



The pricing of carbon risk in syndicated loans

Which risks are priced and why?

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Disclaimer: The views expressed here are those of the authors and do not necessarily represent those of the IMF or BIS

Motivation

- Climate-related risks (eg necessary policy measure for a transitioning to a low carbon economy) can lead to potentially large **revaluations** of financial assets (Carney (2015), Batten et al (2016), Dietz et al (2016))
- The resulting vulnerability of banks to rapid revaluation of carbon-intensive assets poses **credit risks** (Weyzig et al 2014; Bank of England 2015; ESRB 2016; Battiston et al 2016)
- ECB Banking Supervision – Risk Assessment for 2020:
“The economic costs of physical risks are growing steadily, and, at the same time, transitional risks are on the rise, as public policies are increasingly targeting the climate neutrality and environmental sustainability of economic activities.”

Research question and setup

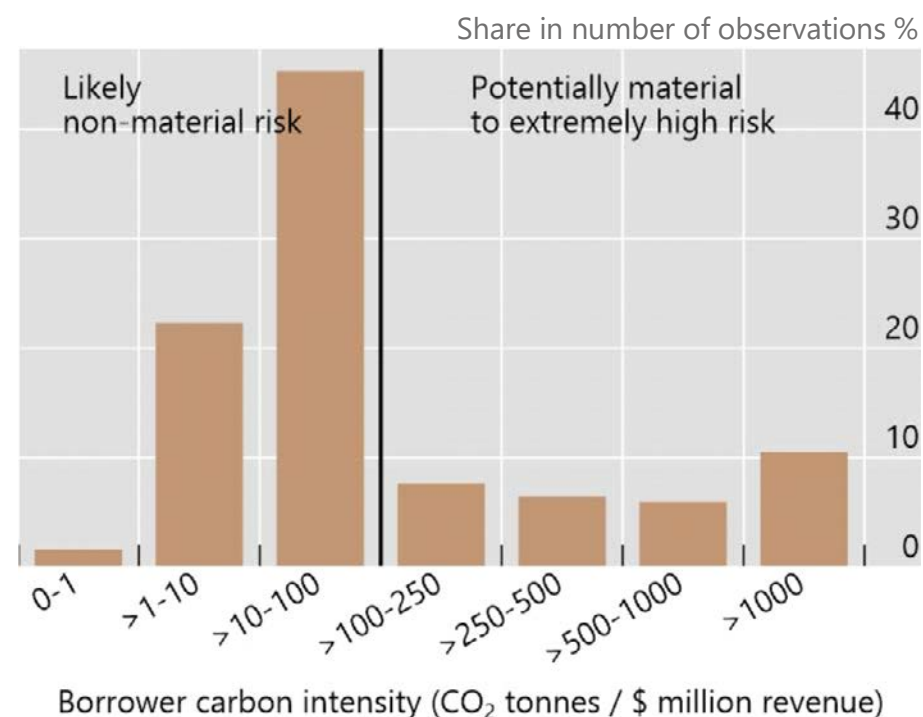
- Does borrower-specific carbon emission-related credit risks affect the pricing in the corporate loan market?
- The pricing of risk is pertinent to channeling more investments into “green” projects (which is one of the stated goals of the Paris Accord)
- Risks are higher, if companies have higher carbon emissions
 - Eg costs that would occur if carbon taxes or emission trading schemes are introduced or levies are increased
 - This is a relevant credit risk, as it impacts the ability to repay debt -> banks should price these risks
- We match firm-specific actual carbon emission data (12000+ listed firms, >90% of global market cap) with syndicated loan data

Are environmentally-related credit risks material (enough)?

