SCHOOL OF ECONOMICS AND MANAGEMENT

LUND UNIVERSITY

Pricing Climate Transition Risk: An Analysis of the Global Syndicated Loans Market

NEKN02 - Master Essay I - Finance Programme

by

Samia Aftab, Vlad Stoicescu

Supervisors

Jens Forssbæck, Najmeh Hajimirza

Abstract

Climate transition risk pricing in capital markets has emerged as a critical area of research. Using a comprehensive dataset of syndicated loans spanning the years 2010 to 2020, combined with greenhouse gas emission and financial data for borrowers and lenders from three different sources, we conduct an extensive cross-sectional regression analysis to assess how greenhouse gas emissions are priced into the syndicated loan market. Our findings reveal that while carbon risk is consistently priced into loan spreads, its economic impact is limited. Lenders predominantly focus on borrowers' Scope 1 emissions intensity and the levels of Scope 1 and 2 emissions, with Lenders' Scope 3 emissions showing no significant effect on loan pricing. Additionally, we observe that the Paris Agreement has exerted a negative, significant, but economically modest influence on loan spreads for high-emitting firms. Furthermore, our analysis indicates that emissions do not have predictive power in determining the likelihood of a loan being sold in the secondary market. These results suggest that while there is recognition of carbon risk in the primary syndicated loan market, its overall influence on loan pricing and secondary market activities remains limited.

Acknowledgements

We thank our supervisors, Jens Forssbæck and Najmeh Hajimirza, and all the teaching staff at Lund University School of Economics and Management. We are also grateful to our fellow students who became friends and to our families.

Contents

List of Figures

List of Tables

1

Introduction

Fossil fuels have powered human life since the late 1700s, resulting in the emission of vast amounts of CO_2 and other heat-trapping gases into the atmosphere (MIT Climate Portal, n.d.). There is an undeniable positive relationship between the concentration of greenhouse gases released by human activities and the rise in global temperature.

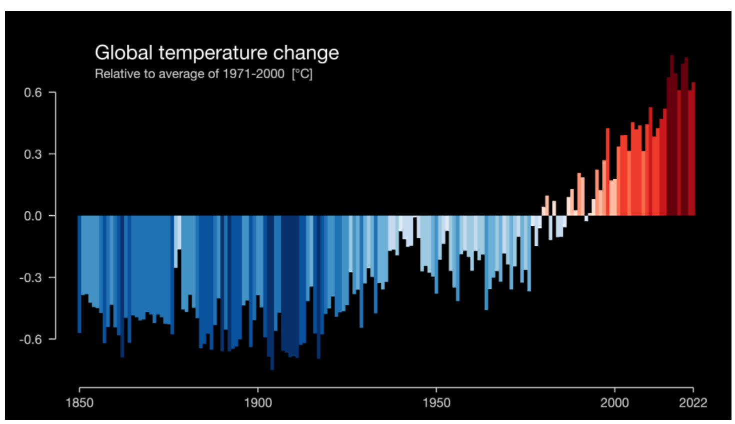

Figure 1.1: This figure shows the global temperature change between 1850 and 2022 relative to the 1971-2000 average.(Hawkins, n.d.)

One major policy event related to the state of climate is represented by the Paris Agreement, an international treaty signed by 195 nations at the UN climate change Conference (COP21) in December 2015. The main objective is to hold "the increase in global average temperature well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels"(UNFCCC, 2015). The Agreement raised climate change awareness and prompted policy actions from the governments worldwide to transition to a greener economy. These actions highlight the need for a better allocation of resources by the financial system for a greener environment. The Paris Agreement is referred to as an event point to measure the changing conditions for credit access to high emission firms in the syndicated loan markets. Previous studies by Degryse et al. (2023), Delis et al. (2024), and Ehlers et al. (2021) found significant evidence of the Paris Agreement as a trigger event for lenders' pricing of carbon risk in the syndicated loan market.

We investigate whether the Paris Agreement led to significant and practically meaningful changes in the pricing of climate transition risk. Our study adds to the ongoing debate on the practical implications of climate policy events on financial markets. These research areas are also of great interest to the regulators who may gain a better understanding of all the implications related to climate mitigation policies. We find significant and negative effects of the Paris Agreement, but the magnitude of the effect is too small to be practically meaningful.

The rising global temperature and climate-related events like the Paris Agreement trigger climate risks to the financial system in the form of physical risk and transition risk. Physical risk arises from drastic changes in climate and weather effects on the economy (BIS, 2021). The climate transition risks arise due to the instability induced by the climate change mitigation policies, technological developments and changing preferences and sentiments of investors and consumers. (Semieniuk et al., 2020; Chenet, 2021) Although the two types of risks — physical risk and transition risk — are interconnected, in this study, we focus mostly on lenders' perception of climate transition risk and on how this risk is incorporated into the lenders' pricing policy in the syndicated loans markets.

We consider greenhouse gas emissions to be a proxy for the transition risk as firms with high emission levels face more instability and will be adversely (and more severely) affected by the policy changes, such as higher carbon taxes, cap-and-trade programs as indicated by Ivanov et al. (2023) and stranded assets according to Delis et al. (2024). High emitters will not be preferred for credit by environmentally conscious lenders as Degryse et al. (2023) finds, and will face more competition from greener alternatives resulting from technological advances. In this study, we will consider carbon pricing as the premium charged by investors to compensate for the risk arising from high levels of emissions. Transition risk, climate transition risk, and carbon risk are used interchangeably.

Carbon pricing is studied extensively in the literature for the equity market (Loyson et al., 2023; Bolton and Kacperczyk, 2021), for the option market (Ilhan et al., 2020), and for the credit market (Chava, 2014). We contribute to the existing literature by analysing the consistency of carbon risk pricing in the syndicated loan market. Our findings show a persistent premium charged by lenders' for high carbon emissions. However, due to low magnitude the premium has limited practical implications.

A firm's emissions can be classified into three categories: emissions from directly controlled resources and operations (Scope 1), indirect emissions from electricity generation (Scope 2), and emissions generated upstream and downstream in the supply chain (Scope 3). The financial impact of climate risk on a borrowing firm is not limited to direct emissions (Scope 1); it can also affect firms through higher electricity costs (Scope 2) and increased input prices (Scope 3). The existing literature on various scope of emissions is inconclusive. Bolton and Kacperczyk (2021) found evidence for pricing for all emission levels but against the pricing of emission intensity for all scopes whereas Ehlers et al. (2021) found evidence of the Paris Agreement triggering pricing of Scope 1 and 2 emissions. Ho and Wong (2022) found lack a of evidence for Scope 2 emissions intensity pricing in spread. Given these varied findings, our research aims to fill the gap by analysing the pricing impact of different scopes of emission levels and intensities in the syndicated loan market. Our results show limited pricing of carbon intensity for Scope 1 by lenders whereas Scope 1 and 2 emission levels are priced.

For a lender, Scope 3 downstream emissions, specifically generated through investment, are considered more relevant (MSCI, n.d.). We propose that for lenders, a higher existing exposure to Scope 3 emissions may expose them to a high transition risk and may further deter them from providing additional credit to high-emitting borrowers. The existing literature suggests that lenders' behaviour towards emissions can be proxied by their "green status," such as being signatories of the Equator Principles or the United Nations Environmental Programme - Financial Initiative (UNEP FI) (Ho and Wong, 2022). In our study, we propose a new approach to estimate lender behaviour based on existing Scope 3 emissions and their impact on carbon pricing in the syndicated loan market. We don't find any significant evidence of lenders' Scope 3 relationship with the spread charged to borrowers.

Previous studies by Ehlers et al. (2021) and Kleimeier and Viehs (2016), examine climate transition risk in the primary market for syndicated loans. However, the impact of carbon emissions on the secondary market sale loans remains largely underexplored. We hypothesise that higher carbon risk from high-emission firms will drive lenders to sell off loans made to these borrowers in the secondary market, especially following the Paris Agreement. Thus, high emitters will have a high probability of their loans being sold. By examining this aspect, we provide a comprehensive understanding of the carbon risk management across different segments of the syndicated loan market. Our findings don't find any significance of any scope of emission intensity in the likelihood of loan being sold in the secondary market.

