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A partially compensatory composite indicator based on multiple reference points Application to the Economic Freedom Index

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Outline

- 1 Study Area and Tools
 - The Economic Freedom Index
 - The MRP-PCI Composite Indicator
- 2 Data and Results
 - Data of the Study
 - Results
- 3 Conclusions

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The Economic Freedom Concept

- **Economic** freedom is an economic system based on:
 - ✓ the protection of **private property** rights,
 - ✓ relatively **low government spending** and taxation,
 - ✓ **monetary soundness**,
 - ✓ **freedom to trade** internationally,
 - ✓ **limited regulations** on businesses and labor markets.
- The **theoretical roots** of the study on economic freedom date back to economists such as:
 - ✓ **Adam Smith**, "An Inquiry into the Nature and Causes of the Wealth of Nations" (1776).
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- These theoretical foundations have served as the **basis for empirical research** that has flourished especially in the last three decades.

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How to Measure Economic Freedom

Some Existing Proposals

- The measurement of economic freedom has been the **subject of extensive debate** in the economic and political literature.
- Over the last few decades, **various organizations have developed indices** that seek to quantify the degree of economic freedom of countries in order to analyze its impact on economic growth, prosperity, and social well-being.
- The **two main** references in this area are:
 - ✓ The **Index of Economic Freedom** by the Heritage Foundation.
 - ✓ The **Economic Freedom of the World Index** by the Fraser Institute.
- Although both share a **similar conceptual framework**, their **methodological differences** have generated variations in the classifications and in the interpretation of economic freedom at a global level.
- **We have chosen Heritage** as an example, but our idea is to extend this analysis to both indices and obtain a mix of both.

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What has been found

Empirical Evidence

- The literature analyzing the effect of economic freedom on economic outcomes is **extensive and generally consistent** in its conclusions.
- This systematization of the literature provides a significant quantitative **support to the hypothesis of a positive association**.
- Economies classified as “free” or “mostly free” by the Index of Economic Freedom enjoy **income levels that more than double the average levels** in all countries and more than six times higher than those of “repressed” economies.
- Economic freedom **accelerates growth**, although it does not alter the long-term rate of growth.
- Its effects are particularly pronounced in the **initial stages of growth**.

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A Commonly used Approach

Composite Indicators

- One of the problems raised in the measurement of Economic Freedom is the **aggregation procedure** of the indicators.
- **Composite indicators** have become essential tools for the management and interpretation of large volumes of information from multiple simple indicators.
- They allow the representation of complex and multidimensional phenomena, **facilitating comparative analysis and decision-making**.
- They inherently entail a certain **loss of information**.
- The **arithmetic mean** is the fundamental and widely adopted technique due to its conceptual simplicity and ease of calculation.
- It presents significant **limitations** when applied to the aggregation of indicators that represent **complex and potentially non-substitutable** dimensions of a phenomenon.
- Thus arises the **MRP-PCI** Scheme.

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The origins

Background

- The reference point method (Wierzbicki, 1980): **Efficient solutions** by using one reference level (desired).
- The double reference point scheme (Wierzbicki et al., 2000): **Efficient solutions and objective rankings** with two reference levels (reservation–aspiration).
- Construction of **composite indicators** with different compensation degrees (Ruiz et al., 2011).
 - Only two reference levels (Reservation and Aspiration levels).
 - A fixed scale -1 0 1 2

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MRP-WSCI

Generalization

The **Multiple Reference Point-Weak and Strong Composite Indicator** (MRP-WSCI) approach (Ruiz et al., 2020)

