	.025***	.02**	.071***
	(.327)	(.36)	(.212)	(.008)	(.009)	(.017)
CarbonShare	.829	1.668	Omitted	.001	-.017	Omitted
	(.883)	(1.026)	-	(.022)	(.035)	-
Post × CarbonShare	-3.109	-2.488	-2.763	-.039	-.047	-.056
	(2.231)	(1.767)	(2.658)	(.033)	(.037)	(.040)
Firm Size	-.215	-.456*	-1.112	-.015***	-.016***	-.010
	(.159)	(.247)	(.850)	(.004)	(.006)	(.022)
Tangibility	.207	.292	.431	-.021	.011	.056
	(.676)	(.705)	(1.613)	(.034)	(.056)	(.077)
ROA	-.579	-2.837	-4.103	-.114*	-.136**	-.161*
	(2.741)	(2.822)	(4.038)	(.067)	(.053)	(.090)
Leverage	7.986	3.702*	4.451	.237***	.221***	.209***
	(5.301)	(1.904)	(4.132)	(.061)	(.05)	(.079)
Tobin's Q	-1.169*	-.559**	-0.914	-.037***	-.033***	-.040***
	(.645)	(.214)	(.660)	(.01)	(.009)	(.010)
Current Ratio	-.02	-.173*	-.107	-.008***	-.009***	-.006***
	(.106)	(.089)	(.101)	(.003)	(.003)	(.002)
Equity Beta	1.476*	.542	.583	.044**	.038*	.011
	(.778)	(.502)	(1.438)	(.019)	(.023)	(.014)
Institutional Own.	-.008*	-.002	Omitted	0***	0**	Omitted
	(.004)	(.003)	-	(0)	(0)	-
Constant	2.356	6.08*	12.951	.173***	.175***	.096
	(2.592)	(3.504)	(7.904)	(.046)	(.055)	(.212)
Industry Fixed Effects	No	Yes	No	No	Yes	No
Pair Fixed Effects	No	No	Yes	No	No	Yes
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes
Clustering	Pair	Pair	Pair	Pair	Pair	Pair
Observations	495	495	490	1203	1203	1201
R-squared	.193	.487	.514	.202	.325	.534

CarbonShare moderation (Eq. 10), with *CarbonShare* constructed from combined Scope 1 and Scope 2 emissions. Columns 1 to 3 use the CDS spread and columns 4 to 6 use PD as the dependent variable, across pooled OLS, industry and year fixed effects, and pair and year fixed effects. The *Post × CarbonShare* coefficient is the test of H3. The standalone *CarbonShare* term is absorbed under pair fixed effects, which retain only the interaction.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 11 - Event study specification

	(1) CDS	(2) PD
Year -3	Omitted as baseline	Omitted as baseline
	-	-
Year -2	-.226	-.012
	(.245)	(.01)
Year -1	-.008	-.01
	(.309)	(.012)
Year 0	.113	.056***
	(.38)	(.016)
Year +1	.378	.019
	(.592)	(.015)
Year +2	.906	.014
	(1.167)	(.014)
Year +3	.023	.004
	(.515)	(.013)
Controls	Yes	Yes
Industry Fixed Effects	No	No
Pair Fixed Effects	Yes	Yes
Year Fixed Effects	No	No
Clustering	Pair	Pair
Observations	490	1201
R-squared	.486	.501

Event-year coefficients from the event-study specification (Eq. 11) with the CDS spread and PD as the dependent variable, relative to event year −3 as the omitted reference category.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 12. Robustness: Baseline and Carbon Moderation, Event-Year 0 Excluded

	(1) CDS baseline	(2) PD baseline	(3) CDS with CarbonShare	(4) PD with CarbonShare
Post-Spinoff Effect	.722	.033*	.439	.030*
	(.569)	(.017)	(.387)	(.017)
CarbonShare			.000	.000
			(.)	(.)
Post × CarbonShare			-3.312	-.078*
			(3.140)	(.041)
Firm Size	-1.046	-.012	-1.239	-.017
	(.802)	(.023)	(.896)	(.023)
Tangibility	.100	.134*	.897	.140*
	(1.795)	(0.073)	(2.011)	(.074)
ROA	-3.966	-.066	-3.650	-.064
	(4.451)	(.086)	(4.250)	(.085)
Leverage	4.250	0.229***	5.023	.246***
	(4.113)	(0.086)	(4.631)	(.089)
Tobin's Q	-.870	-.038***	-1.012	-.040***
	(.644)	(.010)	(.756)	(.011)
Current Ratio	-.043	-.006***	-.087	-.007***
	(.152)	(.002)	(.127)	(.002)
Equity Beta	.808	.017	.772	.017
	(1.670)	(0.014)	(1.611)	(.014)
Institutional Own.	.000	.000	.000	.000
	(.)	(.)	(.)	(.)
Constant	11.807	.092	13.770*	.137
	(7.306)	(.217)	(8.064)	(.218)
Pair Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Clustering	Pair	Pair	Pair	Pair
Observations	418	1023	418	1023
R-squared	0.497	0.525	0.502	0.529