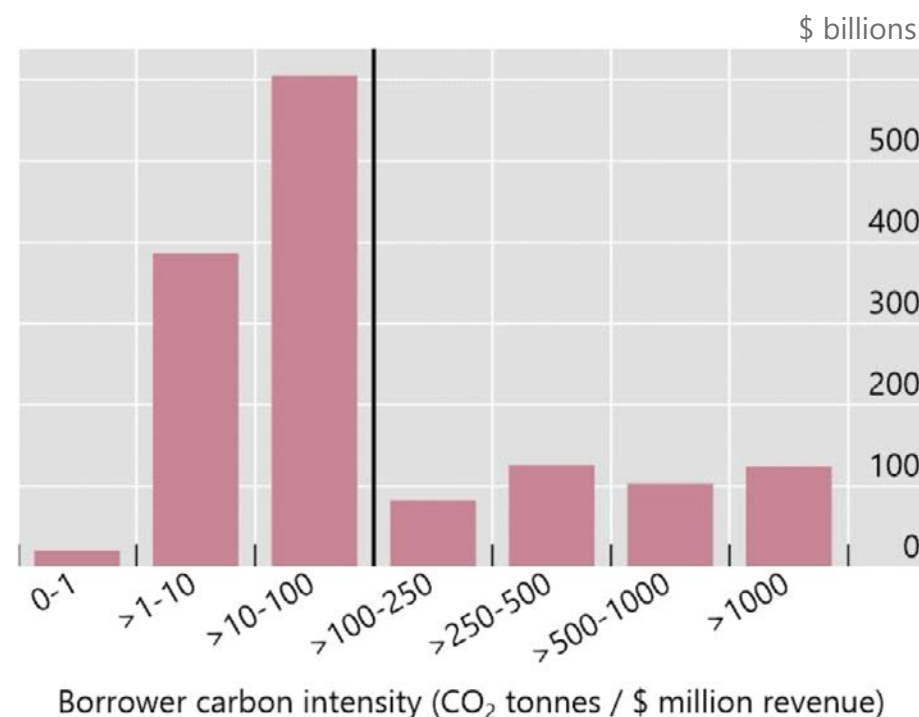
Distribution of carbon intensity¹

Graph 1

By number of observations



By total loan amounts



¹ Based on scope 1 carbon emissions.

Source: S&P Trucost; Dealogic; authors' calculations.

Key results

- The premia for carbon risk, as measured by firm-specific CO₂ emission intensities, are significantly priced, but only since the Paris accord agreement (end-2015)
- The difference in risk premia due to CO₂ emissions is apparent both within industry sectors as well as across industry sectors
- Only greenhouse gas emissions directly caused by the firm are priced (scope 1), and not those indirectly caused by production inputs, transportation or use of final products (scopes 2 or 3)
- “Green” banks—either self-identified or those that lend less to carbon-intensive sectors—do not appear to price risks differently from other banks.
- The carbon risk premium appears to be low relative to the implied credit risks

Econometric model

- $$\text{margin}_{l,f,b,t} = \alpha \text{Carbon Intensity}_{f,t-1} + \beta \text{Carbon Intensity}_{f,t-1} \times D_{\text{Paris Accord}} + \gamma X_{l,f,t} + \delta D_{b,c,t} + \varepsilon_{l,f,b,t}$$

Data	Description	Source
<i>Carbon Intensity</i>	Disclosed and estimated scope 1 emission intensity	<i>TruCost (S&P Global)</i>
<i>D_{Paris Accord}</i>	Post 2015 dummy = 1 post 2015	
<i>X</i>	Term spread, loan and firm controls: amount, maturity, collateral, rating, leverage	<i>Central banks, Bloomberg; Syndicated loan data</i>
<i>D</i>	fixed effects: time, borrower country, and bank effects	<i>Syndicated loan data</i>

- Hypothesis:** Banks have started to price the financial risks related to carbon emissions as the Paris Accord was struck => $\beta > 0$.

