ASIA AND PACIFIC DEPARTMENT

Greening the Financial System: Transition Risks

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Climate transition risks analysis

Transition Risk in IMF FSAPs

"Transition risks" can be driven by policy change, advances in technology, shifts in consumer and market sentiment, or a combination of the above.

- Top-down exercise assessing the impact of carbon taxation
- Scenarios could range from 3- to 5-year horizon, to longer-term scenarios, or include an upfront shock
- Two main approaches
  - ✓ Macro and financial scenarios using macro and sectoral models + "Standard" stress testing methods based on macrofinancial scenarios
  - ✓ Analysis of corporates using micro firm-level data + Stress testing based on direct exposure of banks
- Preliminary analysis of asset valuation effects in selected cases

Deriving a carbon tax path

NGFS approach

- Integrated Assessment Models to estimate carbon price for a given GDP path

CGE approach

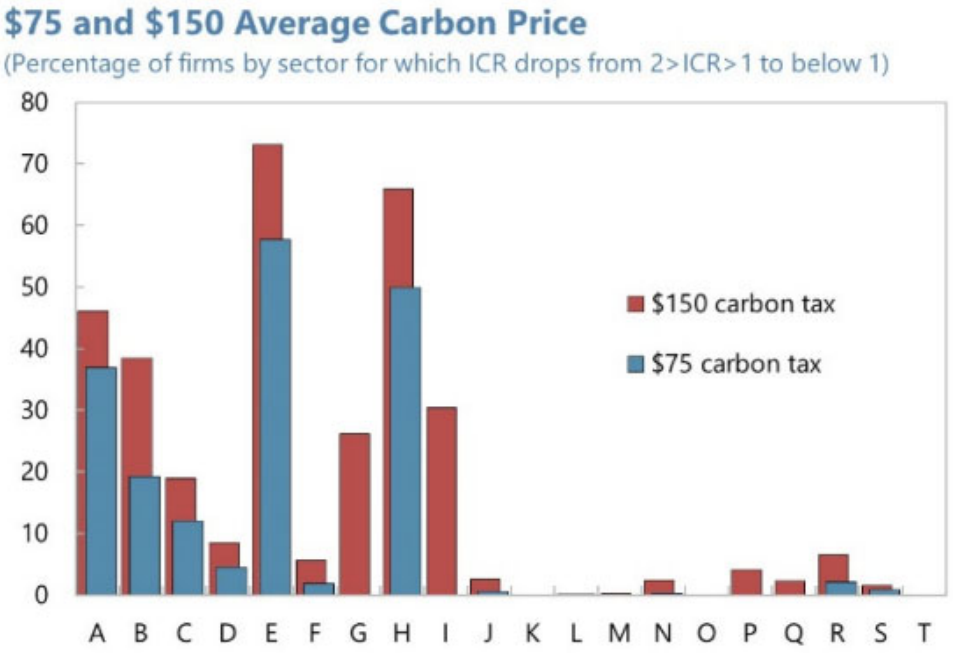
- Carbon prices, sectoral impact and GDP consistent with NGFS scenarios on emissions and temperature

To consider

- ✓ Assumptions regarding policy and technology
- ✓ Exogenous vs endogenous GDP path
- ✓ Sectoral impact
- ✓ Ability to capture near-term impact on GDP
- ✓ Country coverage

IMF FSAP Example: Norway, an Oil Producer

- Static, single-factor, partial equilibrium analysis
- Propagation channels considered
  - Impact of higher carbon price on banks' exposures
  - Impact of falling oil revenues on banks' loan losses
  - Portfolio effects on valuations of oil-related companies, financial wealth of households and other sectors

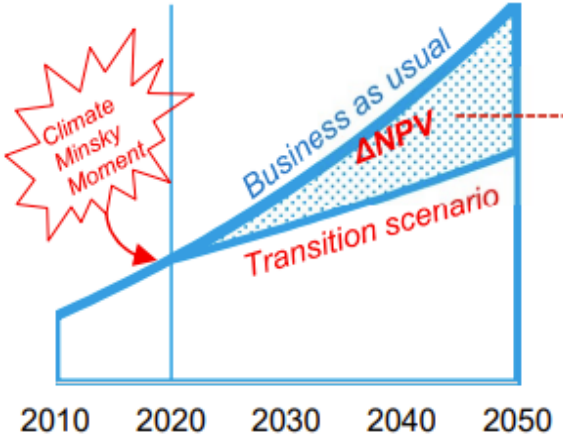


Source: IMF Staff estimates. Notes: Most affected industries include A = Agriculture, forestry and fishing; B = Mining and quarrying; E = Water supply; sewerage, waste management and remediation activities; H = Transportation and storage.

