Energy Efficiency and Institutional Quality: The role of energy efficiency governance

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OVERVIEW

- Introduction
- Index construction and theoretical support
- Results
- Application
- Concluding remarks and further research

1.
Introduction

Every policy, plan, programme or measure may be compromised by one or several of these factors:

- Corruption
- Regulation failures
- Market failures
- Lack of co-ordination
- Lack of transparency
- Rent seeking

Since these failures do not allow for efficient balances, public intervention is needed: **GOVERNANCE** have a relevant role

Governance

"Ability of an administration to generate rules and enforce them in order to achieve particular objectives"

Fukuyama, 2013.

Politics, society and economics

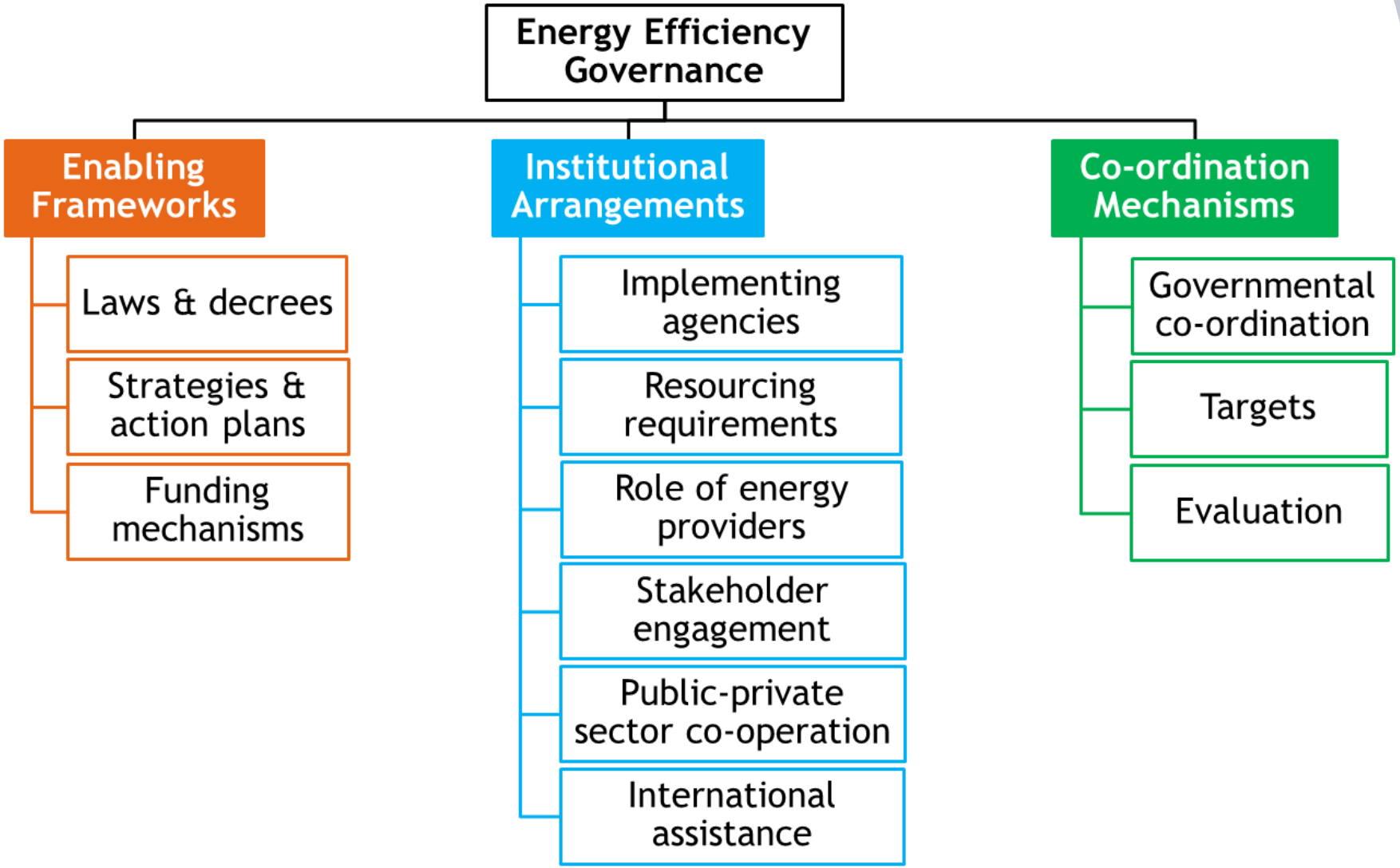
Its effect is well-documented. There exist **indices** to assess this kind of governance.

EE issues

Little is known about the relationship between governance and EE (**EE governance**) due to the absence of any quality indicator.

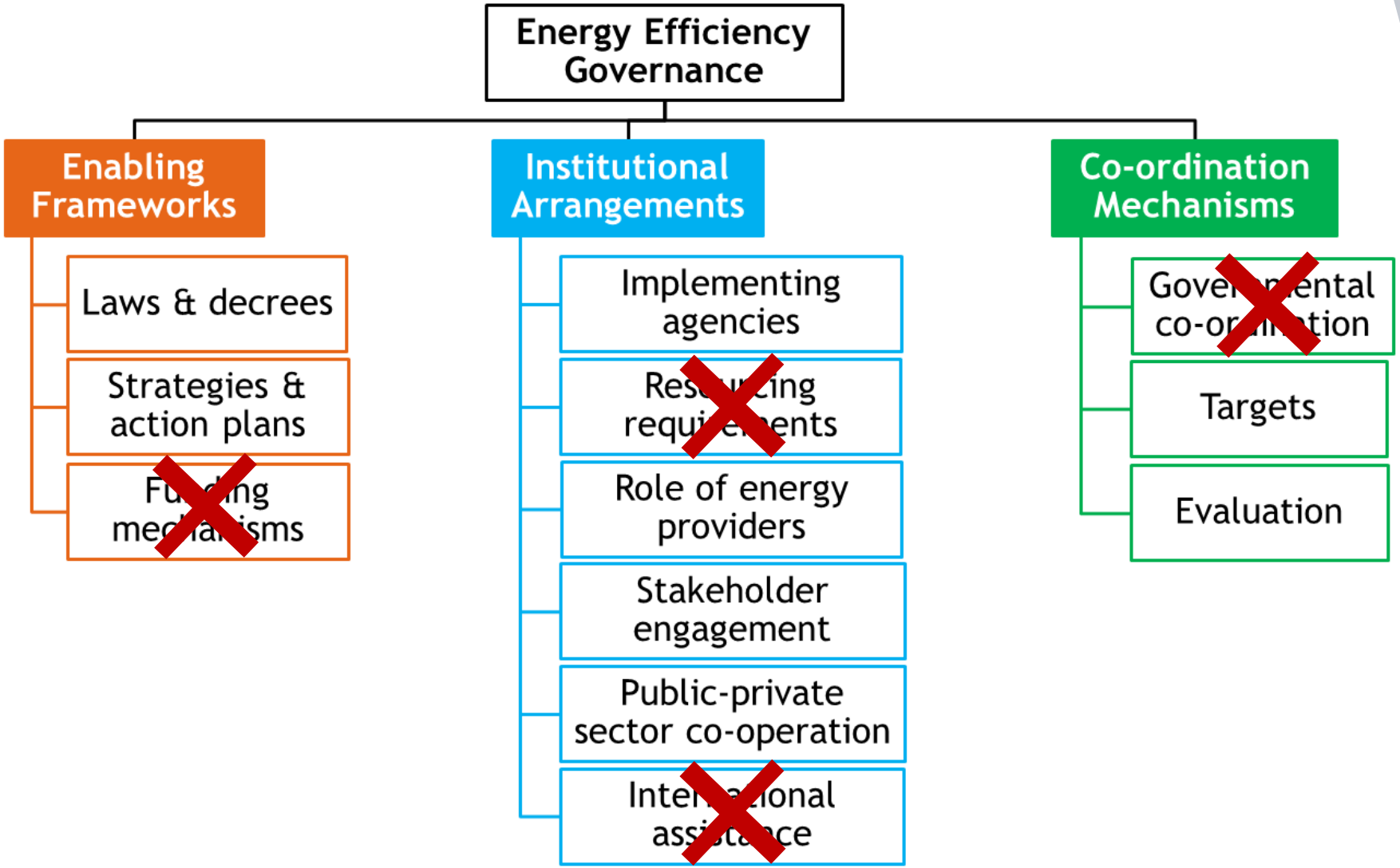
2.
Index construction and theoretical support

> “According to IEA (2010), EE governance is the combination of the institutional and co-ordination arrangements needed to scale-up EE, added to the legislative frameworks and funding mechanisms, which works to support the implementation of EE strategies, policies and programmes”.



Source*: Energy Efficiency Governance (IEA, 2010)*

Enabling frameworks	Basic area for the development of EE measures. It provides the legal basis and the proper strategies to meet national targets.
Institutional arrangements	Practical instruments to enforce the development and performance of EE measures.
Co-ordination mechanisms	Co-ordination between EE measures and policies, as well as the assessment of the final results



Source*: Energy Efficiency Governance (IEA, 2010)*

HIGHLIGHTS

- 32 OECD countries (Israel and Iceland have been excluded).
- 2000-2015 period (persistent factor).
- Three EE governance areas are assessed (8 indicators).

But…

What about the scores?

Data collection

- Huge **collection effort** (WEC, IEA, IRENA…)
- Main block: IEA database
- > 1,800 entries
- *"Entry"* = **Qualitative** and **descriptive** information regarding a specific policy, law, strategy, plan, programme… SCORING CRITERA REQUIRED

Filter

- In force between 2000-2015
- > 1,700 entries
- E.g.: USA (169 entries), Spain (47 entries) or Estonia (4 entries)

Classification

- Descriptive/qualitative information. Each entry has been **carefully read** in order to relate this with the correct EE governance and area and, concretely, with the correct indicator.