Baseline regressions¹

Table 3

Dependent variable: loan margin in basis points; p-values in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Term Spread (bp)	0.488***	0.500***	0.499***	0.497***	0.518***	0.374***	0.587***	0.586***
Maturity (years)		-14.25***	-14.19***	-14.08***	-13.89***	-11.33***	-15.34***	-14.19***
Maturity-squared		0.457***	0.455***	0.443***	0.436***	0.401***	0.463***	0.462***
Rating: B or worse	221.7***	178.1***	177.7***	176.1***				
Rating: B+ to BB+	136.0***	103.4***	103.1***	102.7***				
Rating: BBB- to BBB	76.69***	61.96***	62.11***	61.27***				
Rating: BBB+ to A-	46.42***	34.44***	35.22***	34.90***				
Rating: A or better (Omitted – Base)								
D(Leveraged Loan)		26.60**	26.94**	26.45**	25.53**	18.05	23.32***	29.39**
D(Subordinated Loan)		261.1***	261.2***	261.8***	247.6***	254.1***	159.7**	237.8***
Log(Loan Value)		-10.80**	-10.87**	-11.08**	-7.342*	-7.230**	-4.909	-6.493*
Log(Revenue)		-2.590	-2.674	-2.975	-2.694	0.436	-4.153	-3.325
D(post Paris)				4.593 (0.624)	1.747 (0.845)	-7.308 (0.861)	0.139 (0.989)	
Oil Price								-0.603*** (0.000)
Carbon Intensity			-0.822 (0.407)	-1.367 (0.169)	-1.969 (0.154)	-7.166** (0.048)	-1.217 (0.382)	5.380 (0.161)
Carbon Intensity x D(post Paris)				6.700** (0.023)	6.705** (0.040)	8.356* (0.077)	5.712* (0.079)	6.003* (0.053)
Observations	1,107	1,098	1,098	1,098	1,098	845	1,038	1,098
Adjusted R-squared	0.645	0.694	0.694	0.695	0.717	0.664	0.729	0.728
Borrower Country FE	Y	Y	Y	Y	Y	N	Y	Y
Bank Syndicate FE	Y	Y	Y	Y	Y	Y	Y	Y
Crisis FE	N	Y	Y	Y	Y	Y	Y	Y
Rating Dummies	N	N	N	N	Y	Y	Y	Y
CCPI x D(post Paris) ²	N	N	N	N	N	Y	N	N
Additional Borrower Controls ³	N	N	N	N	N	N	Y	N
Oil Price Interactions ⁴	N	N	N	N	N	N	N	Y

¹ Standard errors double-clustered by borrowing firm and bank syndicate. ² Climate Change Performance Index by Germanwatch interacted with the post Paris dummy as an additional control variable. See Table 1 for a description. ³ Additional borrower controls include operating margins, book-to-market and leverage. See main text for details. ⁴ In addition to the composite oil price in US dollars in the previous month included on its own, the same variable is interacted with i) the post-2015 dummy and ii) carbon intensity as additional control variables. See Table 1 and main text for more details. ***=p-value<1%, **=p-value<5%, *=p-value<10%.

Carbon emissions: disclosure and scopes

- An increasing number of firms (around 4500 in the TruCost database) disclose their emissions (in annual reports or supplementary reports)
- Emissions for other firms (6000+ in the TruCost database) are calculated based on an industry-standard model ("process-based EEIO model" based on the "GHG Protocol Corporate Standard")
- Three different types of carbon emission measures
 - Scope 1: direct emissions from owned or controlled sources
 - Scope 2: indirect emissions from the generation of purchased energy
 - Scope 3: all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company (ie inputs, distribution etc) -> in our sample only "upstream"

Carbon emission scopes

Pricing of carbon intensity – scopes 1-3¹

Table 8

Dependent variable: loan margin in basis point (bp), p-values in brackets.

	(1)	(2)	(3)	(4)
Carbon Intensity Scope 1	-1.969 (0.154)			-1.232 (0.350)
Carbon Intensity Scope1 x D(post Paris)	6.705** (0.0399)			6.118* (0.0677)
Carbon Intensity Scope 1+2		-1.819 (0.191)		
Carbon Intensity Scope 1+2 x D(post Paris)		5.548 (0.130)		
Carbon Intensity Scope 1-3			-1.855 (0.200)	
Carbon Intensity Scope 1-3 x D(post Paris)			5.545 (0.101)	
Carbon Intensity Scope2				-0.0979** (0.0270)
Carbon Intensity Scope 2 x D(post Paris)				0.189** (0.0398)
Carbon Intensity Scope3				-0.0161 (0.299)
Carbon Intensity Scope 3 x D(post Paris)				0.0226 (0.404)
Observations	1,098	1,098	1,098	1,098
Adjusted R-squared	0.717	0.717	0.717	0.721

¹ Standard errors double-clustered by borrowing firm and bank consortium. ***=p-value<1%, **=p-value<5%, *=p-value<10%. ² For simplicity, Loan-level & Borrower Controls include all controls from the baseline model in Table 3 column (5) and not shown here.

