

Discussion of “The term structure of carbon premia”

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Summary

- Research Question: whether there is a “carbon premium” in the US corporate bond market
 - Investors require compensation to hold carbon-intensive assets that are more exposed to climate transition risk
 - The carbon premium could also arise due to investor preference for green assets
- Main Findings:
 - Bonds issued by firms with higher carbon emissions have higher yields
 - Carbon emissions affect bond yields through both the default probability and investor preference for green assets
 - The estimated carbon premium exhibits a hump-shaped term structure
- Overall, this is a well-motivated, carefully executed paper with novel insights!

Existing Literature and Contribution

- A growing literature has examined the carbon premium in equities, debts and derivatives markets, with **mixed evidence**
- Equity markets
 - Bolton and Kacperczyk (JFE 2021; JF 2023): higher stock returns associated with higher levels and growth rates of carbon emissions in both US and global stock markets
 - Pastor et al. (2022): green stocks outperform brown stocks over 2011 - 2020
 - Aswani et al. (RF forthcoming): associations between emission level and stock return are confounded by firm size and estimated versus disclosed emissions
 - Zhang (2022): less carbon-intensive firms earn higher stock returns in US
- Debt markets
 - Duan, Li and Wen (2022): bonds issued by more carbon-intensive firms earn lower return
 - Kontz (2023): investors do not price differences in CO₂ emissions of securitized auto loans
- Derivatives
 - Ilhan et al. (RFS 2020): Climate policy uncertainty is priced in the option market
- What causes the differences?
 - **Different measures of carbon emissions**, contemporaneous or lagged relation, inter-industry vs. intra-industry etc.

Major Comments 1: carbon emission level vs. intensity

- This paper uses the levels of carbon emissions as the measure of carbon risk

Our estimated model is as follows:

$$E(s_{i,j,t}) = \hat{\alpha} + \hat{\beta}_P P_{i,t} + \hat{\beta}_Z Z_{i,j,t} + \hat{\beta}_{P,Carbon} \ln(\text{Emissions}_{i,t-12}) + \widetilde{FE} \quad (3)$$

- The literature debates on whether CO₂ levels or intensity better capture firms' exposure to transition risk (See the debate between BK and Aswani et al. in RF)
 - Those advocating unscaled carbon emissions argue that it is the total GHG emissions in earth's atmosphere that determines climate change
 - And climate polices are aimed at reducing total emissions
 - This argument is problematic
- **A simple thought experiment**
 - Imagine a world with much harsher climate policies where each firm is only allowed a fixed quota of total carbon emissions and no trade on the carbon allowance
 - Firms can circumvent the rules by spinning off certain plants and subsidiaries
 - The economy will be less concentrated with smaller average firm size, but with no material carbon emission reduction

Major Comments 1: carbon emission level vs. intensity

- Conceptually, using unscaled emission to measure carbon risk leads to a logical inconsistency
- Consider Firm A that produces \$100 worth of goods and emits 10 metric tons of CO₂ and Firm B that produces \$50 worth of goods and emits 7 metric tons of CO₂
- Your paper argue that Firm B ought to be thought of as “greener”
- However, if Firm A splits itself into two equally sized parts, each would then produce \$50 worth of goods and emit 5 metric tons of CO₂—making both new firms “greener” than Firm B despite the total amount of emissions in the economy not changing!
- Moreover, if Firm A expands its production and replaces firm B, the overall economy become “greener”
- Total emissions are NOT an appropriate measure of firm-level carbon risk, even though they are the appropriate way to assess transition risk at the economy level

Major Comments 1: carbon emission level vs. intensity

- From the **investor preference** perspective, carbon intensity is also more often used than total emissions in practice
 - MSCI low-carbon indices
- From the econometrics perspective, total emission is highly correlated with firm size
 - Confounding the estimated coefficient on $\ln(\text{Emissions})$
 - Controlling for $\ln(\text{Assets})$ is not the same as scaling due to multicollinearity
- Using unscaled emissions to measure carbon risk is analogous to using net income rather than ratio-based measures (ROA) to measure a firm's financial performance
- Based on my reading of the literature and own study, the choice of emissions level vs. intensity can dramatically affect the results!