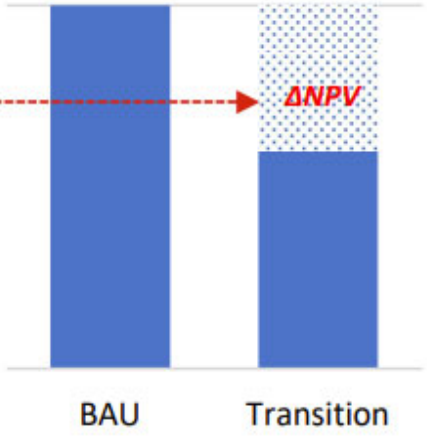
IMF FSAP Example: UK, a “climate Minsky moment”

- A drastic change in expected decarbonization polices is priced upfront and leads to a sudden steep hike in the carbon price
- A CGE model is used to estimate impact of increasing costs on VA for each sector and then applied to corporate asset valuation; changes in valuations are mapped
- Simulation horizon is 2020-50, and risk horizon is 2020-2025

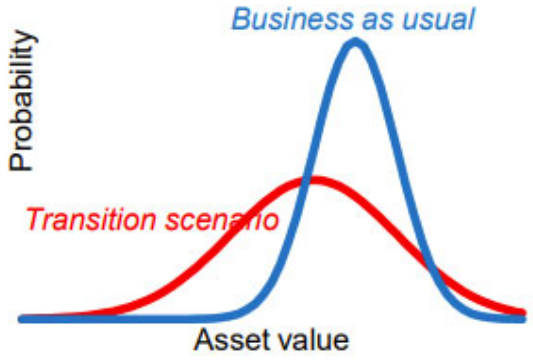
1. Firm X earnings



2. Firm X market value of equity



3. Distribution across firms

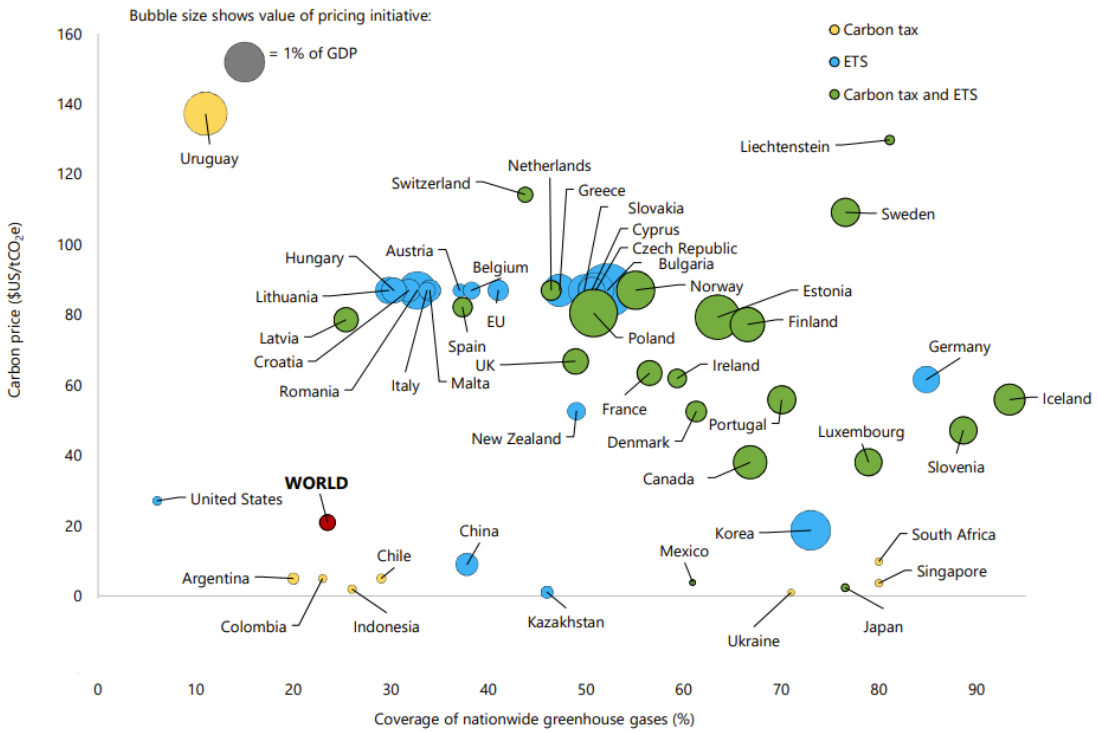


Source: IMF 2022. Note: BAU = business as usual

