C3A Annual Symposium
December 2-6, 2024
World Bank Paris

Research Segment

Session 9: CLIMATE IMPLICATIONS FOR FIRM PRODUCTIVITY & PRIVATE INVESTMENT IN THE TRANSITION

Chair of session: Marcelo C. Pereira & Wellington de Santos Amorim

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December 2-6, 2024
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Accelerating private sector investment for low carbon development: a twin-track approach catalysed with international guarantees

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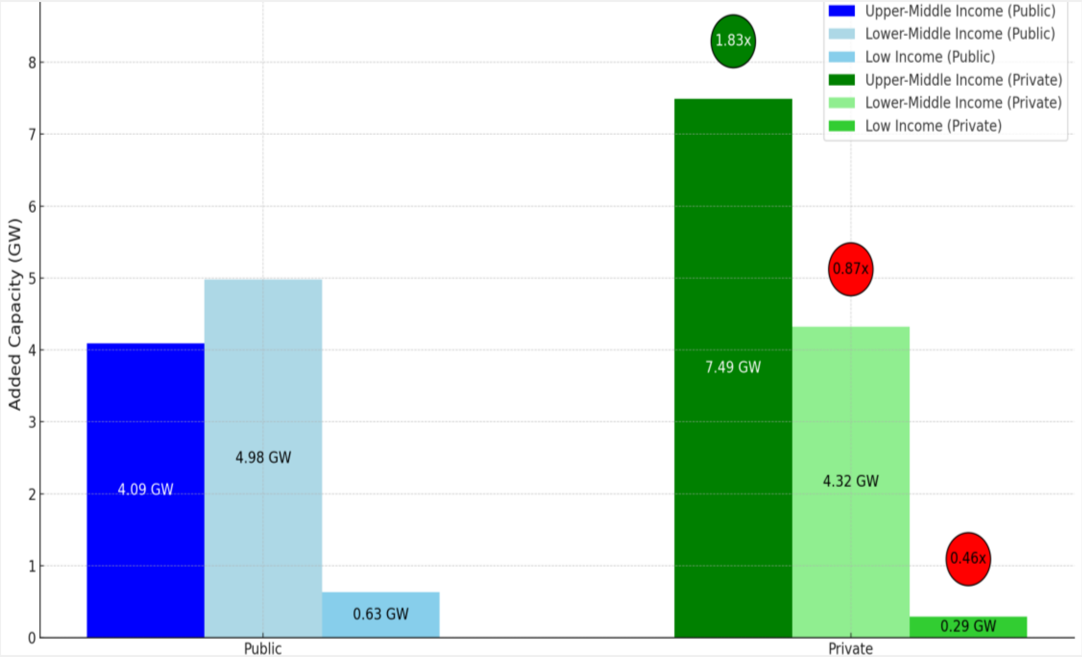
Table of contents

1. Climate investment challenges in developing countries
2. Targeting financial positive tipping for zero-carbon investments
3. The deployment of the guarantee instrument in zero-carbon investments in developing countries

Table of contents

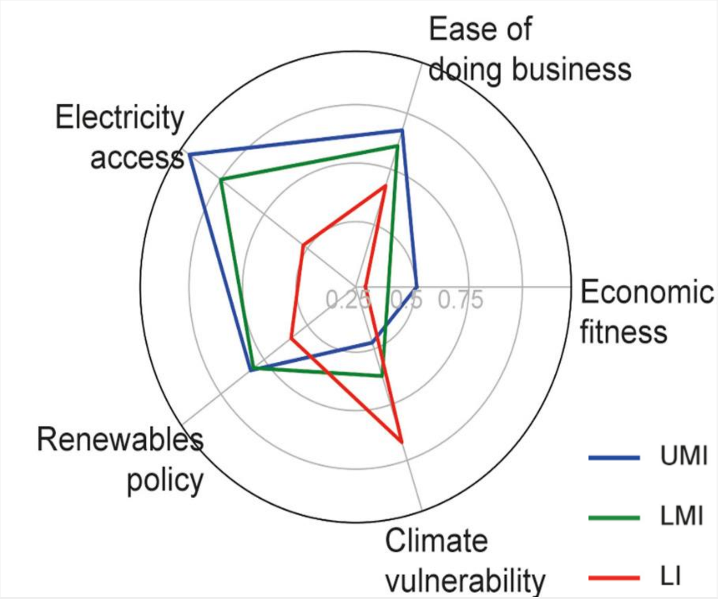
1. Climate investment challenges in developing countries
2. Targeting financial positive tipping for zero-carbon investments
3. The deployment of the guarantee instrument in zero-carbon investments in developing countries

Significant inequity in access to climate finance across developing countries and climate investment trap



Source: own calculation based on Rickman et al. (2023)

Fig. Distribution of public and private climate financed and the leverage factors across developing countries by income group.



Source: adapted from Rickman et al. (2023)

Fig. Average investment suitability scores per income group

Overwhelming reliance on debt instruments in blended finance by MDBs…

Unrealized ambitions:

- The promise to transform "billions into trillions" through blended finance has not materialized as expected.
- Mobilisation of private climate finance has significantly underperformed developing countries' expectations.

Delayed fulfillment of commitments:

- The $100 billion annual commitment by developed countries was nearly met only in 2023, undermining trust.

Limited leverage of private finance:

- For every dollar of public finance provided, less than one dollar was mobilised from the private sector, highlighting inefficiencies in private sector engagement.

Questionable additionality:

- Blended finance is often criticized for failing to provide genuine additionality.
- Seen as a public subsidy for projects that are already commercially viable, undermining its transformative potential.

Inadequate green investment pipelines:

- Blended finance has struggled to deliver robust and scalable green investment pipelines, limiting progress toward climate goals.

….and disincentivised use of guarantee instruments by MDBs

Aspect	Loans	Guarantee Instruments
Usage	Dominates MDB financing; constituted **92%** of capital in 2018.	Underutilised; constituted only **8%** of MDB capital in 2018
Purpose	Directly disbursed to fund projects.	Mitigates investment risks to attract private capital.
Performance Metrics	MDBs' CAFs incentivize loan disbursement due to equivalent provisioning for loans and guarantees.	Treated the same as loans under CAFs, disincentivizing usage despite guarantees rarely being called upon.
Risk Management	MDB loans are constrained by conventional credit rating agency methodologies, leading to high premiums.	Reduces risk perception for private investors, enabling more private sector participation.
Capital Constraints	MDBs constrained by 'paid-in' capital recognition, limiting lending capacity.	Misaligned recognition of guarantees' value in CAFs further limits their use.
Financial Capacity	MDBs: Limited by CAFs.	Development aid agencies: sovereign credit rating in advanced economics offers significant capacity
Institutional Expertise	MDBs: Strong expertise in structuring and disbursing loans.	Development aid agencies: lack financial acument
Leverage Factor	Low leverage, especially in lower-income economies (<0.4 per $1 of public finance).	Higher leverage potential due to reduced risk perception for private finance mobilization (e.g. 1-12 times for Sida guarantees).

Table of contents

1. Climate investment challenges in developing countries
2. Targeting financial positive tipping for zero-carbon investments
3. The deployment of the guarantee instrument in zero-carbon investments in developing countries

Targeting positive deployment and/or financial points

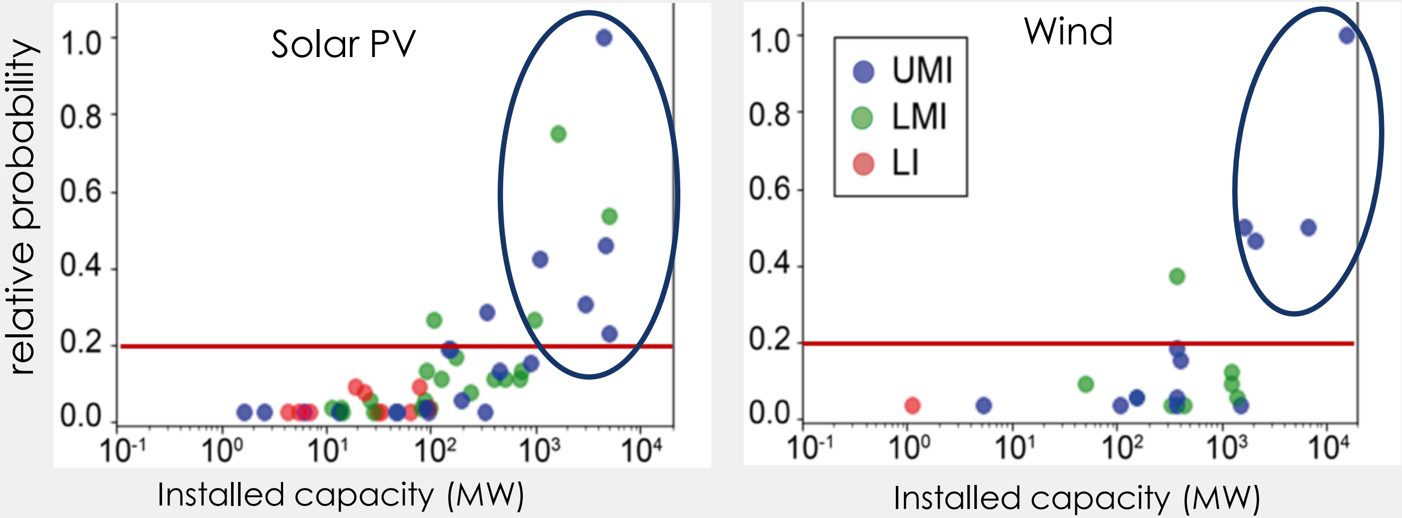


Fig. Empirical relationship between relative probability of private investment and installed renewables
Source: adapted from Rickman et al. (2023)

• **Path dependency:** private investment probabilities in wind and solar increase significantly after achieving **1 GW of installed capacity** in developing countries (excl. India and China)

• Inefficiencies in mobilizing finance in low-Income countries (LICs) that often fall below the 1 GW threshold, limiting private investment opportunities despite receiving public finance.