- J units to be evaluated ($j = 1, 2, \dots, J$).
- I indicators to be aggregated ($i = 1, 2, \dots, I$).
- q_i^0, q_i^{n+1} : minimum and maximum values of indicator i .
- n reference levels: $q_i^1, q_i^2, \dots, q_i^n$.
 - Statistical: relative results.
 - Set by experts: absolute results.
- Performance intervals (e.g. very bad, bad, acceptable, good, very good).
- Common scale: $\alpha^0, \alpha^1, \dots, \alpha^{n+1}$.
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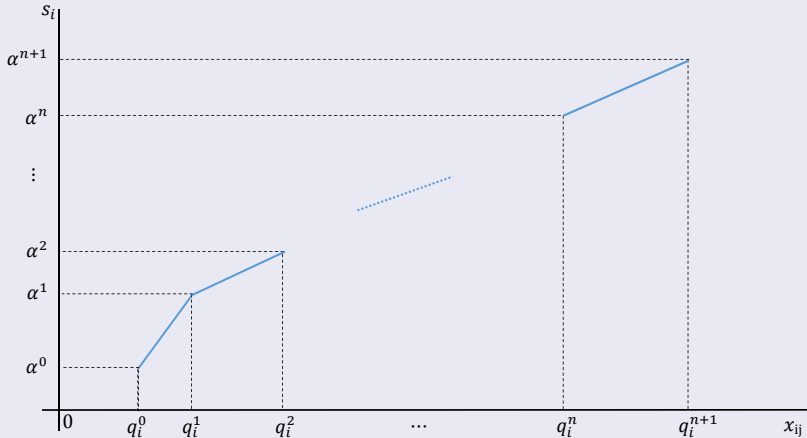
Achievement scalarizing function

$$s_{ij} = s_i(x_{ij}, \mathbf{q}_i) = \alpha^{t-1} + \frac{\alpha^t - \alpha^{t-1}}{q_i^t - q_i^{t-1}} (x_{ij} - q_i^{t-1})$$

$$\text{if } x_{ij} \in [q_i^{t-1}, q_i^t], \quad (t = 1, \dots, n+1).$$

Normalizing

Normalizes and informs



Full aggregation

Weak Composite Indicator

- **Weights** adding up to 1:

$$\mu_i^w = \frac{\mu_i}{\sum_{k=1}^I \mu_k}$$

- **Additive** aggregation :

$$WCI_j = \sum_{i=1}^I \mu_i^w s_i(x_{ij}, q_i)$$

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No aggregation

Strong Composite Indicator

- **Worst** value:

$$SCI_j = \min_{i=1, \dots, I} \{s_i(x_{ij}, \mathbf{q}_i)\}$$

- **Position in the scale** of the worst indicator.
- If $SCI_j \in [\alpha^{t-1}, \alpha^t]$:
 - All the indicators perform above q_i^{t-1} .
 - At least, one indicator performs under q_i^t .
- **Alert** signals.

No aggregation

Strong Composite Indicator

- **Worst** value:

$$SCL_j = \min_{i=1, \dots, I} \{s_i(x_{ij}, \mathbf{q}_i)\}$$

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Partial compensation

Partially compensatory composite indicator (Ruiz and Cabello, 2021)

- We allow a **compensation index** λ_i for each indicator.
- **Fully compensated** values:

$$a_{ij} = \frac{\sum_{k \in I_{ij}} \mu_k s_{kj}}{\sum_{k \in I_{ij}} \mu_k}, \quad I_{ij} = \{k \in \{1, \dots, I\} \mid s_{kj} \geq s_{ij}\}.$$

- **Partially compensatory achievement function:**

$$s_{ij}^c = s_{ij} + (a_{ij} - s_{ij})\lambda_i.$$

- Partially compensatory **composite indicator:**

$$PCI_j = \min_{i=1, \dots, I} \{s_{ij}^c\}.$$

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Hypothetical Example

Different Composite Indicators

Indicator Comp. Index	I_1	I_2	I_3	Composite Ind.		
	1	0.5	0	<i>PCI</i>	<i>WCI</i>	<i>SCI</i>
U_1	0.45	1.24	2.89	1.53	1.53	0.45
U_2	2.62	0.14	2.87	1.01	1.88	0.14
U_3	1.68	1.97	0.57	0.57	1.41	0.57
U_4	0.45	2.96	1.23	1.23	1.34	0.45

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Construction of PCI

	I_1	a_{ij}	I_3	I_1	s_{ij}^c	I_3
		I_2			I_2	
U_1	1.53	2.07	2.89	1.53	1.65	2.89
U_2	2.75	1.88	2.87	2.75	1.01	2.87
U_3	1.83	1.97	1.41	1.83	1.97	0.57
U_4	1.34	2.96	2.10	1.34	2.96	1.23

