The intersection of green finance with clean transportation

Lessons from the market for Green Bonds

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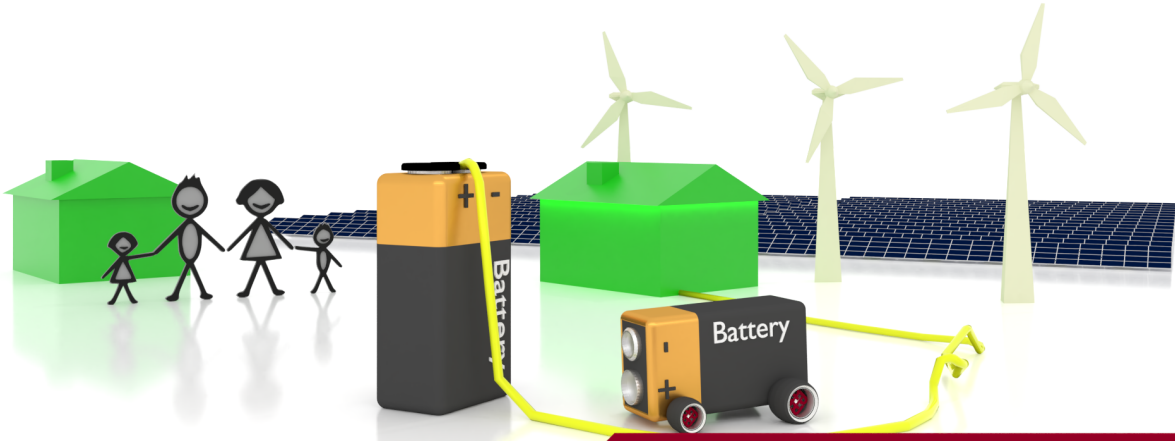
Before we get started... let's review some big issues.



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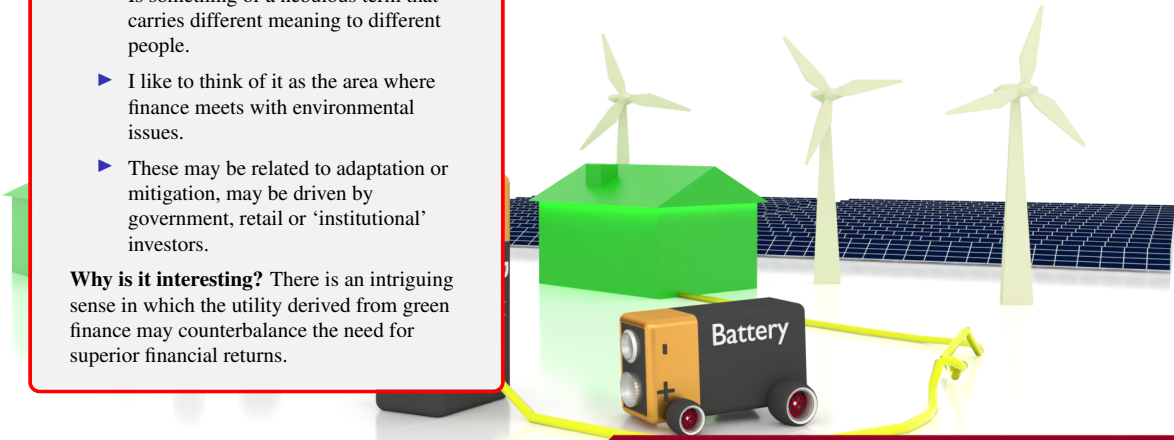
Green Finance

- Is something of a nebulous term that carries different meaning to different people.
- I like to think of it as the area where finance meets with environmental issues.
- These may be related to adaptation or mitigation, may be driven by government, retail or 'institutional' investors.

Why is it interesting? There is an intriguing sense in which the utility derived from green finance may counterbalance the need for superior financial returns.