Twin-track approach to deployment blended finance, addressing technology maturity and financial learning in a local market

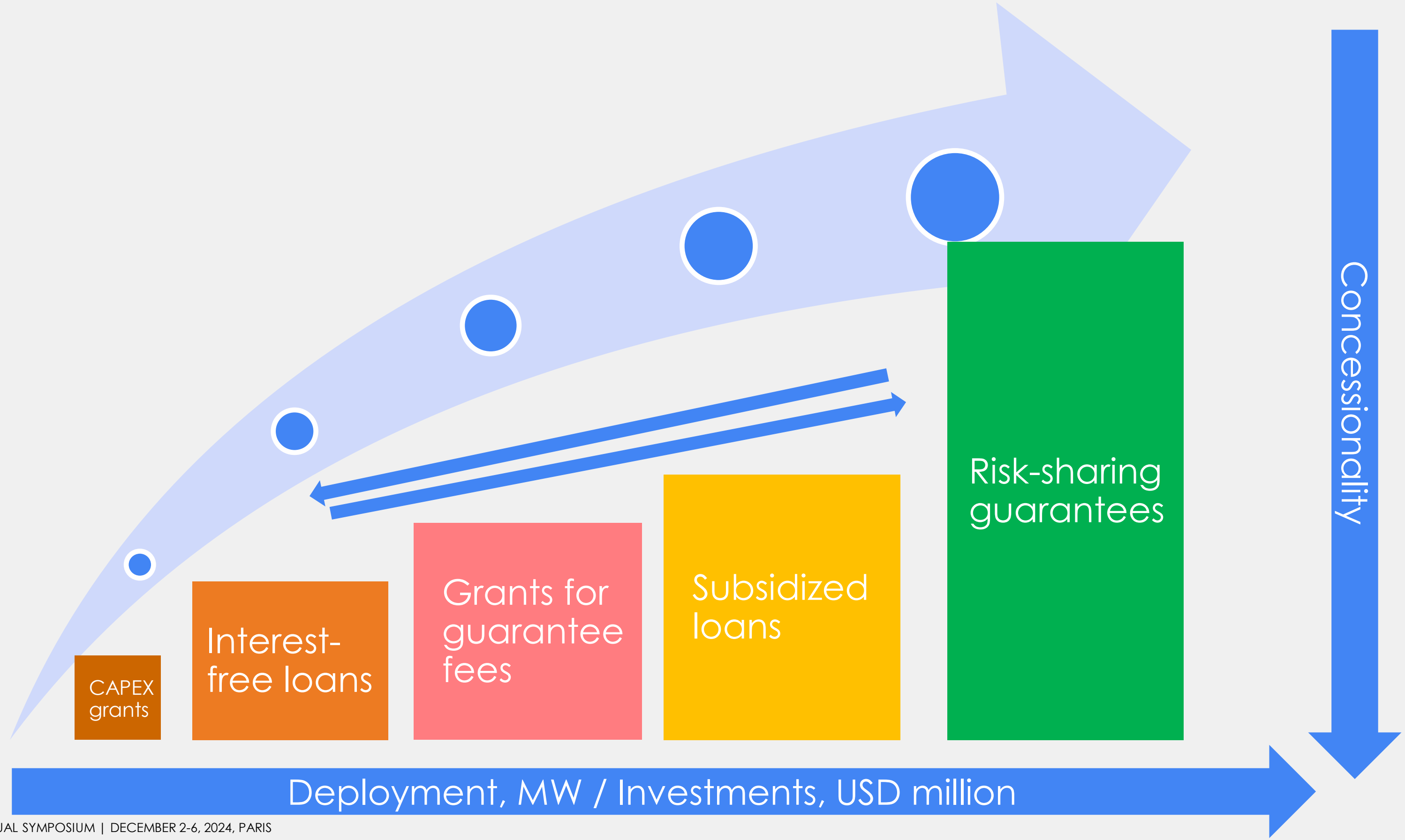
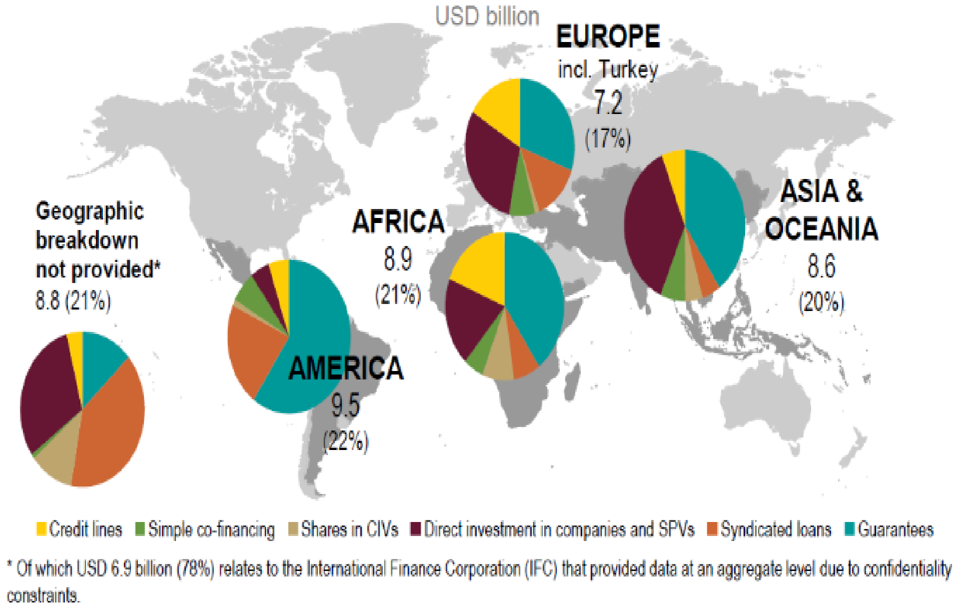


Table of contents

1. Climate investment challenges in developing countries
2. Targeting financial positive tipping for zero-carbon investments
3. The deployment of the guarantee instrument in zero-carbon investments in developing countries

Guarantees are more catalytic than other instruments when mobilizing development finance from the private sector



Source: Garbacz et al. (2021)

Fig. Amounts mobilised from the private sector for development in 2017-2018 average.

- Guarantees mobilized **$80.9bn** (39%) of private development finance (2012–2018) - more than other instrument.
- Primarily supports local capital markets and SMEs in EMDEs.
- Guarantees spread thin across multiple SDGs, diluting impact.
- **Limited focus** on targeted low-carbon investments.

- Track record of development aid agencies:
  - **Mismatch between financial and expert capabilities** in development aid agencies:
  - 43% of guarantees are provided by a few agencies (Sida, USAID).
  - AAA-rated developed economies possess significant potential for scaling up guarantees.
  - Many agencies **prefer grants**, **lacking financial acumen** in deploying guarantees.

The potential of specialised guarantee providers/entities
- **Lower capital adequacy requirements** than MDBs.
- **Better adaptability to local market** needs and risk pricing.
- Positive track record of specialized guarantee providers like **Guarantco** and **African Guarantee Fund (AGF)**.

Potential impact generated by the guarantee instrument

Impact on lending sought by guarantee recipient
- New type of lending (e.g. otherwise too risky or not sufficiently profitable)
- More of same lending (e.g. less constrained or at more attractive terms)

Impact on financials sought by guarantee recipient
- Risk reduction
- Reduced collateral requirements (or other risk/lending constraints)
- Reduced capital consumption and/or improved risk-adjusted return on capital
- Ability to stay within lending limits
- Freeing up capital/funding for other lending

Impact sought by investors
- Risk reduction
- Reduced capital consumption and/or improved risk-adjusted return on capital
- Increased credit rating in underlying investment

