

Scienze Politiche e Sociali



The Role of Industrial Policies in Emerging Countries within Renewable Energy Global Value Chains: An Application of Qualitative Comparative Analysis (QCA)

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Agenda

- The context of the study: Renewable Energies Global Value Chains (GVC) in middle-income countries;
- The methodology: Qualitative Comparative Analysis (QCA)
- The basics of QCA
- And now it's your turn! Apply QCA to your research question

The context



- Green technologies, particularly in renewable energy (RE), are increasingly vital to the global economy.
- However, without active participation in RE supply chains from latecomer countries a socially unjust transition is very likely.
- Middle-income countries with large domestic markets are uniquely positioned to capitalize on Green Windows of Opportunity (GWOs) in RE.
- Yet, strategies for leveraging these GWOs through participation and upgrading within RE global value chains (GVCs) remain significantly underexplored.

Which industrial strategies may facilitate upgrading in renewable energy GVCs in middle-income countries?

Global Value Chains in a nutshell

A global value chain (GVC) encompasses the series of activities involved in producing a product or service for consumers, with each activity adding value and at least two stages located in different countries.

Participation in a GVC requires engagement in at least one of these activities.



Figure 1.1 Where do bicycles come from?

Renewable energy GVCs

• The manufacturing chain includes

designing, producing and assembling of key equipment.

 The *deployment chain* includes installation and utilisation, preproject financing and post project operation and maintenance.



Propositions guiding the empirical analysis

Which industrial strategies may facilitate upgrading in renewable energy GVCs in middle-income countries?

(1) Policy configurations depend on the combinations of country and sector preconditions.

(2) Different configurations of policies and preconditions achieve distinct GVC outcomes.

Figure 2: The conceptual framework



The Empirical Analysis

36 case studies

- 12 middle-income countries: Argentina, Brazil, China, Colombia, Egypt, India, Indonesia, Mexico, Philippines, South Africa, Turkey, Vietnam;
- 3 REs sectors: solar, wind, and biomass energy
- Mix of quantitative and qualitative data
 - Quantitative information:
 - Country preconditions include a) human capital (WB), b) frontier technological readiness index (UNCTAD) and c) size of the electricity market, measured as the average electricity consumption (IEA).
 - Sector preconditions: # of patents in solar PV, wind and bioenergy (IRENA).
 - Qualitative information:
 - Industrial policies and upgrading within GVC: information collected through document research (academic papers, reports from International Organizations and Think Tanks, newspaper articles, business websites, and other grey literature) used for the qualitative coding.

Methodology

- Qualitative Comparative Analysis (QCA) helps to understand how to combine different conditions and determine the overall outcome based on those conditions.
- Identify conditions AND outcomes in our analysis
- QCA captures multiple pathways to reach the same outcome, accounting for the fact that there may be various explanations of what mix of industrial policies and preconditions lead to upgrading in GVCs.

What is QCA?

- Method to systematically compare cases and find common patterns using Boolean algebra.
- It bridges qualitative and quantitative analysis.
- It has roots in social science research (developed by Ragin in 1987).

Boolean algebra is a type of algebra that deals with only two values: true and false (or 1 and 0). It uses logical operations like AND, OR, and NOT to combine these values and produce new ones.

Regression analysis vs. QCA

- Regression analysis is a statistical method that uses quantitative data to model the linear relationship between a dependent variable and one or more independent variables, aiming to predict the dependent variable and quantify the impact of each independent variable (example: economic growth & inequality).
- While suggesting correlations and implying causality, it doesn't definitively prove causality and requires careful interpretation to account for confounding factors.
- It's most effective with large datasets.

- Qualitative Comparative Analysis (QCA) is a method that identifies combinations of conditions (independent variables) necessary or sufficient for a specific outcome (dependent variable).
- It handles both qualitative and quantitative data, exploring complex, non-linear relationships, including multiple causal pathways (equifinality) and situations where multiple conditions are required (conjunctural causation).
- While effective with smaller datasets, data quality and strong theoretical grounding are essential.

Basic steps #1

- Identify the outcome of interest (UPGRADING IN RE GVC) and cases that exhibit this outcome (e.g. China and India in solar, bio and wind).
- Identify cases where the outcome was expected, but did not happen (e.g. Vietnam in solar, bio and wind)
- Identify the streamlined causal factors/ "recipes" that might lead to the outcome.
 - Strong country and sector preconditions with strong demand, supply and technology policy, i.e. a 'comprehensive' policy package, lead to successful upgrading.

Basic steps #2

- QCA's data calibration assigns each case a score (0-1) showing its degree of membership in a defined set.
- For example, to assess the degree to which the Chinese wind industry case is a member of the group that has introduced the different policies.

Policy domain	Category	Indicators	Score
Demand	Subsidies and price regulations	*Feed-in Tariffs *Renewable energy auctions *Low-interest and state backed finance for deployment (users)	1
	Public guarantees	*Mandatory renewable purchasing *Renewable portfolio standards *Direct state procurement	1
	Infrastructure and regulation Total	*Upgrading grids and related infrastructure *Planning and zoning laws *Technical standards	1 3
Supply	Finance and fiscal incentives	*Access to credits (loan for producers/manufacturers) *Tax breaks *Capital for foreign projects (exports) and export subsidies	1
	Startup and growth support	*Industrial parks *SME monitoring and assistance *Incubation schemes	1
	Market protection Total	*Local content requirements *Import tariffs and/or quotas	1 3
Technology	R&D subsidies and tax breaks	*R&D subsidies *R&D tax credits *Subsidies for labour training	1
	Innovation system and human capital	*Establishment of relevant research centres, technical institutes and design centres *Education and training, specialised engineering *Strategic enforcement of intellectual property rights *Demonstration projects	1
	Technology transfer and learning Total	*Rules to enhance technological spillovers from foreign direct investments (e.g., joint venture requirements) *Support for licensing	1 3

The Truth Table

- The truth table is a descriptive representation of the data, aiding in the simplification and analysis of complex causal relationships.
- Rows: each case with all the unique combinations of the outcomes and the independent variables
- Columns: outcomes, independent and dependent variables.
- A software (e.g., <u>fsQCA 4.1</u>) uses this representation to perform more advanced calculations (e.g., identifying sufficient and necessary conditions) and identify the most essential combinations of conditions leading to the outcomes.