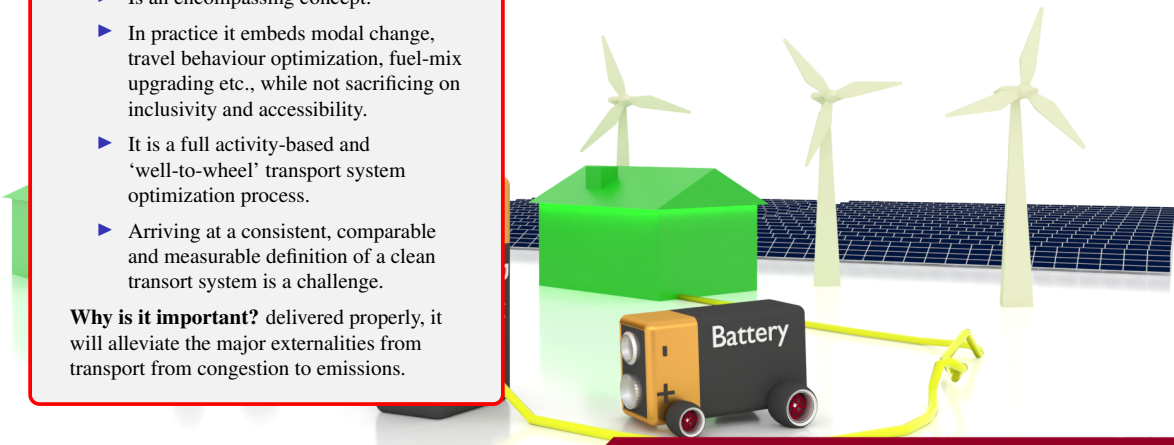


Before we get started... let's review some big issues.

Clean transportation

- Is an encompassing concept.
- In practice it embeds modal change, travel behaviour optimization, fuel-mix upgrading etc., while not sacrificing on inclusivity and accessibility.
- It is a full activity-based and 'well-to-wheel' transport system optimization process.
- Arriving at a consistent, comparable and measurable definition of a clean transort system is a challenge.

Why is it important? delivered properly, it will alleviate the major externalities from transport from congestion to emissions.



Outline for today's talk

In today's talk I hope to establish the foundations of a story that will help you position my thinking, and possibly provide a new trajectory to your own.

I. A reflection on the market for green bonds
What is the scale and scope of the market up to Nov. 2019?

II. A snapshot of Singapore's position in this market
Has Singapore issued green bonds? Is there scope for alternative investment

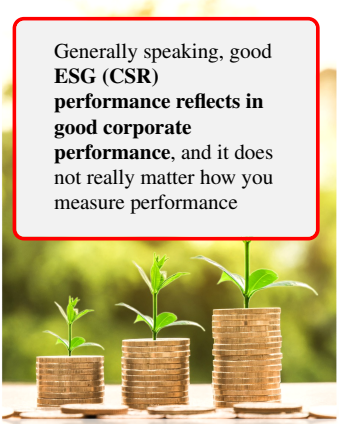
III. The intersection of green finance with clean transportation Part I - existing green bonds
How are green bonds being used to deliver clean transport

IV. The intersection of green finance with clean transportation Part II - Some global empirical benchmarks
Green-finance as an advanced factor of production & the economic performance costs of clean transport

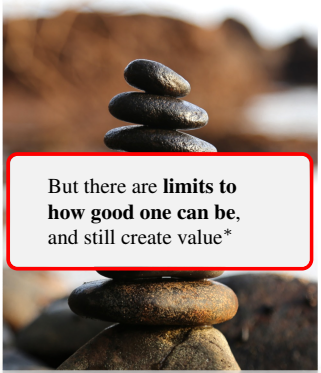
IV. Wrap-up
Some preliminary conclusions will be drawn up with policy implications summarized.

Doing well by doing good: Green finance as an advanced factor of production

Generally speaking, good **ESG (CSR) performance reflects in good corporate performance**, and it does not really matter how you measure performance



Doing well by doing good: Green finance as an advanced factor of production



But there are **limits to how good one can be**, and still create value*

Doing well by doing good: Green finance as an advanced factor of production

There are knowledge spillovers - steps taken in achieving **superior ESG performance creates room for enhanced** exploitative and explorative **innovation** to occur

