



Institute of  
Development Studies

# Enabling factors for climate change technology transfer to developing countries

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**Thematic dialogue on enabling environments and barriers  
to technology development and transfer**

Bangkok, Thailand, September 6th, 2012

# UNFCCC instruments have not delivered significant rates of TT to developing countries

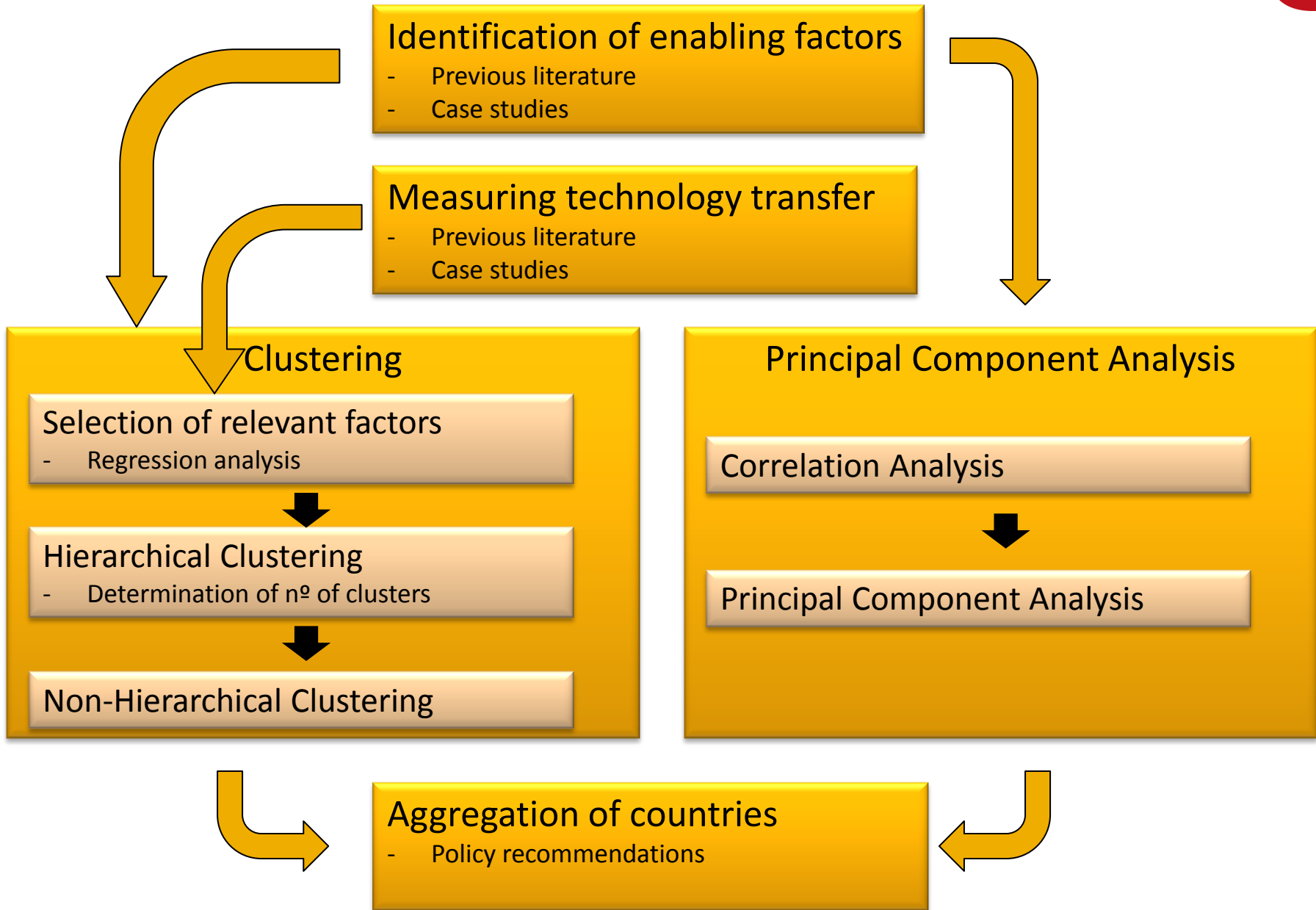


- Disconnection from enabling frameworks that facilitate private investment:
  - Not integrated in national planning
  - Project by project approach
  - Uncertainty
- Homogeneous approach for all developing countries
- Lack of measurement of magnitude and effectiveness of CC TT

