Embedding Water Risk in Corporate Bond Analysis

First steps in developing a tool to link water risks with key financial indicators

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1. Pilot Project Overview and Rationale

First steps in developing a tool to link water risks with key financial indicators

Gaps in the Water Literature to Date

Equity Reports

Identify High Growth Firms

Model High Growth Firms

Model Water Exposure of Equity Index

Credit Reports

Identify Firms Vulnerable to Water Downside

Model Firms Vulnerable to Water Downside

This Project >>

Model Water Exposure in Bond Index

Purpose

- **Aim of this project:** develop specific methodologies to quantify water risks in fixed-income investments.

- **Outcome of this project:** excel-based tool that directly links water risks with core financial indicators that analysts use to determine the value of a corporate bond.

→ This will enable bond analysts to quantify water metrics and incorporate water risks directly in the credit risk analysis for corporate bond valuations.

Project Partners and Structure

Project Management Team
(GIZ/NCD/VfU)

Financial Institution Partners

UBS · Calvert Investments (an Ameritas company) · PAX Pax World Investments · ROBECOSAM Sustainability Investing · J. SAFRA SARASIN Sustainable Swiss Private Banking since 1841 · BANORTE

Expert Council (18 experts from academia, IOs and initiatives, NGOs and private sector)

Guidance on development of framework and tool and feedback from testing

Research Team

(Senior Fixed Income Analyst and Natural Resource Economist)

BMZ Federal Ministry for Economic Cooperation and Development · Natural Capital Declaration (Financial sector leadership on natural capital) · Secretariat: UNEP Finance Initiative (Changing finance, financing change) · GCP Global Canopy Programme · VfU · giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH · Emerging Markets Dialogue

Timeline

Month	Project timeline	Role of participating financial institutions
2014		
Sept.	Phase 1: Preparation and assessment of needs and scope.	input on scope, research design, tool requirements, current risk assessment procedures, relevant methodolgies.
Oct.		
Nov.	Phase 2: Research and framework development.	
Dec.		review of draft methodology
Jan/15		
Feb.		
Mar		
Apr.	Phase 3: Testing application of methodology through trial of tool by financial institutions	Test tool on your corporate bond portfolio and provide feedback
May		
June		
July	Phase 4: Refine and enhance framework.	
Aug.		
Sept.	Phase 5: Launch Tool	participation in launch event

2. Overview Approach

First steps in developing a tool to link water risks with key financial indicators