Other robustness checks

- Is the result driven by high-carbon intensive sectors (literature thus far has concentrated on those) -> No
- What about fees not reflected in margins? -> Fees themselves are not significant, but margins plus all fees ("All-in pricing") yield very similar results
- Are carbon risks priced before the Paris Agreement -> No, though we find weakly significant pricing a year earlier already
- Does climate policy stringency (on a country level) change the results -> we do not find evidence, though our setup is not designed for this (firm-level analysis)

Economic significance

- Our baseline specification has a coefficient of around 6.7 on the regressor $\text{Carbon Intensity}_{f,t-1} \times D_{\text{Paris Accord}}$, sample avg (std) carbon intensity (scope 1) after 2015 is 0.5 (2.5), for the 10% highest emitters about 1 CO2 tonnes per *thousand* USD
 - Yields an **average premium of around 3-4bp**
 - **For the 10% highest emitters, the premium is 7 bp**
 - For the **emitters 1 std above mean**, the implied premium is around **17bp**
- Premia appear to be **low relative to the implied credit risks**
 - Ceteris paribus, the introduction of a carbon price of \$100 per tonne of CO2 would imply that at least 10% of the total revenues of the 10% highest emitting firms would have to be spent on carbon taxes alone
 - The significant impact on credit risks looks small relatively to 17bp premium