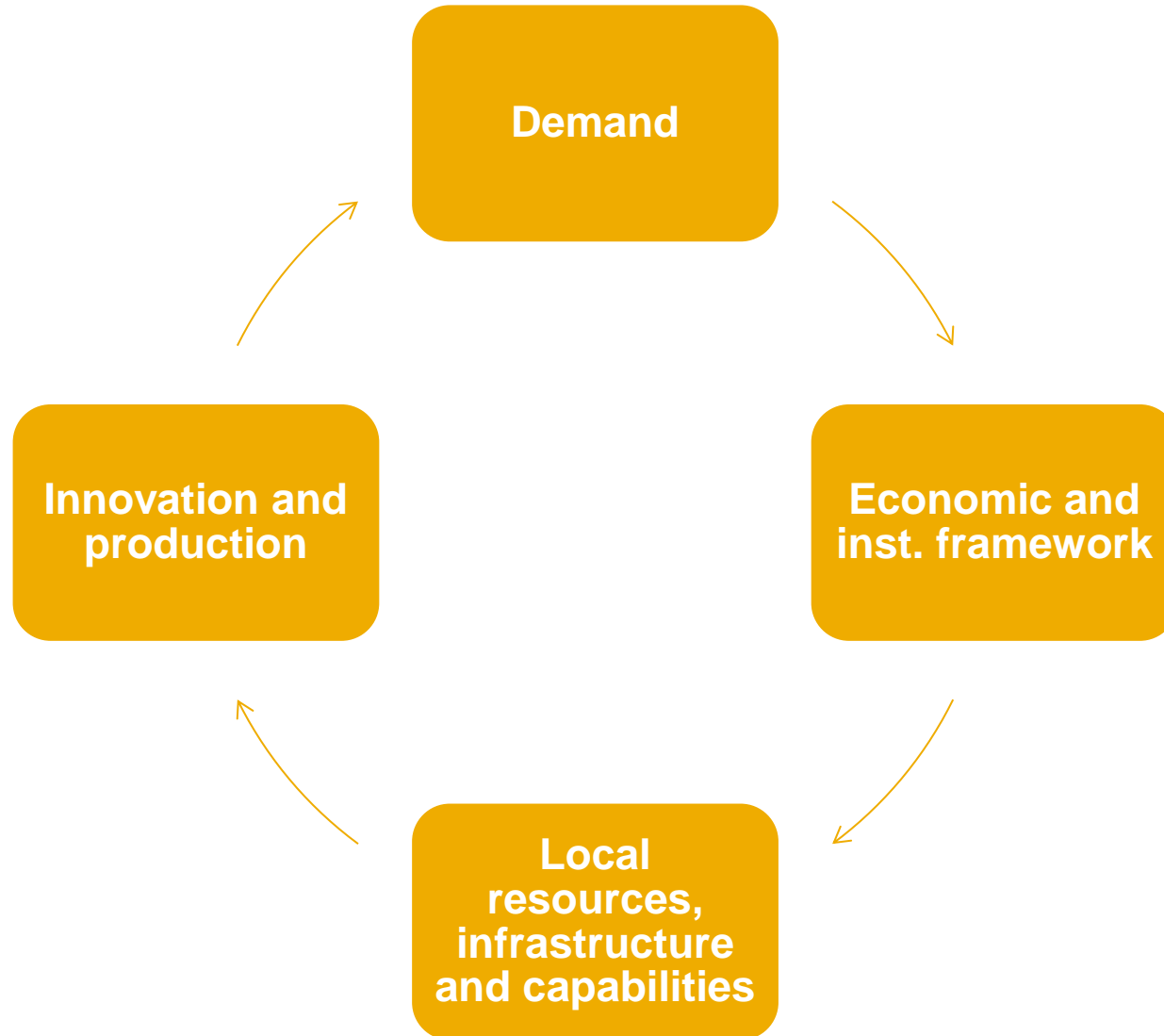
# Research objective

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

# Methodology



# Enabling factors are required for each of the elements of a technology transfer process



# Long list of national enabling factors indicators reduced to a short list of 24 indicators

Demand	Economic and inst. framework	Local resources and infrastructure	Technology development
<ul style="list-style-type: none"> <li>• GDP</li> <li>• GDP growth</li> <li>• GDP pc</li> <li>• Price of diesel fuel (PDIES)</li> <li>• Production of fossil fuels per capita (FOSSILpc)</li> <li>• Feed-in-tariffs (dummy) FIT</li> </ul>	<ul style="list-style-type: none"> <li>• Ease of Doing Business (EDB)</li> <li>• Corruption Perception Index (CPI)</li> <li>• Average income tax (INCOMETAX)</li> <li>• Domestic credit to private sector as % of GDP (CRED)</li> <li>• Tariff levels (TARIFF)</li> <li>• Trade openness (TRADEOP)</li> <li>• FDI openness (FDIOP)</li> <li>• Index of investment freedom (INVESTFREE)</li> </ul>	<ul style="list-style-type: none"> <li>• Tertiary education school enrolment ratio per capita (ENROL3)</li> <li>• Stock of local patents (PATLOCpc)</li> <li>• Stock of foreign patents (PATFORpc)</li> <li>• Logistics performance (LOG)</li> <li>• Estimated annual renewable energy resources (REACpc)</li> </ul>	<ul style="list-style-type: none"> <li>• High technology exports as % of manufacture exports (HTEEXP)</li> <li>• Number of companies with ISO 9001 (ISOpc)</li> <li>• TFP relative to the US (TFP)</li> <li>• Competitive Industrial performance score (CIP)</li> <li>• IPR index (IPR)</li> </ul>

# Enabling factors in developed countries can also lead to technology transfer in DC

Demand	Flow of foreign technologies	Local resources and infrastructure	Technology development
<ul style="list-style-type: none"><li>• Demand-pull policies (FIT, other)</li></ul>	<ul style="list-style-type: none"><li>• Credit availability for exporters</li><li>• Insurance</li><li>• Trade relationship</li><li>• Aid programmes</li><li>• Education to DC students</li><li>• International fairs</li><li>• Technological missions</li></ul>	<ul style="list-style-type: none"><li>• International R&amp;D</li></ul>	<ul style="list-style-type: none"><li>• IPR</li></ul>