Major Comments 2: bond yields vs. returns

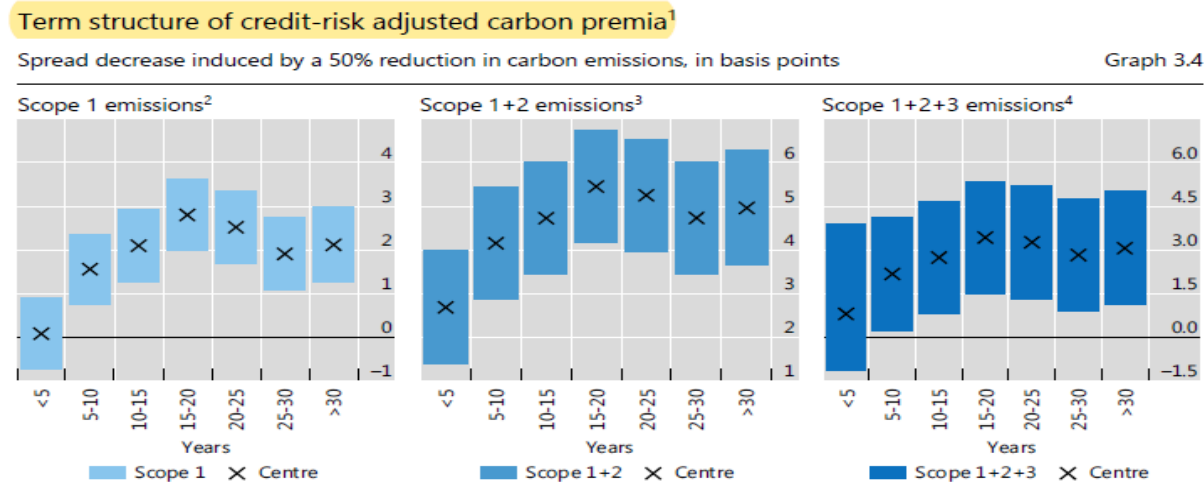
- Looking at the relation between bond yield and carbon emission cannot tell whether carbon risk is **sufficiently priced or not**
 - Possible that carbon risk is underpriced by financial markets
 - A key concern of financial regulators and motivation underlying climate disclosure initiatives
- Survey evidence strongly indicate that transition risk is underpriced by the financial assets
 - Krueger et al. (2020): equity valuations do not fully reflect climate risks
 - Stroebel and Wurgler (2021): 60% (67%) of participants believe climate risk is not sufficiently priced in stock (real estate) markets
- To shed light on this question, examining the relation between carbon risk and bond returns is useful
 - A negative return predictability suggests that realized climate risk is more than investors previously anticipated

Additional Comments 1: reported vs estimated carbon emissions

- Firm-level carbon emissions reported in S&P Global Trucost is either disclosed by firms or estimated by Trucost
 - Aswani et al. (2022): vendor-estimated emissions exhibit systematic differences from firm-disclosed emissions
 - Vendor-estimated emissions are also more highly correlated with fundamental performance measures
- The weaker results using $\ln(\text{scope } 1+2+3 \text{ emissions})$ could also be due to scope 3 emissions being largely estimated by Trucost
- Suggestion: robustness test using disclosed emissions only

Additional Comments 2: hump-shaped term structure of carbon premium

- One novel finding is the hump-shaped term structure of credit-risk adjusted carbon premium



¹ Computed as the coefficient $\hat{\beta}_{P,Carbon}$ on carbon emissions, multiplied by $\ln(0.5)$.

² Corresponds to model (1) in Table 3.3. ³ Corresponds to model (2) in Table 3.3. ⁴ Corresponds to model (3) in Table 3.3.

Sources: Bloomberg; Refinitiv; Trucost; authors' calculations.

- However, when estimating the term structure, the paper only controls for 5-year ahead probability of default
 - the result could reflect differential impact of carbon risk on default probability across horizons (omitted variables)
 - Ideally the default probability should be the same horizon as the bond maturity

Additional Comments 3: tests on the preference channel

- This paper uses only bond price data to test the preference channel
- Preference should also manifest in investors' holdings/positions
 - Examine how carbon risk impacts ownership of bonds by investors, and control for default probability
- Preference also varies with investors' climate change beliefs/concerns
 - Geographic variation in climate beliefs (Bernstein et al. 2022)
 - Time-varying attention to climate change issues
 - Check whether the credit-risk adjusted carbon premium varies intuitively with measures of climate change beliefs