Scoring

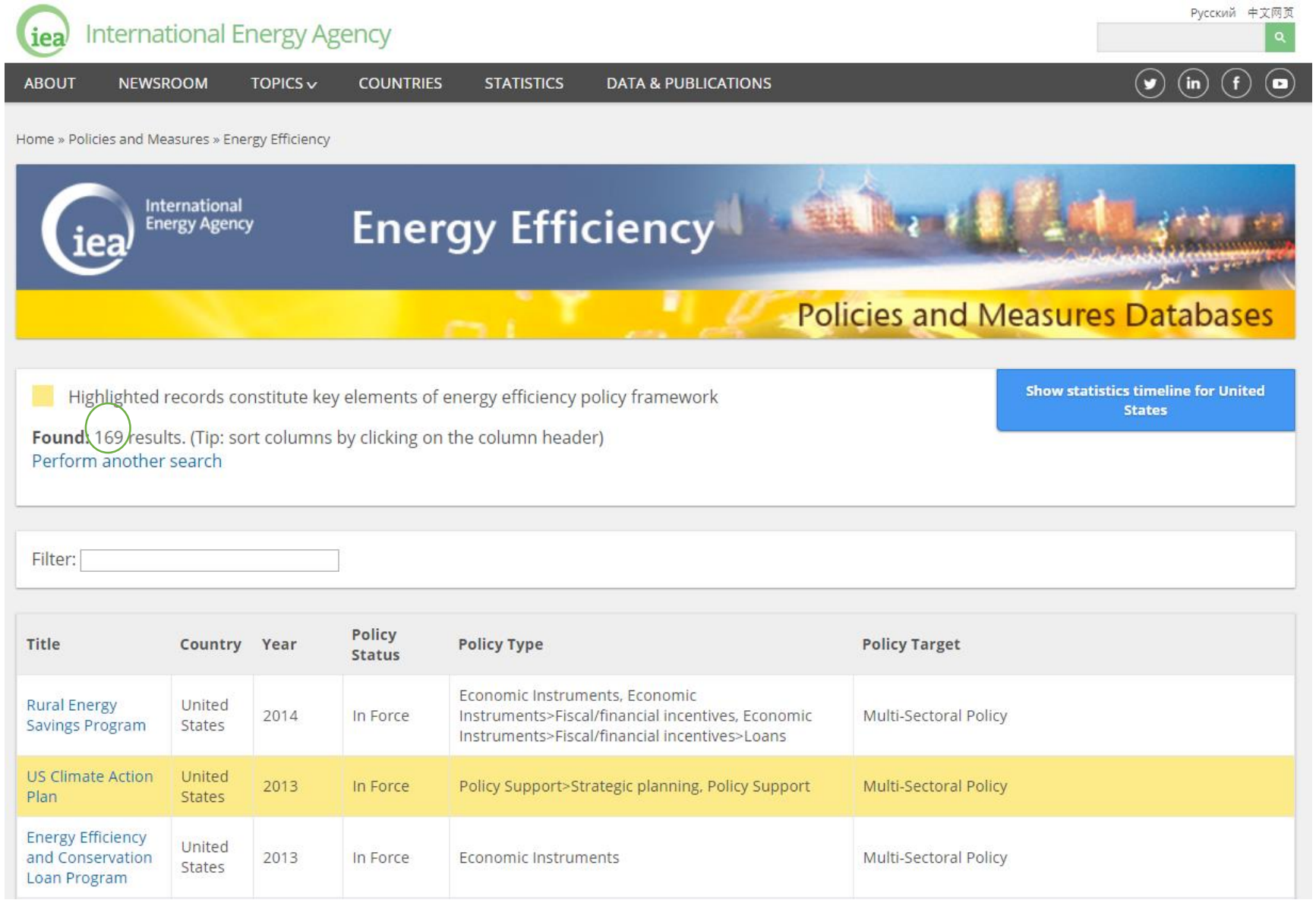
- There are no previous EE governance scores or indicators. Therefore, the scores obtained are **relative scores** (between the countries in the sample).
- 0-4 Scale for each indicator (E. Dabla-Norris et al., 2012)
- Subjectivity is minimized through the establishment of **strict evaluation criteria for each indicator**.

Aggregation

- Three sub-indices: one sub-index by each EE governance area, calculated as the corresponding indicators average.
- One overall index (average of the three sub-indices).

J. B. e. a. E. Dabla-Norris, "Investing in public investment: an index of public investment efficiency," *Journal of Economic Growth,* pp. 17:225-266, 2012.

Joint Research Center and OECD, "Handbook on Constructing Composite Indicators," 2008.

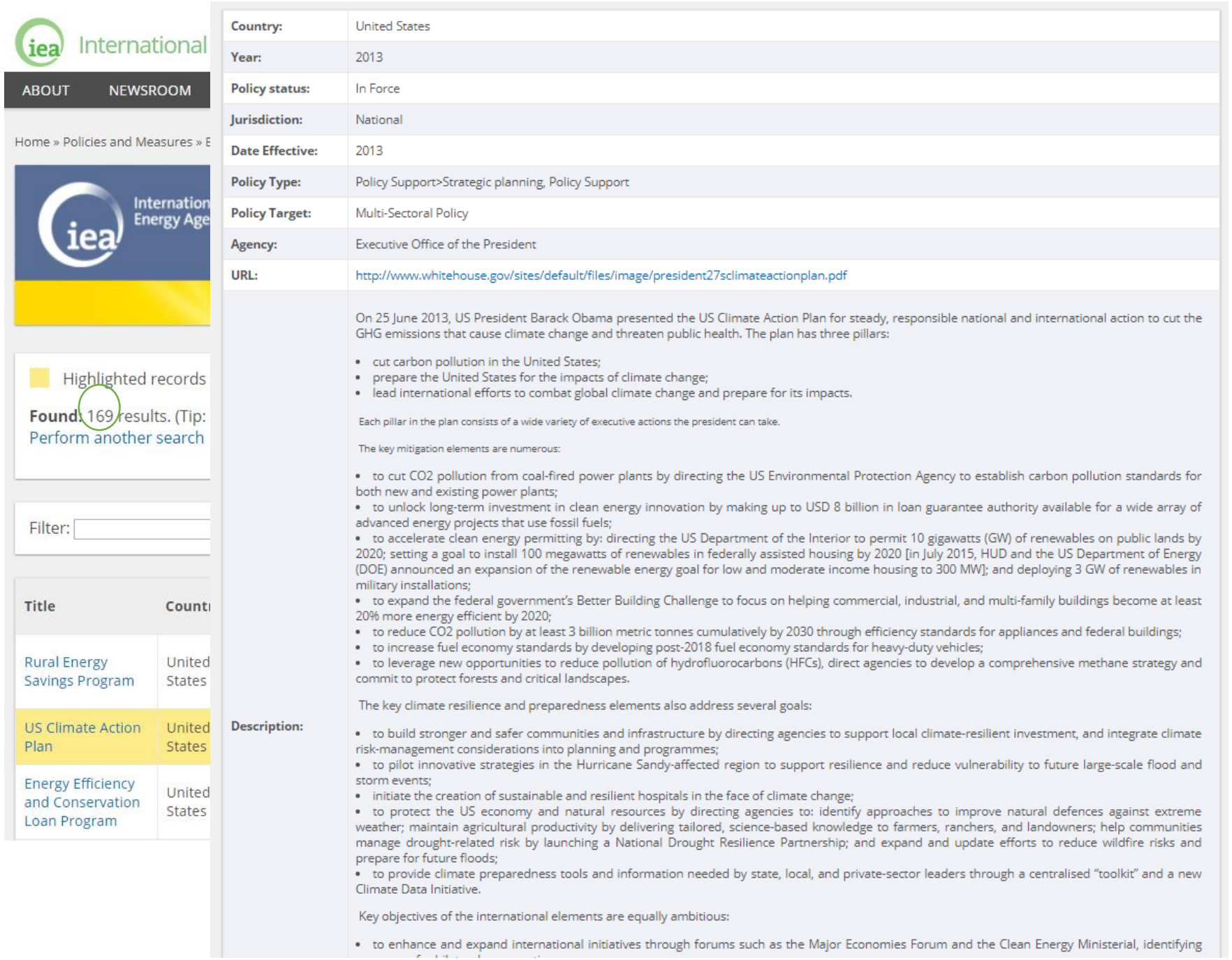


OVERVIEW

Index construction and theoretical support

2.1. Theoretical support

2.2. Index construction



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Index construction and theoretical support