# 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

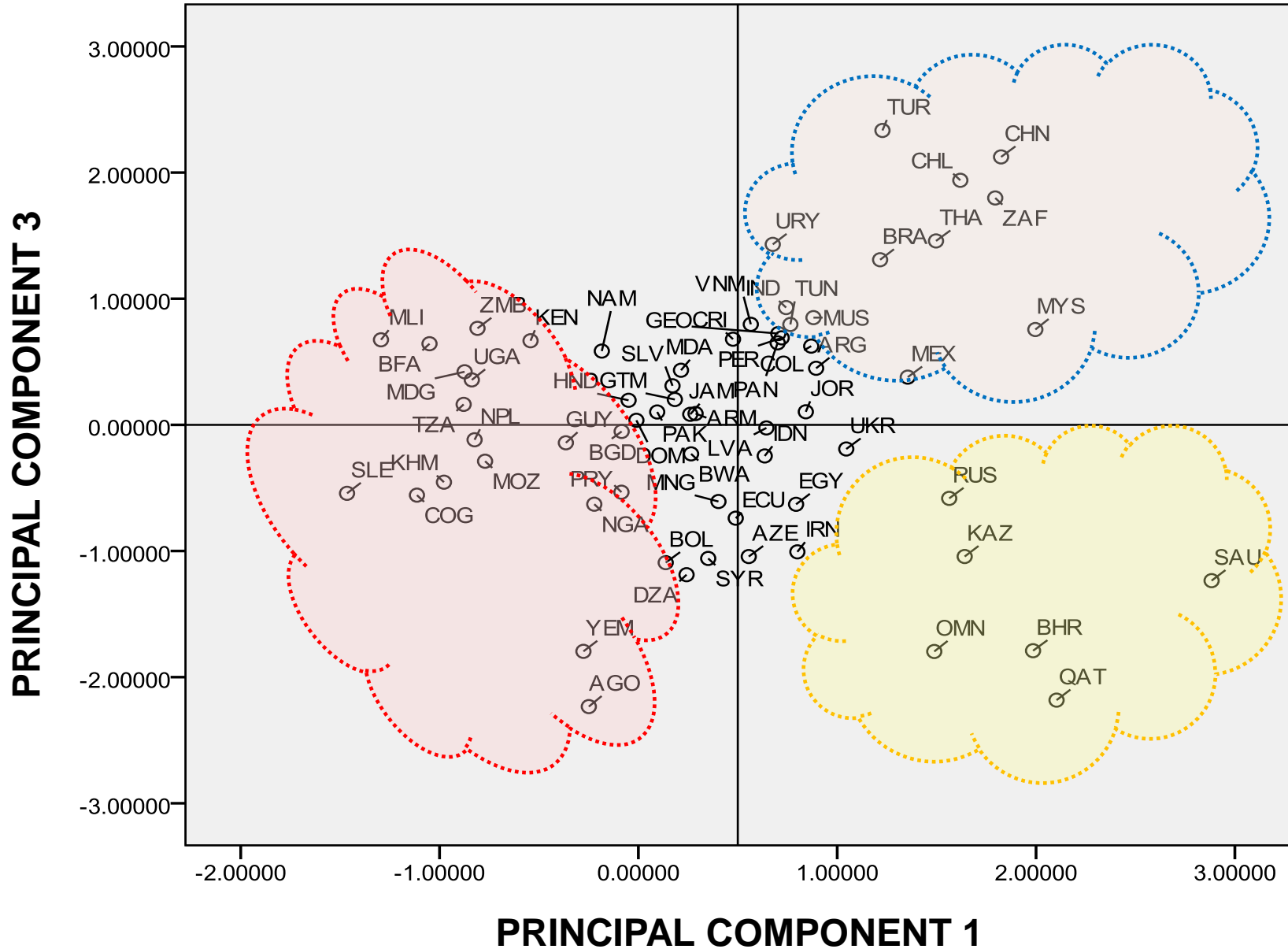
**PC1:** Combined effect of all enabling factors. Countries that rate well in all enabling factors for TT . But PDIES has a negative impact and FOSSIL a positive impact. Not good for low-carbon TT.

**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



# Relevant factors

	RE exports	RE Imports	RE Capacity TT
RESE resources	0.9		0.3
GDP	0.4		
GDPpc		0.7	0.8
IPR	0.6		-0.7
CIP	17		
Private credit		0.7	
Logistics			1.59
Fossil production			-0.13