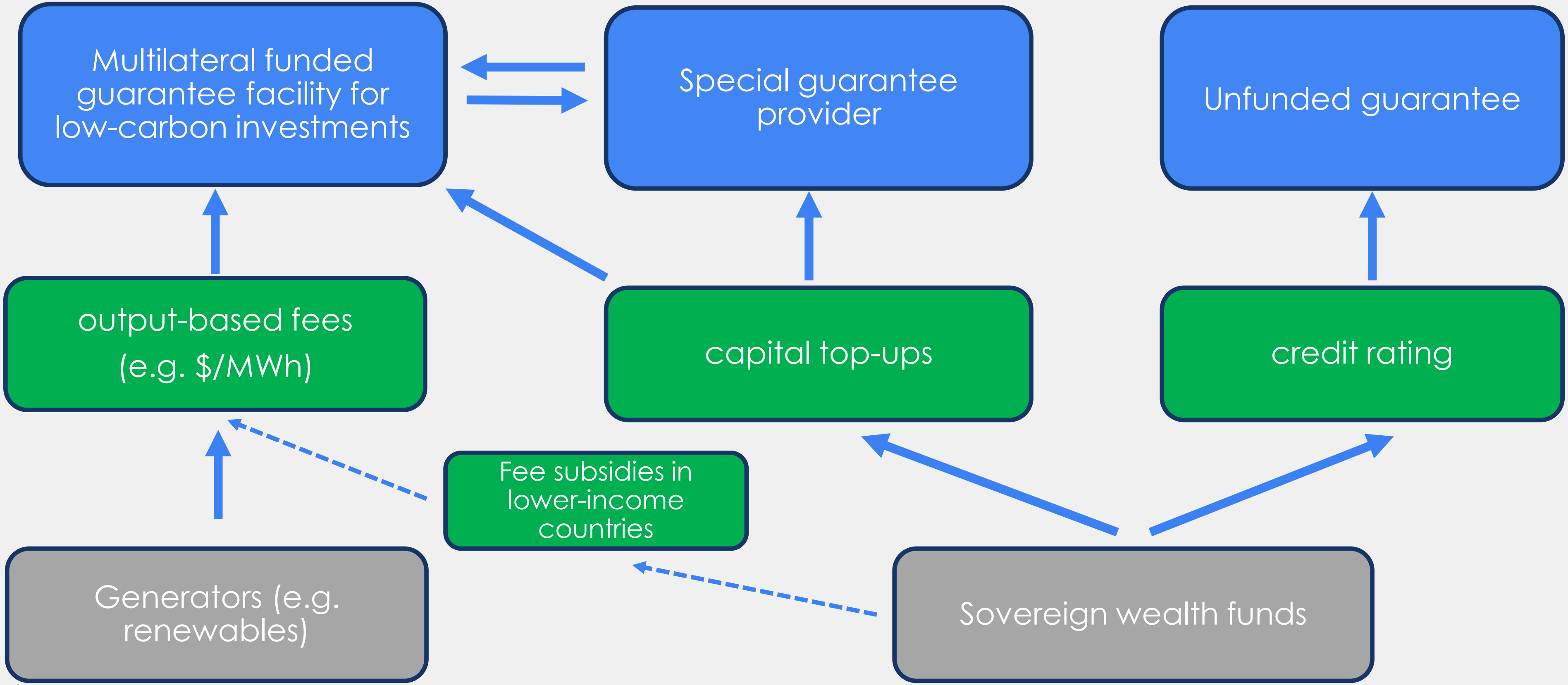
Impact enabled for borrowers
- Access to cheaper finance
- Financing of higher-risk projects
- Financing with less collateral requirement
- Larger loans
- Better loan terms

Partial guarantees are designed to address specific type(s) of project risk and can induce risk-sharing

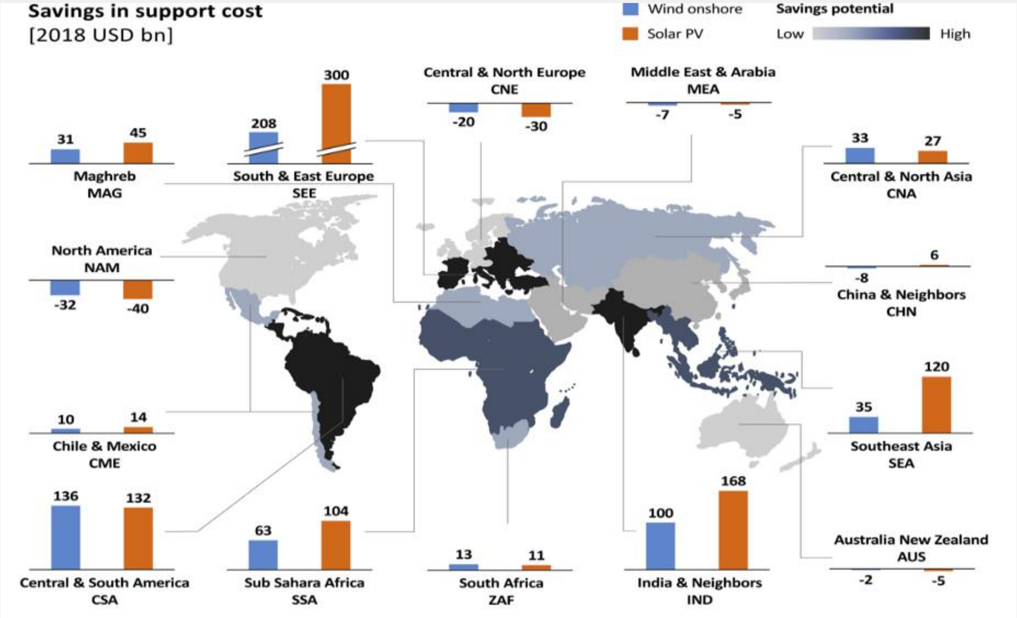
Macro-level risks, e.g. political and macroeconomic risks, are the most significant in EMDEs and public underwriting of macro-risk guarantees would foster private investment with minimal use of public resources.

Micro-level project risks should be borne by developers and investors so that a commercial precedent is established and technological and financial learning drives market development.

Closing the gap in dedicated provision of guarantees for low-carbon investments



How can a potential multilateral guarantee institution for low-carbon investment operate?



	Savings Remuneration [Billion US$$_{2018}$]			Reduction LCOE [US$$_{2018}$/MWh]			
	Wind	Solar	Total	Total	Wind	Solar	Total
AUS	−2.3	−4.8	−7.1	−0.4	−1	−1	−1
CHN	−8.4	6.3	−2.1	0.0	0	0	0
CME	9.5	13.5	23.0	1.5	7	2	3
CNA	33.4	26.8	60.2	3.1	3	5	4
CNE	−20.1	−29.6	−49.7	−0.3	−1	−1	−1
CSA	135.6	132.1	267.7	8.5	53	17	26
IND	100.2	167.8	268.0	8.5	7	7	7
MAG	30.5	44.5	74.9	14.6	39	27	31
MEA	−6.5	−4.5	−11.0	−0.4	0	0	0
NAM	−31.5	−39.7	−71.2	−0.3	−1	−1	−1
SEA	34.8	120.4	155.2	4.8	29	8	9
SEE	207.6	299.6	507.2	7.6	11	10	13
SSA	63.1	104.3	167.4	16.2	32	22	25
ZAF	12.8	10.8	23.6	6.4	8	6	7

Fig. Net savings from establishing a multilateral guarantee facility for renewables.
Source: Matthäus and Mehling (2020)

- Some regions can be net donors due to already high trust from investors, outweighing the economic (but not global public) benefits of participation in the multilateral guarantee mechanism, with **LCOE marginally increasing in advanced economies**
- The potential net **savings** from deploying the multilateral guarantee mechanism can reach **$1.5 trn over a 10-year period**, **freeing up** scarce international **public finance** to less/non- bankable projects where concessional finance and grants are necessary, and making **electricity more affordable**

Twin-track approach can facilitate a more efficient allocation of scarce international public climate finance

Identify thresholds and additionality - using more concessional finance in the early stages of market development can facilitate technology and financial learning, whilst mitigating indebtedness and project defaults in low-investable regions

Dedicated issuer of partial guarantees for low-carbon investments: multilateral facility or institution, a special guarantee provider, and sovereign wealth funds through capital top-ups to special guarantee providers or unfunded guarantees

Guarantees can facilitate risk-sharing, freeing up scarce resources to the more needed regions and policy areas

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Macro Risks In Conducive Investment Environments

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Table of contents

1. Context
2. Approach
3. Results
4. Policy Implications

Context: Mitigation of macro investment risks becoming central to international policy efforts


REUTERS® World Business Markets Sustainability Legal Breakingviews Technology Investig

Brazil unveils FX hedge program for sustainable investments

Reuters
February 26, 2024 4:47 PM GMT · Updated 14 days ago

*"Currency risk is **stifling** climate finance for developing countries. It should – and can – be mitigated" - OECD, 2024*

*"Currency exchange rate risks are a **key barrier** to large-scale foreign investment in climate solutions, such as renewable energy, in developing countries" - Climate Investment Funds, 2024*

*ISA's Global Solar Facility (GSF), through payment guarantees, insurance and investment funds, aims to mitigate **project risks, provide technical assistance to address regulatory gaps, reduce currency risks, resolve contractual and financial uncertainties** in the solar energy sector - Creation of a Global Solar Facility (GSF) in Africa announced at COP27*


REUTERS® World Business Markets Sustainability Legal Breakingviews Technology Investi