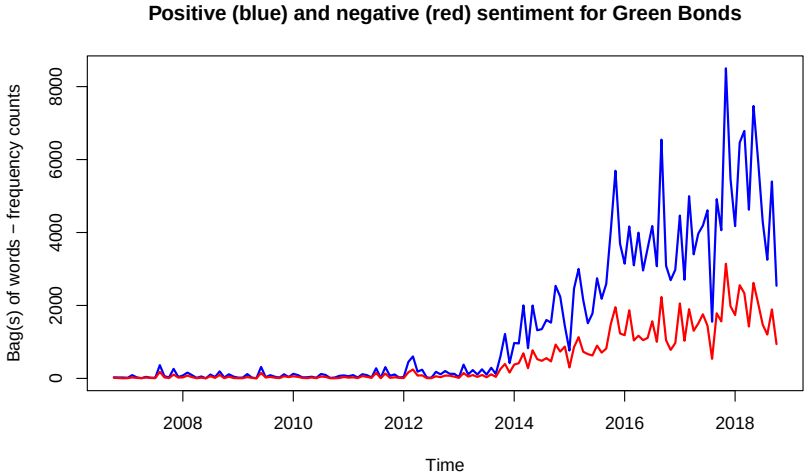
The birth of a financial instrument

https://www.environmental-finance.com/content/the-green-bond-hub/green-bond-reporting.html

- In **March 2007**, the European Union's Energy Action Plan set ambitious targets in the areas of renewable energy and energy efficiency, urging the European Investment Bank to engage in these areas.
- EIB chose to emphasize its commitment via a climate-related capital market product, fostering public awareness and reaching new investors by issuing the world's first green bond – a 600 million Euro-dollar transaction labeled a **'Climate Awareness Bond'** – in June 2007.
- EIB's Climate Awareness Bond **proceeds are earmarked for disbursement to renewable energy and energy efficiency projects**. This **aligns with EU policy goals** of increasing the share of renewable energy, enhancing energy efficiency, and achieving greenhouse gas emission savings of at least 40% by 2030.

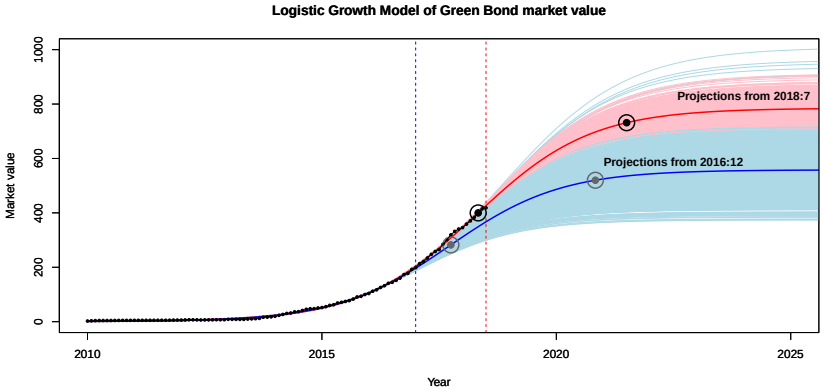
Green Bonds in the news - and the nature of sentiment

Monthly aggregates from (unique) 5300 news articles



An exciting market trend

Has socially responsible investment finally hit the mainstream?



Some key statistics and trends

An initial glance at the first ten years

- **Issuances** refers to the number of new labelled green bonds issued
- **Value** represents the average US$ value of the bonds issued, in billions
- **Maturity** refers to the average termination date of a bond issued

	2007	**2008**	**2009**	**2010**	**2011**	**2012**
Issuances	1	1	3	61	35	25
Value (mean)	0.71	0.38	0.27	0.05	0.03	0.11
Value (total)	0.71	0.38	0.82	2.91	1.01	2.80
Maturity	2012.00	2014.00	2013.33	2015.41	2016.26	2019.44

	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Issuances	49	163	252	393	1560	1032
**Fannie Mae*				108	1143	754
				285	**417**	**278**
Value (mean)	0.21	0.2	0.19	0.23	0.11	0.10
Value (total)	10.29	33.2	45.34	89.16	165.84	98.34
Maturity	2018.98	2022.10	2026.09	2027.58	2028.12	2040.05

What is a green bond?

The 'green bond principles' outlined–initiated in January 2014 by ICMA

Determined by a voluntary coalition of equal numbers of underwriters, issuers & investors (24 in total) of Green Bonds, providing 'best-practice' guide. Europe & US well represented, less prominence for Asia.