$R^2= 0.59$

$R^2= 0.69$

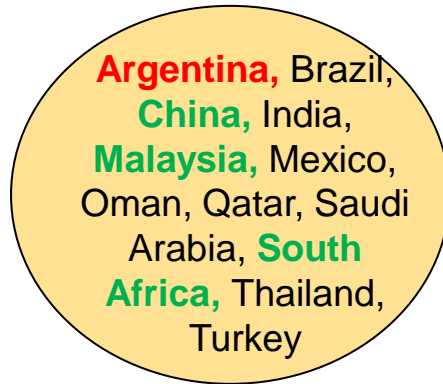
$R^2= 0.4$

# Clustering: Wards method

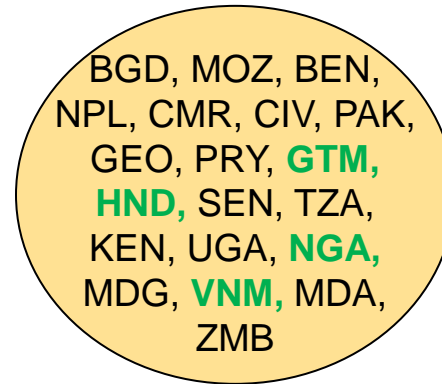
1



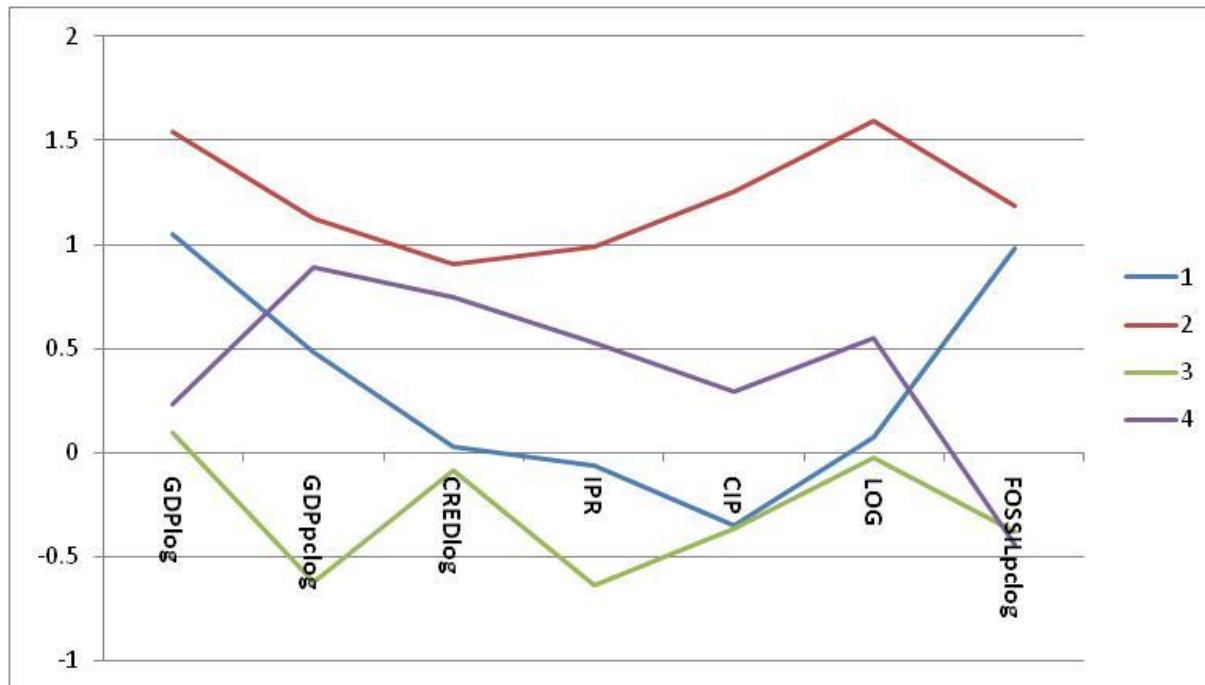
2