Successive aggregations

Hierarchical structure of the system of indicators

- Single indicators of each family are aggregated.
- The composite indicator takes values in the **same scale** as the achievement functions.
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System of Indicators

Families

- 1 Rule of Law
- 2 Government Size
- 3 Regulatory Efficiency
- 4 Open Markets

Indicators

- Property Rights
- Government Integrity
- Judicial Effectiveness

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Indicators

- Tax Burden
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Indicators

- Business Freedom
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Reference Levels

Families

- ☒ 1 Minimum
- ☐ 2 Percentile 25
- ☐ 3 Percentile 50
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Weights and Compensation

Procedure

- **Equal weights** (for indicators and families).
- **Compensation indexes within each family:**
 - ✓ 4 Experts.
 - ✓ Provide indexes 0, 0.5 or 1 to each indicator.
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 - ✓ 0 - no compensation;
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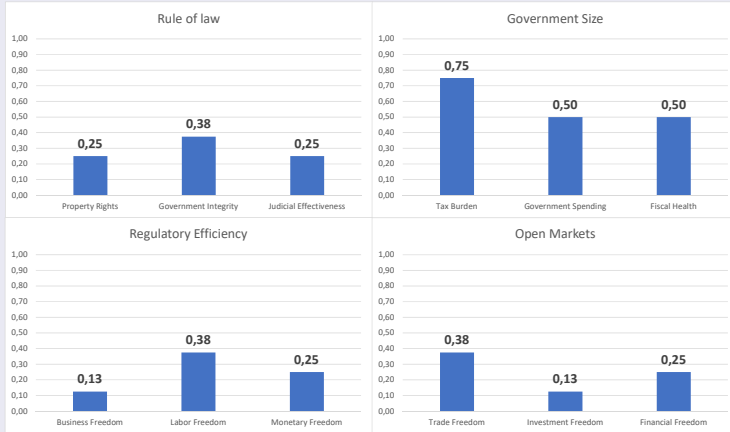
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The 15 Top Countries

Index of Economic Freedom

#	Country	Region	Overall Score	Rule of Law	Government Size	Regulatory Efficiency	Open Markets
1	Singapore	Asia-Pacific	83,50	80,30	85,30	82,90	88,30
2	Switzerland	Europe	83,00	94,50	76,90	76,00	83,80
3	Ireland	Europe	82,60	90,40	84,00	72,20	79,70
4	Taiwan	Asia-Pacific	80,00	83,20	86,70	78,50	72,10
5	Luxembourg	Europe	79,20	92,50	67,60	68,70	84,70
6	Denmark	Europe	77,80	95,20	55,60	72,80	83,10
7	Estonia	Europe	77,80	89,10	71,00	69,90	79,70
8	New Zealand	Asia-Pacific	77,80	92,20	61,40	78,20	79,90
9	Norway	Europe	77,50	97,00	63,70	75,10	73,30
10	Sweden	Europe	77,50	94,90	58,70	73,20	81,40
11	Netherlands	Europe	77,30	93,20	59,40	70,40	83,10
12	Finland	Europe	76,30	97,30	50,10	73,40	81,40
13	Australia	Asia-Pacific	76,20	90,20	50,20	76,90	86,60
14	South Korea	Asia-Pacific	73,10	78,10	76,50	69,30	64,50
15	Lithuania	Europe	72,90	77,20	71,80	69,20	73,10