To address the stated research questions, we employ a combination of quantitative analyses, including ordinary least squares, logit, and linear probability model on a comprehensive data set on loan features from London Stock Exchange Group Loan Pricing Corporation (LPC) DealScan - referred to as DealScan, borrowers' and lenders' financial variables from Standard and Poor's Capital IQ - referred to as Capital IQ, and borrowers' and lenders' emissions data from London Stock Exchange Group Eikon - referred to as Eikon. Our analysis will explore the impact of carbon emissions in both primary and tangentially in the secondary syndicated loan markets.

This study contributes to the growing body of literature on climate risk in financial markets by providing new insights into the pricing of carbon risk in the syndicated loan market. The findings are of interest to relevant regulators seeking to understand the financial implications of climate mitigation policies and to lenders aiming to manage climate risk in their portfolios.

The following sections are organised as follows: Section 2 covers background theory, literature review, and hypothesis building. Section 3 details the data and methodology. Section 4 presents the main findings and implications. Section 5 provides the conclusion and potential areas for further study.

2

Theory

In this section, we cover a selection of recent research developments in the area of climate transition risk pricing in the syndicated loan markets. We start with a brief description of certain concepts related to loan syndications and policy events in the context of transition risk, and continue with a more in-depth analysis of the literature that forms the basis of our research questions.

2.1 Syndicated Loans and Syndicated Loan Markets

Syndications allow multiple lenders to pool together resources to finance very large individual borrower projects that are too big for a single financial institution, may require specific lender expertise in a particular asset class or simply do not fit into a single lender's risk tolerance profile, for example due to excessive concentration risk.

Negotiation of pricing terms and conditions are the lead arranger's responsibility, and they apply to all lenders in the syndicate, potentially with the exception of collateral, where individual lenders may impose different requirements. This makes the lead arranger a very important agent.

Syndicated loans are originated in the primary market, where issuers and investors meet to price and structure the loan product. The secondary market enables investors to sell their shares of the syndicated loan and offers the possibility of trading them.

The syndicated loan market represents a great context to study lenders' perception and pricing of climate risk in the credit market. Firstly, syndicated loans represent very significant exposures for lenders in terms of size and maturity (e.g., in the case of term loans). Lead arrangers are responsible for the pricing and monitoring of all risks on behalf of all the lenders in the syndicate and bear a significant reputational risk. We argue that all types of risks, including climate transition risk, must be carefully priced by the lead arranger.

Secondly, the availability of data with high levels of granularity about loan, borrower, and lender characteristics through DealScan, the most extensive syndicated loan database, makes it possible to isolate the effect of emissions on loan pricing after controlling for the most important factors. When it comes to regular lending activity, the granular level of data is less publicly available, so we argue that lenders' preferences in syndicated loan markets can potentially be extrapolated into their overall loan portfolios, expanding the practical applicability of our study. Regarding carbon pricing in bank loans, Reghezza et al. (2021) found that European banks reallocated capital away from higher polluting firms after the Paris Agreement.

2.2 Policy Events and Transition Risk

The goal of the Paris Agreement is to limit the global temperature increase over the pre-industrial average to well below 2 degrees Celsius, with a target of below 1.5 degrees Celsius. To achieve this goal, drastic policy changes need to be made, and efficient resource allocation is required. According to the Paris Agreement Art. 2 (c), finance flows need to be made “consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.” The Agreement and, more recently, the COP28 Climate Summit have the potential to bring large-scale policy changes.

It is, of course, preferable to have a gradual implementation of climate change policy adjustments to achieve the Paris Agreement goals. This would allow companies to adapt their processes efficiently with lower market disruptions.

However, the EU Climate Change monitoring service announced on the 7th of May 2024 that April 2024 was another addition to a streak of global temperature records, stating that the 12-month (May 2023 - April 2024) average temperature is already +1.61 degrees Celsius above the pre-industrial average. (climate.copernicus.eu, n.d.)

This suggests that the initial target of keeping the global temperature increase below +1.5 degrees Celsius over the pre-industrial average already seems less reasonable, and probably only the target of +2 degrees Celsius is reachable now. Connected to this, a “gradual” climate transition becomes less likely, as well as with higher temperatures, the physical risks increase too, calling for a faster implementation of climate change mitigation policies. Whole industries can be disrupted because of such policy changes. In the banking sector, the credit risk of loan portfolios can be affected because of changes in borrowers’ expected valuations due to the transition risk.

It can be argued that the banking system represents a very important part of the financial system to channel financial flows. Indeed, this is the case especially in the emerging economies (Shleifer and Vishny, 1997), while our empirical study is mainly based on data from Western Europe and the United States of America. However, more often than not, the emerging economies follow the “western” developments in terms of regulation as well. Apart from relying more on the banking system as it is more important for their financial system, these economies are also more dependent on fossil fuels and in a more incipient stage of climate transition. That said, companies in these economies could be more affected by sharp change in climate change regulation in terms of pricing or funding may even dry up. The public awareness may also accelerate the transition pressures.

2.3 Literature Review and Research Questions Formulation

The significance of pricing of climate risk in both its forms - physical and transition - is increasingly gaining traction in the literature. Hong et al. (2019) found an "underreaction" to climate change risks i.e., physical risks incurred e.g., droughts, in a study of publicly traded food equities from thirty-one countries.

In existing literature, higher greenhouse gas emissions are used as a proxy for climate risk, given that firms with higher emissions face more instability due to transition risk, which takes the form of changes in policies, technology and preferences. The higher level of greenhouse gas emissions translates into a deterioration in credit quality and lower future cash flows.

The pricing of carbon risk in the global equity market is inconclusive. Loyson et al. (2023) found that "carbon intensity" has a negative effect on stock returns in the European equity markets whereas Bolton and Kacperczyk (2021) found a carbon premium in the US equity market. Regarding the carbon risk pricing in the option market Ilhan et al. (2020) demonstrated that protection against downside risk is priced higher for carbon intensive borrowers especially during periods of climate related public awareness.

A specific perspective on climate risk extensively covered in the literature over the past decade is the concept of "stranded assets" in the fossil fuel industry (Ansar et al., 2013), a term defining asset elements subject to unanticipated or premature loss in value, caused by deep, transformational changes. In the credit market, Chava (2014) found lenders charged higher rates on bank loans and had lower participation in syndication to the borrowers with environmental concerns. Capasso et al. (2020) shows that distance to default is influenced negatively by firms' carbon emissions and carbon intensity so polluting firms have higher probability to default. Our first research question is whether the risk premium charged by lenders for borrowers with higher climate risk in the syndicated loan market is consistently present over time. The evidence in the literature is inconclusive, as Kleimeier and Viehs (2016) found that the carbon premium is always available whereas Ehlers et al. (2021) concluded that carbon premium is not present independent of the Paris Agreement.

Our second research question regards the influence of the major environmental policy event, the Paris Agreement, on carbon pricing in the syndicated loan market. The Paris Agreement represents a potential trigger event for widespread and drastic policy changes leading to the pricing of climate transition risk in capital markets. Degryse et al. (2023) and Ehlers et al. (2021) found that the Paris Agreement marks the beginning of lenders imposing higher charges on borrowers with poor environmental performance. We aim to determine whether the Agreement has led to a significant and practically meaningful change in the pricing of climate transition risk. We explore whether the magnitude of carbon pricing post-Paris Agreement is substantial enough to impact financial decisions in the market.

Our third research question is concerned with assesing how lenders price the carbon risk arising from various emission scopes. The financial impact of climate risk to the firm isn't just dependent on the emissions generated from resources directly controlled by it i.e., Scope 1 emissions. Climate mitigation policies can influence a firm's operations via higher cost of electricity consumption (Scope 2 emissions) and through higher price of inputs along the supply chain (Scope 3 emissions). The literature on carbon pricing at various scope levels is mixed as Bolton and Kacperczyk (2021) found positive and statistically significant returns for all three levels of emission scopes in the US-equity markets whereas emission intensity of all categories have no significant relationship with returns. In contrast, Ehlers et al. (2021) showed that only Scope 1 and Scope 2 emission intensity is priced by lenders in the syndicated loan market after the Paris Agreement. Ho and Wong (2022) showed that even if Scope 2 emission intensity isn't priced via higher spread, banks still have stringent requirements in terms of longer maturity and collateral requirements for brown firms with higher "Scope 2" emission intensity in emerging markets syndicated loans after the Paris Agreement. Therefore, we aim to fulfil the research gap with pricing impact of various scopes of emission levels and intensity.