3



4



# Clustering: K-means method

1

Argentina,  
Russia, Oman,  
Saudi Arabia

2

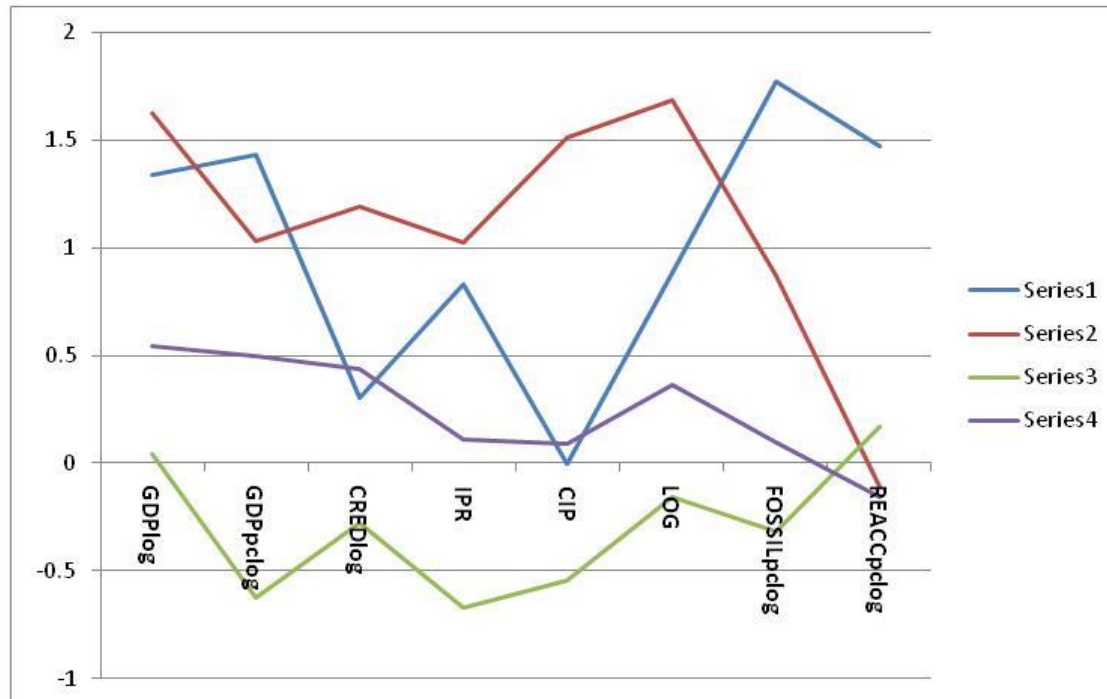
Brazil, **Chile**,  
**China**, India,  
Malaysia, **Mexico**,  
