DC will be responsible for most future growth in GHG emissions and energy consumption

Until 2020, energy efficiency measures represent the bulk of the reduction potent technical and economical terms it is the single most important opportunity in decade.

A large variety of low-cost measures can be used in an early phase, most of which available and have negative or low costs even though the upfront investment considerable. All sectors have potential to improve energy efficiency (both demand sectors)[24]. The POLES model simulates the implementation of energy

[24] Energy efficiency improvements that are not introduced through increases in price, related to the different energy transforming equipments and/or to the final en the industrial, residential and services sectors, are modelled through autonomous ener indicators (AEEIs). For road transport the impact of measures, including standa efficiency improvements of the whole transport fleet is modelled in the transport m POLES model, based by the assessment on their impact on fuel efficiencies of the newl vehicles in the future. Estimates are made for the upfront costs of these energ improvements. These are based on studies by JRC for EU energy efficiency measures

Technology transfer (TT) is critical

- To reduce emissions
- To facilitate global agreements

But the UNFCCC approach is not working well

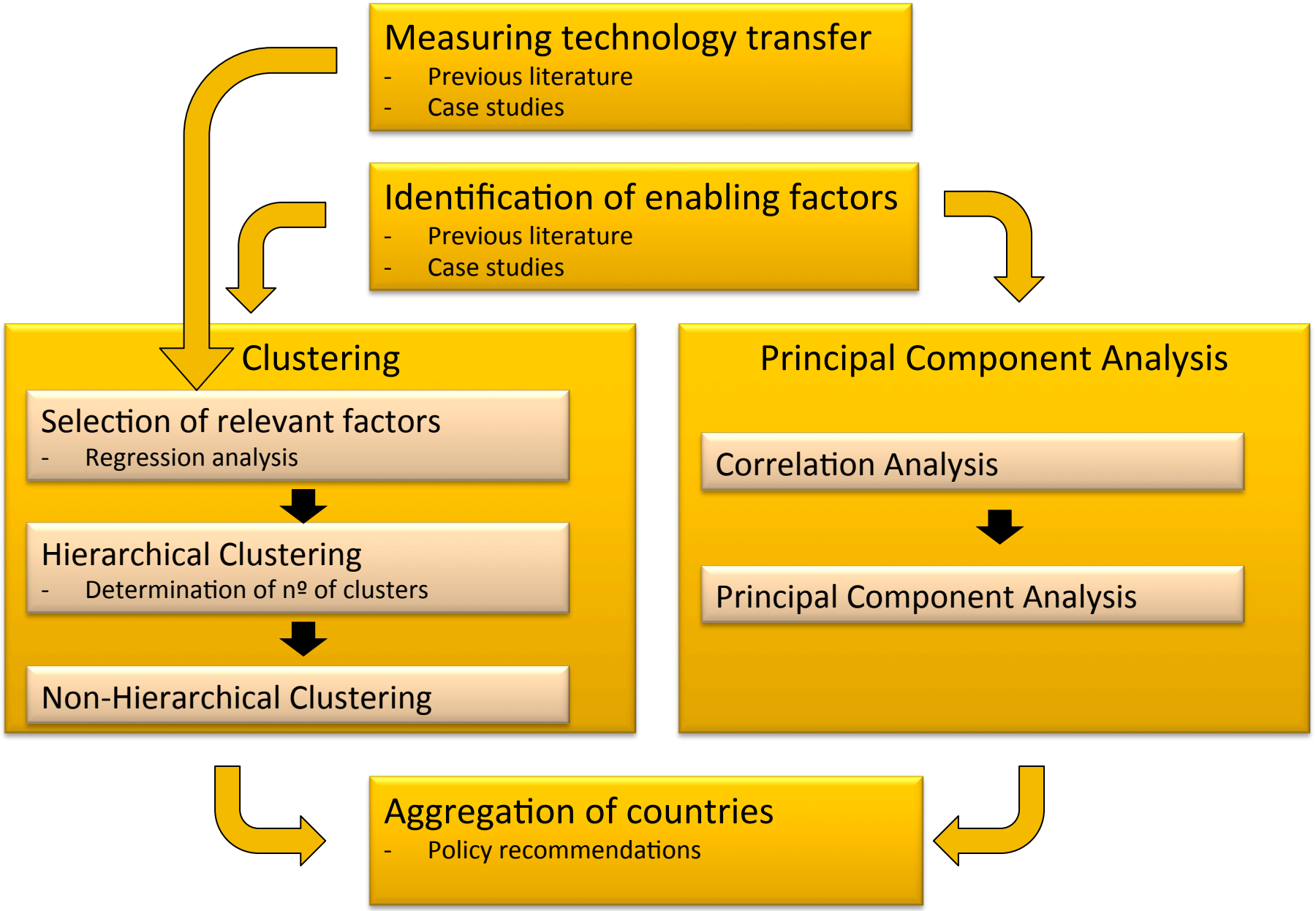
- Disconnected from national enabling factors
- Non-differentiated approaches
- Difficult to measure: difficult to assess

