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## **Carbon Intensity and capital structure: Exploring the impact of leverage on carbon performance**

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# Background and introduction



- Climate change is the dire challenge of the present era.
- Inadequate action on the global climate crisis a rapid transformational change is needed to avoid a climate catastrophe.
- Carbon-emitting companies have been called to set more ambitious science-based targets for reducing their emissions.

## Climate change and firm value

- Environmental protection strategies involve an up-front increase of production, capital, and depreciation expenditures (McKinsey Global Institute, 2021).
- Poor environmental performance might result in legal liabilities and reputational damages (Karpoff et al., 2005), lower credit ratings (Seltzer et al., 2022), higher downside risk (Hoepner et al., 2022), and ultimately higher cost of capital (Chava, 2014; El Ghoul et al., 2011).

# Background and introduction

Environmental investments represent a towering burden, so what's the role played by firms' capital structure in environmental management decisions?

- Lack of carbon-related awareness leads to higher cost of debt as lenders penalize firms with a greater carbon risk profile (Jung et al., 2018).
- Investors require a greater cost of equity capital for firms with higher carbon intensity (Kim et al., 2015).
- Investors expect higher returns from significant emitters of toxic chemicals and greenhouses gases which are also charged higher interest rates on their bank loans (Chava, 2014).
- Socially responsible companies enjoy lower equity market frictions, triggering them to favor equity rather than debt (Pijourlet, 2013).



Firms' environmental performance influences their subsequent capital financing choices

# Literature review

Knowledge gap

It's not clear whether firms' current capital structure can shed light on their future carbon performance

- Free cash flow hypothesis (Jensen, 1986): debt restrains overinvestment in CSR practices, which are just the manifestation of agency problems (Barnea & Rubin, 2010; Moussu & Ohana, 2016).
- Financial constraints hypothesis: companies experiencing financial difficulties due to high leverage are more likely to cut CSR expenditures (Hong et al., 2012; Xu & Kim, 2022).
- Stakeholder theory of capital structure (Maksimovic & Titman, 1991): highly levered firms have lower incentives to honor the implicit contracts they have with stakeholders, thus leading to a reduction of CSR (Bae et al., 2011).



A higher leverage might have an adverse impact on firms' carbon emission levels

# Literature review

- Well-governed firms are inherently more socially responsible (Jo & Harjoto, 2011).
- A strong governance system reduces agency conflicts and is positively linked to capital structure adjustments in the form of higher debt usage (Liao et al., 2015).
- Debt acts as a corporate governance mechanism that fosters a greater managerial commitment to long-term objectives and socially responsible conduct (Ferrell et al., 2016).

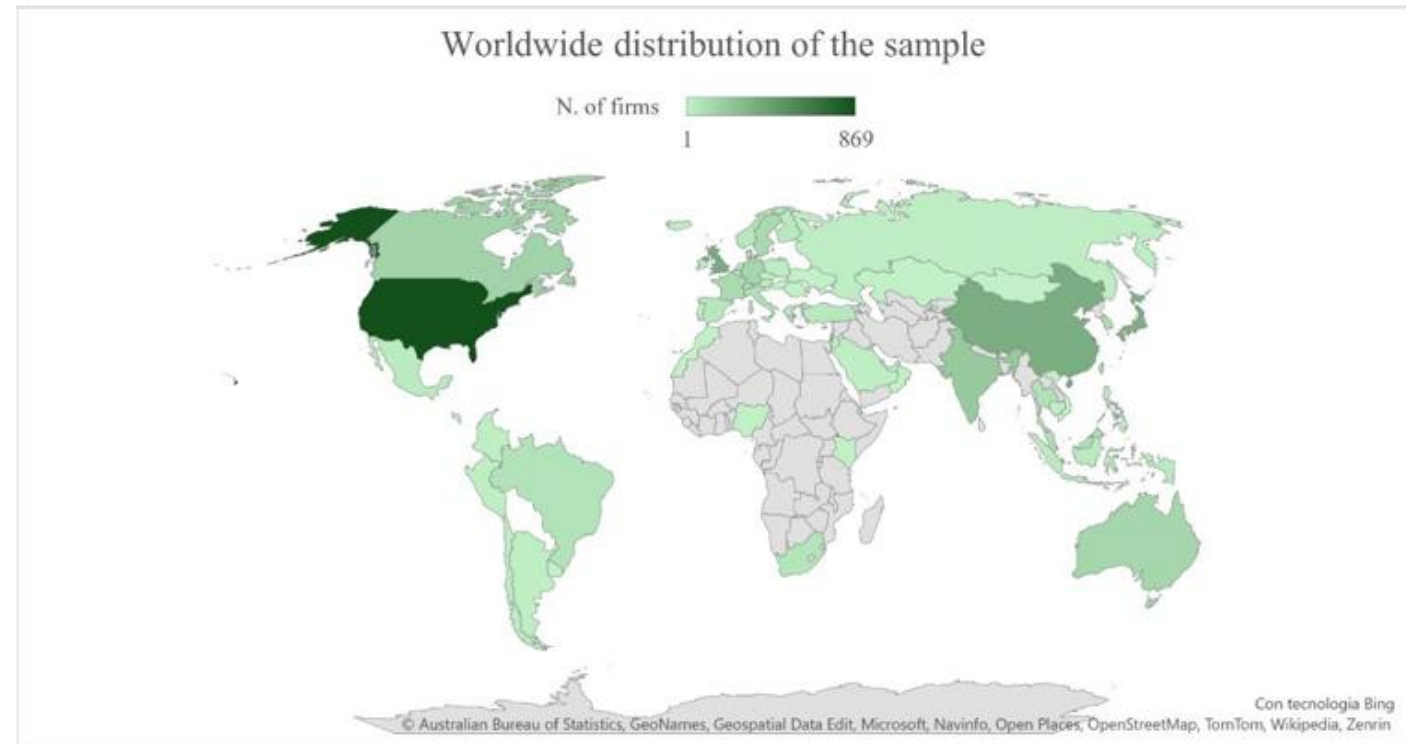


A higher leverage might have a favourable impact on firms' carbon emission levels

The leverage ratio of a firm is significant in explaining its future carbon intensity

# Data sources

- **Data sources:**
  - Thomson Reuters Datastream, Eikon, and Asset4 ESG databases.
- **Timespan:** 2011-2022.
- **Final sample:** 22,086 firm-year observations (4,373 unique companies) worldwide.