Our forth research question relates to capturing the impact of indirect emissions attributed to lenders by considering specifically the Scope 3 indirect emissions generated upstream and downstream of the supply chain. According to MSCI (n.d.), for financial firms, Scope 3 emissions generated through investment activities are the most relevant. We propose that for lenders, higher existing exposure of Scope 3 emission can act as a deterrence to provide additional credit to high emitting borrowers. As lenders' existing holdings will be negatively affected by transition risk it will seek appropriate compensation for any additional credit provided. According to Ho and Wong (2022) and Delis et al. (2024), lenders' behaviour towards emissions is proxied by the"green status" as if they are signatories of Equator Principles or the United Nations Environmental Programme- Financial Initiative (UNEP FI). We propose to estimate lead arrangers behaviour by their existing stock of Scope 3 emissions arising mostly from investments.

In the fifth research question we proposed that higher climate risk from high emission firms will compel lenders to offload loans granted to high emitting borrowers from their holdings after the Paris Agreement. That means a firm with high emissions will incur a high probability of its loan being traded in the secondary market. In current literature, Ehlers et al. (2021) and Kleimeier and Viehs (2016) studied climate transition risk driven by the changing preferences of lenders in the pricing in the primary market of syndicated loans. Our secondary market research question will be able to fill this research gap.

3

Data and Methodology

The novelty of our approach is represented, in part, by the integration of three distinct data sources: London Stock Exchange Group Loan Pricing Corporation (LPC) DealScan - referred to as DealScan, Standard and Poor's Capital IQ - referred to as Capital IQ, and London Stock Exchange Group Eikon - referred to as Eikon. From these sources, we retrieve features related to the syndicated loans together with financial and greenhouse gas emission data for lenders and borrowers.

In our methodological approach, we first conduct a cross-sectional regression analysis, after carefully controlling for different variables, aiming to emphasise lenders' integration of climate transition risk into syndicated loan pricing. Second, we develop a Logit model and linear probability model to assess the relationship between the climate transition risk measures and the probability of syndicated loan sales.

3.1 Data

3.1.1 Syndicated Loan Data

We start with a comprehensive DealScan dataset focused on syndicated loan data in the primary market, covering the years 2010 to 2020. The selected timeframe aims to exclude the post-2007-2008 financial crisis years and centres the analysis around the Paris Agreement date.

The data is organised into deals, each involving one borrower with multiple lenders. Each deal is composed of multiple tranches, also known as facilities. For our dataset we have on average 1.6 tranches for each deal. In this study, each tranche is considered to be an observation. The tranches correspond to a particular type of loan contract, for example a term loan or a credit line and have various features such as activation date, maturity, amount and so on. We group tranches into three categories - credit lines, term loans, and others - based on their type, following the classification proposed by Berg et al. (2016).

Each tranche has a corresponding all-in spread drawn, calculated as the amount the borrower pays in basis points for each dollar drawn down, which is used as a dependent variable. The all-in spread drawn also includes any annual or facility fee paid to the bank group (loanconnector, n.d.). All the observations that lack a value for all-in spread drawn are excluded from the dataset. To control for the effect of outliers, we use winsorization with 1% and 99% limits on the dependent variable.

We also control for loan size, rating, call feature, currency, country of syndication, major industry group, borrower region, collateral (secured), base rate (reference rate) and covenants. Our loan dataset exhibits variation across a range of variables. The table below illustrates how our key variables differ across major industrial groups emphasising the importance of controlling our data across various dimensions.

Industry group	All In Spread Drawn (bps)		Rating	Maturity	Tranche Amount	Carbon Intensity	
	Mean	Std	Mean	Mean	(USD million) Mean	Mean	Obs
Aerospace and Defense	152	127	13	41	2028	45.52	67
Agriculture	161	167	15	33	3097	74.09	20
Automotive	208	152	12	54	919	75.36	159
Beverage, Food, and Tobacco Processing	150	113	13	45	1803	95.85	220
Broadcasting	347	169	7	59	701	35.42	40
Business Services	270	174	11	56	423	89.13	141
Chemicals, Plastics & Rubber	206	144	10	56	799	417.7	265
Construction	248	150	10	48	679	1033.10	162
Financial Services	134	65	10	33	628	139.26	507
General Manufacturing	177	122	10	55	817	519.52	420
Healthcare	160	125	13	41	2516	37.04	295
Hotel & Gaming	298	212	9	63	994	193.21	73
Leisure and Entertainment	328	180	8	57	1342	53.11	80
Media	156	126	10	46	1054	12.47	32
Mining	249	164	11	48	1453	1619.48	172
Oil and Gas	197	125	11	52	1241	539.46	386
Paper & Packaging	184	93	11	58	673	428.52	74
REITS	145	67	12	49	615	133.59	176
Real Estate	248	128	11	53	441	66.88	101
Restaurants	249	120	10	54	747	96.29	35
Retail & Supermarkets	195	174	10	46	1191	45.04	213
Services	227	162	11	52	548	83.87	109
Shipping	174	127	13	70	950	1054.34	61
Technology	206	166	9	52	1083	62.6	367
Telecommunications	212	155	11	56	2280	65.95	151
Textiles and Apparel	191	96	12	55	559	100.25	52
Transportation	222	152	11	60	628	648.69	148
Utilities	166	116	12	50	1046	2806.01	456
Wholesale	218	189	11	53	780	207.94	151
All	195	143	11	50	1080	533	5144

Table 3.1: Industry Group Data Summary

Borrower ratings are considered at the close of the deal, accounting for only three rating agencies: S&P, Moody's, and Fitch. If these ratings are not available (data on this field is scarce), we consider the long-term issuer rating from these same agencies. The ratings are converted to numerical values, with AAA assigned a value of 20 and D assigned a value of 0, following Yıldırım et al. (2021).

3.1.2 Emission data

Key features of syndicated loans, such as pricing terms, syndicate structure, and participants, are generally negotiated at the deal level (?). Therefore, we assume that the lender will have reviewed the emissions data reported for the year prior to the minimum of each deal activation date. The emission data was retrieved from Eikon for each borrower and lender over a period starting from 2002 to 2020, covering multiple emissions measures for borrowers and only Scope 3 emissions for lenders.

On a broader level, emissions are generally reported as greenhouse gas emissions and carbon dioxide (CO2) equivalent emissions. Greenhouse gas emissions (GHG) are a combined measure of all the gases that contribute to the greenhouse effect by absorbing infrared radiation. The different greenhouse gas emissions are combined into a single metric, "CO2 Equivalent Emissions," to represent the amount of CO2 that would have a similar environmental impact . Our data only includes emissions intensity for CO2 equivalent.

Our main variable of interest, the emission, is used in two forms: firstly, as total CO2 equivalent emissions in megatonnes, representing the total annual carbon footprint of the firm; and secondly, as emissions intensity, measured as emissions in tonnes per USD million in revenue.

For two firms with the same level of total emissions, a firm with a higher level of emissions intensity will be more affected by, for example, a potential tax of $100 per CO2 tonne implemented through a climate mitigation policy, resulting in a greater impact on its revenue margin Ehlers et al. (2021)

The Greenhouse Gas Protocol classifies emissions into three scopes defined as below.

Scope 1 represents direct emissions occurring from resources a company owns or controls. An example can be the emissions resulting from burning fossil fuels in order to operate company cars or power a boiler to heat an office building.

Scope 2 emissions are indirect as they are generated from the purchased electricity, steam, heating or cooling activities. Even if these emissions are taking place at a remote location, the company is still responsible for them.