Qatar, **South**  
**Africa**, Thailand,  
Turkey

3

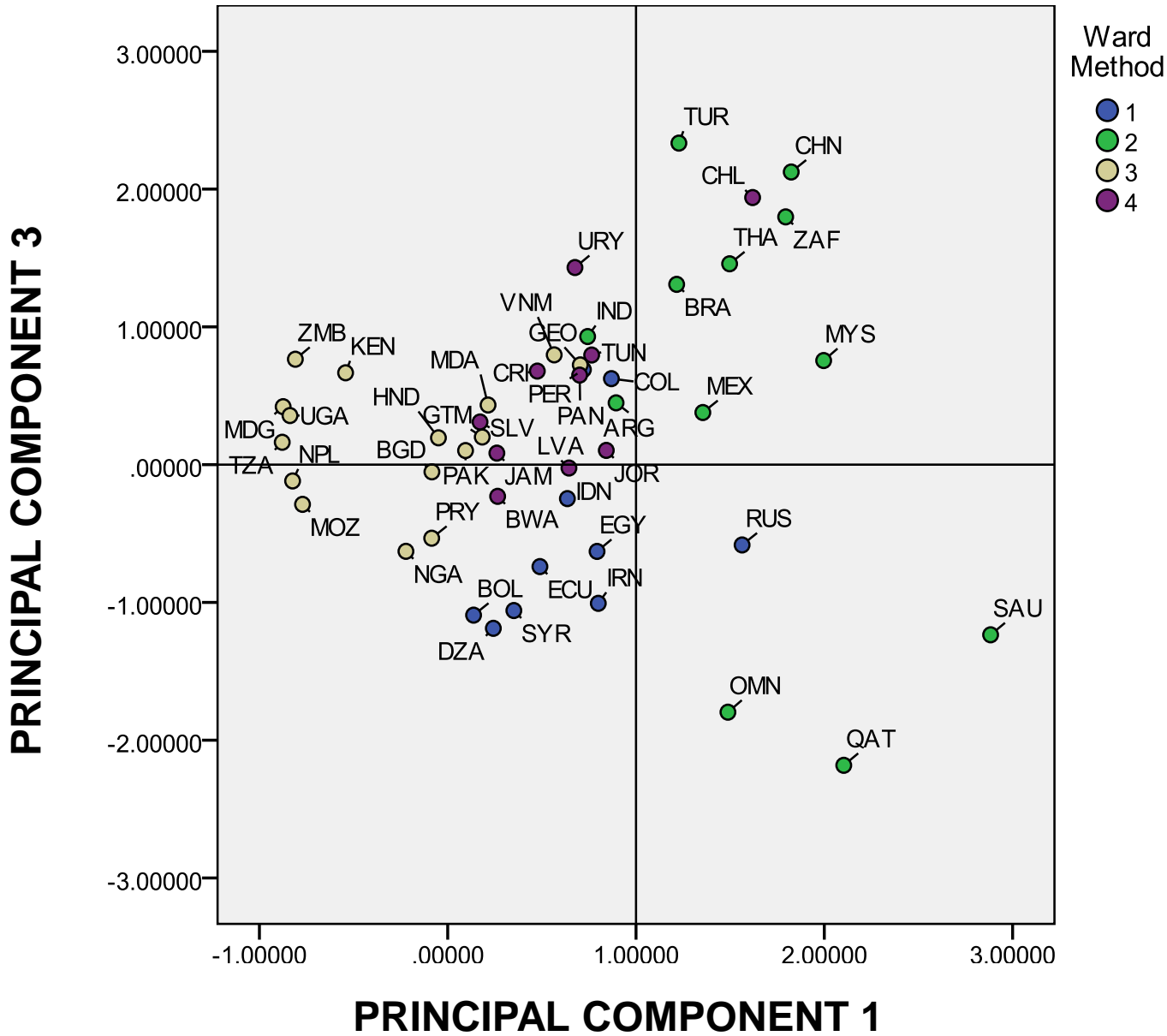
DZA, BGD, BEN, BOL,  
CMR, CIV, GEO, KEN,  
**MDG**, MDA, MOZ,  
NPL, PAK, PRY, SEN,  
TZA, UGA, ZMB