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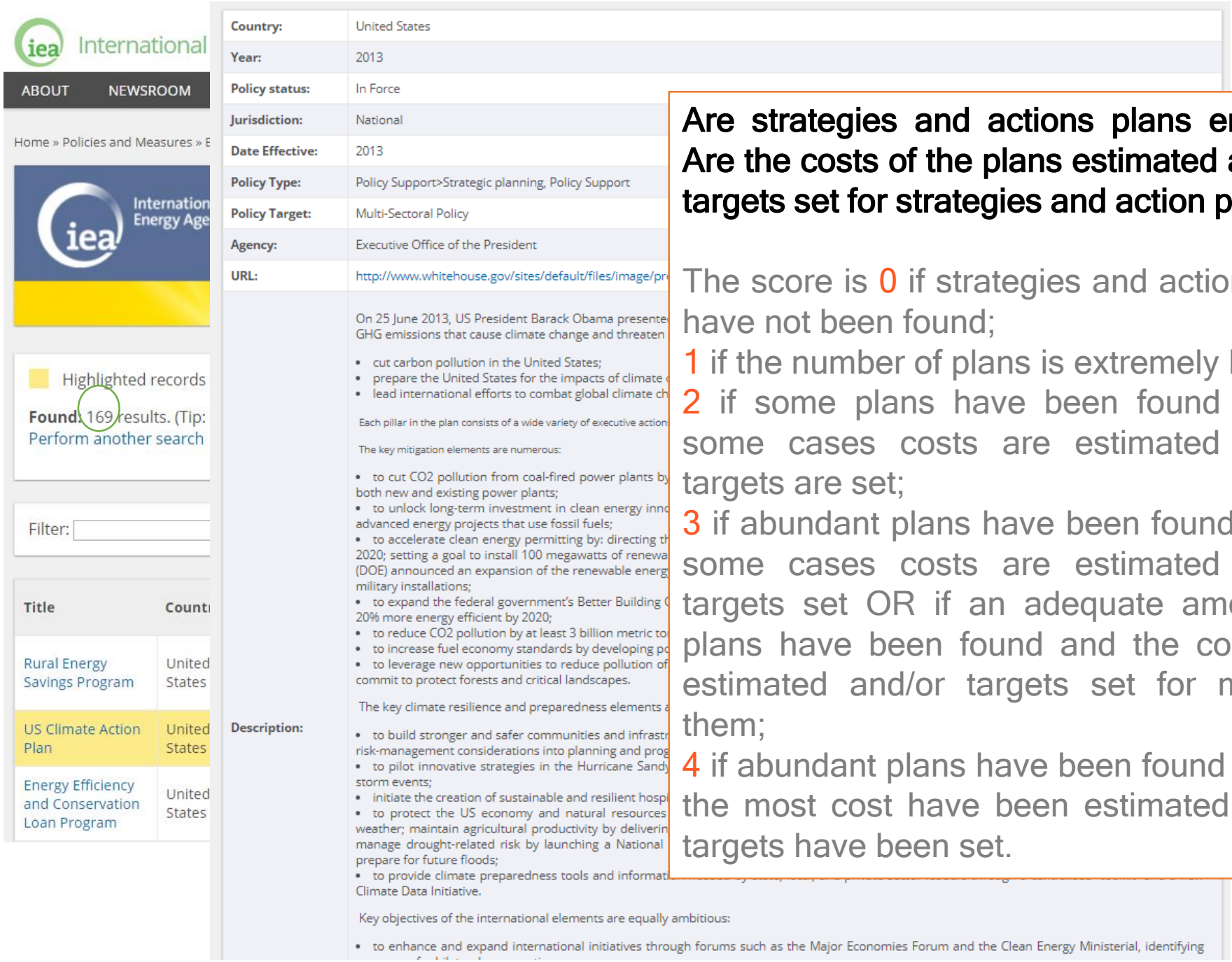
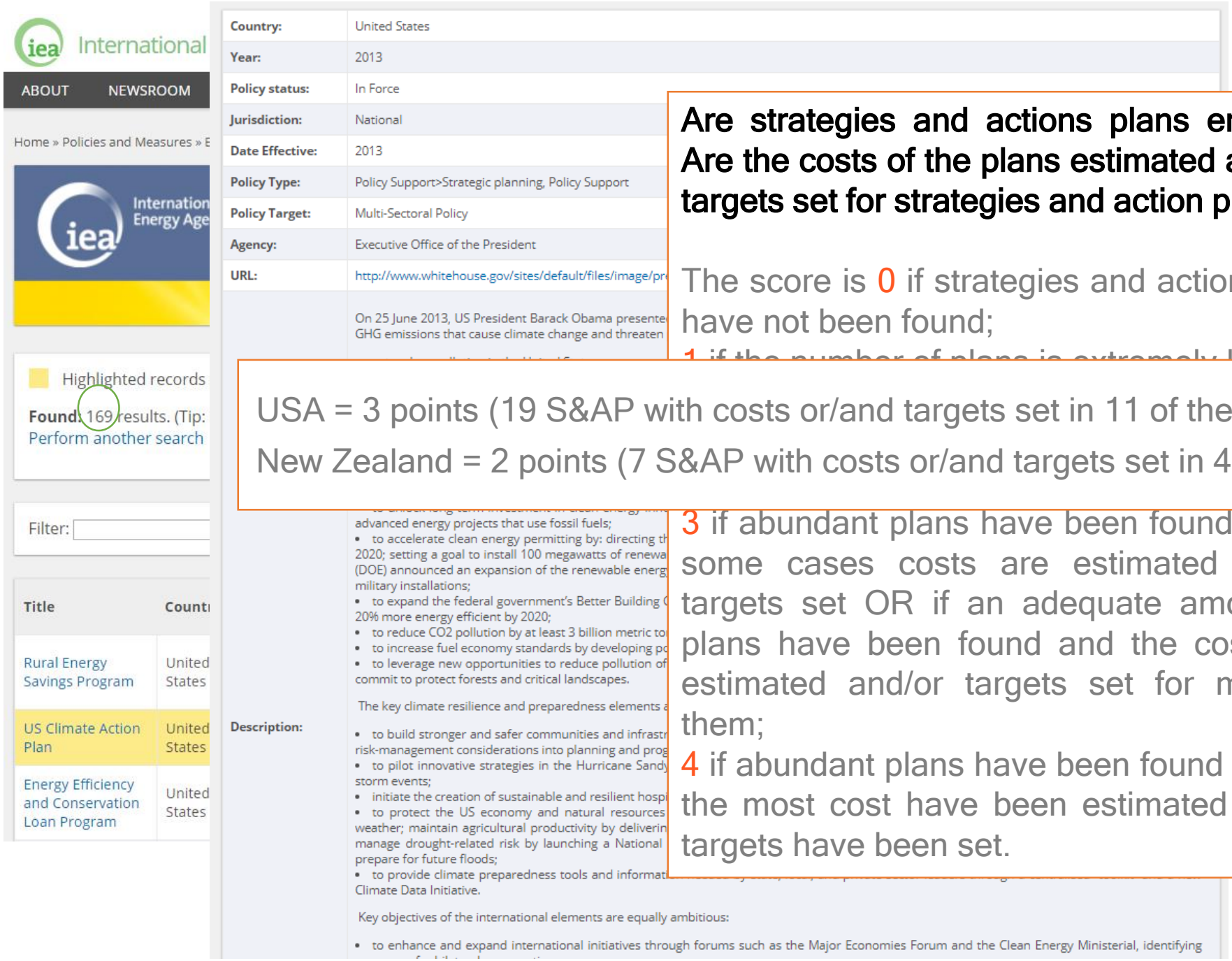


Are strategies and actions plans enough? Are the costs of the plans estimated and the targets set for strategies and action plans?

The score is 0 if strategies and action plans have not been found;
1 if the number of plans is extremely limited;
2 if some plans have been found and in some cases costs are estimated and/or targets are set;
3 if abundant plans have been found and in some cases costs are estimated and/or targets set OR if an adequate amount of plans have been found and the costs are estimated and/or targets set for most of them;
4 if abundant plans have been found and for the most cost have been estimated and/or targets have been set.