# Model and variables

- Empirical methodology: pooled OLS regression and fixed effects panel data models.

- **Dependent variable:**

- Ratio of total CO2 emission over total revenues.

—> Focus on firms' carbon intensity.

- **Main explanatory variable:**

- Ratio of total debt over total assets (one-year lagged).

- Control variables:

1. Financial and economic performance:

- Profitability performance: operating profitability.
- Liquidity performance: cash over total assets.
- Market performance: market-to-book ratio.
- Asset management performance: capex over total assets.

2. Country, industry, and year dummies (pooled OLS).

- All variables have been lagged by one year.

# Results

## Baseline results:

- Firms with a higher proportion of debt relative to equity are likely to exhibit higher carbon intensity.

	(1) Pooled OLS - No controls	(2) Pooled OLS	(3) FE - No controls	(4) FE
Leverage <sub>t-1</sub>	0.454*** (0.109)	0.440*** (0.120)	0.131*** (0.038)	0.116*** (0.042)
Market-to-book <sub>t-1</sub>		-0.014*** (0.003)		-0.001 (0.001)
OperatingProfitability <sub>t-1</sub>		-0.252* (0.139)		-0.098* (0.052)
CashOnAssets <sub>t-1</sub>		-0.123 (0.102)		0.072 (0.053)
CapexOnAssets <sub>t-1</sub>		0.803* (0.444)		-0.167 (0.129)
Industry FE	Yes	Yes	No	No
Country FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	23,262	22,086	23,262	22,086
R-squared	0.312	0.316	0.016	0.016
Mean VIF	2.570	2.280	1.380	1.960



# Endogeneity concerns

- To address endogeneity and the dynamic nature of carbon intensity:  
 → System GMM
- Results are confirmed.

	(1)
CO <sub>2</sub> EmissionsOnRevenues <sub>t-1</sub>	0.338*** (0.113)
Leverage <sub>t-1</sub>	0.431*** (0.126)
Market-to-book <sub>t-1</sub>	-0.019*** (0.004)
OperatingProfitability <sub>t-1</sub>	-0.146 (0.112)
CashOnAssets <sub>t-1</sub>	-0.336*** (0.108)
CapexOnAssets <sub>t-1</sub>	2.020*** (0.486)
Industry FE	No
Country FE	No
Firm FE	Yes
Year FE	Yes
Observations	18,404
No. of instruments	23
AR1 (p-value)	0.000
AR2 (p-value)	0.933
Hansen-J (p-value)	0.138

# Potential mechanisms

## 1) Financial constraints

We split the sample in

- Overleveraged firms: leverage higher than the industry-specific median in a given year.
- Non-overleveraged firms: leverage lower than the industry-specific median in a given year.

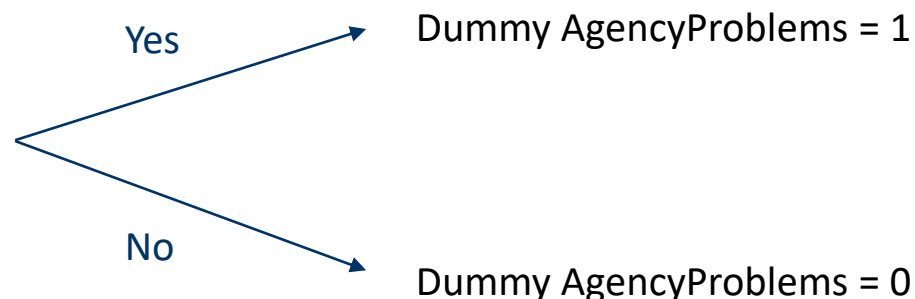
- Distressed firms: Altman Z-Score lower than the industry-specific median in a given year.
- Non-distressed firms: Altman Z-Score higher than the industry-specific median in a given year.

The positive relationship between leverage and carbon intensity is driven by overleveraged and financially distressed firms

# Potential mechanisms

## 2) Agency problems

Does the firm have high free cash flow, but low growth opportunities?



- We add the interaction term between the dummy AgencyProblems and the leverage ratio.
- The coefficient of the interaction term is positive and significant (1% level).



Leverage acts as a safeguard for shareholders' interests, limiting excessive investment in non priority carbon reduction practices

# Conclusion

## Theoretical contribution

- Leverage has a detrimental effect on companies' carbon performance.
- Debt likely becomes critical in worst-case scenarios (i.e., closer to financial distress).
- Debt is not equivalent to traditional governance tools, but it seems to act as an instrument for mitigating agency problems.

## Practical contribution

- Negative externalities (poorer carbon performance) might arise when financial constraints escalate.
- Managers should pay attention to carbon performance because ignoring it makes it harder to handle strict environmental regulations.

### Potential future research:

- Investigation of the perks of equity funding for carbon-efficient practices.
- Discrimination among types of debt contracts (e.g., green bonds?).



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**Thank you for your attention!**

**Any feedback/comment is welcomed**

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