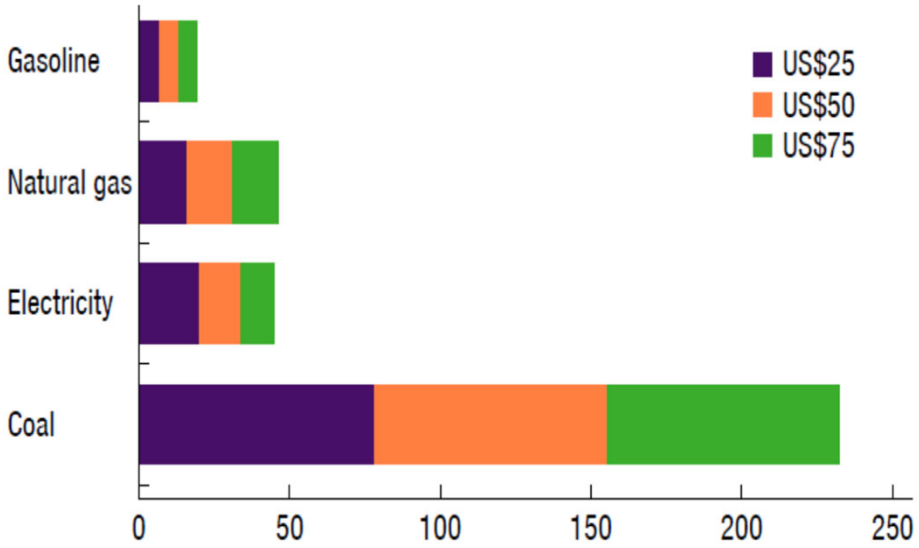
Transition risk in numbers

Carbon pricing

Carbon Pricing Schemes by Country, 2022



Impact of Carbon Tax on Energy Prices, 2030

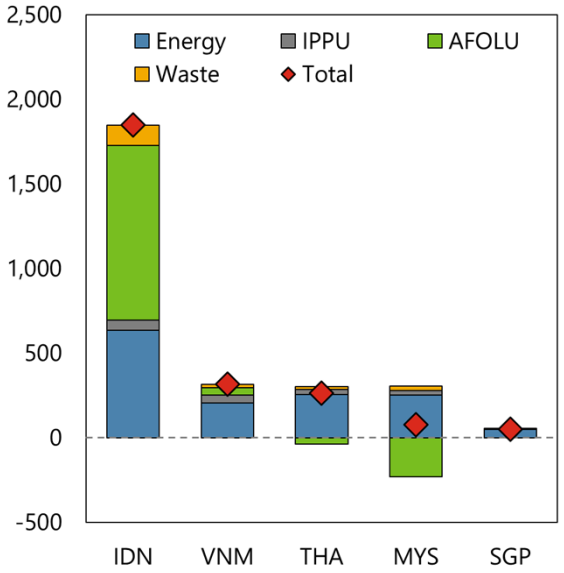


Sources: Government websites; WBG (2022); and IMF staff calculations. Notes: The LEFT chart covers subnational, national and regional schemes. EU ETS includes Iceland, Liechtenstein, and Norway. Prices are emissions-weighted averages between schemes. China's system takes the form of a tradable emissions intensity standard with no fixed cap on emissions. Mexico does not include subnational schemes due to lack of coverage data. On the RIGHT chart, BAU = Business as usual.