OVERVIEW



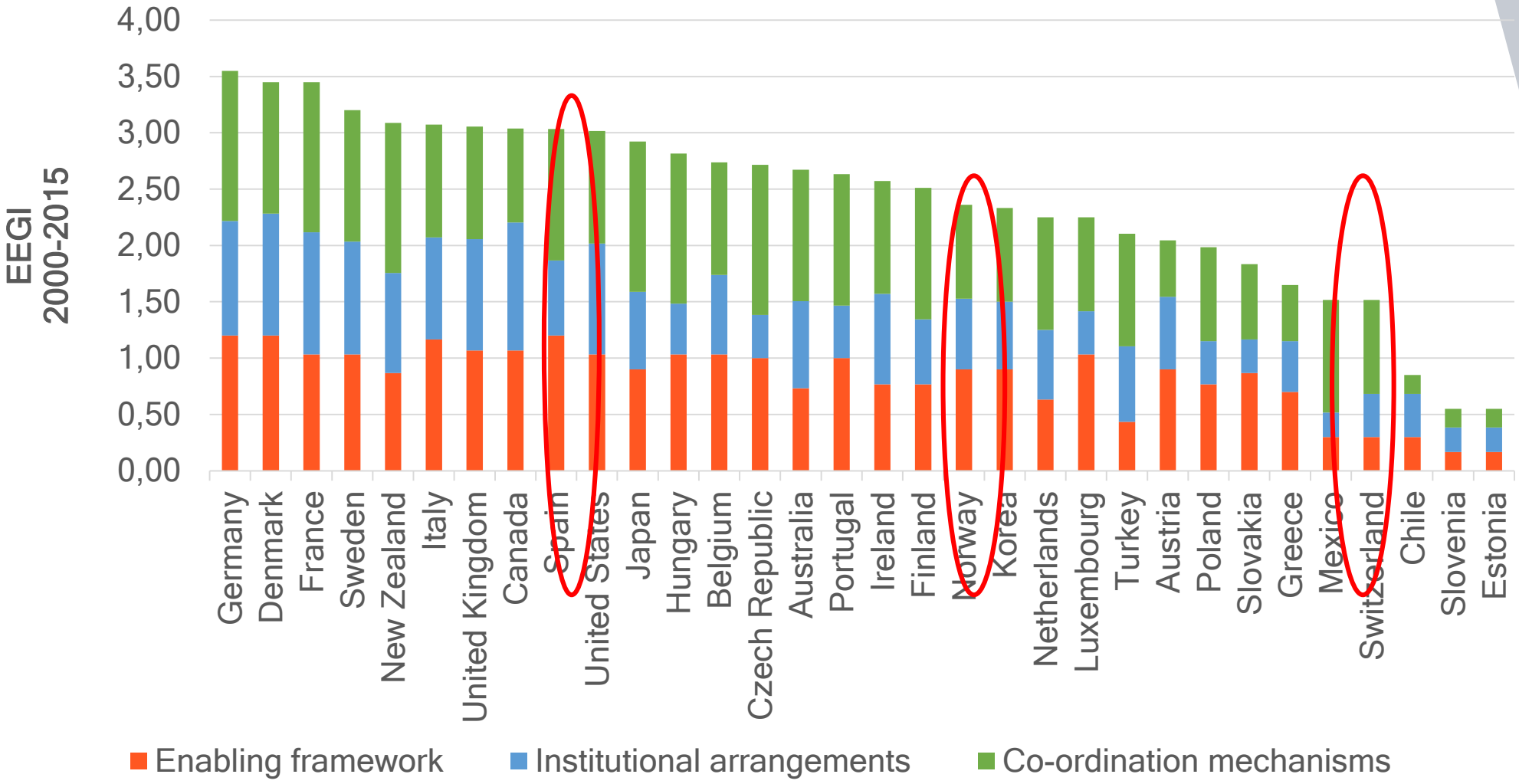
OVERVIEW

Index construction and theoretical support

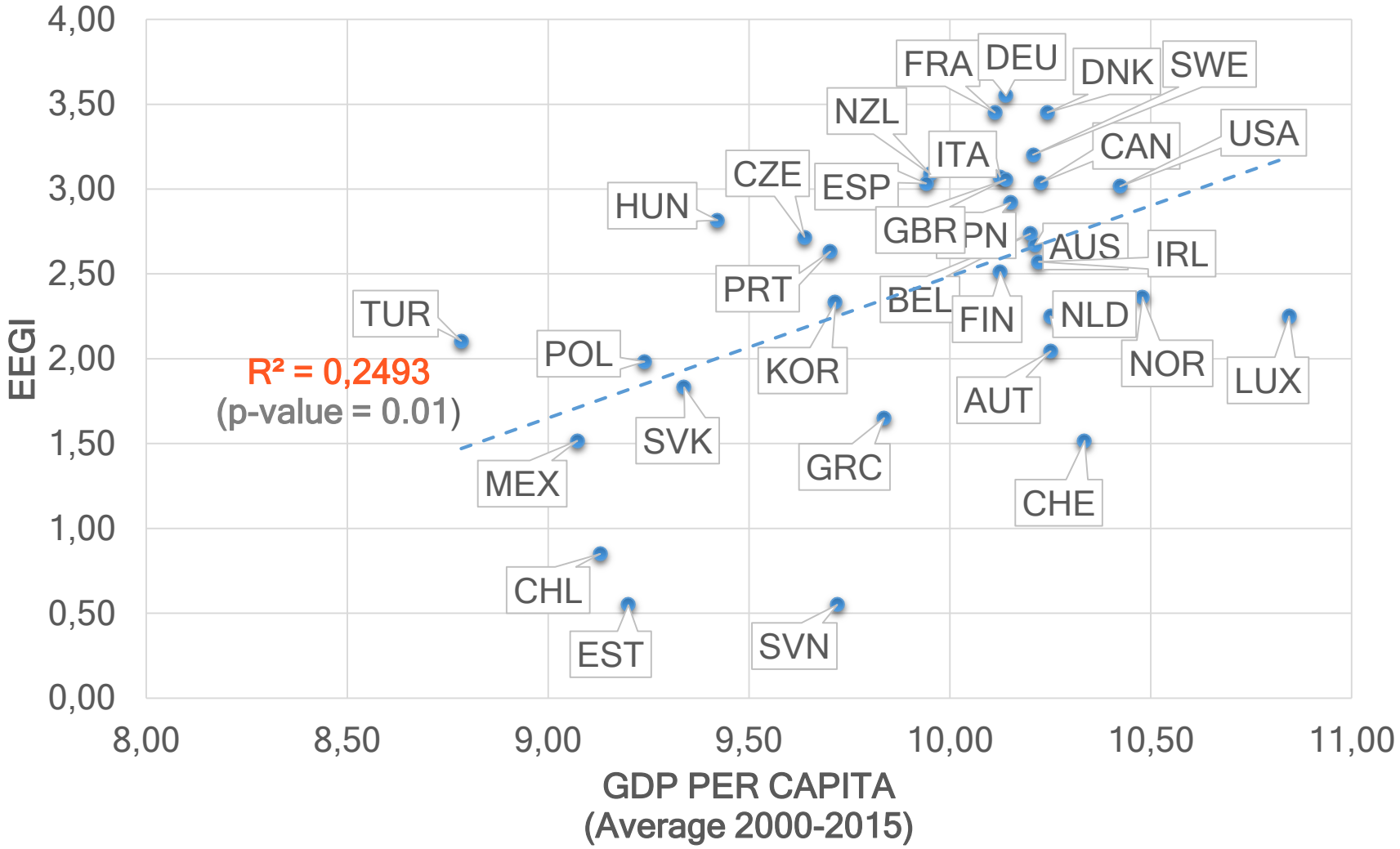
2.1. Theoretical support

2.2. Index construction

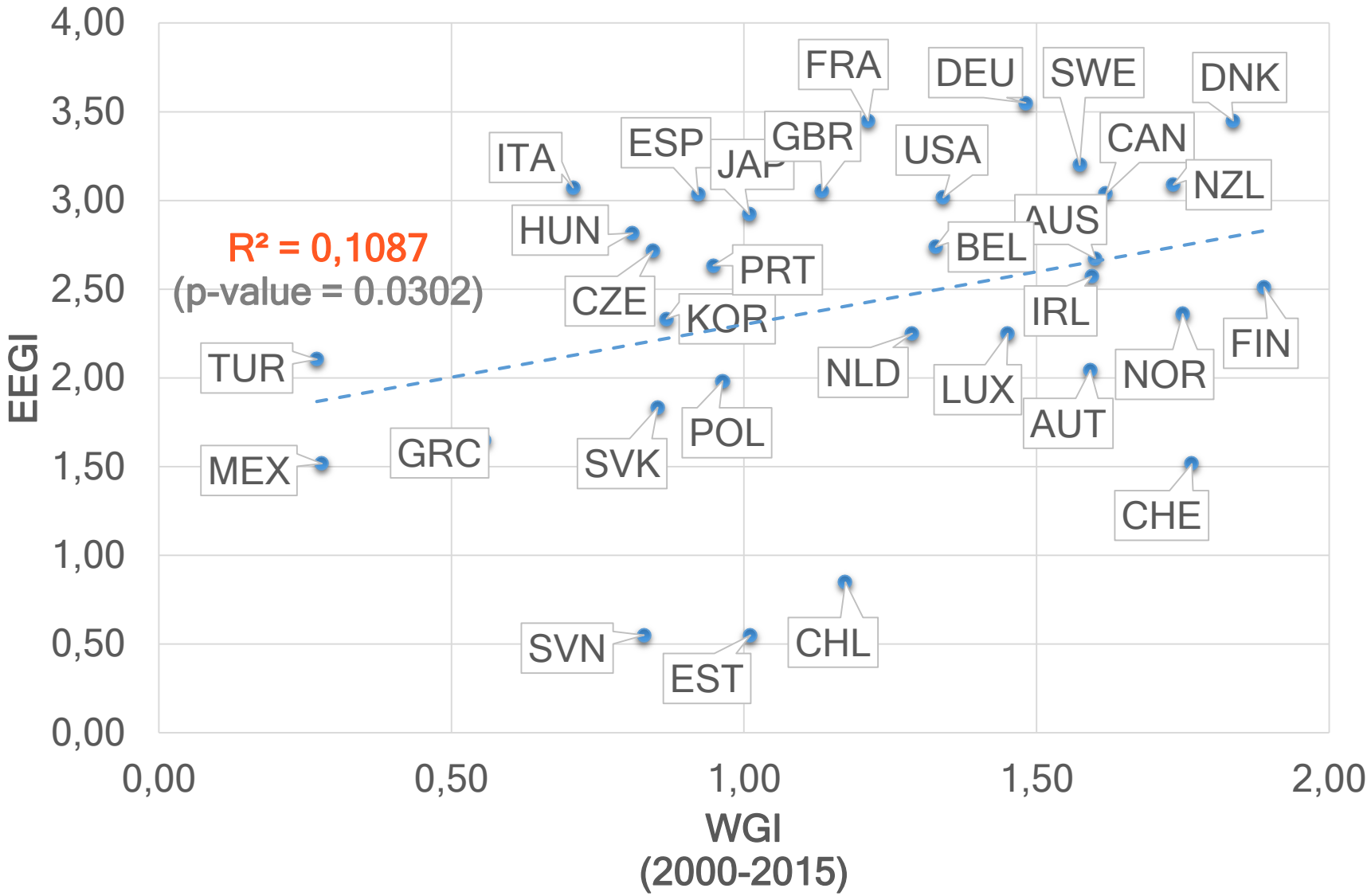
3.
Results


EEGI 2000-2015
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
Germany
Denmark
France
Sweden
New Zealand
Italy
United Kingdom
Canada
Spain
United States
Japan
Hungary
Belgium
Czech Republic
Australia
Portugal
Ireland
Finland
Norway
Korea
Netherlands
Luxembourg
Turkey
Austria
Poland
Slovakia
Greece
Mexico
Switzerland
Chile
Slovenia
Estonia
Enabling framework
Institutional arrangements
Co-ordination mechanisms