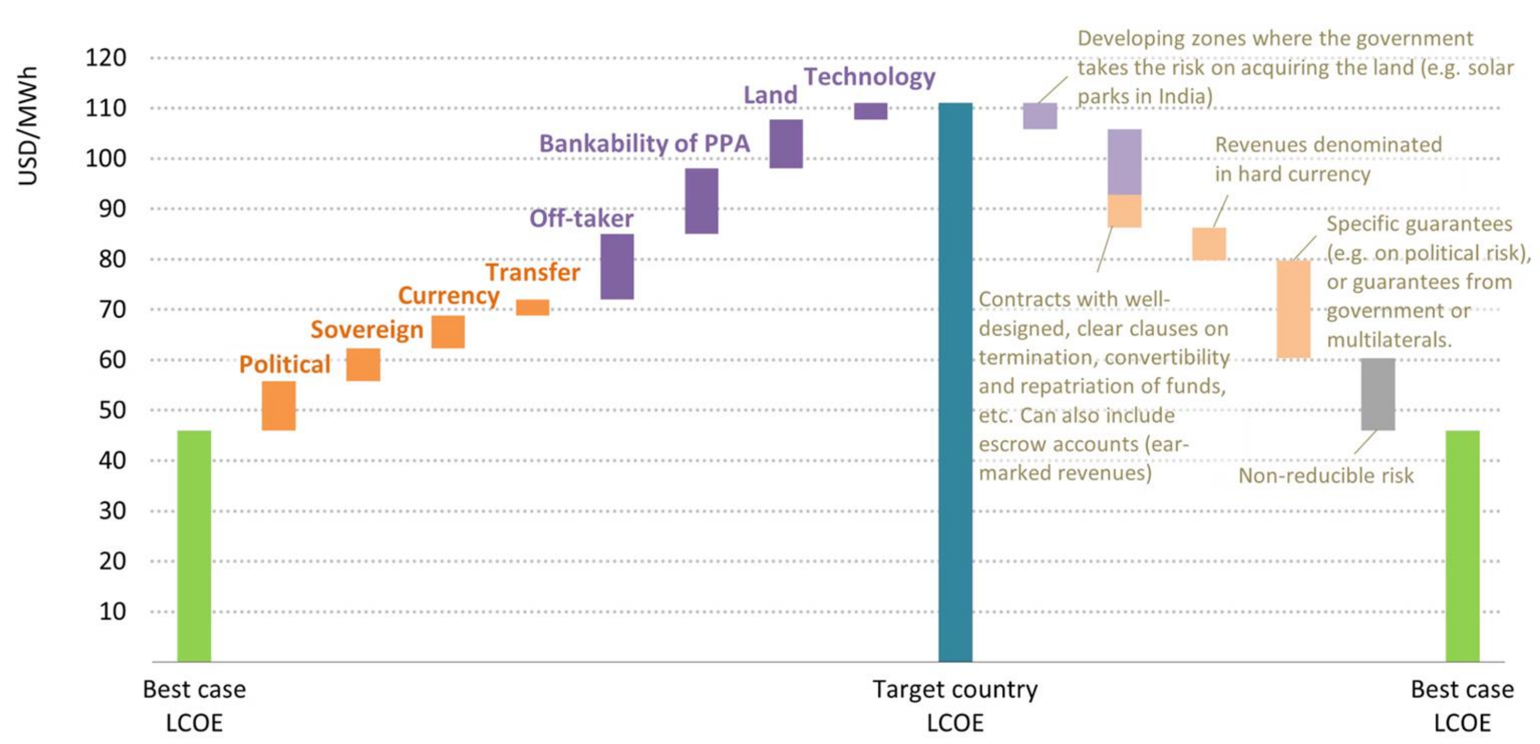
Finance

World Bank to streamline loan, investment guarantees with $20 bln annual goal

By David Lawder
February 28, 2024 8:44 PM GMT · Updated 12 days ago

WORLD ECONOMIC FORUM

Context: A potential disconnect with investor opinions



IEA 2024. Cost of Capital Observatory

Approach: A non-linear understanding of risks

A complex investment environment is characterized by a spectrum of risks which define its suitability for investment as perceived by investors

- An ecological approach that incorporates an interplay of different macro risks instead of a linear additive understanding of risks
- Machine learning algorithms are used to aggregate the risk environments of individual funded solar projects to construct an 'investable space' – a set of investment environments perceived to be most suitable for investments
- Features of the investible space - frontiers, shape and volume – describe the characteristics of conducive investment environments
- The study describes the relative acceptability of different risks and identifies opportunities to mitigate risks by understanding their patterns of co-occurrence

Results: Acceptability of different risks

The distribution of different macro risk levels within the investible space provides insight about their acceptability to investors

FX Risk

Interest Rate Risk

Growth Risk

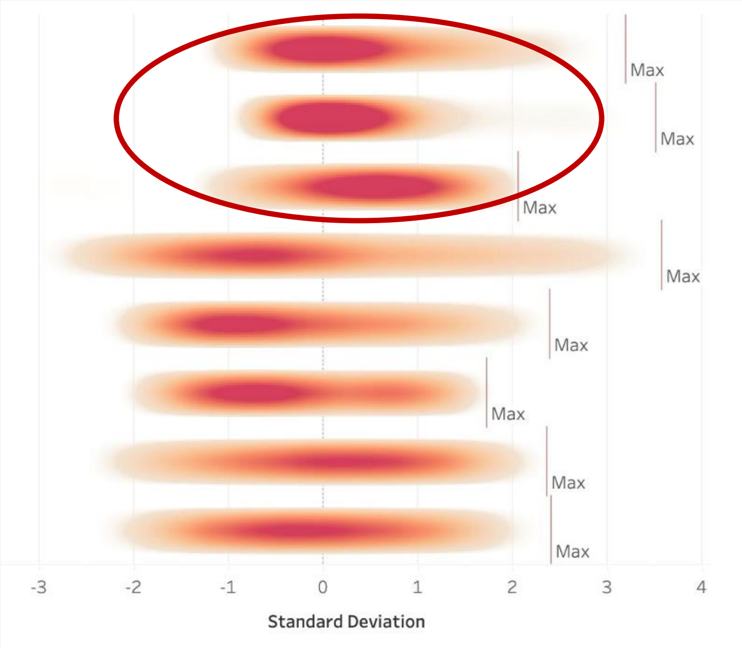
Sovereign Risk

Political Risk

Institutional Risk

Credit Risk

RE Policy Risk



Currency, interest rate and growth risks are centered in the higher risk space and have relatively narrow distributions

This indicates that while moderately higher values for these risks are generally acceptable, these need to be within a narrow range

Positive values indicate higher risks. Stronger colours indicate a higher level of investment suitability

Results: Acceptability of different risks

The distribution of different macro risk levels within the investible space provides insight about their acceptability to investors

FX Risk

Interest Rate Risk

Growth Risk

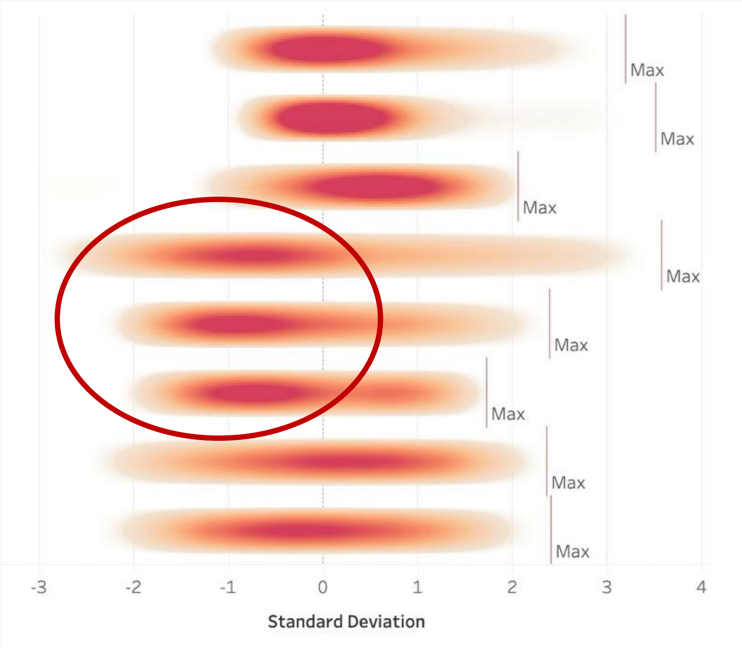
Sovereign Risk

Political Risk

Institutional Risk

Credit Risk

RE Policy Risk



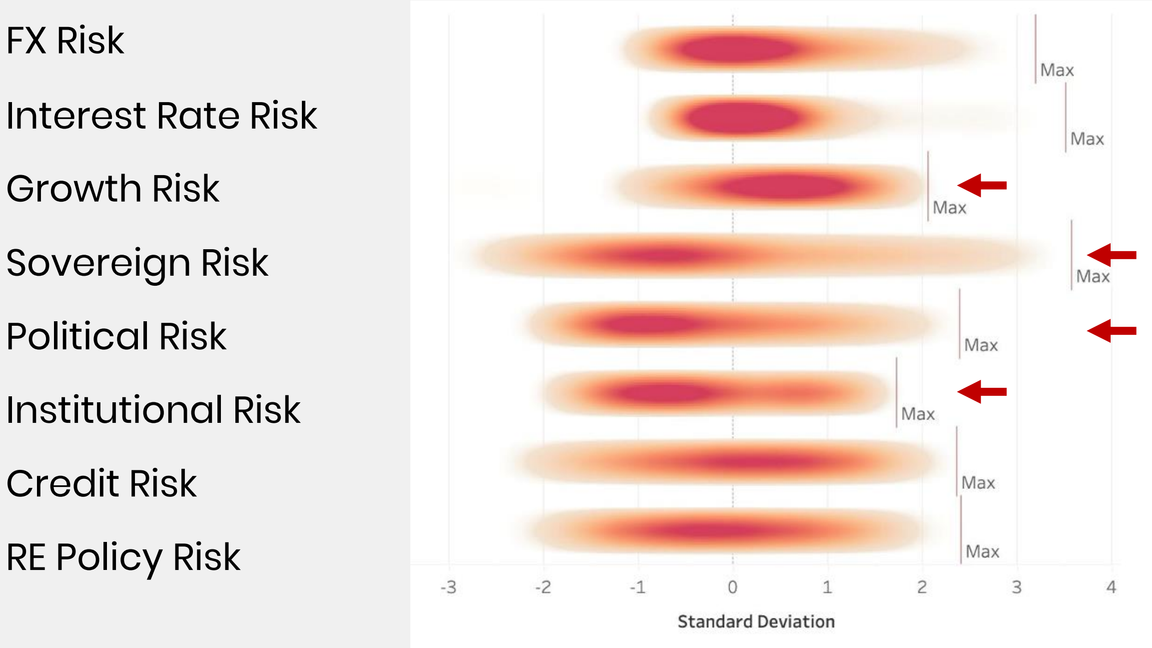
Sovereign, political and institutional risks are centered prominently in the lower risk space

