

# Environmental Externalities and Cost of Capital

Sudheer Chava  
Associate Professor of Finance  
College of Management  
Georgia Institute of Technology

How can environmental externalities be **internalized** by a firm?

- Regulation
- Taxes
- Socially Responsible Investing
- Environmentally Responsible Lending

# Motivation: Socially Responsible Investing

## Socially Responsible Investing (SRI)

- **\$3.07 trillion** in assets tied to SRI in the U.S. as of 2010.
- **12.2%** of total assets under management in the U.S.
- SRI Strategies
  - Incorporation of **environmental**, social and governance (ESG) factors into investment analysis and portfolio construction
  - The filing or co-filing of shareholder resolutions on ESG issues and,
  - Deposits or investments in banks, credit unions, venture capital funds that have a specific mission of community investing

Source: Social Investment Forum's 2010 Trends in Socially Responsible Investing Trends

# Motivation: Environmentally Responsible Lending

- *...Faced with mounting pressure from protest groups, ten of the world's leading banks have agreed to adhere to international environmental and social-impact standards when financing dams, power plants, pipelines and other infrastructure projects... (Wall Street Journal, June 4, 2003)*
- *...Citigroup Inc., JPMorgan Chase & Co. and Morgan Stanley say they've produced **The Carbon Principles** together with several large power companies, Environmental Defense and the Natural Resources Defense Council, that will make it more difficult for new U.S. coal-fired power plants to secure financing. The focus of the principles will be to steer power companies away from plants that emit high levels of carbon dioxide (a greenhouse gas) and to focus on new, cleaner and renewable technologies. ... (Associated Press, Feb 4, 2008).*
- *...After years of legal entanglements arising from environmental messes and increased scrutiny of banks that finance the dirtiest industries, several large commercial lenders are taking a stand on industry practices that they regard as risky to their reputations and bottom lines... (Banks Grow Wary of Environmental Risks, New York Times, Aug 31, 2010)*

## Equator Principles

- Initiated by World Bank and International Financial Corporation (IFC)
- Signatories agree to integrate social & environmental risk in their lending decisions
- Signatories represent approximately 80% of global lending volume
- Signatories include Bank of America, Citibank, J.P. Morgan Chase

## CERES and RiskMetrics Survey

- Citi, Mitsubishi UFJ Financial Group, Mizuho Financial Group, Royal Bank of Canada and Wells Fargo are formally calculating carbon risk in their loan portfolios.
- Bank of America announced a specific target to reduce green house gas (GHG) emissions associated with its lending portfolio targeting a 7% reduction in the rate of GHG emissions
- 29 of the 40 banks analyzed in the study document their involvement in the burgeoning renewable energy and clean tech markets.
- Several U.S. and European banks have made multibillion dollar investments or financing commitments clean energy sector.

# Implications of Socially Responsible Investing (Lending)

- Exclusionary ethical investing can lead to
  - polluting firms being held by fewer investors,
  - a lower stock price for polluting firms and,
  - an **increase in their cost of capital** (Heinkel, Kraus, Zechner (2001))
- Similarly, socially responsible lending can lead to an **increase in the cost of capital** for the affected firms if
  - a significant number of lenders adopt environmentally sensitive lending policies and
  - firms can't easily substitute between various sources of capital
- Potential to impact the environmental policies of firms through the **cost of capital** channel

Does the **environmental profile** of a firm affect

- the firm's cost of equity capital?
- the firm's cost of debt capital?



Source: **KLD Stats**

- information on environmental concerns and environmental strengths for a large sample of firms
- rated by KLD Research & Analytics, Inc.
- S&P500 firms during 1991-2000 and expanding to Russell 2000 firms starting 2001.