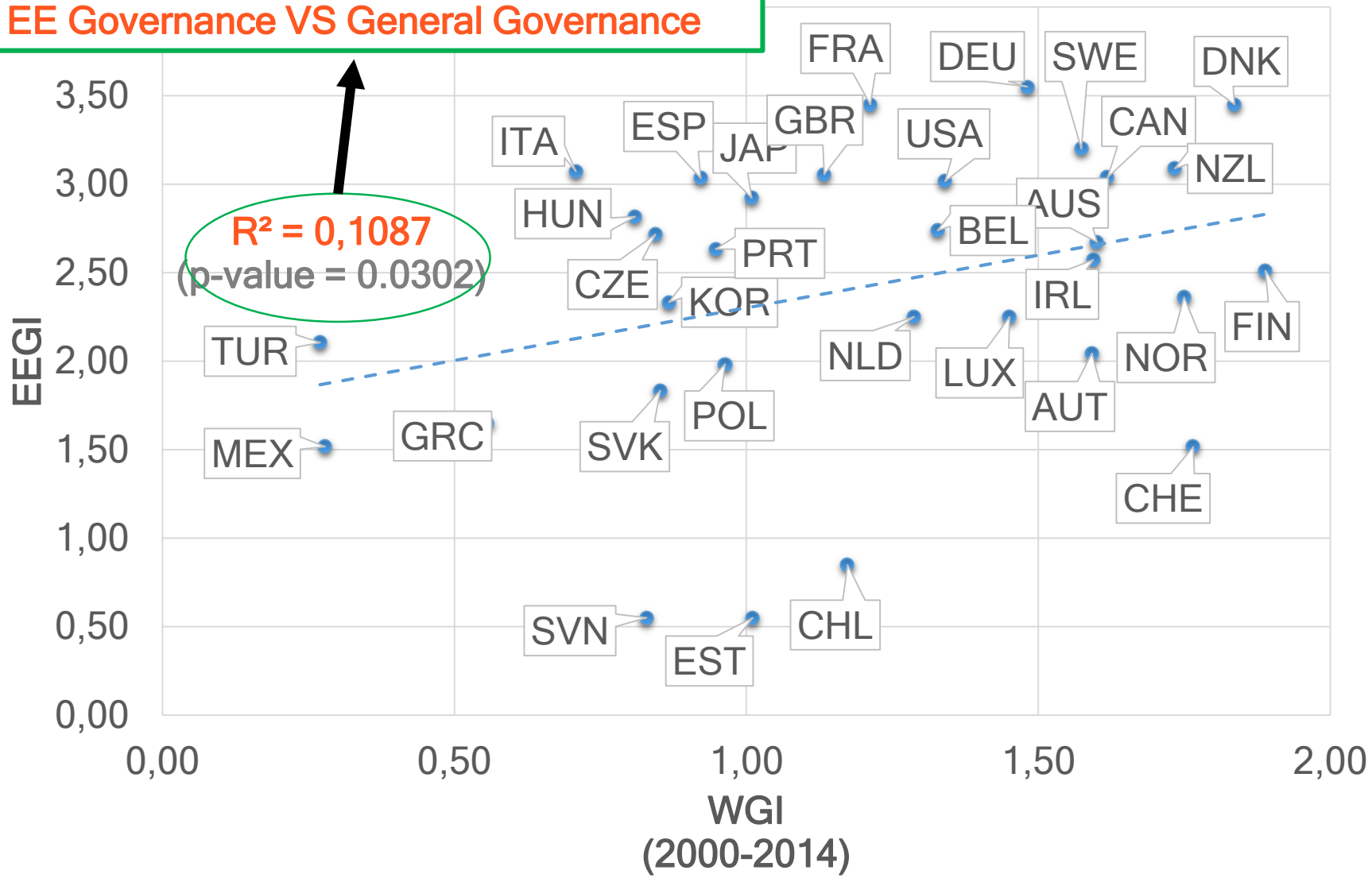
EEGI VS GDP per capita



EEGI VS WGI


4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
EEGI
0,00
0,50
1,00
1,50
2,00
WGI
(2000-2015)
R² = 0,1087
(p-value = 0.0302)
FRA
DEU
SWE
DNK
ITA
ESP
JAP
GBR
USA
CAN
NZL
HUN
AUS
BEL
PRT
CZE
KOR
IRL
FIN
TUR
NLD
LUX
NOR
AUT
POL
GRC
SVK
MEX
CHE
SVN
EST
CHL

Higher correlation with GDP
EE Governance VS General Governance



4.
Application

The relationship between EEGI and EE

This work is based on the **stochastiec frontier function of energy demand** proposed by M. Filippini and L. Hunt (2011), but also considering the **urbanization rate** as P.K. Adom, K. Amakye, K.K. Abrokwa and C. Quaidoo propose.

$$e_{it} = \alpha + \alpha^{y} y_{it} + \alpha^{p} p_{it} + \alpha^{popd} popd_{it} + \alpha^{UR} UR_{it} + \alpha^{a} Ai + \alpha^{oceanic} Oceanic_{i} + \alpha^{cold} Cold_{i} + \alpha^{I} ASH_{it} + \alpha^{A} ISH_{it} + u_{it} + v_{it}$$

Where…

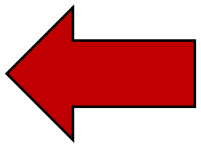
The error term: v_{it}

The inefficiency term: u_{it}

EE is calculated as: $EE_{it} = E_{it}^{F} / E_{it} = exp\,(-\hat{u}_{it})$.

Furthermore…

$$u_{it} = \beta Z_{it} + \varepsilon_{it}$$



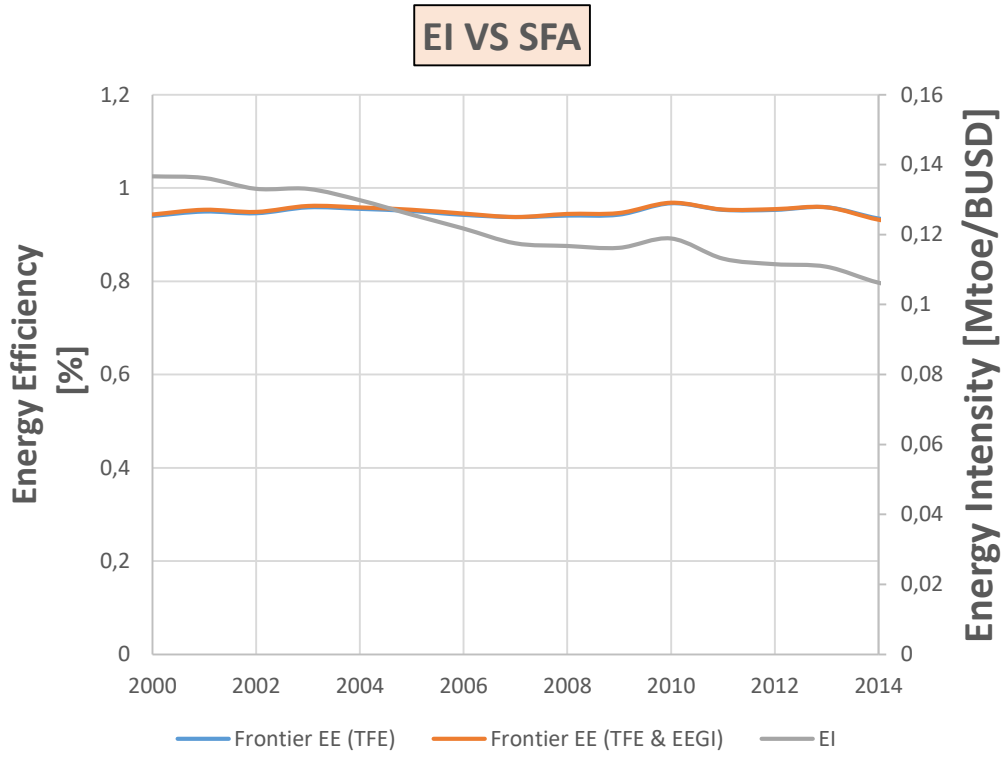
EEGI

The relationship between EEGI and EE

Coefficient	BC95	TFE (Greene 2005)	TRE (Greene 2005)
Parameters of the demand function			
Constant	4.276***	/	4.758***
p	-0.214*	-0.128***	-0.085***
y	0.763***	0.687***	0.645***
pop	0.175***	0.369***	0.280***
a	0.066***	0.088**	0.071***
cold	0.258***	0.638*	0.181***
oceanic	-0.055**	0.298	0.031
ISH	1.719***	4.355***	0.673***
SSH	1.282***	2.825***	0.019
UR	1.489***	1.968***	0.868***
D	-0.012***	-0.013***	-0.012***
Parameters in the one-sided error			
Constant	0.145	-3.332***	-3.732***
IGEE	-1.823***	-1.011***	-1.047***
Variance parameters for the compound error			
Sigma	0.153***	0.031***	0.030***
lambda	0.82***	1.806***	1.517***

*, **, *** denotes 10%, 5% and 1% significance level, respectively.

The relationship between EEGI and EE



5.
Concluding remarks and futher research

LET'S REVIEW SOME CONCLUDING REMARKS

REGARDING THE EEGI

- Unpublished index
- Required index
- Comprehensive results

REGARDING SFA

- Improvements in model results
- Improve in EE results
- EI is not a good proxy

FURTHER RESEARCH

- **EEGI VS Energy Intensity (EI)**

EI can be used in panels in order to assesses the influence of the EEGI and to compare the results with those obtained in SFA.

- **EEGI in other SFA models**

The number of models used can be increased in order to further test the effect of the EEGI.