We need improved policies and instruments for TT

Our objective

- To contribute to the definition of better TT instruments and policies
  - E.g., for the Technology Mechanism
- How?
  - Identifying the enabling factors of TT
  - Assessing their influence on TT
  - Analysing differences in the performance of DC
  - Proposing different policy packages for different groups of countries

Methodology



Measuring Technology transfer

Input	Output	Effect
• **Imports of clean energy technologies (REIMPpclog) 7 tech in COMTRADE** • Foreign R&D expenses in low-carbon technologies • Low-carbon FDI • Foreign workers in low carbon related sectors • Foreign low-carbon patents filed in developing countries • Low-carbon related license payments to foreign companies • Adoptions of foreign technologies	• **Exports of clean energy technologies (REEXpclog) 7 tech COMTRADE** • **Installed renewable capacity adjusted per expected need of TT (RECAPTTpclog)** • Revenues from local patents developed with foreign support • Number of local scientific publications in low-carbon technologies in collaboration with foreign institutions	• TCO_2 reductions explained by foreign low-carbon related financial flows • Learning effects of foreign low-carbon financial flows • Effects of foreign low-carbon financial flows on TFP of recipient country

Enabling factors

Tech supply	Ec and inst framework	Tech demand	Industrial dev.
• Tertiary education school enrolment ratio per capita (ENROL3log) • Stock of local patents (PATLOCpclog) • Logistics performance (LOG) • Estimated annual renewable energy resources (REACpclog)	• Ease of Doing Business (EDB) • Corruption Perception Index (CPI log) • IPR index (IPR) • Average income tax (INCOMETAX) • Domestic credit to private sector as % of GDP (CREDlog) • Tariff levels (TARIFF) • Trade openness (TRADEOPlog) • FDI openess (FDIOPlog) • Index of investment freedom (INVESTFREE) • Stock of foreign patents (PATFORpclog)	• GDPlog • GDP growth • GDP pc log • Price of diesel fuel (PDIES) • Production of fossil fuels per capita (FOSSILpclog) • Feed-in-tariffs (dummy) FIT	• High technology exports as % of manuf exports (HTEEXPlog) • Number of companies with ISO 9001 certification (ISOpclog) • TFP relative to the US (TFPlog) • Competitive Industrial performance score (CIP)

Relevant factors

	RE exports (log)	RE Imports (log)	RE Capacity TT (log)
RE resources log	0.9		0.3
GDP log	0.4		
GDPpc log		0.7	0.8
IPR	0.6		-0.7
CIP	17		
Private credit log		0.7	
Logistics			1.59
Fossil production log			-0.13
	R^2= 0.59	R^2= 0.69	R^2= 0.4

Clustering: Wards method

1

Algeria, Bolivia, Indonesia, Iran, Colombia, Ecuador, Egypt, Peru, **Russia,** Syria