- **Principle 1: Use of proceeds** Description of use of proceeds should be included in the legal documentation
- **Principle 2: Project evaluation and selection** Issuers should outline the process used in determining project eligibility, including the process, criteria, and environmental sustainability objectives
- **Principle 3: Management of proceeds** Recommends the segregation of funds in a separate portfolio (ring fencing of proceeds) and disclosure of intended investments for unallocated proceeds
- **Principle 4: Reporting** The reporting should cover use of proceeds reporting and impact reporting
- **Principle 5: External review is recommended**

The perspective of a ratings agency

What are the typical eligibility factors

Let us borrow the S&P view of the world here:

- **Disclosure:** The issuer must themselves clearly demarcate a bond as being green - which can be done through a number of channels
- **Country/currency:** Any country/currency is viable
- **Green Flag:** Bonds must be certified green by the Climate Bonds Initiative (CBI).
- **Maturity:** Maturity must be greater than one month within the rebalancing period - no bond expires within the index.
- **Coupon type:** Various types are permissible including fixed, xero-coupon, step-up, floaters and fixed-to-float.
- **Pricing:** Bid Price – Thomson Reuters and Securities Evaluations | ICE Data Services are the designated pricing sources. Bonds not priced by Thomson Reuters or Securities Evaluations | ICE Data Services are not eligible for index inclusion.

How the definition was refined in Feb. 2017 (regulation related insight)

Some additional hurdles

- **Currency and Market of Issue:** Bonds issued in non-G10 currencies in the native market of that currency are not eligible. Bonds issued in non-G10 currencies issued in global markets (Foreign, Global, Eurobond) are eligible without any specific restrictions.
- **Maturity:** Each bond must have at least 24 months to final maturity at the time of issuance, in addition to one month to expiry to remain on the index
- **Credit rating quality:**
  - **New issues:** must be rated by rating agency (S&P, Moody's or Fitch)
  - **Non-rated and Defaulted Bonds:** Are removed
  - **Investment grade:** Minimum credit rating is BBB-/Baa3/BBB-.
  - **High-yield:** Maximum credit rating BB+/Ba1/BB+.

These changes are symbolic of the growing need for global regulations for green finance

Green bonds in Singapore

	Issuer Name	Maturity	Principal Currency	Issuer Type	Issue Date	Use of Proceeds	Amount Issued (USD)
1	Industrial and Commercial Bank of China Ltd (Singapore Branch)	2024	US Dollar	Corporate	2019	The Belt and Road Initiative	600,000,000
2	Industrial and Commercial Bank of China Ltd (Singapore Branch)	2022	Euro	Corporate	2019	The Belt and Road Initiative	558,447,070
3	DBS Group Holdings Ltd	2022	US Dollar	Corporate	2017	Alternative Energy	500,000,000
4	DBS Group Holdings Ltd	2022	US Dollar	Corporate	2017	Alternative Energy	500,000,000
5	City Development		Singapore Dollar	Corporate	2004		242,790,033
6	City Developments Ltd	2023	Singapore Dollar	Corporate	2019	Working capital	146,756,677
7	Industrial and Commercial Bank of China Ltd (Singapore Branch)	2022	Chinese Yuan	Corporate	2019	The Belt and Road Initiative	141,548,827
8	City Developments Ltd	2024	Singapore Dollar	Corporate	2019	Green Construction	110,067,508
9	Sindicatum Renewable Energy Company Pte Ltd	2025	Indian Rupee	Corporate	2018		22,388,080
10	Sindicatum Renewable Energy Company Pte Ltd	2028	Philippine Peso	Corporate	2018		20,707,031
11	TLFF I Pte Ltd	2033	US Dollar	Corporate	2018	Eligible Green Projects	15,000,000

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It would seem to remain an open question whether **markets should be left work** or **whether there may be room for more active regulation and involvement.**

Green bonds used for clean transportation

Modern cities require sustainable, smart and clean transportation systems. At the same time modern investors are increasingly drawn to innovative, and socially responsible investment opportunities.

- In contrast **17% of global issuances have raised US$94.3 billion for clean transport projects**.
- 225 bonds issued with maturity dates running up to 2119.
- **Average value of US$424million**, of which **105 are from corporate entities** with an average value US$262million .
- These have been issued across more than 30 countries, In 20 different currencies.
- **As of November 2019, Singapore based entities have raised US$2.9 billion** in capital through the issuance of green bonds.
- However none specifically targeted at clean transport solutions. **Evidence would suggest room for growth in the scope and scale of green bonds in Singapore**.