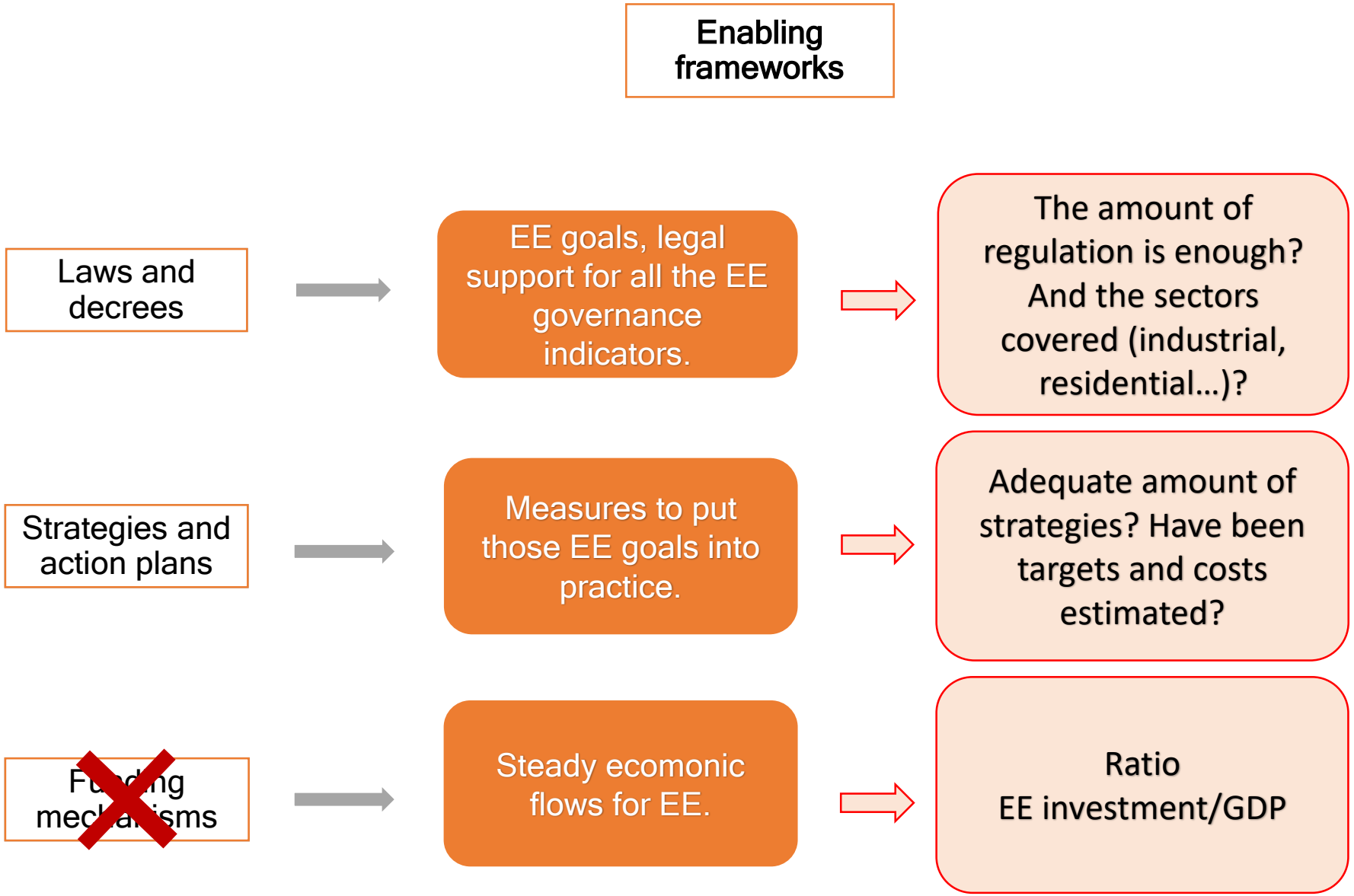
ANY QUESTION?

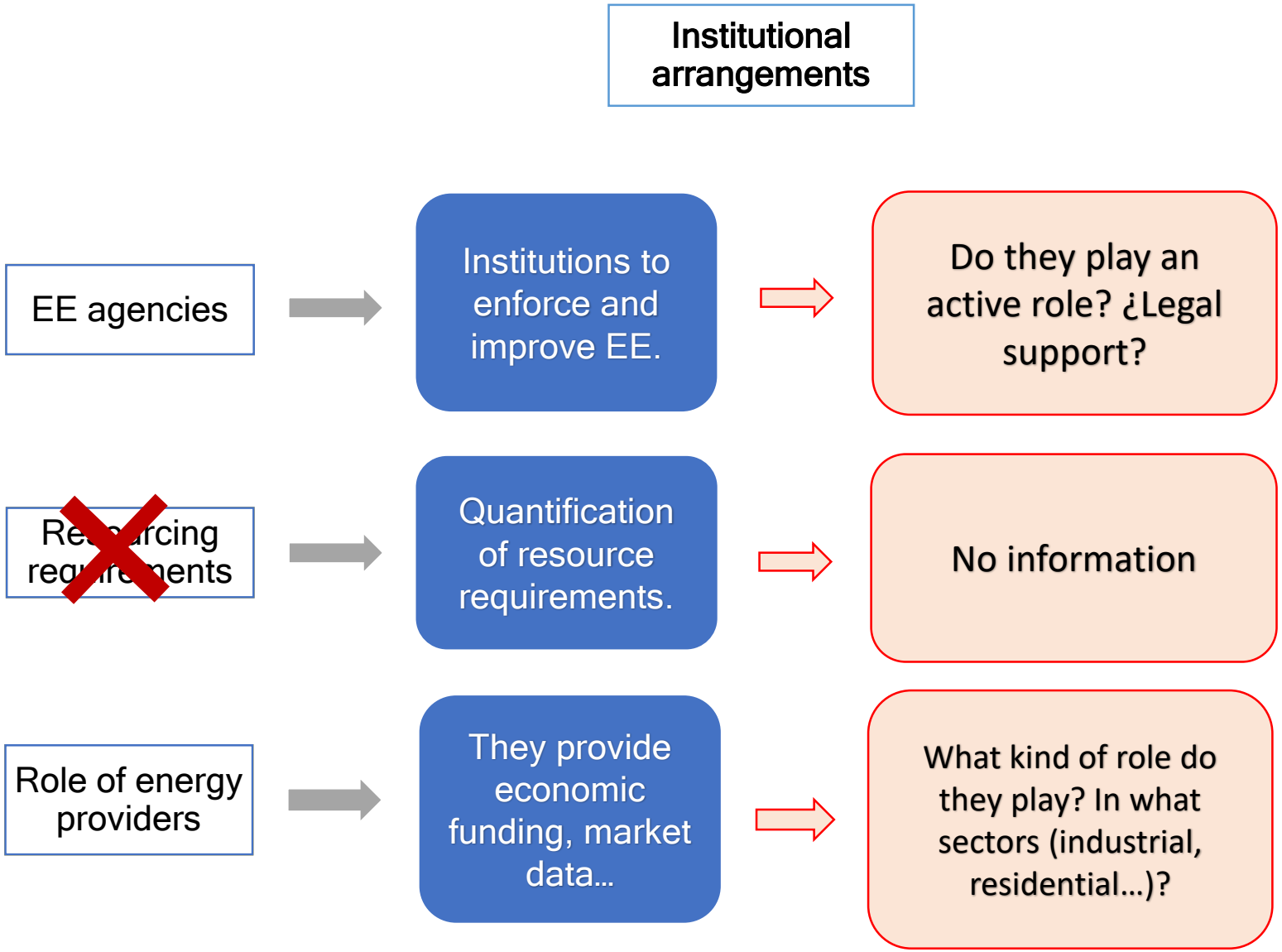
Thanks!