2

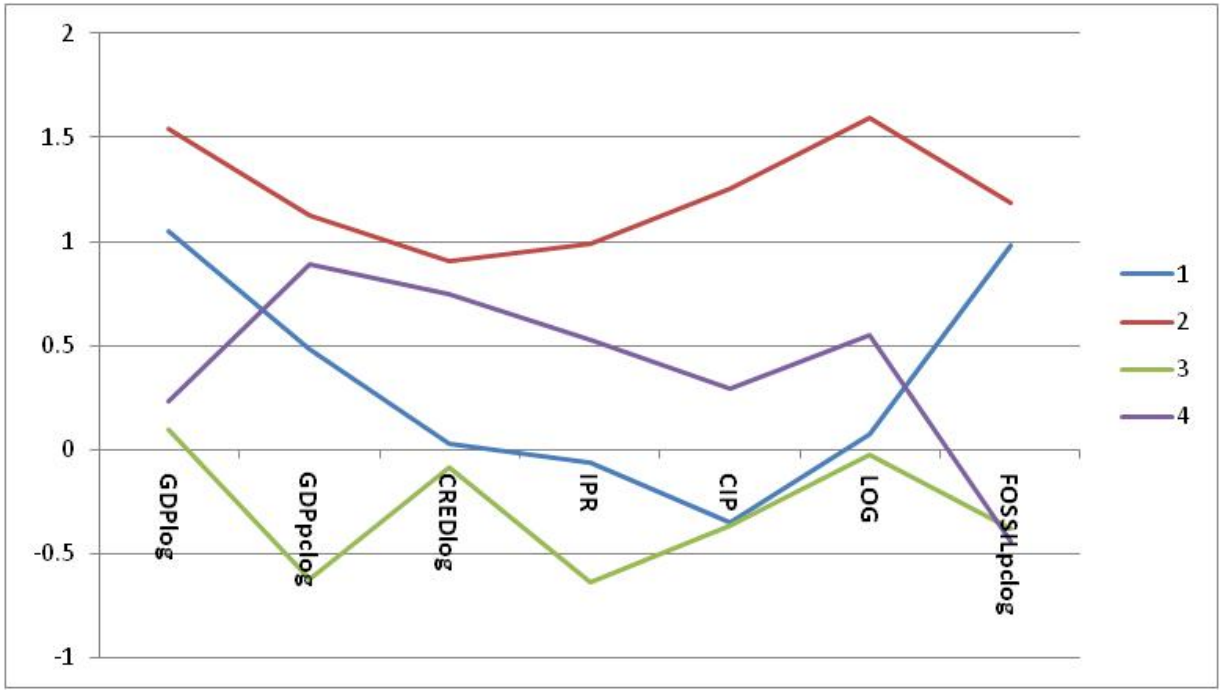
Argentina, Brazil, **China,** India, **Malaysia,** Mexico, Oman, Qatar, Saudi Arabia, **South Africa,** Thailand, Turkey

3

BGD, MOZ, BEN, NPL, CMR, CIV, PAK, GEO, PRY, **GTM, HND,** SEN, TZA, KEN, UGA, **NGA,** MDG, **VNM,** MDA, ZMB

4

Botswana, Jordan, **Chile,** Lebanon, Costa Rica, Panama, Tunisia, **El Salvador, Jamaica,** Uruguay



Clustering: K-means method

1

Argentina, Russia, Oman, Saudi Arabia

2

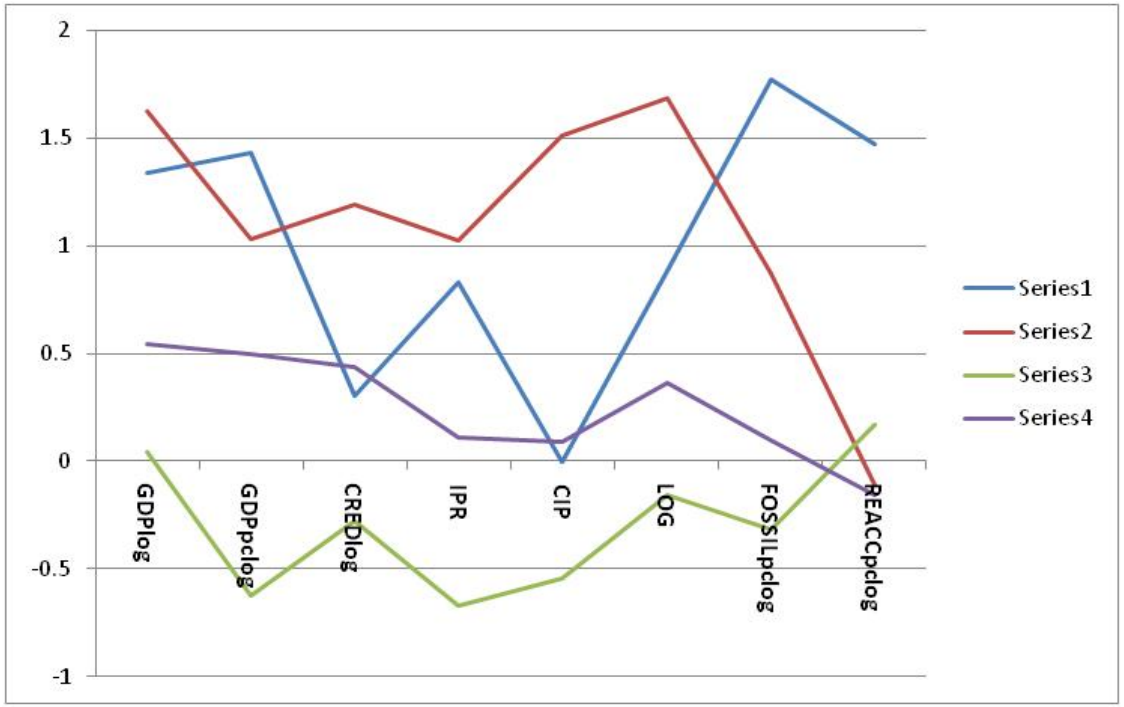
Brazil, **Chile,** **China,** India, Malaysia, **Mexico,** Qatar, **South Africa,** Thailand, Turkey