The 15 Top Countries

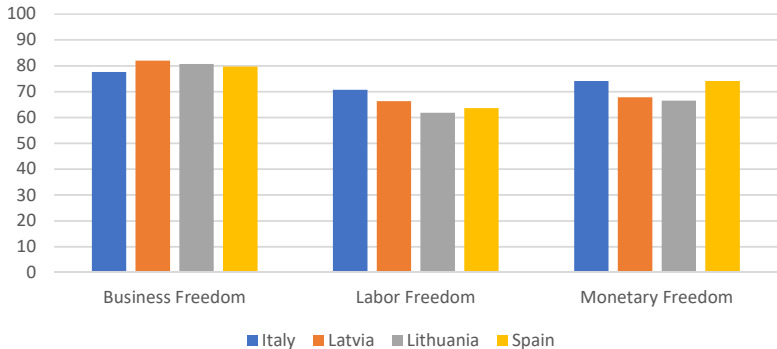
MRP-PCI

#	Δ	Country	Region	Comp 1	Rule of Law	Government Size	latory Effic	pen Marke
1	0	Singapore	Asia-Pacific	79,11	67,70	72,63	83,48	92,64
2	2	Taiwan	Asia-Pacific	78,95	84,91	68,88	86,52	75,47
3	0	Ireland	Europe	78,09	92,08	63,65	78,08	78,54
4	-2	Switzerland	Europe	75,67	95,28	46,24	73,64	87,50
5	5	Sweden	Europe	71,49	96,69	33,91	76,41	78,96
6	7	Australia	Asia-Pacific	70,98	92,24	25,12	80,64	85,91
7	-1	Denmark	Europe	70,26	93,24	31,58	76,63	79,58
8	0	New Zealand	Asia-Pacific	69,12	89,99	32,07	78,02	76,39
9	3	Finland	Europe	68,60	98,40	17,33	79,69	78,96
10	1	Netherlands	Europe	66,32	94,66	32,52	58,50	79,58
11	6	Cyprus	Europe	65,86	75,65	36,26	76,10	75,42
12	-3	Norway	Europe	65,67	98,72	30,16	57,63	76,16
13	10	Iceland	Europe	64,78	92,69	16,17	71,07	79,19
14	-9	Luxembourg	Europe	64,69	93,37	39,62	45,55	80,21
15	17	Austria	Europe	62,55	88,39	10,35	74,16	77,29