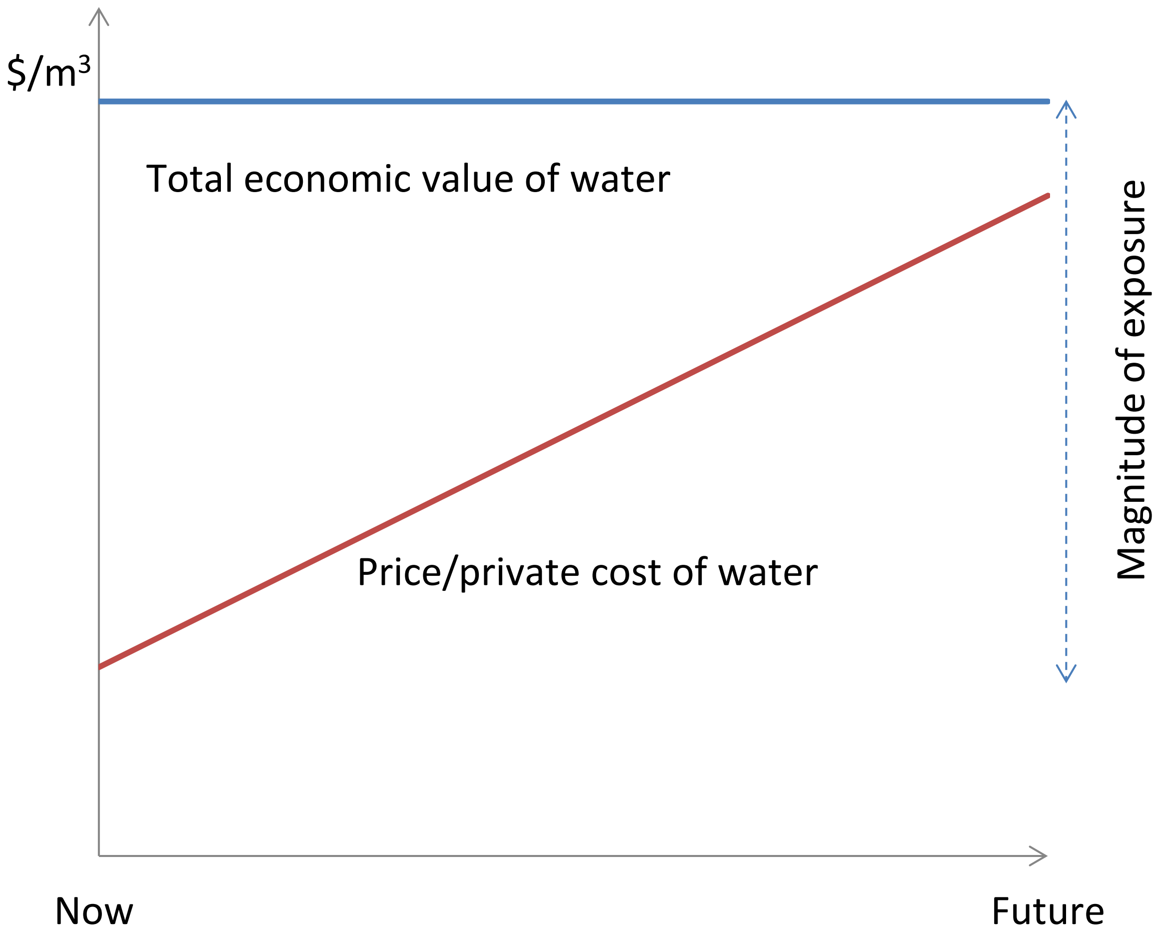
Overview Approach

- **Use data on location-specific water stress** to determine the total economic value/shadow price of water around the world and compare with currently paid costs for water
- **Overlay company data on** location of operations and water extraction/use by location **with the location-specific water valuations**
- **Model impact on companies' financials** if use of water becomes restricted or higher water price is imposed
- **Compare adjusted credit ratios** with those required by the rating agencies

3. Valuing Water and Quantifying Water Risk Exposure

First steps in developing a tool to link water risks with key financial indicators

Underpriced Water in Stressed Areas



Gap can close through:

- Limited physical availability of water
- Increase in price for water/abstraction licenses
- Quantitative restriction of access to water by regulator

Determining the Value of Water

The value of water (used as shadow price) will be determined as a function of several variables:

- Local water stress ratio (withdrawals/supply)
- Local total water availability
- Local population (within 50km)
- Local per capita income
- Local health impacts of reduced water availability
- Local environmental values

Data Sources

Data Required		Sources
Biophysical data	Water supply and demand	Raw data: • FAO Aquastat • Satellite data, Glowasis, GLDAS Hydrological models: • Water GAP, University of Kassel
Bioeconomic data	Location-specific water use of company operations (water exposure)	Water exposure: • Corporate disclosures: company reports CDP, Bloomberg, MSCI • Proxies: Location-specific; intensity-specific
Population growth & income growth		• World Bank
Municipal water prices		• GWI annual municipal water price survey

Outcomes Shadow Pricing Work

- **Spatial map of water values** that provide shadow prices for a given location calculated as a function of water stress and other variables
- Provides a **scientific basis for** choosing **boundaries to stress-test** company revenue projections, EBITDA ratios, etc.
  - E.g. 30%, 60%, 100% of shadow price
- **Caveats:**
  - Validity of valuations depends on underlying assumptions
  - Accuracy may be reduced where using modelled data and averages
- **Issues to tackle in the next two months:**
  - Non-linearity of internalization
  - Different prices for consumptive and non-consumptive water use

4. Integrating Water Risk in Corporate Bond Credit Analysis

First steps in developing a tool to link water risks with key financial indicators

Sector Focus

1. **Mining**
2. Power Generation
3. Food & Beverage/Tech (Semiconductors)/Pulp & Paper

FT 27.07.2014
"**Spending by mining companies on water infrastructure** amounted to **almost $12bn last year**, compared with $3.4bn in 2009, EY said. BHP Billiton and Rio Tinto, the two largest in the world by market capitalisation, are investing $3bn to build a desalination plant at Escondida, the Chilean copper mine that is the world's largest by output."