4

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



# Robustness of Results: PCA vs Clusters-Wards



# Final groups

TECHNOLOGY DEVELOPERS	TECHNOLOGY IMPLEMENTERS	STRUCTURAL CHANGES	AID RECIPIENTS
Brazil (UM) China (LM) India (LM) Mexico (UM) Turkey (UM) Malaysia (UM) South Africa (UM) Thailand (L) Chile (UM) Argentina (UM)	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)	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)	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)

## 1. Technology developers:

- Large economies with high income pc and good business environment and industrial competitiveness but low fossil fuel prices
- Expected to be main recipients of foreign TT, to create the capabilities to use and maintain them, and to develop their own technologies.

### POLICY RECOMMENDATIONS

- Effective demand-pull policies to attract investment and improve local capacity
- Complement with technology-push policies
- Temporary industrial policy to support local infant industries
- Less need of international support than other clusters

# Policy recommendations (II)

## 2. Technology implementers

- Small economies with low industrial competitiveness but good enabling environments for foreign investment and demand signals due to high fossil fuels price
- Expected to attract and implement significant levels of foreign low carbon TT but barriers to become technology developers.

### POLICY RECOMMENDATIONS

- Focus on demand-pull policies to increase investment in clean technologies and improve technological capabilities by learning-by-doing
- Less opportunities for industrial policy- support to exploit specific sources of comparative advantage
- Support demonstration projects to improve local capabilities



# Policy recommendations (III)

## 3. Countries needing structural changes:

- Large economies with weak business environment and competitiveness and large fossil fuels production
- Not expected to attract low carbon TT due to a lack of internal demand and some weak enabling factors

### POLICY RECOMMENDATIONS

- Improve economic and institutional conditions favourable to private investment
- Bilateral agreements to promote low-carbon investments
- Appropriate demand signals: eliminate subsidies to fossil fuels and use fuel rents to support investments in clean energy technologies.

# Policy recommendations (IV)

## 4. Aid recipients:

- Lowest performers in all enabling factors
- Require foreign aid to build an enabling environment for low-carbon TT

### POLICY RECOMMENDATIONS

- 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



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Thanks for your attention

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# Robustness of Results: PCA vs Clusters k-means