Scope 3 emissions are generated from all other indirect activities and are a consequence of the company's operations. However, they are connected to resources not owned or controlled by the company, for example fossil fuels burnt by employees who drive their cars to work fall under this category. Emissions embedded in the production of raw materials (upstream) and emissions resulting from using the final product of a company (downstream) are also part of Scope 3. For lenders we consider Scope 3 emissions to account for the emissions generated due to their investment activities.

In this study, we use different emission measures provided by Eikon with definitions provided in detail in Appendix B. The estimated emission variables we use are gathered from Eikon, which uses a data framework model organised into four pillars - reported data, CO2 model, energy model, and median model. This framework the growing need for carbon data amid limited CO2 emissions reporting, where each model sequentially provides an estimated value if a reported value is unavailable. (London Stock Exchange Group, n.d.)

3.1.3 Borrowers' and Lenders' Financial Data

Due to the importance of loan terms decided at deal initiation date (Ivashina, 2005), borrowers' and lenders' financial data is obtained from Capital IQ one year prior to the deal close date. For borrowers, data is obtained for total assets, return on assets (ROA), and debt to capital ratio. We use the natural logarithm of total assets in our subsequent analysis.

In the case of lenders, we focus only on the lead arrangers - who are responsible for negotiating pricing terms and loan monitoring. According to Ivashina (2005) , lead arrangers are defined firstly as lenders who act as administrative agents, conducting due diligence, loan monitoring, and payment handling. Secondly, lenders who are designated as agent, bookrunner, lead arranger, lead bank, lead manager, or arranger are also defined as lead arrangers. For lender financial variables, we use the average of the financials—return on assets, capital ratio, and total assets—of the lead arranger available for each tranche.

Finally, we combine the data from all three sources into a final dataset. First, to gather financial data for borrowers and lenders we connect the initial DealScan dataset to Capital IQ using the updated version of a matching table compiled by Forssbaeck et al. (2023). We drop the observations where the matching is not possible. Second, using borrowers' and lenders' ISIN (International Security Identification Number) codes we connect the Capital IQ dataset to Eikon to gather emission data, once again dropping the observations where the matching is not possible. The process of dropping observations at different stages could introduce selection bias in the final data set as there are systematic differences between the dropped observations and those included in the final dataset. For example, if certain types of borrowers or lenders are more likely to have missing emission data, the sample may not be representative of the entire population.

Variable	Minimum	Maximum	Standard Deviation	Number of Observations	Mean
Tenor/Maturity (month)	1	725	28	24,098	53
All-In Spread Drawn (bps)	1	1800	169	24,370	247
Tranche Amount Converted USD million	−100	49,000	1295	24,369	552
Borrower's Debt to Capital Ratio	0	30,074	200	23,564	43
Borrower's Return on Assets	−72	106	5	23,623	3
Borrower's Revenue	−10,072	421,105	21,537	23,623	7030
Borrower's Ln Total Assets (natural logarithm)	−11	15	2	21,564	8
Borrower's Revenue (estimated)	1	451,509	39,076	5137	21,669
Borrower's Rating	1	21	5	13,701	9
Lender's Average Return on Assets	−5.3150	17	0	20,029	0
Lender's Average Total Revenue	−2066.9236	78,134	15,814	20,029	18,753
Lender's Average Ln Total Assets (natural logarithm)	5.8059	15	1	20,005	14
Lender's Average Capital Ratio	1.2055	831	9	20,029	12
Total Borrower's Carbon Emission Level	10.0000	240,392,441	22,378,901	5151	7,544,095
Borrower's Carbon Emission Level Scope 1	1.5400	240,369,173	21,054,876	4533	6,570,568
Borrower's Carbon Emission Level Scope 2	5.0000	30,626,090	2,222,921	4417	955,510
Borrower's Carbon Emission Level Scope 3	0.0320	1,591,000,000	102,292,027	2790	20,301,780
Total Borrower's Carbon Emission Level (Estimated)	10.0000	272,151,000	17,808,524	9581	4,591,774
Borrower's Carbon Intensity Scope 1	0.0001	52,150	1659	4500	418
Borrower's Carbon Intensity Scope 2	0.0023	4240	172	4389	69
Borrower's Carbon Intensity Scope 3	0.0000	49,212	2811	2769	606
Total Borrower's Carbon Intensity Level (Estimated)	0.0046	52,150	1796	5137	534
Total Borrower's Carbon Intensity Level	0.0046	52,150	1795	5144	533

Table 3.2: Statistical Data Summary

3.2 Methodology

For the research question one, where we test the existence of a carbon premium independent of the Paris Agreement, we follow the methodologies developed by Ehlers et al. (2021) and Ho and Wong (2022). The setup of the models is presented below.

$$\begin{aligned}
\text{All-in-drawn-spread}_{b,l,f,t} = {} & \alpha\,\text{Emissions}_{b,t-1} + X_{f,t,b,l} \\
& + \text{Lender Financial Variables}_{l,t-1} \\
& + \text{Borrower Financial Variables}_{b,t-1} \\
& + D_{t,l,b,f}
\end{aligned} \tag{3.1}$$

In Equation 3.1, the subscript "f" denotes an observation (tranche/facility) and subscripts "t", "b" and "l" represent time , borrower and lender respectively.

X is a vector of continuous and discrete loan/borrower variables.

D is a vector dummy variables for loan/borrower variables .

"Emissions" represents intensity and level of CO2 equivalent emissions for the borrower one year prior to the deal origination date. (e.g. for a deal that originated in 2010, the emission intensity variable for the borrower is for the year 2009).

For research question two, we employ the ordinary least square regression model to measure the effect of the Paris Agreement in the pricing of emission variables in the syndicated loan market. The methodology we follow at this step draws mainly on the empirical setting proposed by Ehlers et al. (2021).

$$\begin{aligned}
\text{All-in-drawn-spread}_{b,l,f,t} = {} & \alpha\,\text{Emissions}_{b,t-1} \\
& + \beta\,\text{Emissions Intensity}_{b,t-1} \times \text{Paris} \\
& + X_{f,t,b,l} \\
& + \text{Lender Financial Variables}_{l,t-1} \\
& + \text{Borrower Financial Variables}_{b,t-1} \\
& + D_{t,l,b,f}
\end{aligned} \tag{3.2}$$

"Paris" is a dummy variable with value equal to 1 for year 2016 onwards and captures the effect of the Paris Agreement signed in December 2015.

For the Paris Agreement to have a significant impact in the pricing of syndicated loans the sum of parameters $\alpha \quad and \quad \beta$ must be greater than zero. i.e, $\alpha + \beta > 0$. For research questions 3 and 4 related to the impact of various scopes of emission and intensity on the carbon premium, we used the equation 3.3 proposed by Kleimeier and Viehs (2016).

$$
\begin{aligned}
\text{All-in-drawn-spread}_{b,l,f,t} = & \ \alpha \, \text{Emissions}_{b,l,t-1} \\
& + X_{f,t,b,l} \\
& + \text{Lender Financial Variables}_{l,t-1} \\
& + \text{Borrower Financial Variables}_{b,t-1} \\
& + D_{t,l,b,f}
\end{aligned}
\tag{3.3}
$$

The fifth research question is concerned with understanding if the climate transition risk may be a driver for selling a syndicated loan. We consider the loan to be sold if it can be found to be trading in the secondary market. We follow the empirical approach of Fard et al. (2020) which is also employed by Ho and Wong (2022) to analyse another binary outcome potentially connected to the transition risk, namely if banks are more prone to impose collateral for "brown" firms.

$$
\begin{aligned}
\text{Secondary Market}_{f,t} = & \ \alpha \, \text{Emissions Intensity}_{b,t-1} \\
& + \beta \, \text{Emissions Intensity}_{b,t-1} \times \text{Paris} \\
& + \text{Loan Control Variables}_{f,t} \\
& + \text{Lender Financial Variables}_{l,t-1} \\
& + \text{Borrower Financial Variables}_{b,t-1}
\end{aligned}
\tag{3.4}
$$

In Equation 3.4, "Secondary Market" is a binary variable taking the value 1 if the tranche has a loan identification number (LIN) that is o code matching a tranche to a secondary price.