# Firm's Environmental Profile

- **Environmental Concerns**
  - Hazardous Waste Concerns
  - Substantial Emission Concerns
  - Climate Change Concerns
- **Environmental Strengths**
  - Environmentally Beneficial Product Strength
  - Pollution Prevention Strength
  - Clean Energy Strength
  - Environmental Communication Strength

# Summary Environmental Measures

- **number of concerns** measures the total number of environmental concerns for the firm recorded in the KLD database and
- **number of strengths** is the total number of environmental strengths for the firm recorded in the KLD database.
- **net concerns** is a net measure of environmental concerns and is constructed as **number of concerns - number of strengths**.
- **climate score** is constructed as the difference of climate change concerns and clean energy strength.

# Expected Stock Returns

- Implied Cost of Capital (ICC) as a proxy for ex ante expected stock returns
- ICC is computed using discounted cash flow model of equity valuation following Lee, Gebhardt and Swaminathan (2001), Pastor, Sinha and Swaminathan (2007), and Chava and Purnanandam (2009)
- ICC is the internal rate of return that equates the present value of free cash flows to equity to current stock price.
- ICC as a proxy for expected returns
  - Advantages: a forward looking measure, doesn't explicitly rely on any asset pricing model, and doesn't need long sample periods.
  - Disadvantages: requires assumptions on model inputs such as forecasting horizon and dividend payouts. Important to perform several sensitivity analyses.

# Descriptive Statistics: ICC

## Panel C: Desc. Stats for the Firm Level Variables

Variable	Mean	Median	Std. Dev.
<b>Inputs for expected return computation</b>			
EPS1	1.90	1.58	2.20
EPS2	2.25	1.86	2.25
LTG	0.15	0.14	0.10
<b>Measures of Expected Return</b>			
$r_e$	8.23	7.92	2.61
$r_e - r_f$	4.18	3.91	2.87
<b>Firm-Level Characteristics</b>			
<i>assets</i> (billions \$US)	6.05	1.85	12.06
<i>lever</i>	0.22	0.22	0.17
<i>mtb</i>	2.15	1.69	1.37
$ret_{t-1,t}$	0.0051	0.0033	0.0964
<i>stdret</i>	0.0963	0.0856	0.0475

# Bank Loan Data

Source for Bank Loan Data: [Dealscan](#)

- distributed by the Loan Pricing Corporation (Reuters)
- contains information on approximately 106,000 facilities to domestic companies
- approximately 50,000 facilities can be linked firm level balance sheet information in Compustat (using Chava and Roberts (2008) link file)
- merging with the KLD database results in 5879 bank loans to non-financial firms during 1992 – 2007

# Bank Loan Data

- key dependent variable: log of loan spread **aisd** (all-in-spread-drawn).
- similar to Graham, Li and Qiu (2008) and Chava, Livdan and Purnanandam (2009),
- measures the amount the borrower pays in basis points over LIBOR
- adds the spread of the loan with any annual fees (or facility fee) paid to the bank

## Descriptive Statistics: Bank Loan Sample

### Panel C: Desc. Stats for Loan and Firm Level Variables

Variable	mean	median	std. dev.
<b>Loan Characteristics</b>			
<i>aids</i> ( <i>bps</i> over LIBOR)	125.05	87.50	113.03
<i>loansize</i> (millions \$US)	568.46	300.00	739.84
<i>loanmat</i> (months)	44.53	59.00	23.90
<i>perprice</i>	0.51	1.00	0.50
<i>termloan</i>	0.19	0.00	0.39
<b>Firm-Level Characteristics</b>			
<i>assets</i> (billions \$US)	7.83	2.98	12.12
<i>opincbefdep_a</i>	0.04	0.04	0.02
<i>lever</i>	0.29	0.28	0.17
<i>modzscore</i>	0.76	0.76	0.66
<i>unrated</i>	0.26	0.00	0.44
<i>invgrade</i>	0.50	1.00	0.50
<b>Macro Variables</b>			
<i>cspspread</i> ( <i>bps</i> )	0.87	0.83	0.19
<i>tspspread</i> ( <i>bps</i> )	1.29	1.00	1.18