Example Mining

	Antofagasta	Rio Tinto	Vedanta
HQ	London	London	Mumbai
Operations	Chile	Global	India
Metals	Copper	Iron ore, diversified	Iron ore, zinc, lead, copper
Market Capitalisation, £ billion	£7.1 billlion	£55.7 billion	£2.1 billion
EBITDA/Revenues, 2013	45.3%	44.3%	34.7%
Gross debt/EBITDA, 2013	0.51	1.26	3.33
Credit Rating	(NR/NR)	(A3/A-)	(Ba1/BB)

- **Vedanta:** high yield (leverage >3x), modest market capitalization, Emerging Market focus
- **Rio Tinto:** investment grade (leverage < 1.5x), larger market capitalization, diversified by metal and country of operation
- **Antofagasta:** very low leverage, little debt, no bond issuance and no credit rating

Example Mining

Introducing location-specific water costs

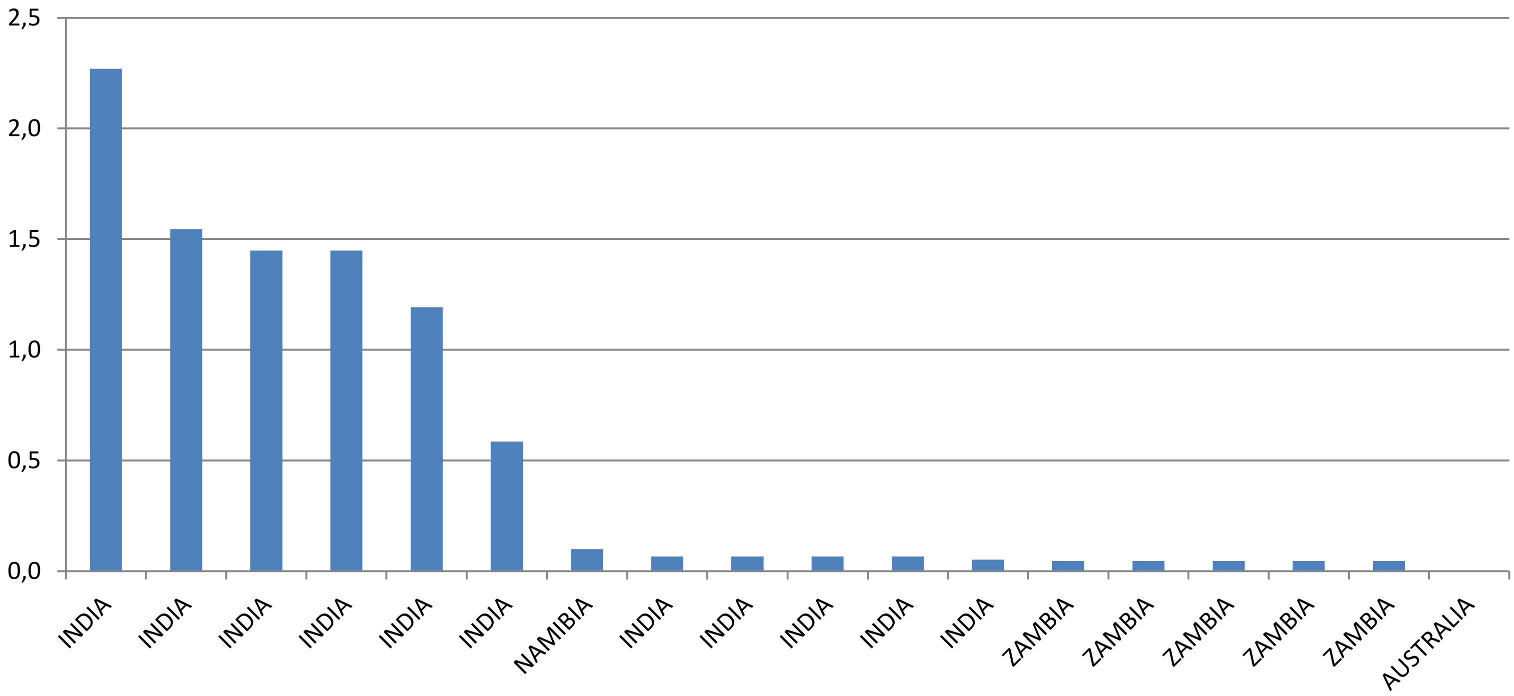
Vedanta:

Mine Name		Primary Metal	Country	Water demand 2020 optimistic	Water demand 2020 BAU	Water demand 2020 pessimistic	Water supply 2020 optimistic	Water supply 2020 BAU	Water supply 2020 pessimistic	Water Demand/Supply 2020
Bicholim Iron Ore Mine	15	Iron Ore	INDIA	0.071	0.072	0.070	1.056	1.080	1.080	0.07
Agnigundala Lead Mine	16	LEAD	INDIA	0.245	0.249	0.248	0.156	0.161	0.161	1.54
Surla Sonshi Iron Ore Mine	17	Iron Ore	INDIA	0.071	0.072	0.070	1.056	1.080	1.080	0.07
Chitradurga Iron Ore Mine	18	Iron Ore	INDIA	0.287	0.290	0.289	0.231	0.243	0.243	1.19
Colomba/Curpem Iron Ore Mines	19	Iron Ore	INDIA	0.064	0.064	0.063	1.212	1.239	1.239	0.05
Sonshi Iron Ore Mine	20	Iron Ore	INDIA	0.071	0.072	0.070	1.056	1.080	1.080	0.07
Codli Iron Ore Mines	21	Iron Ore	INDIA	0.071	0.072	0.070	1.056	1.080	1.080	0.07
Zawar Udaipur Lead/Z	22	LEAD	INDIA	0.161	0.162	0.160	0.275	0.277	0.277	0.59
Rajpura-Dariba Zinc	23	Zinc	INDIA	0.206	0.208	0.207	0.154	0.143	0.143	1.45
Kayar Zinc Deposit	24	Zinc	INDIA	0.172	0.173	0.173	0.081	0.076	0.076	2.27
Rampura-Agucha Lead	25	LEAD	INDIA	0.206	0.208	0.207	0.154	0.143	0.143	1.45
Mount Lyell Copper/G	26	Copper	AUSTRALIA	0.000	0.000	0.000	0.712	0.743	0.743	0.00
Skorpion Zinc Mine	27	Zinc	NAMIBIA	0.000	0.000	0.000	0.000	0.000	0.000	0.10
Nchanga Copper/Cobalt Mine	28	Copper	Zambia	0.021	0.021	0.020	0.466	0.468	0.468	0.05
Konkola Deep Copper Mine	29	Copper	Zambia	0.021	0.021	0.020	0.466	0.468	0.468	0.05
Nchanga UG Copper/Cobalt Mine	30	Copper	Zambia	0.021	0.021	0.020	0.466	0.468	0.468	0.05
Nchanga OP Copper/Cobalt Mine	31	Copper	Zambia	0.021	0.021	0.020	0.466	0.468	0.468	0.05
Konkola Copper/Cobalt Mine	32	Copper	Zambia	0.021	0.021	0.020	0.466	0.468	0.468	0.05

Example Mining

Ranking mines by demand/supply ratios

Vedanta: Projected 2020 Water Demand/Supply Ratio, by Mine



Example Mining

Proportion of mines in water stressed areas

Water cost assumptions:

$10/m³ extreme stress areas; $5/m³ in stressed areas, $1/m³ in non stressed areas

Antofagasta

7 out of 21 mines	33.3%	are in areas of extreme water stress	(D/S>2)	Average water price: $5.28/m³
7 out of 21 mines	33.3%	are in areas of water stress	(D/S>0.5)	
7 out of 21 mines	33.3%	are in areas of limited water stress	(D/S<0.5)	

Rio Tinto

5 out of 92 mines	5.4%	are in areas of extreme water stress	(D/S>2)	Average water price: $1.62/m³
3 out of 92 mines	3.3%	are in areas of water stress	(D/S>0.5)	
84 out of 92 mines	91.3%	are in areas of limited water stress	(D/S<0.5)	

Vedanta

1 out of 18 mines	5.6%	are in areas of extreme water stress	(D/S>2)	Average water price: $2.61/m³
5 out of 18 mines	27.8%	are in areas of water stress	(D/S>0.5)	
12 out of 18 mines	66.7%	are in areas of limited water stress	(D/S<0.5)	

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Example Mining

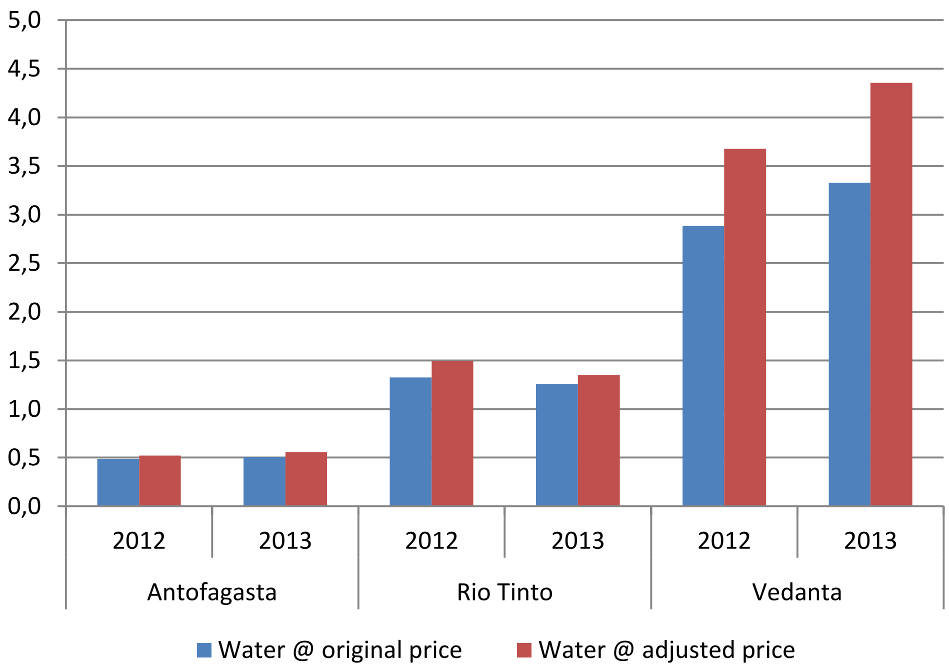
Introducing location-specific water costs