This indicates that suitable environments will in general have lower values of these risks

Positive values indicate higher risks. Stronger colours indicate a higher level of investment suitability

Results: Acceptability of different risks

The distribution of different macro risk levels within the investible space provides insight about their acceptability to investors



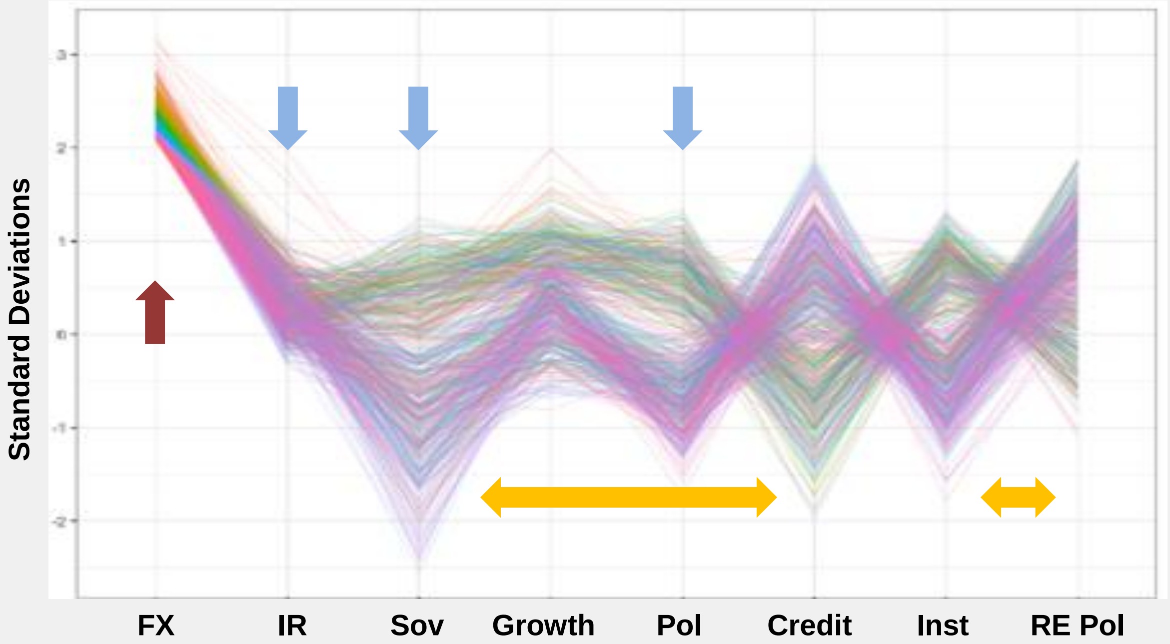
Positive values indicate higher risks. Stronger colours indicate a higher level of investment suitability

Growth and institutional risks, have low upper limits signifying that low-growth economies and weak governance contexts have very low acceptability

Sovereign and political risks have wide ranges with a greater acceptance for higher risk values, reflecting the environments in some MI and LI countries that receive limited investments despite high levels of these risks

Results: Response to risk configurations

Investment suitability is determined by investors' response to collective risk configurations



Highest 1% of Risk Levels

Mitigating risks

Correlated Risks

Different risk factors combine to form a risk landscape that determines the investment suitability of macro environments.

Risks balance, accentuate, correlate and combine with each other in distinct ways to produce non-linearity in investment outcomes

Results: Risk interactions

- Foreign exchange, interest rate and sovereign risks combine to create a riskier environment for investments
- Sovereign, Institutional and Political risks are highly correlated
- High levels of sovereign risk needs to be balanced with low counterparty credit risk and a supportive RE policy environment which can mitigate high institutional risks
- High level of interest rate risk, alongside low FX and Sovereign risks, can be acceptable with relatively low political risk in a broadly supportive RE policy
- Environments with high growth risk (low growth), need to feature low institutional, political, foreign exchange and sovereign risks
- High counterparty credit risks need to be balanced with low sovereign risk or a well performing economy alongside a supportive institutional environment

Policy Implications: Complexity of risk interactions creates opportunities to mitigate risks more effectively

- A systemic measure of risk indicates the importance of individual risk factors for investment suitability – reducing institutional, currency and interest rate risks creates the maximum 'headroom' for other risks
- Systemic analysis captures how entire investment systems respond to macro risk changes, highlighting the need to manage risks collectively, when they interact and don't
- Combinations of international mechanisms, financing structures and domestic policies can mitigate risks effectively by targeting risk combinations, instead of individual risks, based on viability, mitigation costs and investor preferences
- Solutions can be tailored for countries in specific socio-economic contexts based on their risk contexts and interactions, such as the income levels, growth potential, governance context, and the possibility to affect these in the short run

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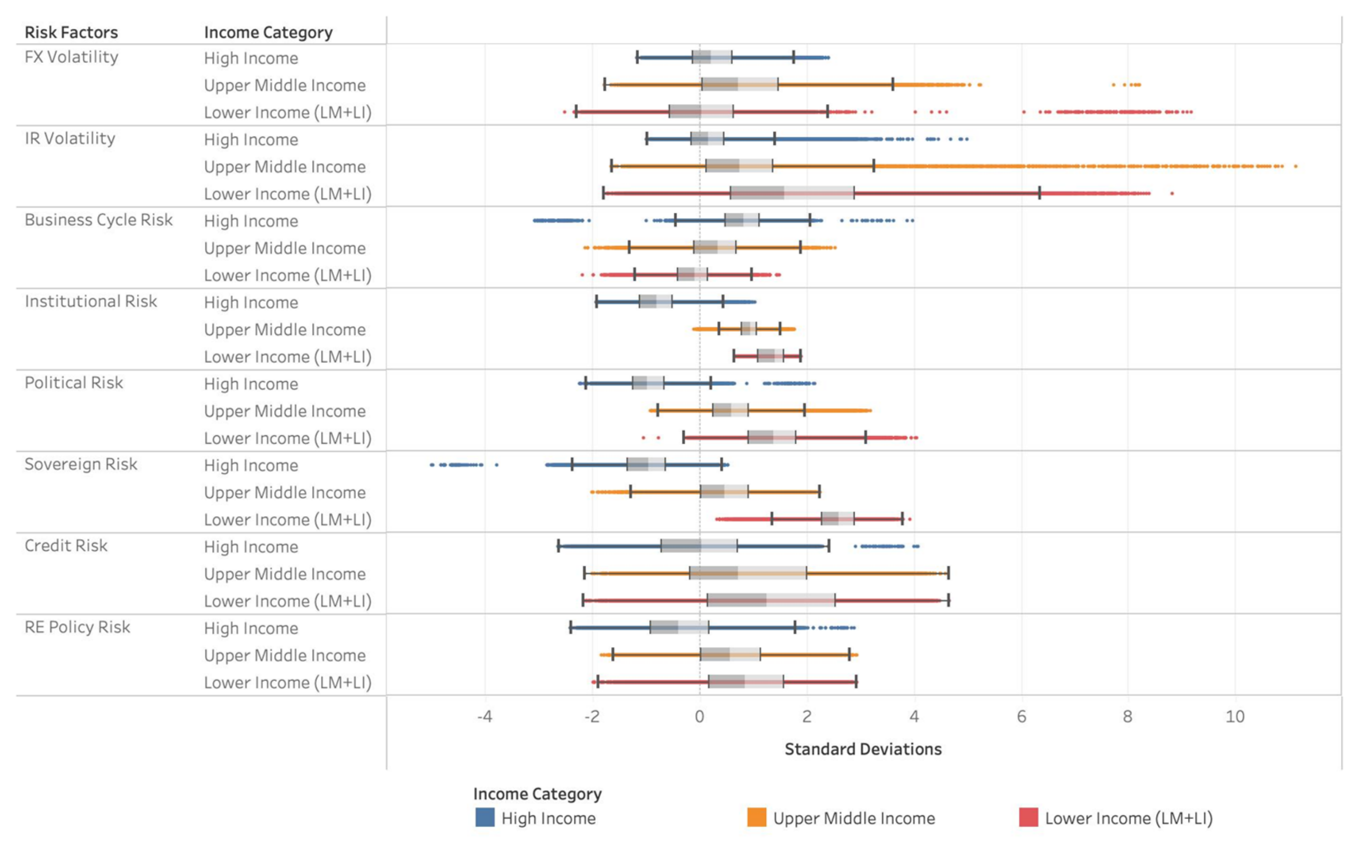
Our Policy Brief on Macro Risks In Conducive Investment Environments can be found here

Annex

Results: Risk distributions across country groups



Intricate relationship between income levels of countries and the acceptability of risks – some risks are largely correlated with income groups while others follow an altogether different pattern

Results: Risk interactions across income groups

- UMI and LI countries generally have higher political, sovereign, and institutional risks than HI countries, influencing acceptable risk thresholds
- Institutional risk tolerance is limited in UMI and LI countries (narrow distributions), meaning the tolerance for greater levels of these risks is limited
- In LI countries, suitable foreign exchange risk levels are lowest, while in UMI countries, high foreign exchange risk must be balanced with low sovereign, political, institutional, and credit risks
- High levels of growth risk are largely acceptable only for HI countries and in UMI countries with low sovereign and institutional risks and a low-risk environment overall. LI countries, however, will struggle to compensate for a low-growth environment
- In contrast, interest rate risks have a higher range of acceptable levels in LI countries but need to be balanced with lower growth and foreign exchange risks
- Counterparty credit and renewable energy policy risks have wide levels of acceptability across countries, but they similarly need to be balanced out with other risks, particularly low foreign exchange and growth risks in LI countries

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Research Segment

Session 9: Climate implications for firm productivity & private investment in the transition

C3A Annual Symposium, 6th December

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The heat is on: Heat stress, productivity and adaptation among firms

Hélia COSTA Guido FRANCO
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Background: heat stress and productivity

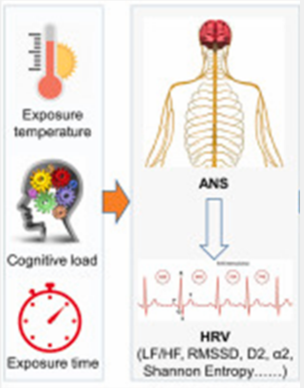
- The pace of temperature increase has been steadily accelerating (IPCC, 2021) and will continue to do so even if targets are met (IPCC, 2023)
- What does it mean for economic activity?