Restricted to event years -3, -2, -1, +1, +2, and +3; event year 0 is excluded. Standard errors clustered at parent-spin-off pair level. Standalone *CarbonShare* is absorbed in the pair FE columns.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 13A - Robustness: Relative Size Moderation, Subsample Split

	(1) CDS Small RelSize	(2) CDS Large RelSize	(3) PD Small RelSize	(4) PD Large RelSize
Post-Spinoff Effect	.087	.100	.045*	.095***
	(.436)	(.184)	(.023)	(.026)
Firm Size	-5.085	-.558**	-.037	-.004
	(3.679)	(.223)	(.049)	(.019)
Tangibility	-12.298	-1.315**	.330*	-.087
	(9.047)	(.646)	(.167)	(.078)
ROA	2.270	-4.640*	.053	-.318**
	(7.108)	(2.345)	(.124)	(.137)
Leverage	30.710	.181	.291*	.164**
	(19.363)	(.354)	(.169)	(.078)
Tobin's Q	-.769	-.239*	-.035***	-.040**
	(.613)	(.120)	(.013)	(.016)
Current Ratio	.183	-.157*	-.005**	-.010
	(.488)	(.081)	(.002)	(.010)
Equity Beta	2.253	-1.445**	.014	.005
	(1.776)	(0.636)	(.018)	(.021)
Institutional Own.	.000	.000	.000	.000
	(0)	(0)	(0)	(0)
Constant	48.212	9.724***	.244	.105
	(34.293)	(2.497)	(.460)	(.175)
Pair Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Clustering	Pair	Pair	Pair	Pair
Observations	271	219	639	562
R-squared	.587	.764	.639	.422

Estimates of the baseline specification (Eq. 8) estimated separately on parent–spin-off pairs with above-median (Large) and below-median (Small) *RelSize*, for the CDS and PD samples. The *Post Spin-Off* coefficient measures the post-separation change in credit risk within each subsample, providing a non-parametric complement to the continuous *Post* × *RelSize* interaction in Table 9.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 13B. Robustness: Relative Size Moderation, Subsample Split, Event-Year 0 Excluded

Variable	(1) CDS Small RelSize	(2) CDS Large RelSize	(3) PD Small RelSize	(4) PD Large RelSize
Post-Spinoff Effect	0.642	0.158	0.005	0.058**
	(0.899)	(0.367)	(0.025)	(0.026)
Firm Size	-5.332	-0.827**	-0.060	0.000
	(3.686)	(0.358)	(0.051)	(0.018)
Tangibility	-16.158	-1.409	0.433***	-0.008
	(11.823)	(1.045)	(0.155)	(0.069)
ROA	2.575	-4.405	0.099	-0.163
	(8.399)	(2.701)	(0.136)	(0.123)
Leverage	33.142	0.253	0.358**	0.188**
	(20.220)	(0.528)	(0.165)	(0.085)
Tobin's Q	-0.997	-0.307**	-0.032**	-0.043**
	(0.709)	(0.147)	(0.013)	(0.018)
Current Ratio	0.133	-0.176	-0.006**	-0.010
	(0.575)	(0.126)	(0.002)	(0.009)
Equity Beta	2.287	-1.680**	0.019	0.010
	(1.777)	(0.823)	(0.021)	(0.019)
Institutional Own.	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Constant	51.289	12.767***	0.431	0.043
	(34.838)	(4.039)	(0.475)	(0.166)
Pair Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Clustering	Pair	Pair	Pair	Pair
Observations	231	187	543	480
R-squared	0.586	0.751	0.635	0.400

Standard errors in parentheses
Subsamples split at the outcome-specific median of Relative Size measured at t=-1.
Restricted to event years -3, -2, -1, +1, +2, and +3; event year 0 is excluded.
Standard errors clustered at parent-spin-off pair level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14 - Robustness: Joint Specification with both Interactions