3

DZA, BGD, BEN, BOL, CMR, CIV, GEO, KEN, **MDG**, MDA, MOZ, NPL, PAK, PRY, SEN, TZA, UGA, ZMB

4

BWA, **COL**, **CRI**, ECU, EGY, SLV, GTM, **HND,** IDN, IRN, **JAM**, **JOR**, LVA, NGA, PAN, PER, **SYR,** TUN, URY, VNM



Principal Components Analysis

- Three principal components explain 72% of the total variance of the 14 variables.
- 61 countries have data for the 14 variables

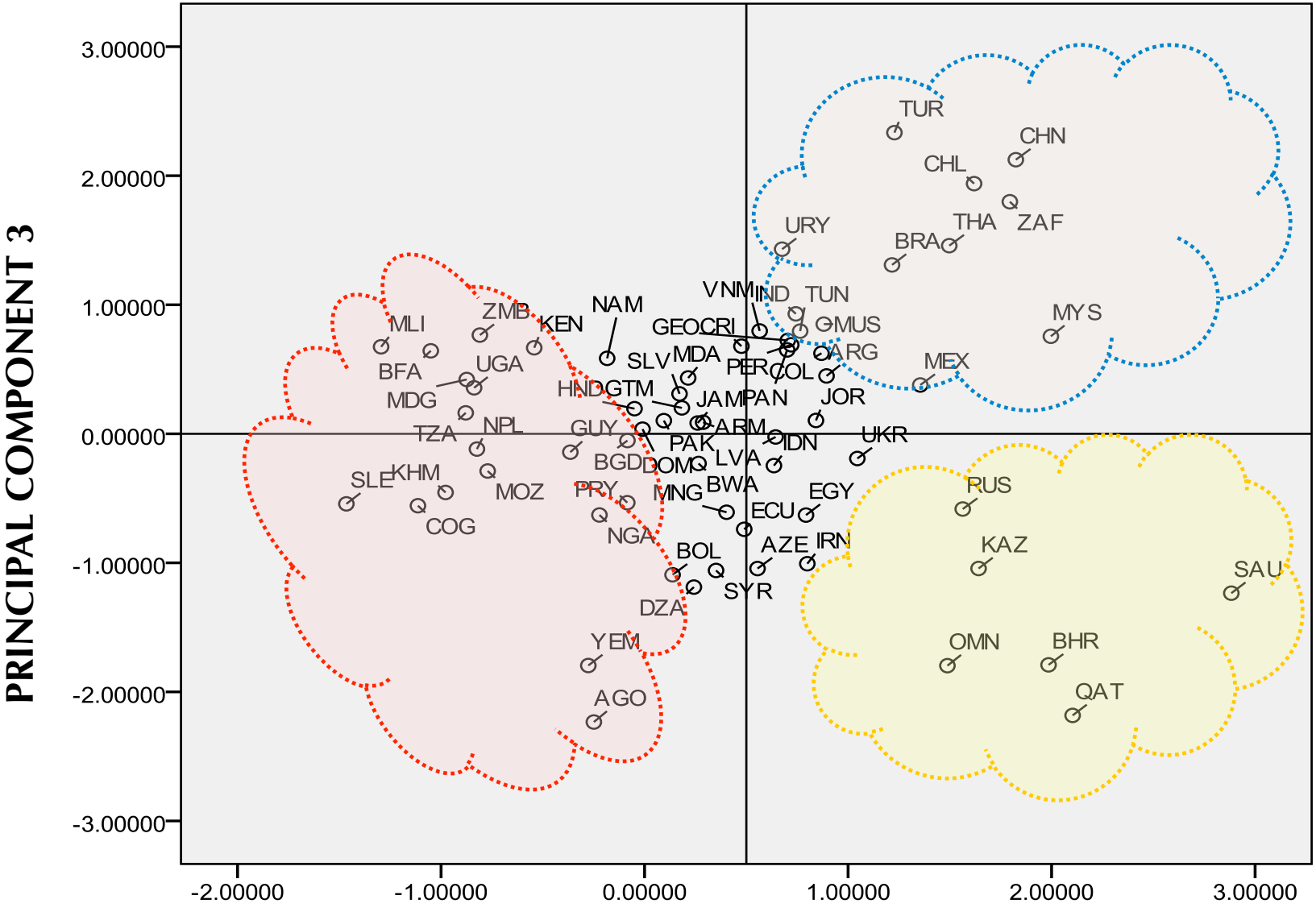
	Component		
	1	2	3
Zscore(ISOPClog)	.906	-.007	.163
Zscore(CO2PClog)	.859	-.077	-.308
Zscore(GDPpclog)	.828	-.159	-.173
Zscore(LOG)	.751	.074	.329
Zscore(GDPlog)	.721	.525	.037
Zscore(CREDlog)	.698	-.322	.314
Zscore(EDB)	-.688	.438	-.148
Zscore(PATLOCPClog)	.650	.354	.183
Zscore(FOSSILPClog)	.644	.454	-.434
Zscore(PATFORPClog)	.628	.607	.399
Zscore(CPIlog)	.465	-.565	.407
Zscore(TARIFF)	-.398	.507	.096
Zscore(PDIES)	-.436	-.113	.767
Zscore(INCOMETAX)	-.448	.429	.537