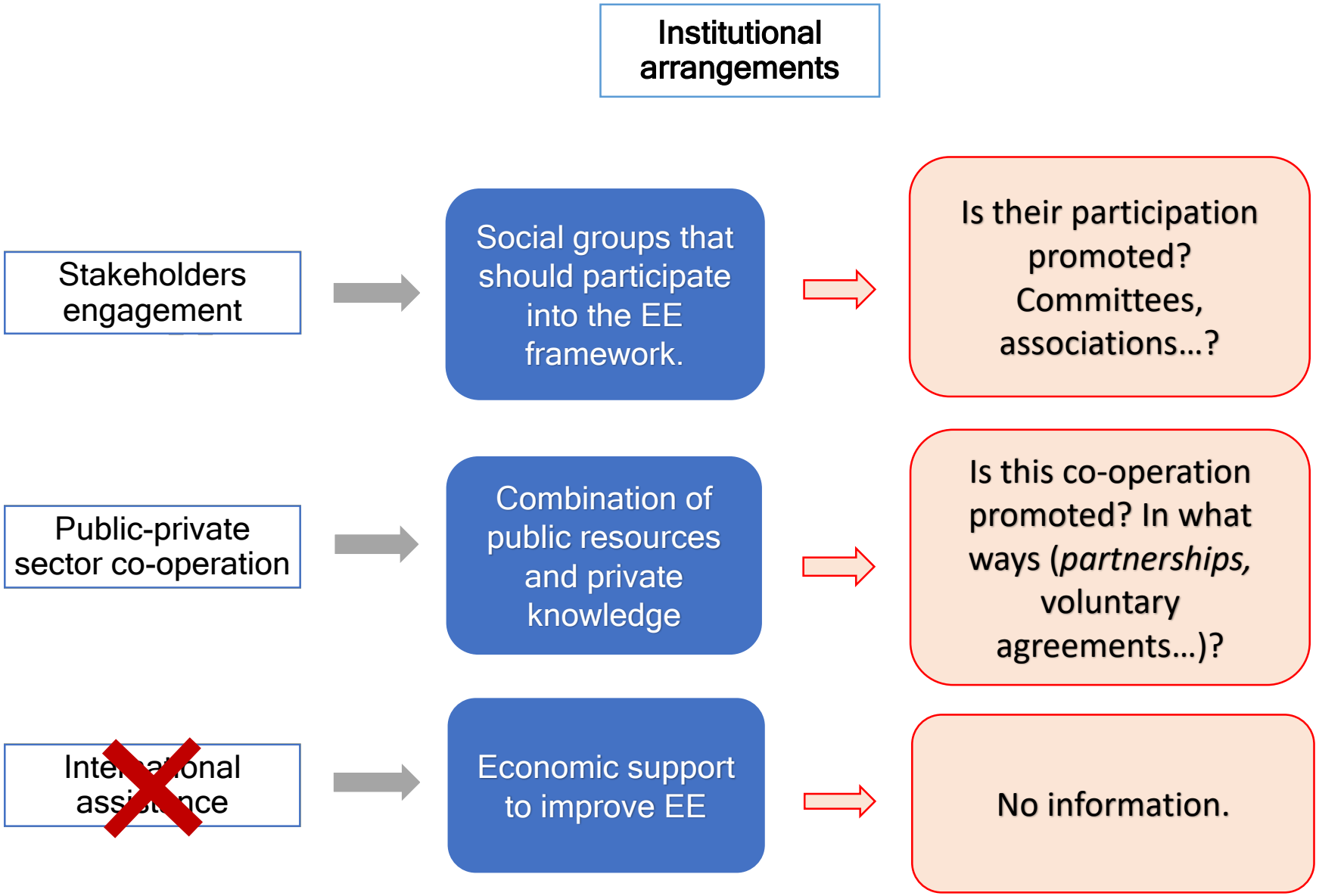
You can find me at

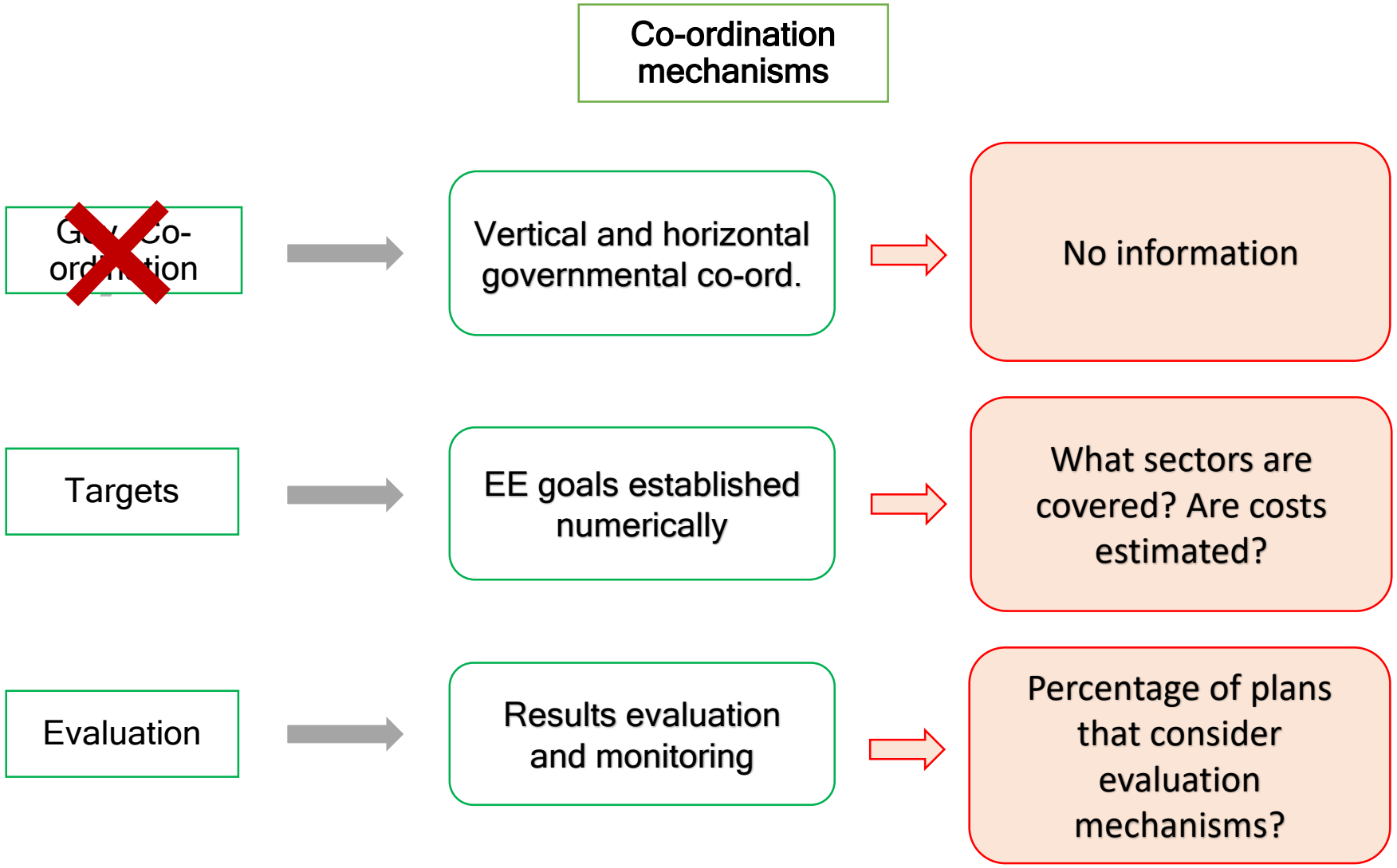
jbarrers@ull.es

I.
Annex


Enabling frameworks
Laws and decrees
EE goals, legal support for all the EE governance indicators.
The amount of regulation is enough? And the sectors covered (industrial, residential…)?
Strategies and action plans
Measures to put those EE goals into practice.
Adequate amount of strategies? Have been targets and costs estimated?
Funding mechanisms
Steady ecomonic flows for EE.
Ratio
EE investment/GDP


Institutional arrangements
EE agencies
Institutions to enforce and improve EE.
Do they play an active role? ¿Legal support?
Resourcing requirements
Quantification of resource requirements.
No information
Role of energy providers
They provide economic funding, market data…
What kind of role do they play? In what sectors (industrial, residential…)?


Institutional arrangements
Stakeholders engagement
Social groups that should participate into the EE framework.
Is their participation promoted? Committees, associations…?
Public-private sector co-operation
Combination of public resources and private knowledge
Is this co-operation promoted? In what ways (*partnerships,* voluntary agreements…)?
International assistance
Economic support to improve EE
No information.


Co-ordination mechanisms
Co-ordination
Vertical and horizontal governmental co-ord.
No information
Targets
EE goals established numerically
What sectors are covered? Are costs estimated?
Evaluation
Results evaluation and monitoring
Percentage of plans that consider evaluation mechanisms?

ROBUSTNESS ASSESSMENT

Inter-item and indicator correlations

Spearman correlation to assess the relations between indicators.

The correlations are significant and with the righ sign.

Alpha-Cronbach

It is used to assess whether indicators have been properly grouped.

The results reveal that the grouping is correct.

Sentivity analysis

Alternative aggregation methods (PCA, 8-overall EEGI).

The Spearman correlation between the ranks is correct, so the selected aggregation method also is correct.

ROBUSTNESS RESULTS

	Average interitem correlation	No. Of ítems	Alpha-Cronbach
Sub-indices			
Enabling frameworks	0.54	2	0.64
Institutional arrangements	0.50	4	0.70
Co-ordination mechanism	0.68	2	0.65
Basic overall EEGI (3 sub-índices average)	0.52	3	0.83
Basic 8-overall EEGI (8 indicators average)	0.51	8	0.83

Country	Basic overall EEGI			Extended overall EEGI		
	Score	Rank	Quartile	Score	Rank	Quartile
Germany	3.55	1	Q1	3.42	1	Q1
Denmark	3.45	2	Q1			
France	3.45	2	Q1	3.28	2	Q1
Sweden	3.20	4	Q1			
New Zealand	3.09	5	Q1			
Italy	3.07	6	Q1	2.95	3	Q1
United Kingdom	3.06	7	Q1	2.88	5	Q1
Canada	3.04	8	Q1			
Spain	3.03	9	Q2	2.90	4	Q1
United States	3.02	10	Q2			
Japan	2.92	11	Q2			
Hungary	2.82	12	Q2	2.56	7	Q2
Belgium	2.74	13	Q2	2.48	9	Q2
Czech Republic	2.72	14	Q2	2.65	6	Q2
Australia	2.67	15	Q2			
Portugal	2.63	16	Q2	2.39	10	Q3
Ireland	2.57	17	Q3	2.49	8	Q2
Finland	2.51	18	Q3	2.34	11	Q3
Norway	2.36	19	Q3			
Korea	2.33	20	Q3			
Netherlands	2.25	21	Q3	2.22	12	Q3
Luxembourg	2.25	21	Q3			
Turkey	2.11	23	Q3	1.96	16	Q4
Austria	2.04	24	Q3	2.10	13	Q3
Poland	1.98	25	Q4	1.99	14	Q3
Slovakia	1.83	26	Q4	1.99	15	Q4
Greece	1.65	27	Q4	1.59	17	Q4
Mexico	1.52	28	Q4			
Switzerland	1.52	28	Q4			
Chile	0.85	30	Q4			
Slovenia	0.55	31	Q4	0.85	18	Q4
Estonia	0.55	31	Q4			
PROMEDIO	**2.42**			**2.39**		
Desv. Estándar	0.785			0.597		

SCORES BY SUB-INDICES

Enabling frameworks

- The sub-index most correlated with the EEGI.
- L&D is the indicator accounting the highest correlation with the overall EEGI.

Institutional arrangements

- Well-correlated with the overall EEGI.
- Implementing agencies is the most important indicator.