Empirical benchmarking: Green-finance as an advanced factor of production

I next wish to explore some empirical dimensions of 'awakened' economies - are they exploring advanced factors of production and/or

I. Introduction to the meta-frontier concept
Exploring productivity in the presence of heterogeneity

II. The productive efficiency of 'awakened' economies
Are green financial systems aligned with higher efficiency

III. The marginal product of capital (and labor) in 'awakened' versus 'pre-aware' economies
Does resource utilization differ across groups

IV. Evaluating the technology gap
Might there be hints of a social cost (possibly even a latent value)

Data used for today's talk

I. Thomson Reiters Eikon - Bond data & Climate Bonds Initative data (+ Dow Jones Factiva)

II. PENN World tables 9.1

III. BP Statistical review of World Energy

IV. MSCI Global ESG data

IV. UN Principles of Responsible Investment policy map

'Awakened' economies (i) issue green bonds (ii) have MSCI ESG reporting coverage and (iii) have PRI policies in place.

'Pre-aware' economies have non of the above.

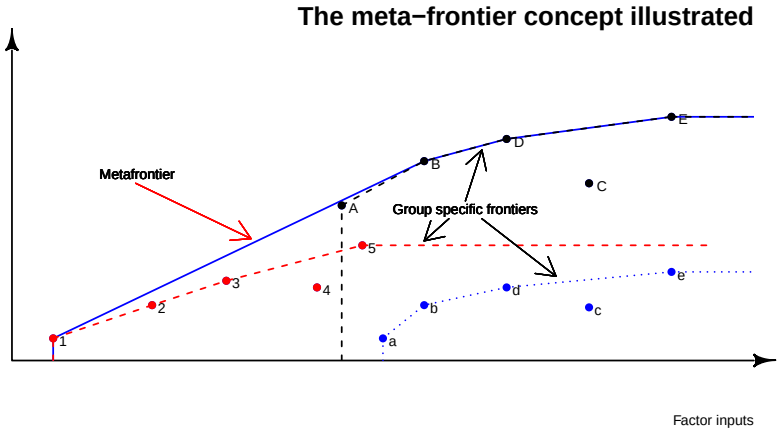
'Others' lie in between.

I. Introduction to the meta-frontier concept

Metafrontier frameworks over an alternative way to explore systematix hetrogeneity **one may essentially think of it as a clustering tool**.

In this case we have three types (lower case and upper case letters, and numbers).

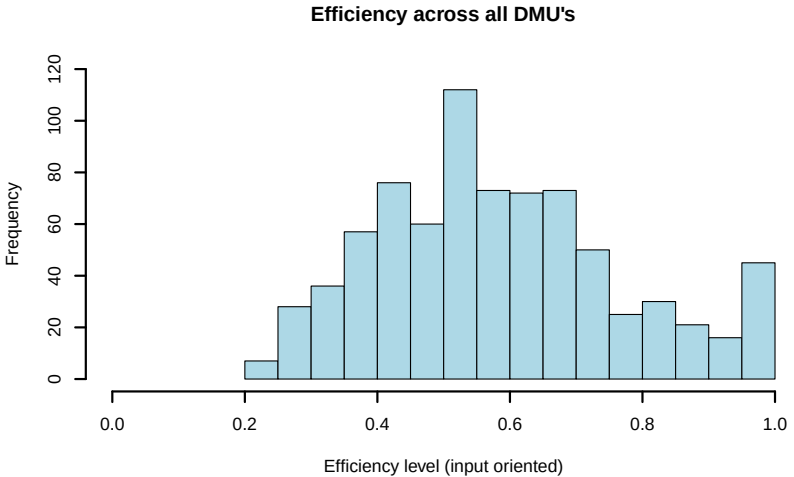
Where would toxic or toxic economies be?



The ‘unconstrained’ frontier model output looks satisfactory

The first step in working with (meta-)frontier models is of course to check the overall group efficiency scores are plausible.

Working with global data, it makes a degree of sense that a number of unique/star exonomies define the frontier, and others work hard to ‘catch-up’.