- Dependent variable is **expected risk-premium** calculated as the difference between the ICC and one-year risk-free rate
- All regressions include (based on Chava and Purnanandam (2010))
  - log(total assets)
  - leverage
  - market to book ratio
  - past one month stock return
  - standard deviation of firm's daily stock returns over the past year
  - **year fixed effects**
- Separate specifications with and without **industry fixed effects** (2-digit SIC)
- Standard errors are clustered at the **firm** level

# Bank Loan Pricing Regression Specification

- Dependent variable is **log(loan spread)**
- All regressions include (based on Chava, Livdan and Purnanandam (2010))
  - **loan level controls**: loan maturity, loan purpose indicators, performance pricing dummy, dummy for loan type
  - **firm level controls**: log(total assets), ratio of operating income before depreciation to total assets, leverage, modified z-score, dummies for unrated and investment grade rating
  - **macro variables**: term spread and credit spread
  - **year fixed effects**
- Separate specifications with and without **industry fixed effects** (2-digit SIC)
- Standard errors are clustered at the **firm** level

# Impact of Environmental Concerns and Strength Indices on ICC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>netconcerns</i>	0.1726 [4.47]	0.1298 [3.77]						
<i>numconcern</i>			0.1762 [3.95]	0.1465 [3.81]				
<i>numstrength</i>					-0.0598 [-0.93]	-0.0421 [-0.72]		
<i>climscore</i>							0.4804 [4.04]	0.2462 [2.17]
$R^2$	0.220	0.364	0.217	0.363	0.219	0.364	0.191	0.330
$N$	13114	13114	13114	13114	13114	13114	9413	9413
control variables	yes	yes	yes	yes	yes	yes	yes	yes
industry fixed effects	no	yes	no	yes	no	yes	no	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm	firm	firm

# Impact of Environmental Concerns and Strength Indices on Bank Loan Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>netconcerns</i>	0.0502 [3.24]	0.0535 [3.01]						
<i>numconcern</i>			0.0518 [3.05]	0.0606 [3.07]				
<i>numstrength</i>					-0.0360 [-1.06]	-0.0448 [-1.31]		
<i>climscore</i>							0.0503 [1.28]	0.0276 [0.62]
$R^2$	0.632	0.719	0.632	0.718	0.630	0.717	0.610	0.690
$N$	5879	5879	5879	5879	5879	5879	4602	4602
industry fixed effects	no	yes	no	yes	no	yes	no	yes
loan level controls	yes	yes	yes	yes	yes	yes	yes	yes
macro variables	yes	yes	yes	yes	yes	yes	yes	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm	firm	firm

# Impact of Individual Environmental Concerns on ICC

	(1)	(2)	(3)	(4)	(5)	(6)
<i>hazardwaste</i>	0.2673 [2.30]	0.2338 [2.38]				
<i>submissions</i>			0.2922 [2.35]	0.1801 [1.72]		
<i>climchange</i>					0.6879 [4.34]	0.4777 [2.75]
$R^2$	0.218	0.363	0.218	0.363	0.191	0.331
$N$	13114	13114	13114	13114	9413	9413
control variables	yes	yes	yes	yes	yes	yes
industry fixed effects	no	yes	no	yes	no	yes
year fixed effects	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm

# Impact of Individual Environmental Concerns on Bank Loan Spreads

	(1)	(2)	(3)	(4)	(5)	(6)
<i>hazardwaste</i>	0.1229 [2.74]	0.1332 [2.76]				
<i>submissions</i>			0.0904 [1.90]	0.1174 [2.36]		
<i>climchange</i>					0.1492 [3.03]	0.0293 [0.45]
$R^2$	0.631	0.718	0.630	0.717	0.612	0.690
$N$	5879	5879	5879	5879	4602	4602
industry fixed effects	no	yes	no	yes	no	yes
loan level controls	yes	yes	yes	yes	yes	yes
macro variables	yes	yes	yes	yes	yes	yes
year fixed effects	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm

# Impact of Individual Environmental Strengths on ICC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>benproduct</i>	-0.2269 [-1.33]	-0.2550 [-1.41]						
<i>polprevent</i>			0.2348 [2.11]	0.0956 [0.87]				
<i>cleanenergy</i>					-0.4082 [-3.22]	-0.0668 [-0.54]		
<i>envcomm</i>							0.2320 [1.23]	0.2098 [1.31]
$R^2$	0.218	0.363	0.218	0.363	0.218	0.363	0.222	0.360
$N$	13114	13114	13114	13114	13114	13114	10783	10783
control variables	yes	yes	yes	yes	yes	yes	yes	yes
industry fixed effects	no	yes	no	yes	no	yes	no	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm	firm	firm

# Impact of Individual Environmental Strengths on Bank Loan Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>benproduct</i>	-0.2090 [-3.33]	-0.1617 [-2.40]						
<i>polprevent</i>			-0.0984 [-1.28]	-0.0597 [-0.69]				
<i>cleanenergy</i>					0.0606 [1.01]	-0.0725 [-1.08]		
<i>envcomm</i>							-0.0646 [-0.85]	-0.0015 [-0.02]
$R^2$	0.631	0.717	0.630	0.717	0.630	0.717	0.625	0.706
$N$	5879	5879	5879	5879	5879	5879	5186	5186
control variables	yes	yes	yes	yes	yes	yes	yes	yes
loan level controls	yes	yes	yes	yes	yes	yes	yes	yes
macro variables	yes	yes	yes	yes	yes	yes	yes	yes
industry fixed effects	no	yes	no	yes	no	yes	no	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
std err clustering	firm	firm	firm	firm	firm	firm	firm	firm



Why do investors demand higher expected returns on stocks with environmental concerns?

- Risk
  - Regulatory Risk
  - Litigation and Compliance Costs for Borrower
  - Credit Risk
- Exclusionary Socially Responsible Investing

Why would lenders consider the environmental profile of the firm in pricing loans?

- Credit Risk
  - Regulatory Risk
  - Litigation and Compliance Costs for Borrower
- Lender Liability Laws
- Reputation Risk for the lender

- All the original signatories of Equator Principles had been the targets of NGO campaigns beforehand
- Environmental action groups have
  - persuaded supporters to cut up their credit cards and mail them back to the company,
  - Introduced shareholder proposals related to environmental policies
  - kept the pressure on banks financing mountain top removal coal mining and tar sand exploration.
  - For example, Bank of America announced its withdrawal from mountain top removal, with other banks being reluctant to step into financing tar sands.

# Are Environmental Concerns and Strengths Proxying for an Omitted Component of Firm's Default Risk?

## Bankruptcy Model

- Bankruptcy data from Chava and Jarrow (2004) and Chava, Stefanescu and Turnbull (2008)
- Sample period is 1990-2008
- Cox proportional hazards model
- Dependent variable is bankruptcy set to one if the firm has filed for bankruptcy that year and zero otherwise
- Shumway (2001) variables: net income to total assets, total liabilities to total assets, volatility of stock returns, excess return and relative size

# Are Environmental Concerns and Strengths Proxying for an Omitted Component of Firm's Default Risk?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<i>netconcerns</i>	-0.3068 [-1.31]										
<i>numconcern</i>		-0.1165 [-0.46]									
<i>numstrength</i>			0.4341 [1.76]								
<i>climscore</i>				-1.4313 [-2.73]							
<i>hazardwaste</i>					-0.5376 [-0.94]						
<i>submissions</i>						0.3421 [0.60]					
<i>climchange</i>							-0.2387 [-0.28]				
<i>benproduct</i>								0.6108 [1.08]			
<i>polprevent</i>									0.4585 [0.70]		
<i>cleanenergy</i>										1.1633 [2.88]	
<i>envcomm</i>											1.0806 [2.61]