Heat stress can imply **less production** per worker

As temperatures increase, cognitive and physical capacity of workers decrease (Thompson et al., 2024; Picchio and Ours, 2024)

Temperature increases lead to absenteeism as they affect health and transport (Dell, Jones and Olken, 2014; Nemry and Demirel, 2012)

Further indirect impacts
Disruption to infrastruction, increased production costs, reallocation of investment, supply disruption



Macro-level aggregate studies + Country-level and case studies

Overview of the paper

Cross-country, micro-level study covering European and Asian economies

Research question:
How does heat stress affect firm productivity?

Temperature changes (Slow onset event)	**Heat waves** (Extreme weather event)

How do impacts vary across firms, sectors, regions, countries, and weather conditions?

What are the implications for productivity dynamics?

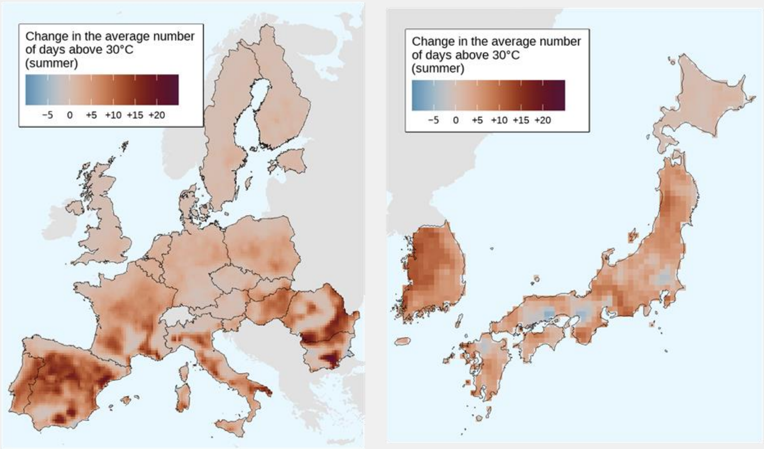
What is the role of adaptation in reducing these costs?

Manufacturing and services sectors for 2.7 million firms across 23 countries between 2000-2021

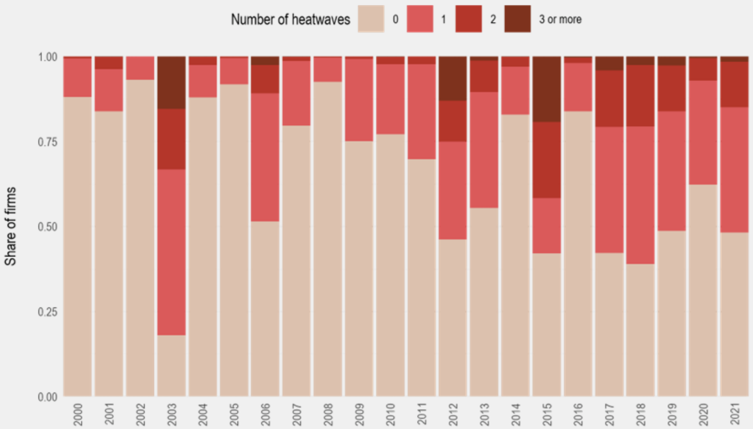
Heat stress data: collection and evolution

- **Daily temperature and weather** information available at maximum 28km x 28km grids are overlaid with firm location information to match with **annual balance sheet information**.
- This resulted in a dataset with over 2.7 million firms across 23 countries between 2000 and 2021.

Change in the average number of days where temperatures rose above 30°C, in 2016-2021 vs 2000-2004



Share of firms by number of heat waves 2000-2021



Empirical strategy: Baseline specification

Fixed effects panel data model:

$$LP_{igcst} = \beta_0 + \beta_1 Heat_{gct} + \beta_2 \boldsymbol{X}_{igcs,t-1} + \beta_3 \boldsymbol{W}_{gct} + \delta_i + \delta_{cst} + \varepsilon_{icst}$$

✓The subscripts *i, g, c, s, t* stand respectively for firm, location, country, sector, and year

✓LP_{igcst}: log level of value-added based labour productivity.

✓$Heat_{gct}$: i) the number of days in a location and year in which the maximum daily temperature goes beyond a certain threshold (30, 35 or 40°C) or; ii) the number of heatwaves occurring in each location in each year.

✓$\boldsymbol{X}_{igcs,t-1}$: set of lagged firm level controls, including firm size class, age, profitability and capital to assets ratio.

✓$\boldsymbol{W}_{gct}$: set of weather-related controls, including wind speed, precipitation and humidity.

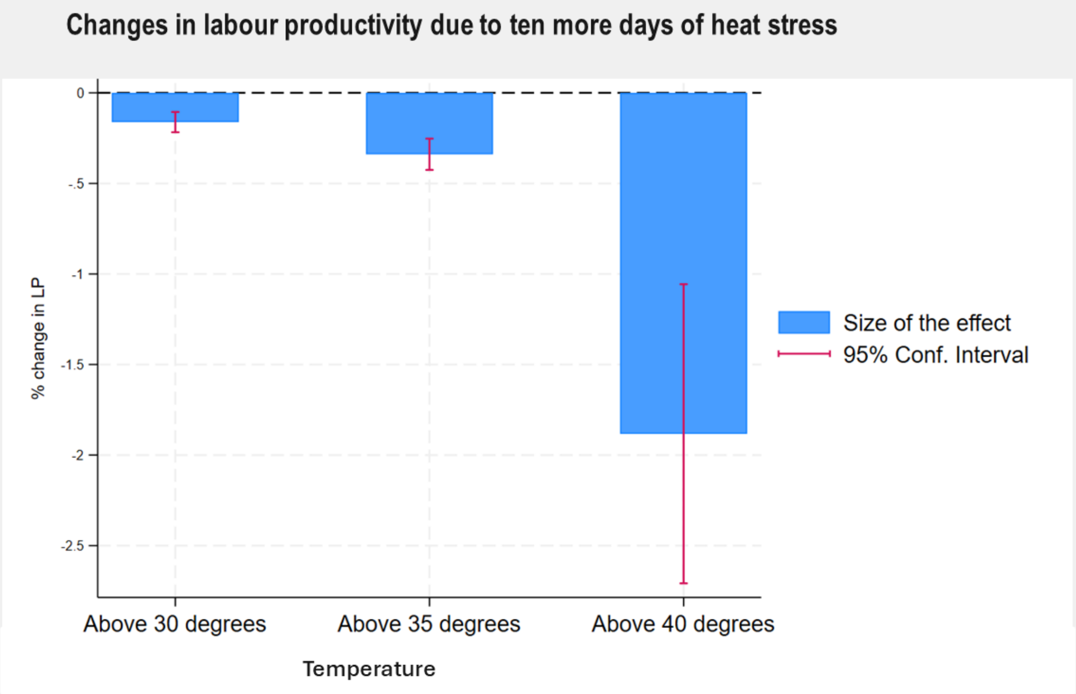
✓δ_i: firm fixed effects, subsuming location fixed effects.

✓δ_{cst}: triple interacted country by sector by year fixed effects.

✓Standard errors clustered at the location level (i.e., the level of the treatment).