	(1) OLS CDS	(2) IND+YR CDS	(3) PAIR+YR CDS	(4) OLS PD	(5) IND+YR PD	(6) PAIR+YR PD
Post Spin-Off Effect	.06	-.05	-.062	.027***	.023**	.075***
	(.244)	(.197)	(.420)	(.01)	(.01)	(.018)
RelSize	-1.199	2.631	.000	-.08	-.083	.000
	(1.137)	(2.012)	(0)	(.05)	(.057)	(0)
Post × RelSize	-1.984	-3.163	-3.059	.08	.091	.100
	(3.396)	(3.426)	(4.335)	(.077)	(.077)	(.080)
CarbonShare	1.298	.569	.000	.027	.01	.000
	(1.045)	(.832)	(0)	(.023)	(.029)	(0)
Post × CarbonShare	-2.632*	-1.274	-1.682	-.067	-.078	-.088
	(1.565)	(.856)	(1.377)	(.045)	(.05)	(.054)
Firm Size	-.297*	-.479**	-1.334	-.016***	-.017***	-.008
	(.151)	(.219)	(1.118)	(.005)	(.006)	(.022)
Tangibility	.224	.316	.710	-.021	.012	.061
	(.661)	(.696)	(1.793)	(.034)	(.055)	(.078)
ROA	-.934	-2.551	-4.059	-.106	-.13**	-.154*
	(2.874)	(2.866)	(4.041)	(.066)	(.052)	(.088)
Leverage	8.07	3.828*	4.696	.235***	.218***	.208**
	(5.317)	(2.012)	(4.410)	(.061)	(.049)	(.080)
Tobin's Q	-1.182*	-.588**	-.946	-.037***	-.033***	-.039***
	(.659)	(.226)	(.705)	(.01)	(.009)	(.010)
Current Ratio	.009	-.187**	-.121	-.008***	-.009***	-.006***
	(.114)	(.092)	(.107)	(.003)	(.003)	(.002)
Equity Beta	1.425*	.497	.495	.043**	.037*	.013
	(.732)	(.486)	(1.342)	(.018)	(.022)	(.014)
Institutional Own.	-.008*	-.001	.000	0***	0**	.000
	(.004)	(.003)	(0)	(0)	(0)	(0)
Constant	3.222	6.449**	15.308	.18***	.179***	.074
	(2.221)	(3.111)	(10.664)	(.049)	(.058)	(.218)
Industry Fixed Effects	No	Yes	No	No	Yes	No
Pair Fixed Effects	No	No	Yes	No	No	Yes
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes
Clustering	Pair	Pair	Pair	Pair	Pair	Pair
Observations	495	495	490	1203	1203	1201
R-squared	.199	.489	.516	.204	.327	.535

Estimates of a combined specification including the *Post* × *RelSize* and *Post* × *CarbonShare* interaction terms simultaneously, testing whether the two moderation channels operate independently given the 0.474 correlation between *RelSize* and *CarbonShare*. Reports six regressions across OLS, industry-and-year fixed effects, and pair-and-year fixed effects for both the CDS and PD samples.

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 15 - Robustness: Scope 1 Emissions Only

	(1)	(2)	(3)	(4)	(5)	(6)
	CDS	CDS	CDS	PD OLS	PD	PD
	OLS	IND+YR	PAIR+YR		IND+YR	PAIR+YR
Post Spin-Off Effect	.278	.232	.347	.025***	.02**	.071***
	(.368)	(.391)	(.247)	(.008)	(.009)	(.017)
CarbonShare	.747	1.286	.000	.006	-.002	.000
	(.854)	(.814)	(0)	(.022)	(.031)	(0)
Post × CarbonShare	-1.842	-1.367	-1.374	-.028	-.041	-.046
	(1.463)	(1.162)	(1.564)	(.03)	(.034)	(.037)
Firm Size	-.206	-.466*	-1.044	-.015***	-.015***	-.008
	(.166)	(.245)	(.821)	(.004)	(.006)	(.022)
Tangibility	.286	.224	.119	-.02	.016	.058
	(.631)	(.656)	(1.531)	(.034)	(.057)	(.077)
ROA	-.33	-2.607	-4.123	-.113*	-.133**	-.163*
	(2.649)	(2.688)	(4.043)	(.067)	(.053)	(.089)
Leverage	7.699	3.527*	3.926	.236***	.216***	.203**
	(5.226)	(1.856)	(3.808)	(.062)	(.05)	(.080)
Tobin's Q	-1.145*	-.545**	-.866	-.037***	-.033***	-.040***
	(.639)	(.209)	(.634)	(.01)	(.009)	(.010)
Current Ratio	-.003	-.165*	-.089	-.008***	-.009***	-.006***
	(.11)	(.088)	(.101)	(.003)	(.003)	(.002)
Equity Beta	1.52*	.568	.590	.045**	.04*	.012
	(.807)	(.521)	(1.461)	(.019)	(.024)	(.015)
Institutional Own.	-.007*	-.003	.000	0***	0**	.000
	(.004)	(.003)	(0)	(0)	(0)	(0)
Constant	2.138	6.16*	12.329	.169***	.166***	.086
	(2.725)	(3.487)	(7.714)	(.046)	(.054)	(.211)
Industry Fixed Effects	No	Yes	No	No	Yes	No
Pair Fixed Effects	No	No	Yes	No	No	Yes
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes
Clustering	Pair	Pair	Pair	Pair	Pair	Pair
Observations	495	495	490	1203	1203	1201
R-squared	.186	.485	.511	.201	.323	.528

CarbonShare moderation (Eq. 10) estimated with *CarbonShare* constructed from Scope 1 emissions only. Columns 1 to 3 use the CDS spread and columns 4 to 6 use PD as the dependent variable, across pooled OLS, industry and year fixed effects, and pair fixed effects. The *Post* × *CarbonShare* coefficient is the test of H3.

Standard errors clustered at the parent–spin-off pair level in parentheses.

**** p<0.01, ** p<0.05, * p<0.1.*