4

Results

By regressing all-in drawn-spread on reported versus estimated total emission levels to estimate Equation 3.1, the results in columns (1) and (3) of Table A.1 indicate that emissions are priced independently of the Paris Agreement. Our results are consistent with Kleimeier and Viehs (2016) showing that carbon pricing is consistently present in syndicated loan markets. However, despite the significance of carbon pricing, the magnitude is very small. For example, if the emissions of a firm increase from zero to the mean reported CO2 emissions of 7.5 megatonnes, the average spread will increase by 1.29 bps, assuming all factors remain constant.

As described in the data section, LSEG Eikon employs various methodologies to estimate CO2 emissions for companies that do not report them. The number of observations almost doubles if we consider the estimated emissions; however the coefficient and significance of the "Paris" interaction term and total emissions remains the same for reported and estimated emission levels as shown in column (2) and (4). These results are consistent with findings of Ehlers et al. (2021) who found no difference between reported and partially estimated emission measures retrieved from S&P Global Trucost database.

Columns (2) and (4) present the effect of the Paris Agreement on spreads (Equation 3.2) in relation to our research question examining the effect of policy events on carbon pricing. The combined post Paris Agreement effects of emissions for reporting companies as shown in column (2) is negative (coefficient of -0.056 bp) implying that for an average firm with a 7.5 megatonne emissions level, the spread decreases by 0.42 basis points. The effect is statistically significant but practically not meaningful as it is close to zero. The emissions for non reporting companies yield an even lower decrease of 0.38 basis points combined post-Paris Agreement effect.

The control variables for lenders and borrowers further substantiate the robustness of our findings. Borrower's debt to capital ratio representing existing leverage has a significant positive relationship with spread. Borrowers' return on assets showing its profitability and efficiency show a negative and significant relationship with the spread. Total assets of the borrower have a significant and negative relationship with spread to show a firm with more diversified operations, greater stock of resources and strong financial position will have high credit worthiness and thus lower spread.

Lead arranger return on asset and total asset are negatively related to the loan spread, showing that highly efficient and large lenders can offer competitive pricing strategies to attract high quality borrowers.

The results are repeated when we conduct the analysis using emission intensity variables (equation 3.1 and 3.2) and are shown in Table A.2. The emission intensity results presented in column (1) and (3) show the presence of carbon pricing independent of the Paris Agreement as also found by Kleimeier and Viehs (2016). However, these results contrast with the findings of Ehlers et al. (2021) that carbon risk is not priced independent of the Paris Agreement for a sample of 1.107 observations covering the years 2006-2018.

The Paris Agreement effect on spreads is negative in magnitude and statistically significant as shown in columns (2) and (4) (Equation (3.2)). However, due to small magnitude, the effect is not practically meaningful. Ehlers et al. (2021) found that post Paris Agreement combined results lead to a positive and significant impact, in carbon emission pricing in contradiction with our findings.

The results in Table A.3 show how borrowers' Scope 1, 2 and 3 emission intensity and lenders' Scope 3 emission intensity are priced in the syndicated loan market (Equation 3.3).

The results in columns (1), (2) and (3) show how each emission level is priced by lenders without adjusting for other scope. These results are similar to the findings of Kleimeier and Viehs (2016) as they found only Scope 1 emission intensity is priced in the syndicated loan market while Scope 2 intensity does not have significant results. Therefore, if the Scope 1 emission intensity of a firm increases by 1 standard deviation the standard deviation of spread will increase by 3%, keeping everything else constant. These results show limited practical implications of Scope 1 intensity carbon pricing in the syndicated loan market.

When we consider the partial effect of each scope intensity after adjusting for the level of other scope intensities - results presented in column (4) - only Scope 1 emission remains significant. These results only partially match those of Ehlers et al. (2021) as they found both Scope 1 and Scope 2 intensities to be significant and positive after the Paris Agreement. However, the dataset compiled by Ehlers et al. (2021) only comprises around 1000 observations. The same results are also supported by Ho and Wong (2022) who did not find significant evidence of Scope 2 pricing in the emerging market loans.

In Column (5) we show that lenders' Scope 3 emissions are not significant at 10% p-value in carbon pricing. However, the negative sign shows that the group of syndicated banks with high levels of Scope 3 emissions charge a lower rate to high emitting firms. This indicates some level of acceptance when providing the credit to high pollution emitters. However, due to the limited availability of data for Scope 3 emissions, these results should be interpreted with some caution.

The results in table A.4 show how borrowers' emission Scope 1,2 and 3 levels and lenders' Scope 3 emission levels are priced in the syndicated loan market using equation 3. The result from Column (1), (2) and (3) shows that each emission Scope is individually added to regression without considering the effects of other Scopes. Only borrowers' Scope 1 emissions are significant when considered in isolation. The column (4) shows the borrower emission level Scopes 1 and 2 are significant as partially matched by the results of Bolton and Kacperczyk (2021) who found statistically significant returns for all three levels of scopes of emission in the US equity market.

In column (5) we show the results considering the lender average Scope 3 emissions that mostly consist of indirect emissions from the investments holdings. The results show that the average level of lenders' Scope 3 emissions has no significant relationship with the carbon pricing in the syndicated loan market.

As shown in the results, even though Scope 1 emissions are statistically significant in most cases, the practical implications are limited. For example, as shown in column (1), for a firm with 1 mega tonnes of Scope 1 emissions level increase will translate into a 0.25 bps spread increase keeping everything else constant. For an average firm with 6.5 megatonnes it will have a spread of 1.34 bps. So for a firm with 1 standard deviation increase in Scope 1 emissions, the spread's standard division will increase by 2.56%. The Scope 2 emission level has a negative and significant relationship with the spread as shown in column (4). Because Scope 2 emissions are defined as indirect emissions generated at remote locations due to purchased electricity, these emissions can be outsourced to geographical areas with more relaxed emission policies according to Ben-David et al. (2021).

To answer the fifth research question, we test that carbon emissions are significant to the secondary market sale of the syndicated loans as referred in equation 3.4. The logit model as presented in the table A.5 analyses the relationship between carbon intensity variables (Scope1, 2 and 3) and likelihood of syndicated loans being traded in the secondary market. However, none of the emission variables showed any statistical significance for the likelihood of secondary market sale in isolation or when interacting with the Paris Agreement.

The higher borrower debt to capital ratio is positive and significantly related to secondary market sale, likely due to higher risk perceived from the highly leveraged borrower. Similarly, large borrower size is positively and somewhat significantly related to secondary market sale as large firm loans have high liquidity. The larger lender size shows a positive and significant relationship implying that larger lenders are more active in the secondary market. The capital ratio of lenders is negative, showing that well capitalised lenders have greater ability to retain risky loans till maturity.

To check the robustness of the model we regressed the same model with a linear probability model as presented in table A.6. The results remain consistent as none of the carbon intensity variables show a significant relationship with likelihood of secondary market sale of syndicated loans; however borrower leverage, size and lenders' capitalization play a significant role in determining the loan sales.

5

Conclusion and Future Research

5.1 Conclusion

This study aimed to investigate the pricing of transition risk in the syndicated loan market. Our findings indicate that carbon risk is consistently priced; however, its impact is economically limited. Lenders exhibit a narrow focus on emission scopes, primarily pricing only Scope 1 emissions intensity and Scope 1 and 2 emission levels. Lender Scope 3 emissions have no significance in loan pricing. We also found that the Paris Agreement has had a negative, significant but economically small impact on loan spreads for high-emitting firms. Additionally, emissions do not have any explanatory power in determining the likelihood of a loan being sold in the secondary market. These results contribute to the literature by providing empirical evidence of transition risk pricing in the syndicated loan market. The study highlights the implications of transition risk in loan pricing and its integration into financial decision-making.

5.2 Further Research

Future research could employ a difference-in-differences approach to compare pre- and post-Paris Agreement periods. This would help ensure that the underlying characteristics of borrowers remain consistent across both datasets, providing a clearer understanding of the Paris Agreement's impact on loan pricing.