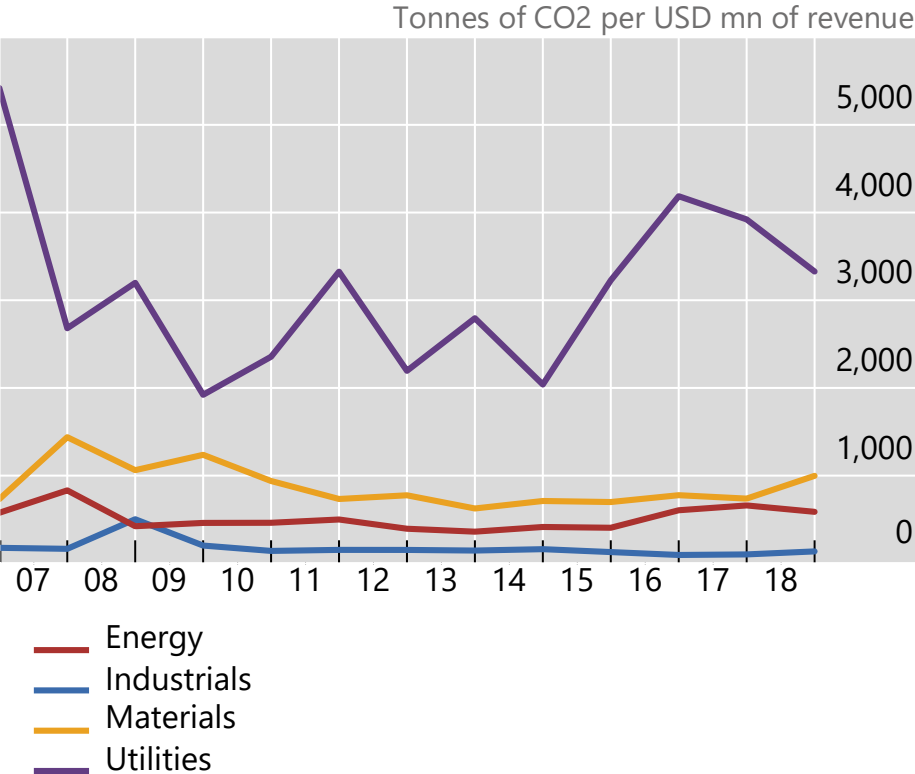
Additional slides

Carbon intensity (scope 1) by sector

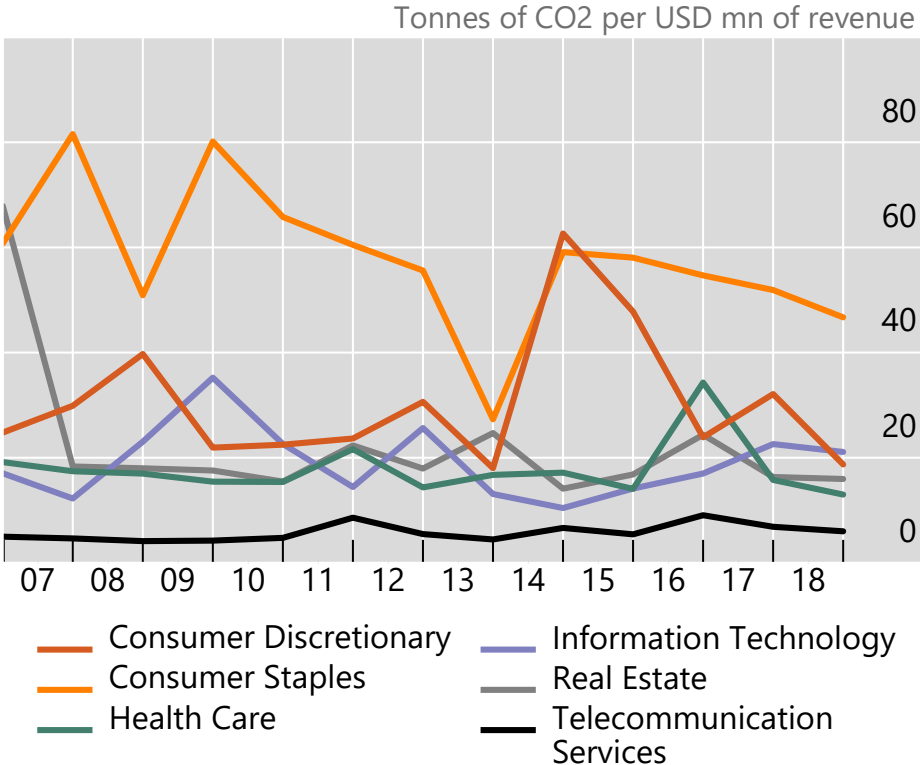
Carbon Intensity by sector¹

Graph 2

High carbon sectors



Lower carbon sectors



¹ Value weighted by US dollar value of total loan origination.

Source: Dealogic; TruCost; authors' calculations.

Materiality – thought experiment

- Say scope 1 carbon intensity is 3000 tonnes of CO₂ per USD mn (annual) – slightly lower than the sample average for the utilities sector
- Assume the optimal price / social cost of carbon is 50 USD per tonne of CO₂ (lower end)
- Implies that the cost of carbon emissions of 15% of total revenue
($50\text{USD/ton} \times 3000\text{tonnes} / 1000000\text{USD} = 0.15$)
- Compare this to (net) operating profit margins which were around 11.5% (17.5% pre-tax) for the utilities sector (averages for 2018)
- For the materials sector, scope 1 carbon intensity around 1000 ton of CO₂ per USD mn (annual), net operating profit margins are 8%

Carbon intensities vary widely *within* sectors

Mean and standard deviation of borrowers' carbon intensity by sector¹

Table 6

Sector	Consumer Discretionary	Consumer Staples	Energy	Health Care	Industrials	Information Technology	Materials	Real Estate	Tele-communication Services	Utilities
Mean	29	113	466	20	203	23	863	20	6	3121
Std	96	253	585	20	720	55	2130	58	6	7491

¹ GICS sector of the borrowing firm. All numbers value weighted by US dollar value of total loan origination.

Source: Trucost; Dealogic; authors' calculations.