Identification assumption: fluctuations in temperature relative to a location average are exogenous to firms' LP
Unlikely that firms are able to anticipate deviations/shocks (rather than average temperatures)

Warm days negatively affect productivity



Labor productivity decreases as the number of warm days increases

Particularly for extreme temperatures

Ten more days above 35 degrees decreases the average productivity by **0.3%**

The effect is larger for smaller firms, in more humid and less windy regions, and in some more exposed sectors

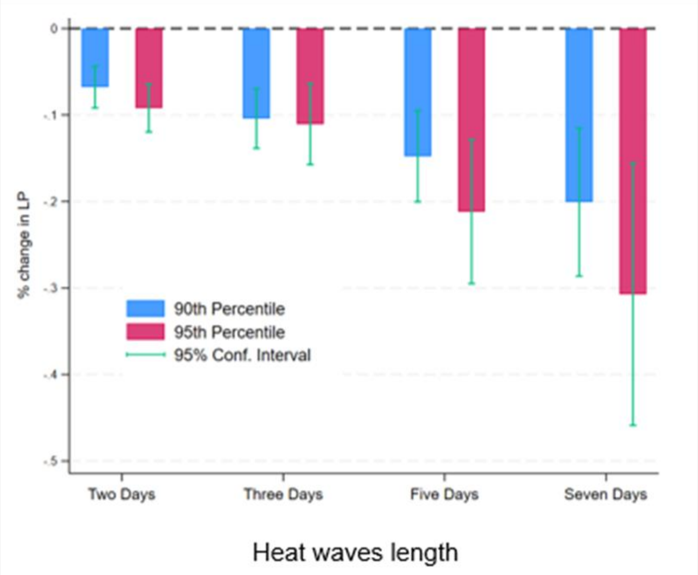
Heat waves also affect productivity

Labor productivity decreases as the number of heat waves increases

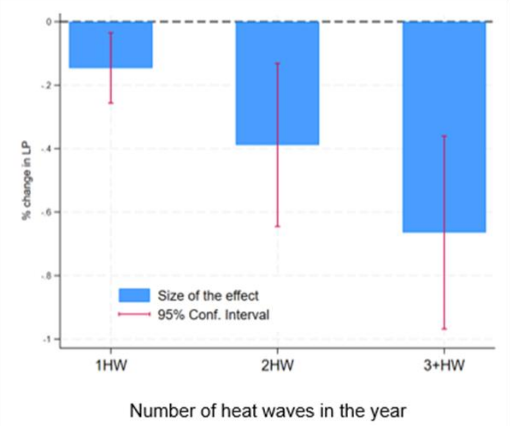
Longer heat waves cause larger costs

More heat waves per year carry larger costs

Changes in labour productivity due to an additional heat wave several heat wave definitions

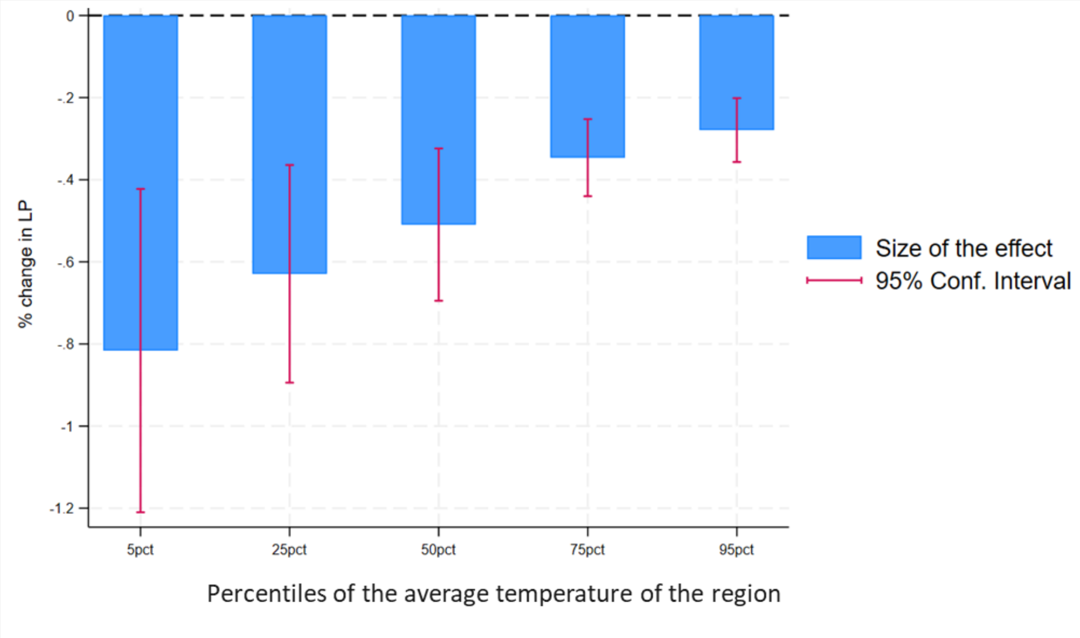


Changes in labour productivity due to due to one, two or three or more additional heat waves



Some evidence of adaptation

Change in labour productivity from extra 10 days above 35 degrees
By average temperature in firm location



Firms in places that are on average warmer & firms that experienced more heat waves in the past have smaller productivity losses

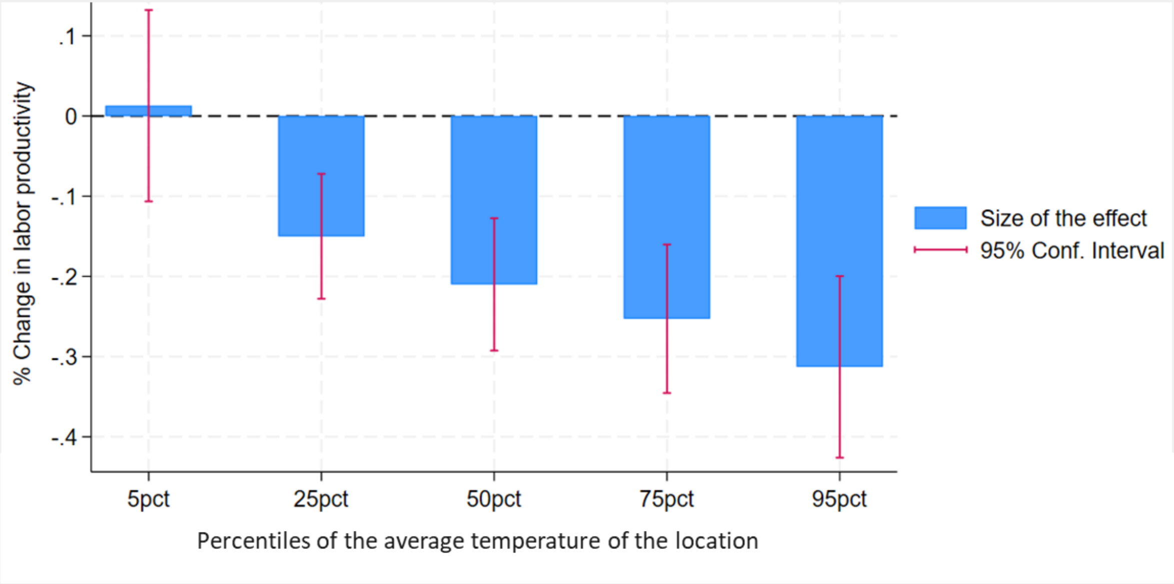
↓

Indicative that ***autonomous adaptation*** takes place

Adoption of adaptation measures is also associated with lower losses

Adaptation to extremes is limited

Change in labour productivity from an additional heat wave
By average temperature in firm location



All firms experience comparable productivity losses when temperatures exceed 40 degrees Celsius

Extreme temperatures relative to an already warm baseline cause larger losses

Indicative of soft or hard limits to adaptation

Conclusions and policy implications

Important to strengthen **mitigation** efforts, particularly given **non-linearities of costs** and **limits to the effectiveness of adaptation**

Adaptation requires an approach tailored to different national and regional contexts to account for relevant heterogeneities in impacts and capacity

↓

Policy can promote **private sector adaptation** to complement new public sector investment across a range of adaptation measures, including *infrastructure like green roofs*, *urban planning interventions*, or *behavioural measures like changing working hours*

Requires aligning public and private finance flows with adaptation objectives, mobilising additional funding

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Research Segment

Session 9: Climate implications for firm productivity & private investment in the transition

Chairs: Marcelo C. Pereira & Wellington de Santos Amorim

December 6th 2pm Meeting Room Trocadero

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Crisis breeds Innovation: The 2022 energy crisis and green technology adoption

Paulo Bastos, Jacob Greenspon, Katherine Stapleton & Daria Taglioni

Contact: kstapleton@worldbank.org

Table of contents

1. Motivation

2. Data

3. Stylized facts

4. Empirical strategy

5. Results

6. Conclusions

Motivation

- Meeting net-zero goals will require **rapidly accelerating the diffusion of low-carbon technologies (LCTs)**
- But to date **limited evidence on diffusion** of a wide range of LCTs across countries, industries and firms
- Still an open debate about **the most important factors that influence diffusion** including the role of energy prices

This paper

1. Develops **a text-based method to measure diffusion of a wide range of LCTs** across countries, industries and firms using online job postings

2. Shows there was **rapid growth in diffusion of LCTs in 2022**, with growth in a wide range of countries, regions and industries

3. Explores the **role of the 2022 energy crisis**:

- Faster diffusion in **countries more exposed to the energy price shock** due to natural gas import dependence
- Faster diffusion **for more energy intensive firms** within these countries

Data

- **Online job postings:** 580 million online job postings from Lightcast. Focus on 16 advanced economies with data since 2014 (46% of global GDP)

- **Firm level data:** financial and balance sheet data for publicly traded companies and their supply chains from Factset Fundamentals and Factset Revere. Firm-level energy consumption data for 4793 publicly listed firms that could be matched to Lightcast and Factset data from Carbon Disclosure Project (CDP)

- **Country energy import data:** from IEA World Indicators

Example:

Contracts Manager, Australia –

*"leading a large engineering procurement and construction services company which deliver projects of pipeline **wind farms** and facilities throughout australia and ppg this is an exciting opportunity for an experienced contracts manager who has **wind farm** delivery experience to join this company"*

Measuring LCTs

- Build on literature that **infers adoption of innovative technologies from their footprint in demand for new tasks** in text of job adverts (e.g. Acemoglu et al. (2022), Goldfarb et al.(2023), Bloom et al. (2021))
- Hand extract list of **nouns related to 46 LCTs** from EPO Y02B, Y02C, Y02D, Y02E, Y02T, Y02P, Y02W and Y04S classification of patents related to 'climate change mitigation technologies'
- Search for these in job **in English and translation into national language** postings