ASEAN CO_2 Profiles

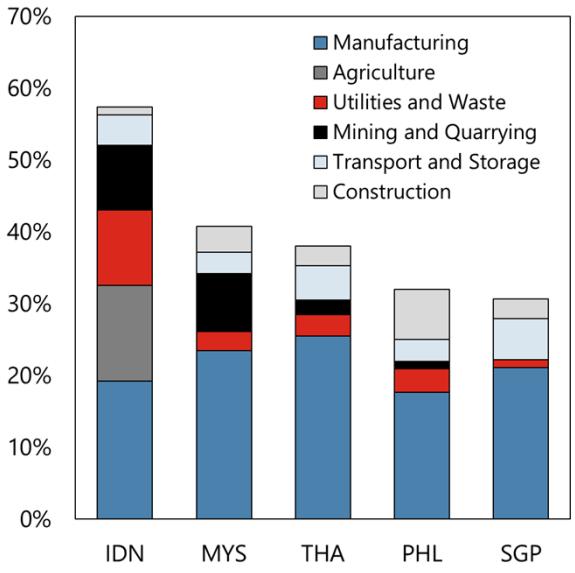
ASEAN-5: Greenhouse Gas Emissions by Activity

(In carbon dioxide-equivalent million tons)



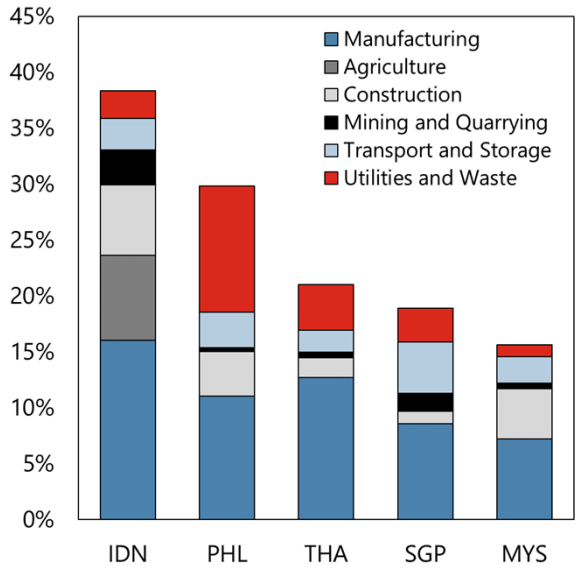
ASEAN-5: GDP Exposure to Main Emissions Sectors

(In percent of total GDP)



ASEAN-5 Banks: Loan Exposure to Main Emissions Sectors

(In percent of total banking sector loans)



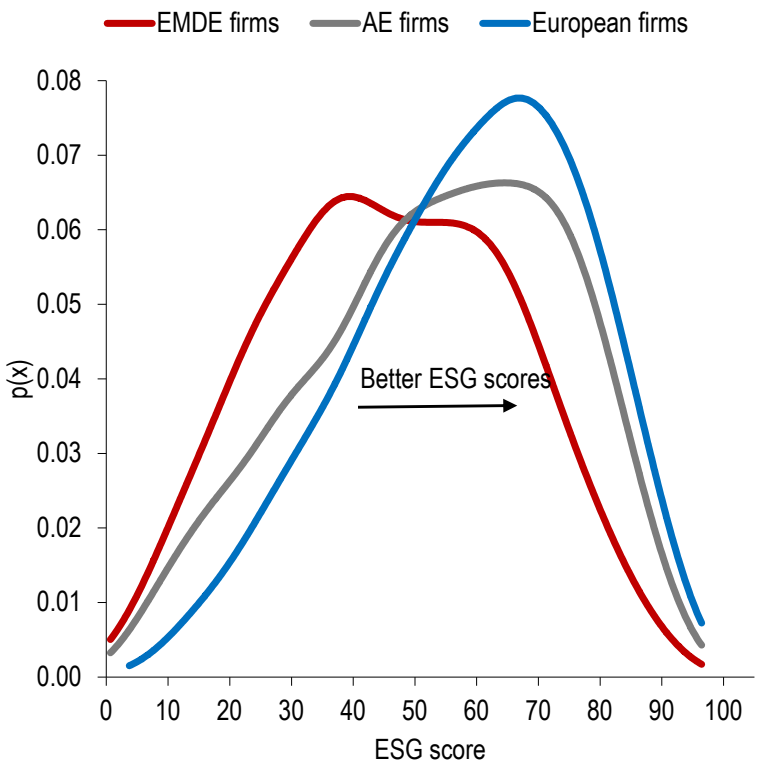
Note: Data as of 2016, except for Indonesia (2019). IPPU - Industrial Processes and Product Use, AFOLU - Agriculture, Forestry, and Other Land Use.