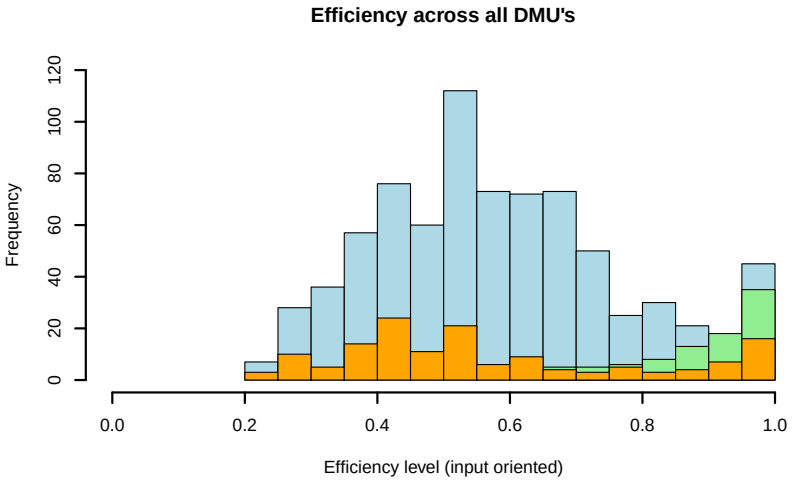


II. The productive efficiency of 'awakened' economies

The **toxic of 'pre-aware' economies** have variable efficiency **but are more centrally clustered between 0.4-0.6.**

Conversely **green or 'awakened' economies** are more **visibly clustered closer to 0.8-1, and with no observations in the lower efficiency ranges.**

Being 'green' enhances core efficiency.



III. The marginal product of capital (and labor) in 'awakened' versus 'pre-aware' economies

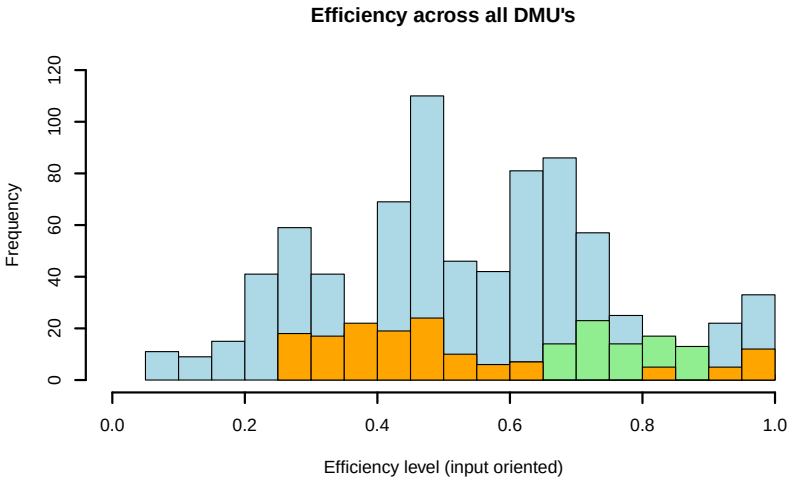
	Estimated (error-components) model: $\ln(Y) = \alpha + \beta_K \ln(K) + \beta_L \ln(L)$				
	ALL	GREEN	TOXIC	OTHER	Meta-frontier
β_K	0.312***	0.728***	0.726***	0.291***	0.693***
	(0.028)	(0.007)	(0.046)	(0.043)	(0.003)
β_L	0.640***	**0.020**	0.246***	0.664***	0.235***
	(0.028)	(0.981)	(0.051)	(0.039)	(0.002)
Observations	781	90	145	546	781
Log Likelihood	662.6134	100.5006	93.29382	468.9856	
LR Test	Pass	Pass	Pass	Pass	

Note: *p<0.1; **p<0.05; ***p<0.01

SFA results qualitatively similar to DEA

Briefly: The core structure of the SFA efficiency results are consistent with the DEA findings.

This talks towards the **robustness of the findings** and the potential reliability of the marginal products of capital discussed in the previous slide.



IV. Evaluating the technology gap

The metafrontiers reveal that 'awakened' economies are unable to reach the 'best' technology set. Though this pattern is not matched in the SFA, which includes time-effects - possibly implying some non-trivial dynamics to further explore.

	TE_k		*MTE*		*TG*	
	Avg.	Max	Avg.	Max	Avg.	Max
Bootstrap DEA metafrontier (DCB 'hybrid')						
Green	0.90	1	0.61	1	**0.62**	**0.76**
Toxic	0.57	1	0.56	1	0.99	1
Other	0.62	1	0.59	1	0.91	1
Stochastic meta-frontier						
Green	0.76	0.99	0.76	0.99	0.77	1*
Toxic	0.49	0.97	0.47	0.94	0.51	1*
Other	0.54	0.99	0.53	0.99	0.56	1*

So why the increase in demand for SRI even if there is a productivity gap? Perhaps there is an *evolving* role for the *social value*?

Part IV(b): Clean-transport at the interection of green finance

Quantifying 'clean-transport' is something of a challenge - to this end I take a pragmatic view by making use of energy-intensity type measures.