	Antofagasta		Rio Tinto		Vedanta	
	2012	*2013*	*2012*	*2013*	*2012*	*2013*
Revenues	6,740	5,972	50,942	51,171	14,640	12,945
EBITDA	3,864	2,702	20,291	22,672	4,909	4,491
Gross debt	1,889	1,374	26,904	28,551	14,158	14,950
EBITDA/Revenues	57.3%	45.3%	39.8%	44.3%	33.5%	34.7%
Gross debt/EBITDA	0.49	0.51	1.33	1.26	2.88	3.33
Water consumption; million m^3	46	45	1,396	952	406	405
Water consumption; m^3/$1,000 revenues	6.8	7.5	27.4	18.6	27.7	31.3
Assumed water price	5.28	5.28	1.62	1.62	2.61	2.61
Adjusted EBITDA	3,622.6	2,466.7	18,030.1	21,130.2	3,849.0	3,433.0
Gross debt/adjusted EBITDA	0.52	0.56	1.49	1.35	3.68	4.35

Example Mining

Introducing location-specific water costs

Gross debt/EBITDA Ratios



Differences in Water Efficiency

Antofagasta:

- has higher proportion of its mines in extreme stress regions
- therefore higher average water price (average 5.28/m^3)
- But: water intensity of only 7.5 m^3/$1000 revenue (compare Vedanta: 31,3 m^3/$1000 revenue)

→ Antofagasta's ratios are still little impacted vs peers when it has to pay more for its water

Next Steps in Developing the Model

- Model introduction of **shadow pricing** at each location
- Obtaining **location-specific corporate data** for third sector
- **Model how firms** (by sector) are likely to **respond to/internalize** higher water costs:
  - Absorb ("eat") the higher water costs (base model)
  - Cut production to avoid higher water costs or respond to physical/regulatory limits to water withdrawals
  - Invest CAPEX to reduce water use (water efficiency technology) or create water (e.g. desalination)

    → model the technology costs

5. Conclusions and Questions for Feedback

First steps in developing a tool to link water risks with key financial indicators

Conclusions

- We use the gap between total economic/public cost of water and the prices currently charged/private cost of water as an **indicator for the magnitude of water risk**.
- We derive a **location-specific shadow price** reflecting these total economic/public costs **as a function of water stress** and other variables.
- We model water risk exposure by **overlaying location-specific corporate data with shadow prices**.
- Result: By **adjusting company financials to** reflect potential **costs of water stress**, water risk is reflected in ratios like debt/EBITDA and **enhances the credit risk analysis** for corporate bonds valuation.

Next steps:

- **Model** different **adaptation responses**: absorbing price, cutting production, investing in CAPEX (water efficiency and water creation).
- Differentiate shadow pricing between water for **consumptive and non-consumptive use**

Thank you very much for your attention!

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BMZ Federal Ministry for Economic Cooperation and Development

Natural Capital Declaration Financial sector leadership on natural capital

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Questions for Feedback

- **Complexity vs. accuracy**: How exact should the modelling, e.g. of different technology options, be for the purposes of a bond analyst?
- **Non-linearity/probability of internalization**: So far no attempt to model drivers for internalization (such as regulation) except water stress. Role of the bond analyst to monitor changes in regulatory framework und use this tool accordingly?
- Do you think the approach of **modelling water risk through a shadow price** makes sense? Other approaches you consider more valid?
- **What changes would you make** to the design we are planning for the tool to make it relevant for your credit risk analysis?
- Which **sector focus** would you choose for Brazil?