Sources: UN Framework Convention on Climate Change (UNFCCC), Haver, IMF Staff Calculations

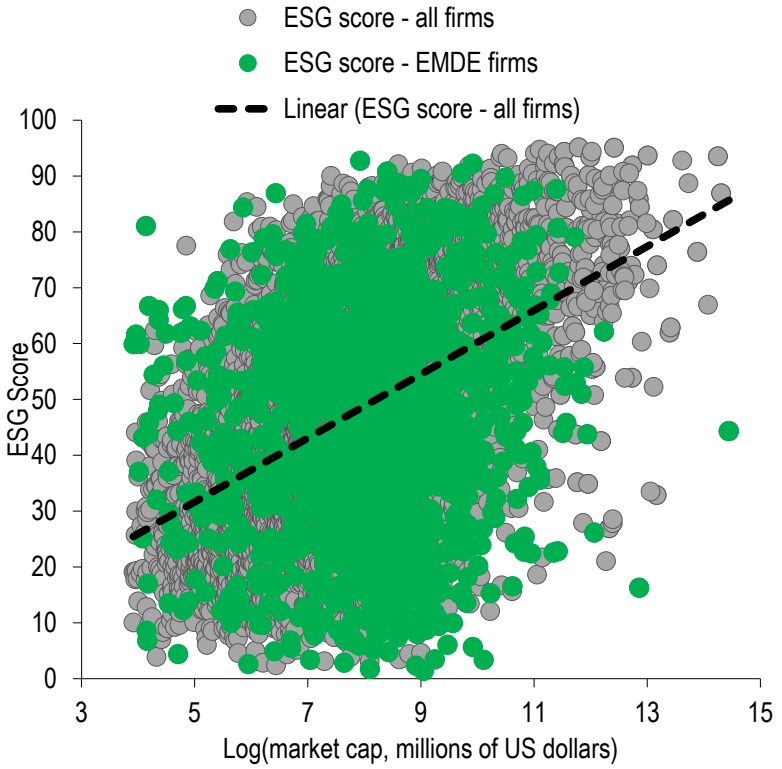
Greening financial system

ESG scores put EMDE firms at a disadvantage

Smoothed Distribution Function of ESG Scores
(Probability)



ESG Scores and Firm Size

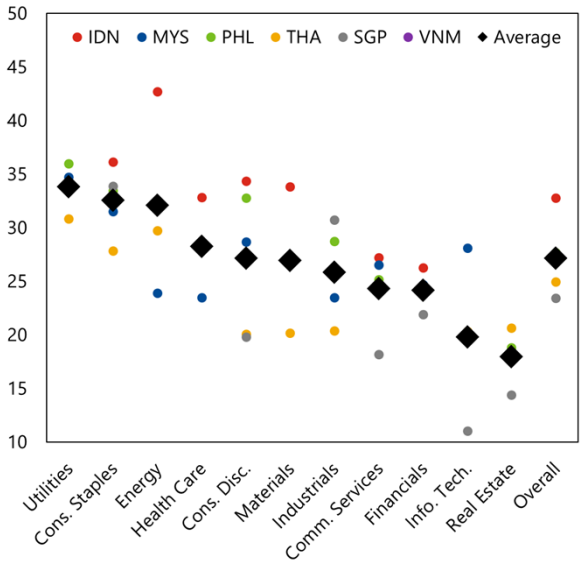


Sources: Morningstar; Refinitiv; and IMF staff calculations

ESG Risk Scores in ASEAN-6: Level and Availability

ASEAN-6: Sustainalytics ESG Risk Scores

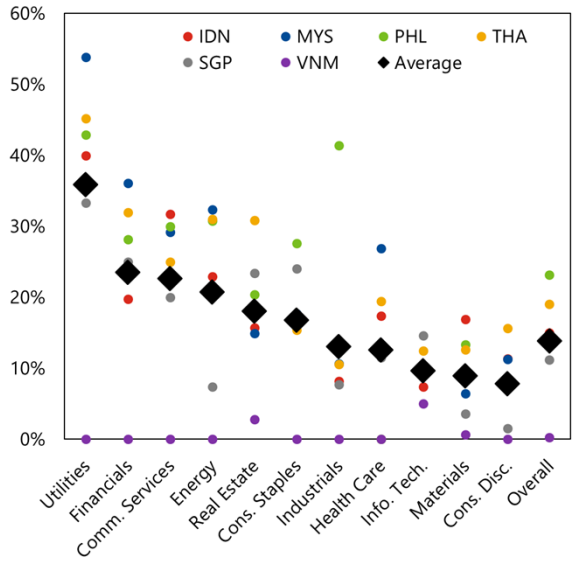
(By sector)



Note: Higher scores denote higher ESG-related risks.