First, to reflect the importance of energy, the production function is extended from:

$$Y = f(K, L)$$

To incorporate energy, separated into energy for transport, and energy for other uses

$$Y = f(K, L, E_T, E_O)$$

Then, DEA models are implemented for meta-frontiers defined by the upper and lower (20%) quintiles of the 'transport-fuel intensity of real consumption of households and government'

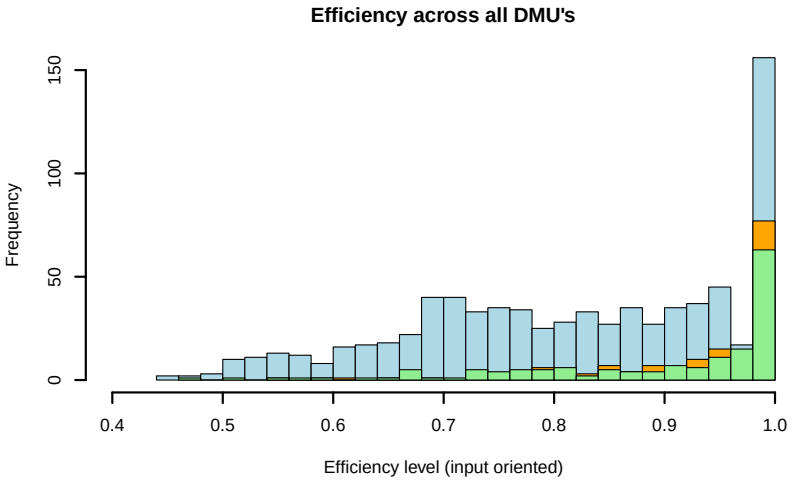
This aspect is still to be further refined, but some insights begin to emerge nonetheless.

Efficiency summary for clean versus dirty transport

There is a fairly intriguing preliminary conclusion in play here.

Both clean and dirty modes of transport give a route through to equally efficient overall transport systems i.e. they are two means to the same objective.

However to at this stage I have not inspected the frontier rankings relative to the technology set.



Conclusions I: Opportunities

The evidence, both anecdotal and statistical, points towards a market in transition - yet there are many things we can understand

I. A material amount of investment is still needed
It is expected that more than US$1 trillion of investment needed in very narrow time frames (and maybe considerably more)

II. Massive inertia
The global demand for green bonds and socially responsible finance is higher than ever before

III. Proven expertise and interest in GB market in China
Since the the latest US administration formed, Asia has a taken more of a leadership role in socially responsible finance - but lacks knowledge/sophistication in knowledge (capacity gap)

IV. Singapore has a market that can be fostered
Green finance is already being used here, including green bonds, but argually too few, too small and no locally focussed, or on clean transport

Conclusions II: Challenges

I. Lack of single global (legal) regulatory framework is both a risk and an opportunity
Harder to know how to begin, yet an opportunity to be the thought-leader.

II. Cross-border governance management
OBOR projects exemplify complex cross-border investments that require careful structuring and create external risks

III. Global financial markets remain fairly volatile
Are markets on the verge of a crisis, or maybe a bullish period emerging? What are the implications of this to the demand for bonds? Given the elasticity of demand for transport, would the same 'risks' apply here?

IV. Environmental audit becoming an accounting function?
Due diligence against the use-of-proceeds requires knowledge and skills not yet in place among business professionals - there is a demonstrable capacity gap, but maybe less so in transport

Conclusions III: Policy priorities

I. Promote liquidity (financial market considerations)
Inertia is required, and a proven effective way to achieve this is to created liquidity, especially by opening mechanisms to permit faster turnover of cash investments.

II. Incentivize uptake - highlight infrastructure development opportunities
Transport falls into two type, local and strategic. Justifying bonds for projects with localized benefits is challenging, but strategic investments are more viable. The government could consider a white-paper on the types of transport projects eligible for alternative investment structures

III. Educate potential users - 'soft infrastructure' to be enhanced
There are knowledge gaps about options, but most importantly, appraisal. Skill development must be targeted at existing professionals

IV. Identify, target and eliminate (or maybe utilize) 'greenwash'
Awareness needs to be raised over the risks of greenwashing to both issuers and investors are voluntarily adhering to responsible investment practices.

Thanks for listening!

Any questions/comments are warmly welcomed.

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