			Manufacturing		Deployment		Preconditions		Policy		
	Case	Participa	Upgradi	Participa	Upgradi	i Countr	Sector	Dema	Supply	Techno!	
Argentina	Solar	1	0	1	0	0	0	0	0	0	
Argentina	Wind	1	0	1	0	0	0	0	0	1	
Argentina	Bio	1	0	1	1	0	0	0	0	1	
Brazil	Solar	1	1	1	1	1	1	1	1	0	
Brazil	Wind	1	1	1	1	1	1	1	0	1	
Brazil	Bio	1	0	1	1	1	1	1	1	0	
China	Solar	1	1	1	1	1	1	1	1	1	
China	Wind	1	1	1	1	1	1	1	1	1	
China	Bio	1	0	1	1	1	1	1	1	1	

The Findings

Pathway			Deployment RE GVC		Manufacturing RE GVCs		
leading to upgrading in	DCU1 Absence of all preconditions & technology policy	DCU2 Demand policy and absence of supply and technology policy	DCU3 Sector preconditions & Demand policy and absence of technology policy	DCU4 All preconditions & Technology policy	DCU5 Country preconditions & Full policy package	MCU1 All preconditions & Technology policy	MCU2 Country preconditions & Full policy package
Country preconditions	\otimes			•	•	•	•
Sector preconditions	\otimes		•	•		•	
Demand policy		•	•		•		
Supply policy		\otimes			•		•
Technology policy	8	\otimes	8	•	•	•	•
Raw coverage	41%	43%	36%	36%	40%	53%	56%
Unique coverage	9%	3%	5%	3%	3%	6%	9%
Consistency	98%	100%	100%	100%	100%	95%	89%
Overall solution of Overal	coverage consistency	80 99	0%				62% 90%

Symbols:

presence of the precondition in the configuration

presence of the policy in the configuration

 \otimes absence of the precondition in the configuration

😣 absence of the policy in the configuration

Blank spaces indicate that the condition's presence or absence is irrelevant

Raw coverage: The proportion of cases that are explained by the pathway (i.e. by the configuration of casual condition), including overlaps with other pathways. *Unique coverage*: The proportion of cases explained solely by a specific pathway, excluding overlaps with other pathways.

Consistency: The degree to which cases sharing a specific pathway also share the outcome, indicating how consistently the condition leads to the outcome.

Overall solution coverage: The proportion of cases explained by the entire 'solution', which includes all the causal paths identified in the analysis.

Overall solution consistency: The degree to which all the identified causal paths consistently lead to the outcome across the entire solution set.

Summary of the main findings

Deployment

Manufacturing

- There are 5 distinct pathways leading to upgrading, which involve different combinations of country and sector preconditions, demand policies, supply policies, and technological policies.
- Achieving upgrading is possible even without strong preconditions.
- Demand policy is key for upgrading.

- Only a few middle-income countries like Brazil, India, and China have achieved upgrading.
- There are only 2 pathways to achieve upgrading in which country preconditions and technological policies are important.
- Across both chains deployment and manufacturing strong country preconditions with strong demand, supply and technology policy, i.e. a 'comprehensive' policy package, lead to successful upgrading.

Some examples of QCA application

- Explaining democratic transitions: to identify combinations of factors (e.g., economic development, civil society strength, international pressure) that are necessary or sufficient for successful democratic transitions in different countries.
- Analyzing foreign policy decisions: to understand why countries choose specific foreign policy actions (e.g., military intervention, diplomatic engagement) by identifying the configurations of domestic and international factors that lead to those choices.
- Analyzing firm performance: to explore the combinations of factors (e.g., innovation strategies, organizational structure, market conditions) that contribute to high firm performance. QCA can reveal different successful business models.
- **Investigating mergers and acquisitions success**: to identify the combinations of factors (e.g., industry characteristics, firm size, integration strategies) that predict successful mergers and acquisitions.
- Analyzing poverty: to examine the configurations of individual and societal factors (e.g., education, employment opportunities, social support) that influence poverty levels.
- Analyzing the spread of infectious diseases: to identify the combinations of factors (e.g., sanitation levels, access to healthcare, population density) associated with high rates of disease transmission.

Apply QCA to a research question of your choice

- In team (2/3 people)
 - Identify a research question which can be addressed with QCA;
 - Identify the outcome(s) of interest and the cases that exhibit (or not) this (these) outcome(s)
 - Identify causal factors that might lead to the outcome(s).
 - Prepare 1 slide to illustrate your QCA.

Thank You! Terima Kasih! Grazie!

Ambrogi J., Lema R. & Rabellotti R., 2024, Seizing windows of opportunity in renewable energy GVCs: The role of industrial policies in emerging economies, Draft

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