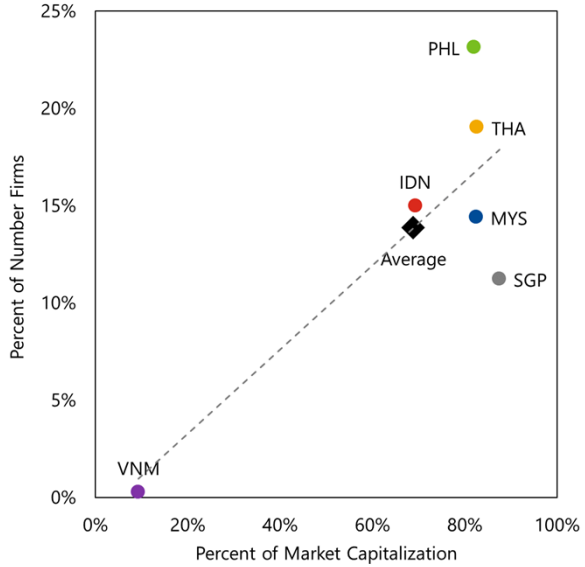
ASEAN-6: ESG Score Coverage

(In percent of number of firms, by sector)



ASEAN-6: ESG Score Coverage

(In percent)

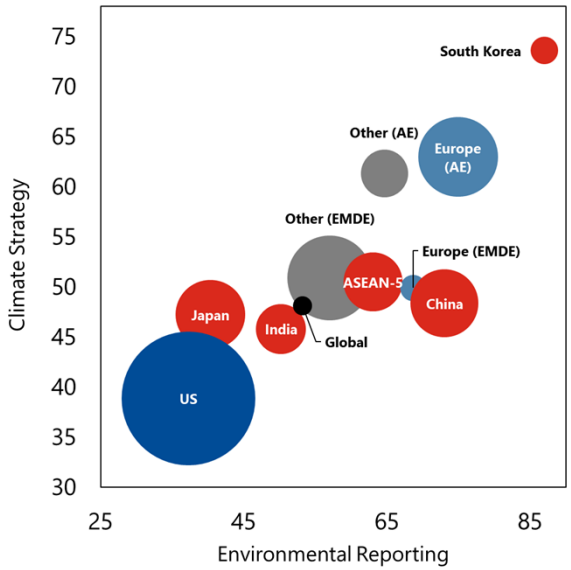


Notes: ESG score coverage pertains to the percentage of stock-listed firms within each sector that have at least one of the following scores: S&P Global ESG Rank, Sustainalytics ESG Risk Score, MSCI ESG Rating.

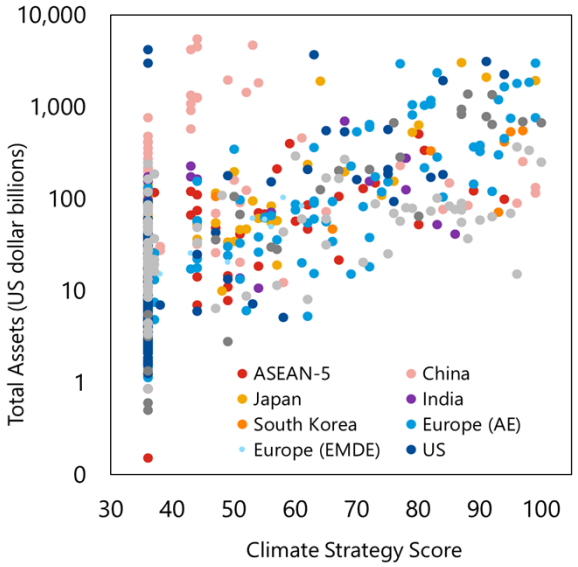
Source: Bloomberg, IMF Staff Calculations.