Comparison - Regulatory Efficiency

Original Data

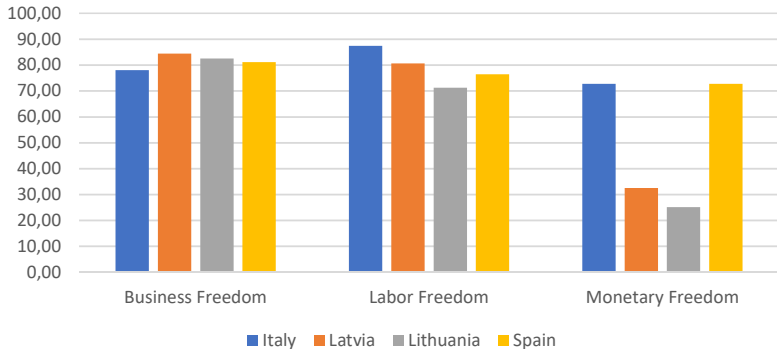
Original Data



Comparison - Regulatory Efficiency

Achievement Functions

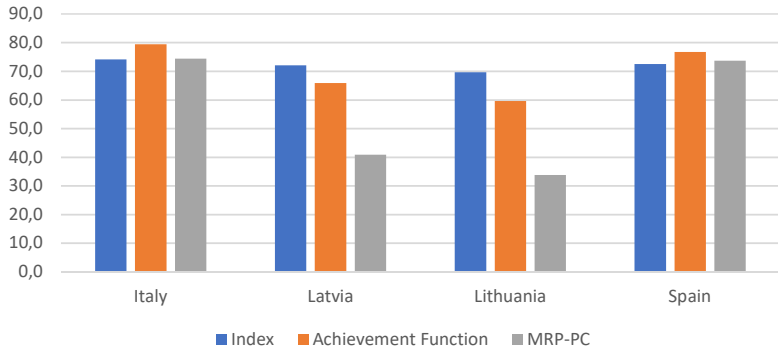
Achievement Function



Comparison - Regulatory Efficiency

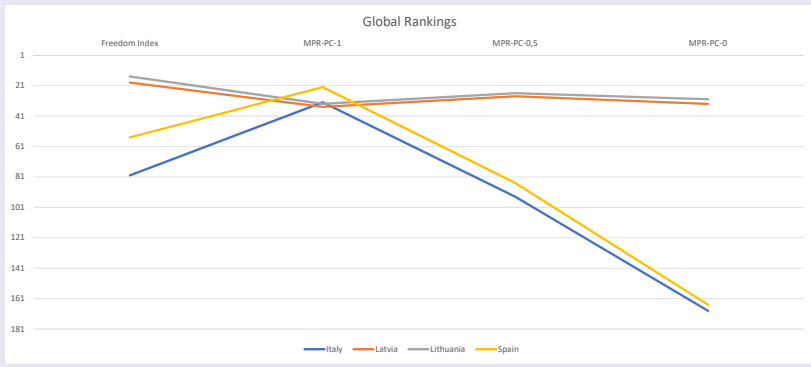
Family Composite Indicators

Different Effects



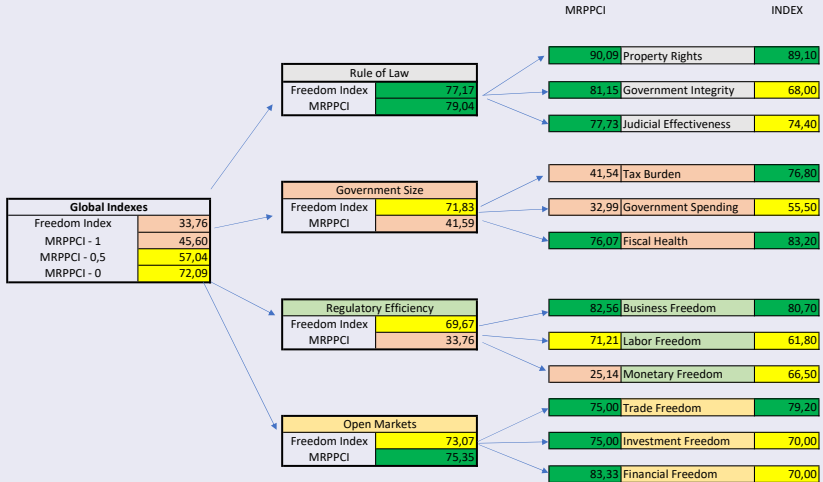
Global Composite Indicators

Global Rankings



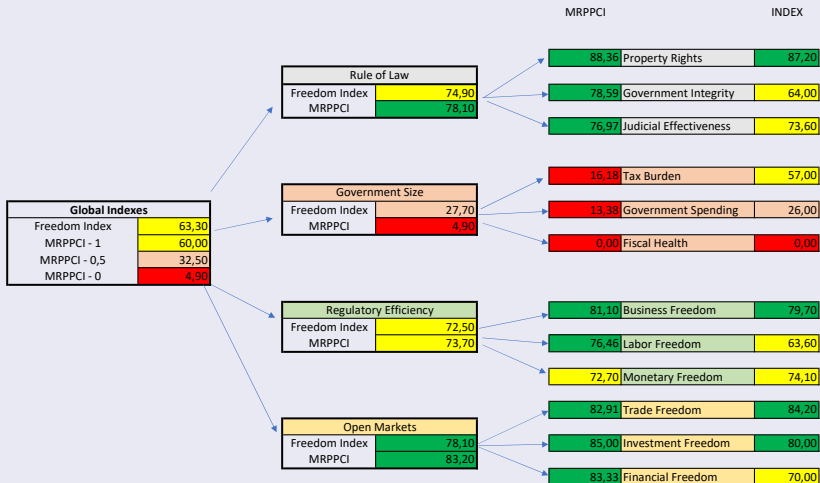
Global Composite Indicators

Lights Diagram - Lithuania



Global Composite Indicators

Lights Diagram - Spain



Conclusions

Some conclusions

- We need an accurate way to **measure Economic Freedom** from a system of indicators.
- Most widely used **normalizations do not provide very useful information**.
- Existing indexes are **fully compensatory**, thus hiding bad behaviors.
- The **MRP-PCI** scheme allows us to:
 - ✓ Use a **distance-based normalization**, which informs about the relative position of each country with respect to the rest;
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References

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Thank you!