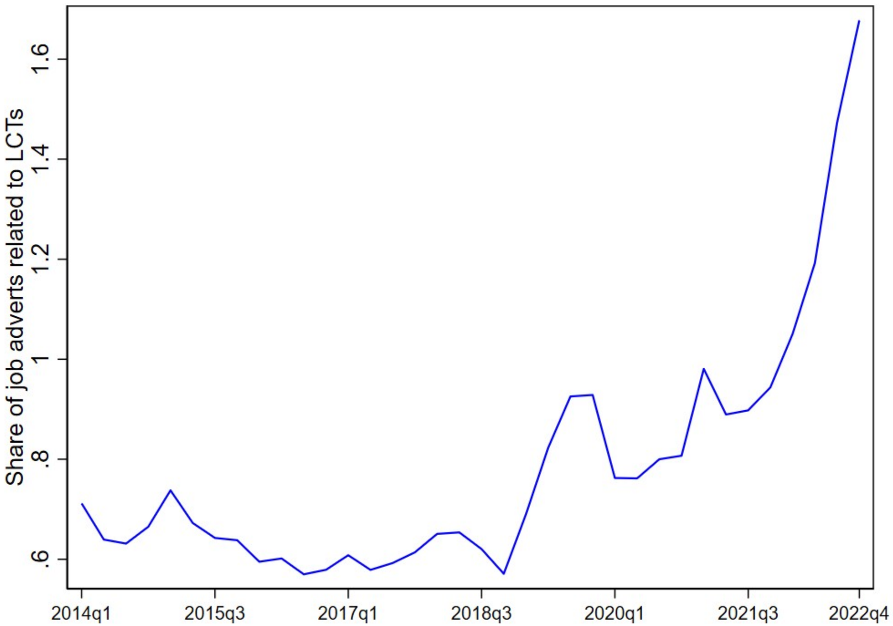
Stylized facts

1. Rapid growth in **LCT-related hiring in 2022**
   - LCT share of job postings grew from 1% in Q1 2022 to 1.7 percent by Q4 2022

2. Growth **fastest in Europe**
   - Fastest in Germany, France and Luxembourg

3. Growth driven by **jobs related to renewable energy, electric vehicles, heat pumps and insulation**

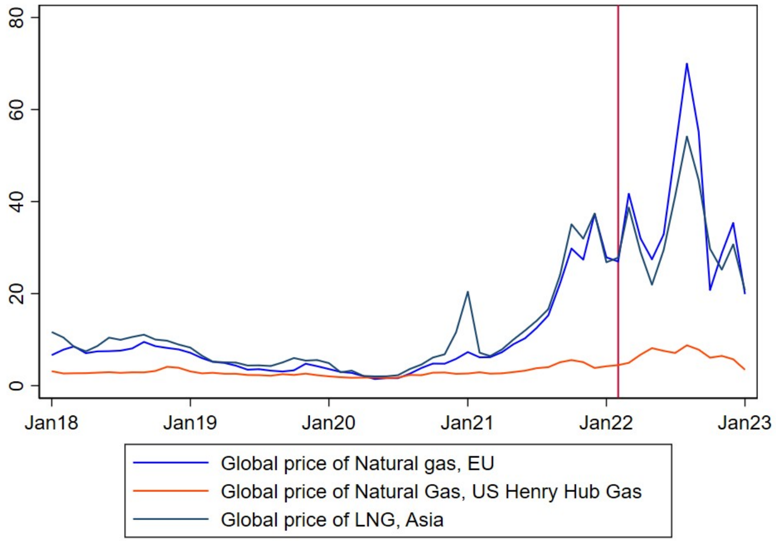
Share of online job postings related to LCTs, 16 countries (%)



Role of the 2022 global energy crisis

- The Russia-Ukraine war introduced the **largest energy price shock** since the 1970s
- But **countries were differentially exposed** depending on their reliance on natural gas imports
- By Aug. 2022 half of European countries had **wholesale electricity prices more than 12 times** their Jan. 2018 levels
- By contrast, the **US Henry Hub Gas price changed very little**
- Firms were also **differentially exposed** depending on their pre-crisis energy intensity

Natural gas price indices



Empirical strategy

$$\text{IHS}(LCT_{j,c,t}) = \alpha_0 + \beta_1(\mathbf{I}(YM_t \geq Feb2022) * Exposure_c) + \psi_j + \zeta_t + \epsilon_{j,c,t} \quad (1)$$

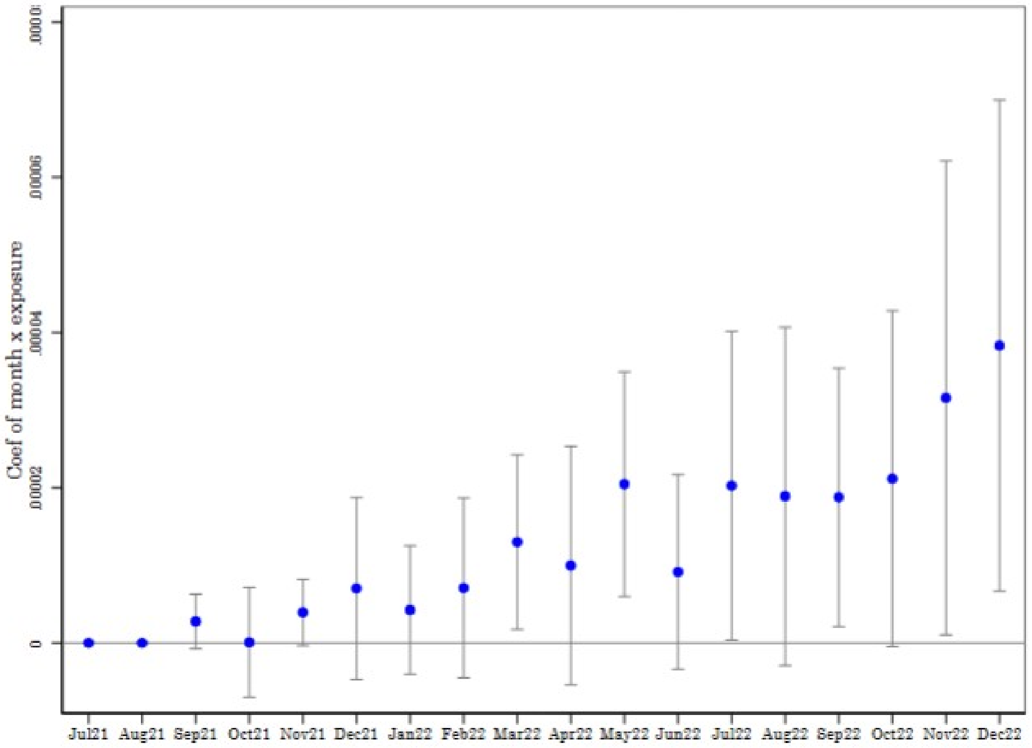
$$\begin{aligned}\text{IHS}(LCT_{j,c,t}) = \; & \alpha_0 + \beta_1(\mathbf{I}(YM_t \geq Feb2022) * Exposure_c) \\ & + \beta_2(\mathbf{I}(YM_t \geq Feb2022) * EnergyIntensity_j) \\ & + \beta_3(\mathbf{I}(YM_t \geq Feb2022) * Exposure_c * EnergyIntensity_j) \\ & + \psi_j + \zeta_t + \epsilon_{j,c,t} \quad (2)\end{aligned}$$

- $IHS(LCT_{j,c,t})$ is the inverse hyperbolic sine transformed number of LCT postings in establishment j in country c at year-month t
- $Exposure_c$ is the country's share of energy consumption from imported natural gas or fossil fuels
- $EnergyIntensity_j$ is establishment j's energy consumption per unit of sales

Baseline Results: more exposed countries and firms saw faster growth in LCT hiring

	Dep var: Total LCT job ads (IHS transformation)		
	(1)	(2)	(3)
Post-February 2022 × Country exposure	0.155***		0.153***
	(0.049)		(0.049)
Post-February 2022 × Country exposure × Firm exposure		0.154**	0.034**
		(0.065)	(0.015)
Year-month FE	Yes	Yes	Yes
Establishment FE	Yes	Yes	Yes
Post-Feb '22 x Firm Exposure	No	No	Yes
Observations	1,982,647	1,982,647	1,982,647
Adjusted R-squared	0.608	0.607	0.608

Faster growth began in March 2022 and was highest by December 2022



Further results and robustness

- Results driven by **hiring related to energy generation** technologies

- Greatest differential hiring for these technologies by energy intensive firms in **Netherlands, Switzerland, Italy, Germany, UK**

Robustness

- No evidence of difference in baseline characteristics for countries more dependent on imports of natural gas
- Little evidence of different baseline characteristics of energy intensive firms
- Results robust to dropping fossil fuel producers
- Results robust to controlling for green industrial policies
- Results robust to controlling for fossil fuel subsidies

Conclusion *& key messages*

- Rapid **diffusion of LCTs in 2022** as measured using online job postings in 35 countries
- Growth driven by jobs related to **renewable energy, electric vehicles, insulation and heat pumps**
- Growth was **not limited to research roles or production**, suggestive of accelerated adoption
- Firms in countries with **greater natural gas import dependence** increased LCT-related hiring after March 2022 and this increase was **greater for more energy-intensive firms**
- Suggests the **energy price shock played an important role** in the diffusion of LCTs

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Thank you

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