S&P Global Bank Environmental Scores

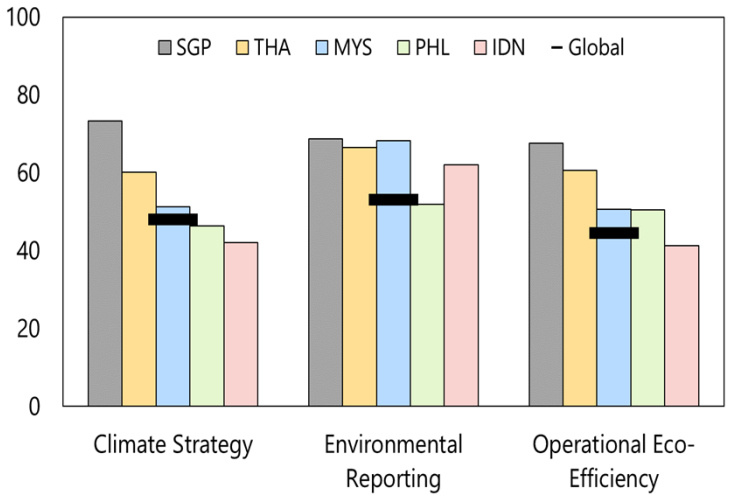
Global Banks: S&P Global Environment Pillar Scores
(By region)



Global Banks: S&P Global Climate Strategy Scores
(By region)



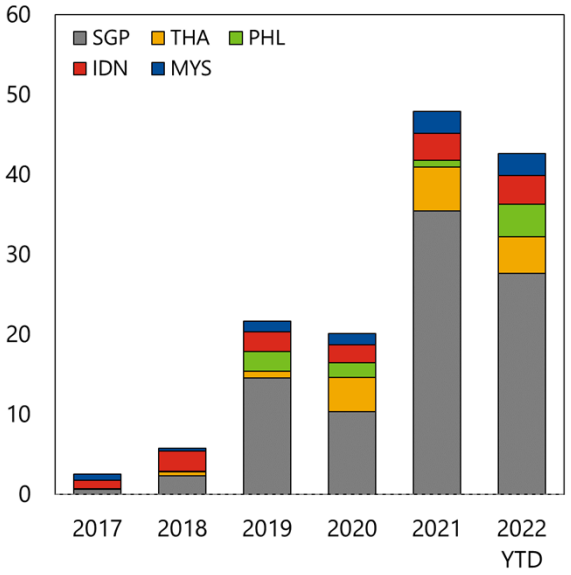
ASEAN-5 Banks: S&P Global Environment Pillar Scores
(By region)



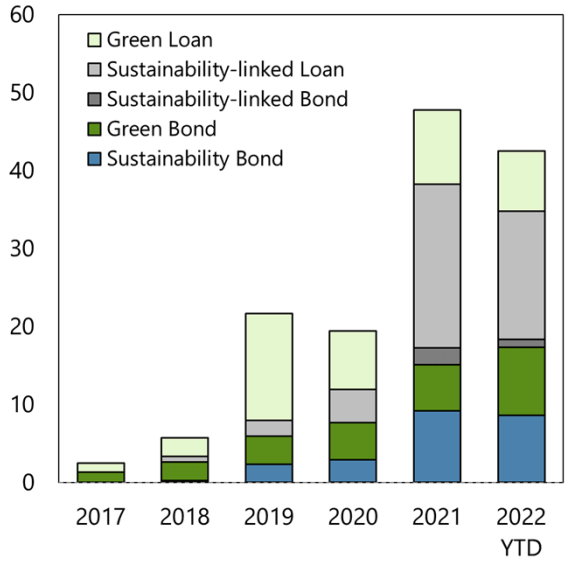
Sources: Bloomberg Intelligence, IMF Staff Calculations. Note: LEFT chart - Larger-sized bubbles indicate regions with higher sample size (e.g., US = 235, ASEAN-5 = 46). Bubble size does not apply to Global bubble. RIGHT chart - Country / regional / global scores were computed as simple averages of related company-level scores.

Sustainable Finance in ASEAN

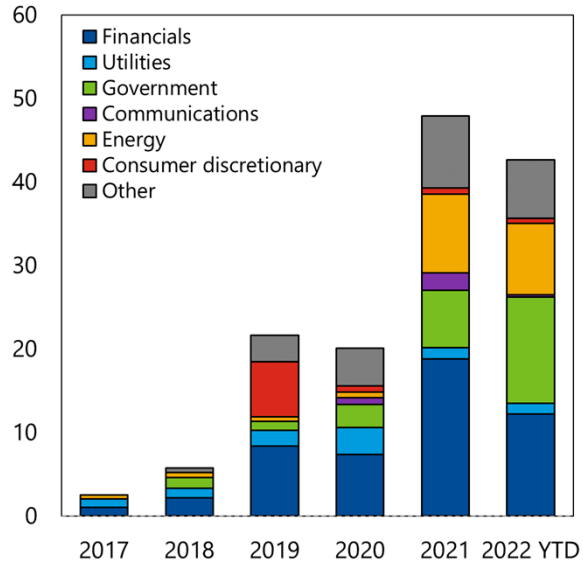
ASEAN-5: Sustainable Financing Volumes
(In billions of US dollars, by country of risk)



ASEAN-5: Sustainable Financing Volumes
(In billions of US dollars, by theme and type)



ASEAN-5: Sustainable Financing Volumes
(In billions of US dollars, by issuer industry)



Note: Data is as of October 31, 2022.
Source: BloombergNEF, IMF Staff Calculations.