PC1: Combined effect of all enabling factors. Countries that rate well in all enabling factors for TT . But PDIES has a negative impact and FOSSIL a positive impact. Not good for low-carbon TT.

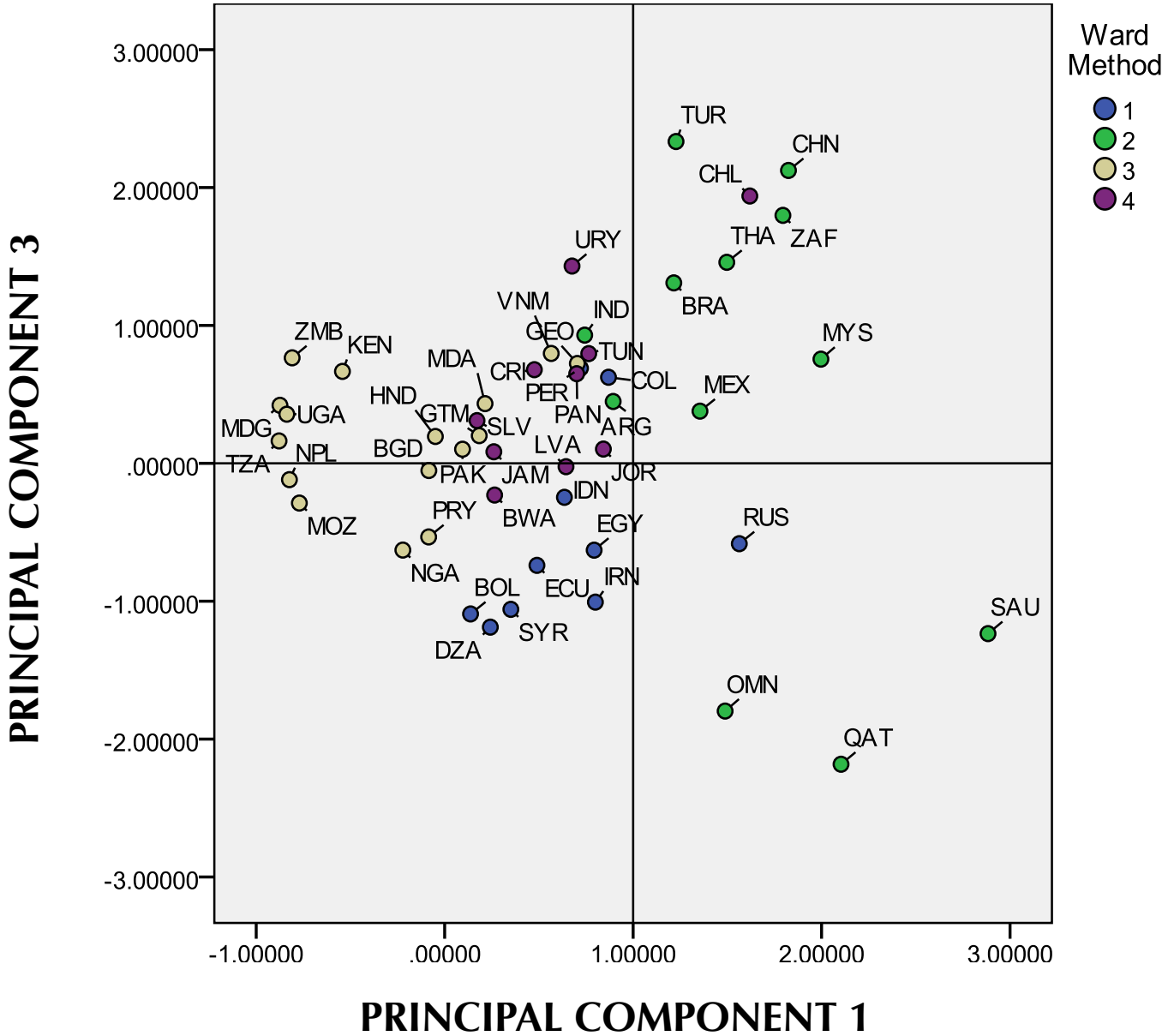
PC2: Will rate high for countries facing some important barriers to TT , but with large economies and abundant fossil fuels