While this study explored the role of emissions in the likelihood of loans being sold in the secondary market, further research should investigate how emissions impact the pricing of loans in the secondary market. Understanding whether high-emission loans are priced differently once they are traded could offer deeper insights into lenders' risk management practices.

Conducting a comparative study of emission data from various vendors could help identify any variations in significance due to differences in data sources. This could enhance the reliability of emissions data used in financial analyses and improve the robustness of future research findings.

References

Ansar, A., Caldecott, B. and Tilbury, J. (2013), 'Stranded assets and the fossil fuel divestment campaign: What does divestment mean for the valuation of fossil fuel assets?', https://www.smithschool.ox.ac.uk/sites/default/files/2022-03/SAP-divestment-report-final.pdf. [Accessed 2024-04-25].

Ben-David, I., Jang, Y., Kleimeier, S. and Viehs, M. (2021), 'Exporting pollution: Where do multinational firms emit co_2?', *Economic Policy* **36**(107), 377–437.

Berg, T., Saunders, A. and Steffen, S. (2016), 'The total cost of corporate borrowing in the loan market: Don't ignore the fees', *The Journal of Finance* **71**(3), 1357–1392.

BIS (2021), 'Basel committee on banking supervision climate-related risk drivers and their transmission channels', https://www.bis.org/bcbs/publ/d517.pdf. [Accessed 2024-03-31].

Bolton, P. and Kacperczyk, M. (2021), 'Do investors care about carbon risk?', *Journal of Financial Economics* **142**(2), 517–549.

Capasso, G., Gianfrate, G. and Spinelli, M. (2020), 'Climate change and credit risk', *Journal of Cleaner Production* **266**, 121634.

Chava, S. (2014), 'Environmental externalities and cost of capital', *Management Science* **60**(9), 2223–2247.

Chenet, H. (2021), Climate change and financial risk, *in* 'Financial Risk Management and Modeling', pp. 393–419.

climate.copernicus.eu (n.d.), 'Copernicus: Global temperature record streak continues – april 2024 was the hottest on record', https://climate.copernicus.eu/copernicus-global-temperature-record-streak-continues-april-2024-was-hottest-record. [Accessed 2024-05-16].

Degryse, H., Goncharenko, R., Theunisz, C. and Vadasz, T. (2023), 'When green meets green', *Journal of Corporate Finance* p. 102355.

Delis, M. D., de Greiff, K., Iosifidi, M. and Ongena, S. (2024), 'Being stranded with fossil fuel reserves? climate policy risk and the pricing of bank loans', *Financial Markets, Institutions and Instruments* .

Ehlers, T., Packer, F. and de Greiff, K. (2021), 'The pricing of carbon risk in syndicated loans: Which risks are priced and why?', *Journal of Banking & Finance* p. 106180.

Fard, A., Javadi, S. and Kim, I. (2020), 'Environmental regulation and the cost of bank loans: International evidence', *Journal of Financial Stability* **51**, 100797.

Forssbaeck, J. et al. (2023), 'Foreign and domestic loans over the business cycle', *SSRN Electronic Journal* . Available online: https://www.ssrn.com/abstract=xxxxx.

Hawkins, E. (n.d.), 'Figure 1.1: This figure shows the global temperature change between 1850 and 2022 relative to the 1971-2000 average', Graphics and lead scientist: Ed Hawkins, National Centre for Atmospheric Science, University of Reading. Data from Berkeley Earth, NOAA, UK Met Office, MeteoSwiss, DWD, SMHI, UoR, ZAMG.

Ho, K. and Wong, A. (2022), 'Effect of climate-related risk on the costs of bank loans: Evidence from syndicated loan markets in emerging economies', *Emerging Markets Review* p. 100977.

Hong, H., Li, F. W. and Xu, J. (2019), 'Climate risks and market efficiency', *Journal of Econometrics* **208**(1), 265–281.

Ilhan, E., Sautner, Z. and Vilkov, G. (2020), 'Carbon tail risk', *The Review of Financial Studies* .

Ivanov, I. T., Kruttli, M. S. and Watugala, S. W. (2023), 'Banking on carbon: Corporate lending and cap-and-trade policy', *The Review of Financial Studies* .

Ivashina, V. (2005), 'Structure and pricing of syndicated loans', Presented at The New York City Area Conference on Financial Intermediation (A conference jointly sponsored by the Federal Reserve Bank of New York and the Salomon Center). Available at: https://www.newyorkfed.org/medialibrary/media/research/conference/2005/financial_intermed/ivashina.pdf.

Kleimeier, S. and Viehs, M. (2016), 'Carbon disclosure, emission levels, and the cost of debt', *SSRN Electronic Journal* .

loanconnector (n.d.), 'Glossary', https://www.loanconnector.com/EikonHelp/glossary.html. [Accessed 2024-04-09].

London Stock Exchange Group (n.d.), 'Esg carbon data and estimate models', https://www.lseg.com/content/dam/data-analytics/en_us/documents/fact-sheets/lseg-esg-carbon-data-and-estimate-models.pdf. [Accessed 2024-05-06].

Loyson, P., Luijendijk, R. and van Wijnbergen, S. (2023), 'The pricing of climate transition risk in europe's equity market', *SSRN Electronic Journal* . [online].

MIT Climate Portal (n.d.), 'What we know about climate change', https://climate.mit.edu/what-we-know-about-climate-change. [Accessed 2024-04-12].

MSCI (n.d.), 'Scope 3 carbon emissions: Seeing the full picture', https://www.msci.com/www/blog-posts/scope-3-carbon-emissions-seeing/02092372761. [Accessed 2024-04-18].

Reghezza, A., Altunbas, Y., Marques-Ibanez, D., d'Acri, C. R. and Spaggiari, M. (2021), 'Do banks fuel climate change?', *SSRN Electronic Journal* . [online].

Semieniuk, G., Campiglio, E., Mercure, J.-F., Volz, U. and Edwards, N. R. (2020), 'Low-carbon transition risks for finance', *WIREs Climate Change* **12**(1). [online].

Shleifer, A. and Vishny, R. W. (1997), 'A survey of corporate governance', *The Journal of Finance* **52**(2), 737–783. [online].

UNFCCC (2015), 'Paris agreement', https://unfccc.int/sites/default/files/english_paris_agreement.pdf. [Accessed 2024-03-28].

Yıldırım, N. E., Üre, S. and Karaköy, (2021), 'Credit rating agencies and their effects: An analysis on balkan countries', *Journal of Process Management. New Technologies* **9**(3-4), 28–48.

Appendix A

Regression Results

Variables	(1)	(2)	(3)	(4)
Total Borrower's Carbon Emission Level	0.1721**	0.2727***		
	(0.003)	(0.000)		
Total Borrower's Carbon Emission Level x Post Paris		-0.3287***		
		(0.000)		
Total Borrower's Carbon Emission Level (Estimated)			0.1065**	0.1586**
			(0.035)	(0.011)
Total Borrower's Carbon Emission Level (Estimated) x Post Paris				-0.2169***
				(0.008)
Borrower's Debt to Capital Ratio	0.1762***	0.2031***	0.1593***	0.1734***
	(0.008)	(0.004)	(0.000)	(0.000)
Borrower's Return on Asset Ratio	-1.2829***	-1.4492***	-1.0489***	-1.1767***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln Borrower's Total Assets	-0.3778	-0.7881	-4.4878***	-4.8401***
	(0.709)	(0.433)	(0.000)	(0.000)
Average Lender's Return on Asset Ratio	-20.8531***	-12.8821***	-26.5586***	-15.8094***
	(0.000)	(0.003)	(0.000)	(0.000)
Average Lender's Total Revenue	0.0005***	0.0003**	0.0003***	6.523e-05
	(0.000)	(0.033)	(0.000)	(0.551)
Ln Average Lender's Total Asset	-12.6970***	-11.0847***	-13.5623***	-10.6549***
	(0.000)	(0.000)	(0.000)	(0.000)
Average Lender's Capital Ratio	0.2736	1.1275***	-0.0234	0.0702
	(0.455)	(0.004)	(0.895)	(0.944)
No. Observations:	5151	5151	9581	9581
Adj. R-squared:	0.518	0.526	0.469	0.481
Country of Syndication FE	Y	Y	Y	Y
Base/Reference Rate FE	Y	Y	Y	Y
Currency FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y