Co-ordination mechanisms

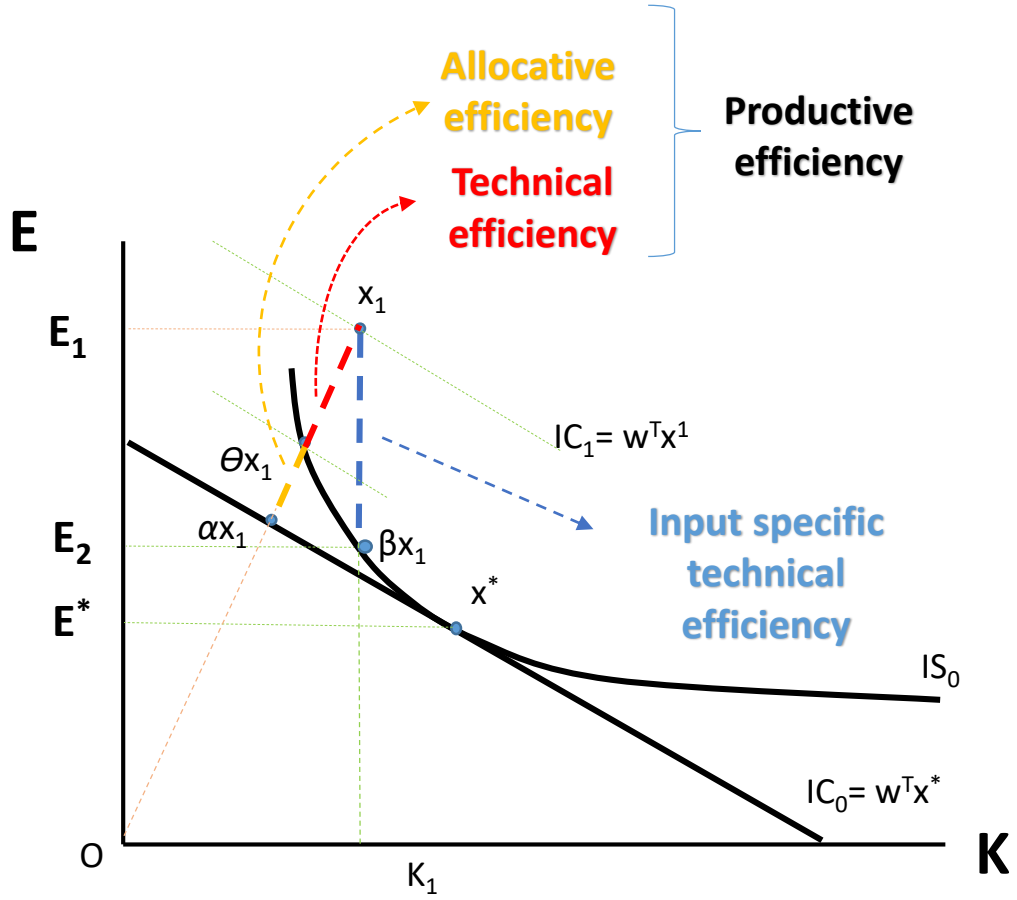
- High scores → Targets are widely considered.
- ¿Improving governement co-ordination indicator?

Country	Enabling framework			Institutional arrangements			Co-ordination mechanisms		
	Score	Rank	Quartile	Score	Rank	Quartile	Score	Rank	Quartile
Denmark	3.60	1	Q1	3.25	2	Q1	3.50	7	Q1
Germany	3.60	1	Q1	3.05	4	Q1	4.00	1	Q1
Spain	3.60	1	Q1	2.00	15	Q2	3.50	7	Q1
Italy	3.50	4	Q1	2.72	8	Q1	3.00	13	Q2
United Kingdom	3.20	5	Q1	2.97	6	Q1	3.00	13	Q2
Canada	3.20	5	Q1	3.42	1	Q1	2.50	21	Q3
France	3.10	7	Q1	3.25	2	Q1	4.00	1	Q1
Sweden	3.10	7	Q1	3.00	5	Q1	3.50	7	Q1
United States	3.10	7	Q1	2.95	7	Q1	3.00	13	Q2
Belgium	3.10	7	Q1	2.12	12	Q2	3.00	13	Q2
Hungary	3.10	7	Q1	1.35	22	Q3	4.00	1	Q1
Luxembourg	3.10	7	Q1	1.15	24	Q3	2.50	21	Q3
Czech Republic	3.00	13	Q2	1.15	24	Q3	4.00	1	Q1
Portugal	3.00	13	Q2	1.40	21	Q3	3.50	7	Q1
Japan	2.70	15	Q2	2.07	13	Q2	4.00	1	Q1
Norway	2.70	15	Q2	1.88	17	Q3	2.50	21	Q3
Korea	2.70	15	Q2	1.80	19	Q3	2.50	21	Q3
Austria	2.70	15	Q2	1.93	16	Q2	1.50	28	Q4
New Zealand	2.60	19	Q3	2.67	9	Q2	4.00	1	Q1
Slovakia	2.60	19	Q3	0.90	29	Q4	2.00	27	Q4
Ireland	2.30	21	Q3	2.42	10	Q2	3.00	13	Q2
Finland	2.30	21	Q3	1.73	20	Q3	3.50	7	Q1
Poland	2.30	21	Q3	1.15	24	Q3	2.50	21	Q3
Australia	2.20	24	Q3	2.32	11	Q2	3.50	7	Q1
Greece	2.10	25	Q4	1.35	22	Q3	1.50	28	Q4
Netherlands	1.90	26	Q4	1.85	18	Q3	3.00	13	Q2
Turkey	1.30	27	Q4	2.02	14	Q2	3.00	13	Q2
Chile	0.90	28	Q4	1.15	24	Q3	0.50	30	Q4
Mexico	0.90	28	Q4	0.65	30	Q4	3.00	13	Q2
Switzerland	0.90	28	Q4	1.15	24	Q3	2.50	21	Q3
Slovenia	0.50	31	Q4	0.65	30	Q4	0.50	30	Q4
Estonia	0.50	31	Q4	0.65	30	Q4	0.50	30	Q4
PROMEDIO	**2.48**			**1.94**			**2.83**		
Desv. Estándar	0.907			0.827			1.006		

EE: Energy Intensity VS Stochastic frontiers

Energy Intensity (EI) is one the most commonly used indicators used to approximate EE performance. EI → Drawbacks

Instead, in this work Stochastic Frontiers Analysis (SFA) is used.



The relationship between EEGI and EE

$$e_{it} = \alpha + \alpha^{y} y_{it} + \alpha^{p} p_{it} + \alpha^{popd} popd_{it} + \alpha^{UR} UR_{it} + \alpha^{a} Ai + \alpha^{oceanic} Oceanic_{i} + \alpha^{cold} Cold_{i} + \alpha^{I} ASH_{it} + \alpha^{A} ISH_{it} + u_{it} + v_{it}$$

Variable	Mean	Std Dev	Min	Max	Obs	Source
e	11.153	1.286	8.457	14.665	464	IEA
p	4.540	0.137	4.187	4.835	464	IEA
y	6.407	1.284	3.038	9.717	464	IEA
pop	2.929	1.271	0.270	5.774	464	IEA
a	19.290	1.614	17.260	22.984	464	IEA
$cold$	0.241	0.428	0	1	464	OE[a]
$oceanic$	0.310	0.463	0	1	464	OE[a]
ISH	0.257	0.051	0.137	0.403	456[b]	WB
SSH	0.622	0.062	0.481	0.764	456[b]	WB
UR	0.757	0.102	0.534	0.979	464	WB
$IGEE$	2.540	0.677	0.55	3.55	464	OE

IEA: International Energy Agency; OE: Own Elaboration; WB: World Bank.

[a] Köppen-Geiger climate classification.

[b] There is no available data for Canada between 2000-2006 and 2015.

The relationship between EEGI and EE

Coefficient	TFE (Greene 2005)		
Parameters of the demand function			
p	-0.068**	-0.125***	-0.323***
y	0.582***	0.672***	0.194***
pop	0.442***	0.392***	0.406**
a	0.089**	0.089*	0.074**
cold	0.527***	0.650**	0.906***
oceanic	0.248	0.315***	0.983**
ISH	4.772***	4.338***	5.523***
SSH	3.104***	2.646***	2.035***
UR	1.937***	2.029***	1.515***
D	-0.013***	-0.013***	-0.009***
Parameters in the one-sided error			
Constant	-4.142***	-4.386***	-5.716***
EF	-0.660***	/	/
IA	/	-0.687***	/
CM	/	/	-0.209
Variance parameters for the compound error			
Sigma	0.032***	0.031***	0.053***
lambda	1.744***	1.892***	0.794***
Average EE scores			
EF	0.947	/	/
IA	/	0.945	/
CM	/	/	0.959

The relationship between EEGI and EE

country	TFE	Rank	TFE1	RanK	Δ	IGEE3
EEGI	No		Yes			
Australia	0.96	10	0.96	14	4	2.67
Austria	0.93	25	0.92	27	2	2.04
Belgium	0.96	5	0.97	6	1	2.74
Canada	0.97	1	0.97	3	2	3.04
Czech Republic	0.96	9	0.96	9	0	2.72
Denmark	0.95	18	0.96	10	-8	3.45
Estonia	0.90	28	0.86	29	1	0.55
Finland	0.94	22	0.93	21	-1	2.51
France	0.97	2	0.98	1	-1	3.45
Germany	0.97	4	0.98	2	-2	3.55
Greece	0.94	21	0.93	22	1	1.65
Hungary	0.96	7	0.97	7	0	2.82
Ireland	0.93	23	0.93	23	0	2.57
Italy	0.96	13	0.97	8	-5	3.07
Japan	0.94	20	0.95	16	-4	2.92
Korea	0.96	8	0.96	12	4	2.33
Mexico	0.96	16	0.94	20	4	1.52
Netherlands	0.93	24	0.93	24	0	2.25
New Zealand	0.92	27	0.92	25	-2	3.09
Norway	0.93	26	0.92	26	0	2.36
Poland	0.96	14	0.95	18	4	1.98
Portugal	0.96	11	0.96	13	2	2.63
Slovak Republic	0.88	29	0.88	28	-1	1.83
Spain	0.96	12	0.96	11	-1	3.03
Sweden	0.96	15	0.97	5	-10	3.2
Switzerland	0.96	6	0.95	17	11	1.52
Turkey	0.95	17	0.95	19	2	2.11
United Kingdom	0.95	19	0.96	15	-4	3.05
United States	0.97	3	0.97	4	1	3.02
AVERAGE	0.949		0.947		2.69	2.54

IGEE ↑ => EE ↑