Conclusion

- ✓ Climate risk analysis serves more than one objective
- ✓ Stress tests covering climate-related transition risks are becoming more common, but the methodologies are still evolving
- ✓ Exercises so far tend to demonstrated such risks could have meaningful effects, however, there is no threat to the banking systems
- ✓ Meanwhile, financial institutions already started to integrate environmental factors in their investment strategies

Additional materials & References

CGE models for climate mitigation analysis

Different modelling frameworks for different purposes

- **Top-Down or Macroeconomic Models**
  - Integrated Assessment Models (IAMs) – Economic Oriented : Nordhaus (1991), Tol(2002)
  - Computable CGE: GTAP, ENVISAGE/ENV-Linkages, GEM-E3
  - Macro-econometric models: E3-ME
  - DSGE (Dynamic Stochastic General Equilibrium), Benjamin & Simon
- **Bottom-up models**
  - Integrated Assessment Models (IAMs) – bio-physical Oriented: IMAGE, MESSAGE
  - Partial equilibrium: Economic models
  - Partial equilibrium: Engineering models (POLES, IEA-WEM, GLOBIOM)
- **Hybrid Models** (G-Cubed mix of CGE and DSGE)
- **Economic models for distribution analysis**: static DSGE, micro-simulation, ABM,…

Source: J. Chateau (2021)

Illustrative Energy Price Impacts for US$$50 carbon tax p/tCO2e by 2030

Country	Coal		Natural gas		Electricity		Gasoline	
	Baseline Price, $/GJ	Price Increase	Baseline Price, $/GJ	Price Increase	Baseline Price, $/kWh	Price Increase	Baseline Price, $/liter	Price Increase
Argentina	2.9	172%	3.7	86%	0.08	18%	1.14	13%
Australia	3.4	154%	7.9	37%	0.12	25%	1.13	12%
Brazil	4.4	122%	9.2	34%	0.07	7%	1.23	8%
Canada	2.6	209%	4.2	69%	0.08	10%	1.14	11%
China	4.4	114%	10.5	25%	0.05	46%	1.13	12%
France	6.2	94%	15.8	18%	0.13	2%	1.77	9%
Germany	5.8	91%	12.4	23%	0.17	9%	1.74	8%
India	5.0	99%	3.5	98%	0.06	47%	1.12	12%
Indonesia	2.7	187%	5.7	44%	0.08	57%	0.45	31%
Italy	4.6	116%	15.4	24%	0.12	11%	1.90	8%
Japan	3.7	132%	11.1	24%	0.12	24%	1.37	10%
Mexico	1.8	284%	3.0	91%	0.09	26%	0.97	14%
Russia	2.2	209%	2.7	95%	0.08	36%	0.73	18%
Saudi Arabia			3.9	69%	0.10	33%	0.27	45%
South Africa	1.6	285%	3.7	62%	0.05	66%	1.16	10%
Korea	4.7	103%	11.4	25%	0.08	37%	1.46	8%
Turkey	1.4	421%	7.6	41%	0.06	59%	1.40	10%
United Kingdom	6.9	74%	11.5	27%	0.12	9%	1.72	8%
United States	2.4	220%	4.4	69%	0.07	23%	0.83	16%
Simple Average	3.7	171%	7.8	51%	0.11	39%	1.19	14%

Source: IMF staff calculations.
Note: Baseline prices are retail prices updated from Coady and others (2019) and include preexisting energy taxes. Baseline prices for coal and natural gas are based on regional reference prices. Baseline prices for electricity and gasoline are from cross-country databases. Impacts of carbon taxes on electricity prices depend on the emissions intensity of power generation. Carbon tax prices are per ton. GJ = gigajoule; kWh = kilowatt-hour. All prices are stated in real 2018 terms.

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