Table A.1: Regression Results for Carbon Emission Levels: Reported vs Estimated

*Dependent Variable: All-in drawn Spread in basis points (bps) at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Variables	**(1)**	**(2)**	**(3)**	**(4)**
Total Borrower's Carbon Intensity Level	0.0027***	0.0041***		
	(0.000)	(0.001)		
Total Borrower's Carbon Intensity Level x Post Paris		-0.0069***		
		(0.000)		
Total Borrower's Carbon Intensity Level (Estimated)			0.0027***	0.0041***
			(0.000)	(0.001)
Total Borrower's Carbon Intensity Level (Estimated) x Post Paris				-0.0069***
				(0.000)
Borrower's Debt to Capital Ratio	0.1699***	0.1960***	0.1704***	0.1968***
	(0.008)	(0.004)	(0.008)	(0.004)
Borrower's Return on Asset Ratio	-1.2022***	-1.3652***	-1.2015***	-1.3655***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln Borrower's Total Assets	0.4912	0.1228	0.5189	0.1557
	(0.625)	(0.902)	(0.606)	(0.876)
Average Lender's Return on Asset Ratio	-20.5237***	-13.1666***	-20.6073***	-13.2441***
	(0.000)	(0.003)	(0.000)	(0.002)
Ln Average Lender's Total Asset	-12.8805***	-11.4365***	-12.8879***	-11.4640***
	(0.000)	(0.000)	(0.000)	(0.000)
Average Lender's Capital Ratio	0.3079	1.1329***	0.3013	1.1261***
	(0.400)	(0.004)	(0.411)	(0.004)
No. Observations:	5144	5144	5137	5137
Adj. R-squared:	0.518	0.528	0.518	0.528
Country of Syndication FE	Y	Y	Y	Y
Base/Reference Rate FE	Y	Y	Y	Y
Currency FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y

Table A.2: Regression Results for Carbon Intensity: Reported vs Estimated

*Dependent Variable: All-in drawn Spread in basis points (bps) at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Borrower's Carbon Intensity Scope 1	0.0031***			0.0038*	0.003
	(0.001)			(0.069)	(0.182)
Borrower's Carbon Intensity Scope 2		0.0055		0.02	0.028**
		(0.414)		(0.126)	(0.044)
Borrower's Carbon Intensity Scope 3			-0.0003	-0.0005	-0.0005
			(0.485)	(0.304)	(0.332)
Average Lender's Carbon Intensity Scope 3					-0.0403
					(0.107)
Borrower's Debt to Capital Ratio	0.2786***	0.2661***	0.1071	0.1315*	0.143*
	(0.0000)	(0.0000)	(0.147)	(0.069)	(0.077)
Borrower's Return on Asset Ratio	-1.144***	-1.2937***	-0.9216**	-1.0031**	-1.5184***
	(0.0000)	(0.0000)	(0.027)	(0.014)	(0.0000)
Ln Borrower's Total Assets	1.3829	0.3922	0.3769	1.8458	1.5382
	(0.119)	(0.716)	(0.78)	(0.121)	(0.212)
Average Lender's Return on Asset Ratio	-23.1859***	-22.7766***	-20.536***	-24.3929***	-25.4853***
	(0.0000)	(0.0000)	(0.002)	(0.0000)	(0.0000)
Average Lender's Revenue	-13.1092***	-13.992***	-11.1342***	-8.8023**	-7.0807
	(0.0000)	(0.0000)	(0.007)	(0.03)	(0.123)
Ln Average Lender's Total Assets	0.2125	0.3619	1.4441***	1.4657***	1.2216**
	(0.562)	(0.361)	(0.007)	(0.004)	(0.016)
Average Lender's Capital Ratio	0.0006***	0.0006***	0.0004**	0.0005**	0.0005**
	(0.0000)	(0.0000)	(0.03)	(0.012)	(0.01)
No. Observations:	4500	4389	2769	2107	2651
Adj. R-squared:	0.536	0.527	0.543	0.577	0.556
Country of Syndication FE	Y	Y	Y	Y	Y
Base/Reference Rate FE	Y	Y	Y	Y	Y
Currency FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y	Y

Table A.3: Carbon Intensity Pricing for Borrower Scope 1-3 and Lender Scope 3

*Dependent Variable: All-in drawn Spread in basis points (bps) at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Variables	**1**	**2**	**3**	**4**	**5**
Borrower's Carbon Emission Level Scope 1	0.2005***			0.299***	0.2827**
	(0.003)			(0.007)	(0.012)
Borrower's Carbon Emission Level Scope 2		-0.3296		-3.035***	-1.525
		(0.603)		(0.001)	(0.125)
Borrower's Carbon Emission Level Scope 3			0.02027	0.02205	0.02555*
			(0.191)	(0.145)	(0.097)
Average Lender's Carbon Emission Level Scope 3					-0.582
					(0.15)
Borrower's Debt to Capital Ratio	0.2893***	0.268***	0.1039	0.131*	0.1471*
	(0.0000)	(0.0000)	(0.157)	(0.071)	(0.069)
Borrower's Return on Asset Ratio	-1.2057***	-1.2067***	-0.8453**	-0.9349**	-1.3948***
	(0.0000)	(0.0000)	(0.037)	(0.019)	(0.001)
Ln Borrower's Total Assets	0.3971	0.4004	-0.0918	2.1273*	1.0777
	(0.659)	(0.711)	(0.944)	(0.082)	(0.394)
Average Lender's Return on Asset Ratio	-23.9138***	-23.1117***	-21.4049***	-25.7311***	-26.9231***
	(0.0000)	(0.0000)	(0.001)	(0.0000)	(0.0000)
Ln Average Lender's Total Asset	-12.9115***	-14.0568***	-11.0445***	-8.6878**	-7.0835
	(0.0000)	(0.0000)	(0.007)	(0.033)	(0.123)
Average Lender's Capital Ratio	0.2033	0.3761	1.4704***	1.4174***	1.2513**
	(0.579)	(0.34)	(0.006)	(0.006)	(0.013)
Average Lender's Revenue	0.0006***	0.0005***	0.0004**	0.0005**	0.0005**
	(0.0000)	(0.0000)	(0.031)	(0.015)	(0.012)
No. Observations	4500	4389	2769	2107	2651
Adj. R-squared	0.536	0.527	0.543	0.577	0.556
Country of Syndication FE	Y	Y	Y	Y	Y
Base/Reference Rate FE	Y	Y	Y	Y	Y
Currency FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y	Y

Table A.4: Carbon Emission Level Scope 1-3 and Lender Scope 3

*Dependent Variable: All-in drawn Spread in basis points (bps) at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Carbon Intensity Scope 1	-0.0589			-0.0673	
	(0.400)			(0.370)	
Carbon Intensity Scope 1 X Post Paris	0.0132			-0.0104	
	(0.809)			(0.887)	
Carbon Intensity Scope 2		0.0093		0.0494	
		(0.875)		(0.414)	
Carbon Intensity Scope 2 X Post Paris		-0.0497		0.0159	
		(0.482)		(0.818)	
Carbon Intensity Scope 3			-0.0270	-0.0283	
			(0.768)	(0.768)	
Carbon Intensity Scope 3 X Post Paris			0.0647	0.0787	
			(0.495)	(0.429)	
Carbon Intensity Scope 1, 2 and 3				-0.0916	
				(0.156)	
Carbon Intensity Scope 1, 2 and 3 X Post Paris				0.0303	
				(0.570)	
Borrower's Debt to Capital Ratio	0.2025***	0.1872***	0.2215***	0.2435***	0.1531***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Borrower's Return on Asset Ratio	-0.0516	-0.0643	0.0969*	0.054	-0.0589
	(0.247)	(0.165)	(0.099)	(0.376)	(0.160)
Ln Borrower's Total Assets	0.0687	0.0844*	0.1128	0.0853	0.0474
	(0.142)	(0.076)	(0.054)	(0.156)	(0.281)
Average Lender's Return on Asset Ratio	-0.0854*	-0.0878*	-0.0072	0.0076	-0.0929**
	(0.059)	(0.053)	(0.899)	(0.897)	(0.029)
Ln Average Lender's Total Assets	0.1562**	0.1709**	0.1082	0.1098	0.1696**
	(0.007)	(0.004)	(0.131)	(0.142)	(0.002)
Average Lender's Capital Ratio	-0.1322***	-0.1333**	-0.1575**	-0.1572**	-0.1361**
	(0.002)	(0.003)	(0.005)	(0.007)	(0.001)
No. Observations:	4465	4354	2747	2629	5107
PusedoR-squared:	0.272	0.267	0.273	0.285	0.27
Country of Syndication FE	N	N	N	N	N
Base/Reference Rate FE	N	N	N	N	N
Currency FE	N	N	N	N	N
Industry FE	Y	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y	Y