PC3: Will rate high for countries with right demand signs for low-carbon TT and good performance in some key enablers of general TT

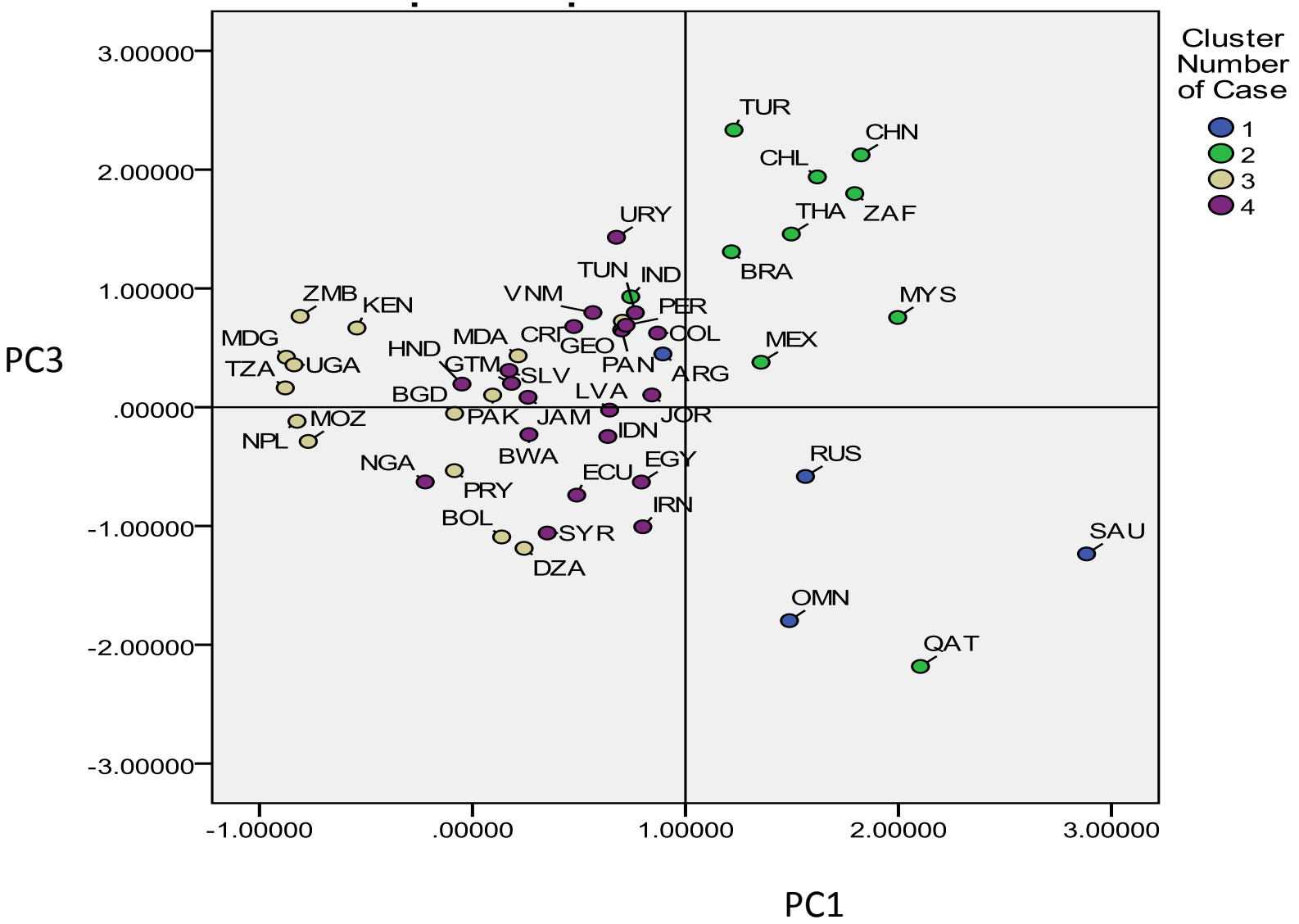
Principal Components Analysis



Robustness of Results: PCA vs Clusters Wards



Robustness of Results: PCA vs Clusters k-means



Final groups

TECHNOLOGY DEVELOPERS

Brazil (UM)
China (LM)
India (LM)
Mexico (UM)
Turkey (UM)
Malaysia (UM)
South Africa (UM)
Thailand (L)
Chile (UM)
Argentina (UM)

TECHNOLOGY IMPLEMENTERS

Botswana (UM)
El Salvador (LM)
Jamaica (UM)
Uruguay (UM)
Costa Rica (UM)
Jordan (LM)
Lebanon (UM)
Panama (UM)
Tunisia (LM)
Colombia (UM)
Vietnam (L)
Chile (UM)
Peru (UM)

STRUCTURAL CHANGES

Algeria (UM)
Russia (UM)
Oman (U)
Qatar (U)
Saudi Arabia (U)
Ecuador (LM)
Egypt (LM)
Iran (LM)
Syria (LM)
Indonesia (LM)
Argentina (UM)
Colombia (UM)
Peru (UM)

AID RECIPIENTS

Bangladesh (L)
Bolivia (LM)
Benin (L)
Cameroon (LM)
Côte d´Ivoire (LM)
Georgia (LM)
Guatemala (LM)
Honduras (LM)
Kenya (L)
Madagascar (L)
Moldova (LM)
Mozambique (L)
Nepal (L)
Nigeria (LM)
Pakistan (LM)
Paraguay (LM)
Senegal (L)
Tanzania (L)
Uganda (L)
Zambia (L)
Vietnam (L)

Policy recommendations (I)

- **Technology developers**
  - RE promotion policies to attract investments and increase local capacity
  - Temporary industrial policies to support local infant industry
  - Less need of international support
- **Technology implementers**
  - Focus on demand-pull policies to increase investment in clean technologies and improve technological capabilities by learning-by-doing
  - Support to niche industries to exploit specific sources of comparative advantage
  - Support demonstration projects to improve local capabilities

Policy recommendations (II)

- **Countries needing structural changes**
  - Improve economic and institutional conditions favorable to private investment
  - Create the appropriate demand signals for investment in clean energy technologies: eliminate subsidies to fossil fuels and use fuel rents to support investments in clean energy technologies.
- **Aid recipients**
  - Create capabilities, institutions and infrastructure to enable the flow and implementation of foreign low-carbon technologies
  - Foreign aid required to create enabling conditions
  - Once appropriate institutions and technological capabilities are in place implement small scale demand-pull policies, such as demonstration projects

Limitations and further research

- Qualitative analysis limited by the study of a single country, Chile
- Quantitative analysis limited by unavailability of data on climate change TT
- Policy recommendations could be further developed and tailor-made
- Further research
  - Study causal effects
  - Analyze learning effects
  - Assess technology spillovers

Institute of
Development Studies

Thanks for your attention

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