# Impact of Environmental Concerns and Strengths on Institutional Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>netconcerns</i>	-0.0114 [-3.16]	-0.0059 [-1.59]						
<i>numconcern</i>			-0.0232 [-5.98]	-0.0143 [-3.31]				
<i>numstrength</i>					-0.0281 [-4.44]	-0.0157 [-2.66]		
<i>climscore</i>							-0.0251 [-1.90]	-0.0119 [-1.20]
<i>hazardwaste</i>	-0.0385 [-3.60]	-0.0241 [-2.16]						
<i>submissions</i>			-0.0291 [-2.92]	-0.0090 [-0.94]				
<i>climchange</i>					-0.0932 [-6.53]	-0.0392 [-2.54]		
<i>benproduct</i>	0.0072 [0.49]	0.0016 [0.12]						
<i>polprevent</i>			0.0013 [0.11]	-0.0238 [-1.97]				
<i>cleanenergy</i>					-0.0909 [-6.15]	-0.0193 [-1.60]		
<i>envcomm</i>							-0.0340 [-2.16]	-0.0250 [-1.78]

# Impact of Environmental Concerns and Strengths on # of Institutional Owners

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>netconcerns</i>	-0.0151 [-4.22]	-0.0184 [-4.62]						
<i>numconcern</i>			-0.0122 [-2.82]	-0.0201 [-3.98]				
<i>numstrength</i>					0.0140 [2.16]	0.0074 [1.08]		
<i>climscore</i>							-0.0372 [-3.21]	-0.0243 [-1.95]
<i>hazardwaste</i>	-0.0424 [-3.30]	-0.0575 [-4.12]						
<i>submissions</i>			-0.0086 [-0.87]	-0.0202 [-1.94]				
<i>climchange</i>					-0.0380 [-2.57]	-0.0223 [-1.22]		
<i>benproduct</i>	0.0468 [2.84]	0.0331 [1.93]						
<i>polprevent</i>			0.0162 [1.13]	-0.0015 [-0.10]				
<i>cleanenergy</i>					0.0143 [0.94]	0.0282 [2.00]		
<i>envcomm</i>							-0.0242 [-1.54]	-0.0381 [-2.67]

## Impact of Environmental Profile on the Loan Syndicate Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>netconcerns</i>	-0.0418 [-2.36]	-0.0479 [-2.43]						
<i>numconcern</i>			-0.0441 [-2.23]	-0.0492 [-2.19]				
<i>numstrength</i>					0.0271 [0.70]	0.0538 [1.32]		
<i>climscore</i>							-0.0352 [-0.84]	-0.0430 [-0.91]
$R^2$	0.283	0.414	0.283	0.414	0.282	0.413	0.334	0.413
$N$	5879	5879	5879	5879	5879	5879	4602	4602
<i>hazardwaste</i>	-0.0035 [-0.06]	-0.0392 [-0.66]						
<i>submissions</i>			-0.1898 [-3.42]	-0.1680 [-2.86]				
<i>climchange</i>					-0.0548 [-0.95]	-0.0539 [-0.73]		
$R^2$	0.282	0.413	0.285	0.414	0.334	0.413		
$N$	5879	5879	5879	5879	4602	4602		



- **Yes.** The environmental profile of a firm affects the expected stock returns
  - Environmental Concerns: increases the ICC
  - Environmental Strengths: **no** meaningful relation with ICC
- Environmental profile is **not** simply proxying for an omitted component of **default risk** of the firm.
- But it is a challenging task to conclusively rule out the risk story
- Why do investors expect higher returns on stocks with environmental concerns?
  - Stocks with environmental concerns have a **lower** institutional ownership and are held by **fewer** institutional investors
  - Consistent with exclusionary socially responsible investing having an impact on the expected returns

- **Yes.** The environmental profile of a firm affects the price and non-price terms of its bank loans
  - Environmental Concerns: increases loan spreads
  - Environmental Strengths: decreases loan spreads
- Why would lenders consider the environmental profile of the firm in pricing loans?
  - Environmental profile is **not** simply proxying for an omitted component of **default risk** of the firm
  - **Lower** syndicate size for firms with environmental concerns
- Consistent with **reputation risk** channel.
- But it is a challenging task to conclusively rule out the risk story

## Socially responsible investing / lending

- can increase the cost of capital of firms with environmental concerns
- has a potential to impact the environmental policies of the firm through the cost of capital channel