Table A.5: Logit model specifications

*Dependent Variable: Secondary Market at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Carbon Intensity Scope 1	-0.000004			-0.000010	
	(0.132)			(0.295)	
Carbon Intensity Scope 1 X Post Paris	-0.000001			-0.000003	
	(0.941)			(0.883)	
Carbon Intensity Scope 2		0.000003		0.000072	
		(0.960)		(0.372)	
Carbon Intensity Scope 2 X Post Paris		-0.000019		0.000050	
		(0.779)		(0.676)	
Carbon Intensity Scope 3			-0.000003	-0.000003	
			(0.541)	(0.522)	
Carbon Intensity Scope 3 X Post Paris			0.000005	0.000006	
			(0.338)	(0.282)	
Carbon Intensity Scope 1, 2 and 3				-0.000006	
				(0.032)	
Carbon Intensity Scope 1, 2 and 3 X Post Paris				0.000002	
				(0.705)	
Borrower's Debt to Capital Ratio	0.0011***	0.0011***	0.0015***	0.0015***	0.0008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)
Borrower's Return on Asset Ratio	-0.0014	-0.0018	0.0031*	0.0017	-0.0016
	(0.244)	(0.134)	(0.073)	(0.344)	(0.167)
Ln Borrower's Total Assets (natural logarithm)	0.0079*	0.0110**	0.0153***	0.0112*	0.0074
	(0.063)	(0.023)	(0.009)	(0.042)	(0.110)
Average Lender's Return on Asset Ratio	-0.0509**	-0.0529**	-0.0181	-0.0074	-0.0535***
	(0.019)	(0.015)	(0.549)	(0.815)	(0.009)
Ln Average Lender's Total Assets (natural logarithm)	0.0215***	0.0251***	0.0163	0.0143	0.0247***
	(0.006)	(0.002)	(0.137)	(0.194)	(0.001)
Average Lender's Capital Ratio	-0.0072***	-0.0077***	-0.0091***	-0.0083***	-0.0076***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
No. Observations:	4465	4354	2747	2629	5107
Adj. R-squared:	0.295	0.288	0.291	0.302	0.292
Country of Syndication FE	N	N	N	N	N
Base/Reference Rate FE	N	N	N	N	N
Currency FE	N	N	N	N	N
Industry FE	Y	Y	Y	Y	Y
Borrower Region FE	Y	Y	Y	Y	Y
Loan Control Variables/FE	Y	Y	Y	Y	Y

Table A.6: Linear Probability Model

*Dependent Variable: Secondary Market at lender, borrower, and loan level; p-value in brackets ***=p-value<1%, **=p-value<5%, *=p-value<10%. Standard errors are robust. FE stands for fixed effects.*

Appendix B

Variables Description

Variable Name	Definition	Source
All-in Spread Drawn	The amount a borrower pays in basis points over a reference rate for each dollar drawn and all annual or facility fees paid to the lenders.	DealScan
Lead Arranger	The lead arranger is defined as the lender who acts as administrative agent and conducts due diligence, loan monitoring and payment handling. If an administrative agent isn't available then lenders who are sole lenders, agent, bookrunner, lead arranger, lead bank or lead manager and arranger are defined as lead arranger (Ivashina, 2005).	DealScan
Tranche Type	The facility type is divided into three dummy categories: (i) credit line (i.e, 364-Day facility and Revolver/Line less or equal to 1 year) (ii) Term Loan (i.e, Term Loan A and Bridge loan) and (iii) other category to include facilities that don't fulfill the conditions of previous two categories such as "Ijara" and "Guarantee" (Berg et al., 2016).	DealScan
Maturity	The tenor in months for a particular tranche.	DealScan
Base/Reference Rate	As the dependent variable is the margin rate over the base rate we used a dummy variable for each base/reference rate.	DealScan
Call Protection	Dummy variable for the call protection.	DealScan
Tranche Amount in USD	Natural logarithm of the tranche amount converted into USD in millions.	DealScan
Secured	Dummy variable indicating whether a tranche is secured or not.	DealScan
Seniority Type	Dummy variables for the level of seniority of a tranche.	DealScan
Tranche Currency	Dummy variable for the currency of a tranche.	DealScan
Deal Amended	Dummy variable indicating if the deal is amended or not.	DealScan
Covenants	Dummy variable for the financial covenants related to a tranche.	DealScan
Country of Syndication	Dummy variable for the country of loan syndication.	DealScan
Secondary Market	Binary variable taking the value of 1 if the tranche has a Loan Identification Number (LIN), which is a field matching a tranche to a secondary market.	DealScan

Table B.1: Syndicated Loan Variables

Variable Name	Definition	Source
Major Industry Group	The broad industry classification for the borrower.	DealScan
Rating	Borrower ratings from S&P, Moody's and Fitch considered at the close of the deal and if not available, populated with long term issuer ratings. A numerical transformation is applied to the ratings. (more details in the section related to data)	DealScan
Region	Dummy variable for the operating region of the borrower	DealScan
Ln Total Asset (natural logarithm)	The natural logarithm of the total assets of borrower at t-1 (one year prior to the deal date).	Capital IQ
Debt to Capital Ratio	Leverage ratio for the borrower at t-1 (one year prior to the deal date).	Capital IQ
Return on Assets	Profitability measure for the borrower at t-1 (one year prior to the deal date).	Capital IQ

Table B.2: Borrower Variables

Variable Name	Definition	Source
Ln Total Asset (natural logarithm)	The natural logarithm of the total assets of all the lead arrangers in the syndication at time t-1 (one year prior to the deal date).	Capital IQ
Capital Ratio	The capital adequacy ratio of all the lead arrangers in the syndication at t-1 (one year prior to the deal date).	Capital IQ
Return on Assets	The return on asset of all the lead arrangers in the syndication at t-1 (one year prior to the deal date).	Capital IQ

Table B.3: Lender Variables

Variable Name	Description	Source
Total Borrower's Carbon Emission Level	Total CO2 equivalent emissions as reported	Eikon
Borrower's Carbon Emission Level Scope 1	Direct CO2 equivalent emissions, Scope 1	Eikon
Borrower's Carbon Emission Level Scope 2	Indirect CO2 equivalent emissions, Scope 2	Eikon
Borrower's / Lender's Carbon Emission Level Scope 3	Indirect CO2 equivalent emissions, Scope 3	Eikon
Total Borrower's Carbon Emission Level (Estimated)	Estimated total CO2 equivalent emissions based on the emission estimation framework	Eikon
Total Borrower's Carbon Intensity Level	Total CO2 equivalent emissions to revenues in USD million based on the reporting methodology	Eikon
Borrower's Carbon Intensity Scope 1	Direct CO2 equivalent emissions, Scope 1 to revenue in USD million	Eikon
Borrower's Carbon Intensity Scope 2	Indirect CO2 equivalent emissions, Scope 2 to revenue in USD million	Eikon
Borrower's / Lender's Carbon Intensity Scope 3	Indirect CO2 equivalent emissions, Scope 3 to revenue in USD million	Eikon
Total Borrower's Carbon Intensity Level (Estimated)	CO2 equivalent emissions Scope 1, 2 and 3 based on the estimation framework	Eikon

Table B.4: Emission variables for Borrowers and Lenders