Was the Construction Sector in 20 European Countries Anti-Cyclical during the Recession Years 2008-2009 as measured by Multicriteria Analysis (MULTIMOORA)?

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Can Keynes do it?

- Keynes saw the solution of Depressions or Recessions by extensive programs of public works
- Keynes thought in 1929 of public investment in: “roads, electricity, telephones, ports, drainage and also on railways and houses” which essentially means the Construction Sector.
- We will examine this thesis on basis of the Recession 2008-2009.

How to Measure?

- Criteria for the construction sector of 20 European countries, describing the decrease/increase of the particular objectives within the year (comparison of 2008–2009 data compared with the previous year). :
- 1. Total employment: a ratio of the total employed population over the total number of people aged 15-65;
- 2. Production index number for construction which measures changes in the price adjusted output of construction;
- 3. The production index number for civil engineering which measures changes in real terms on previous year the price adjusted output of civil engineering constructions (consist of: roads, streets, and highways; railroads; harbors; airports; canals and waterways; pipelines for gas, water and sewer systems; telephone and telegraphs systems; electricity transmission infrastructure; oil wells, gas wells, mine shafts, dams, dikes etc.);
- 4. Investment in production of construction rehabilitation and maintenance;
- 5. Index number of building permits for new residential buildings
- 6. Index number of building permits for new office buildings.
- 7. Construction cost index number

CONCLUSION different units: ratios, index numbers and money mean Normalization, whereas optimization is planned → which Method?

Which Method?

1. Saw Method
2. Selection 2 by 2
3. MULTIMOORA

1. SAW Method

$$\sum_{i=1}^{i=n} w_i = 1$$

$$Max.x_j = w_1 x_{1j} + w_2 x_{2j} + \ldots + w_i x_{ij} + \ldots + w_n x_{nj}$$

WEIGHTS → DUAL SITUATION:

1) NORMALIZATION

2) IMPORTANCE

2. Paradox of Condorcet- Arrow

Drink Consumption	**thirstiness**	**nutrition**	**enjoyment**	**total**
Wine Milk	**2** **8**	**8** **2**	**4** **6**	**14** **16**

Drink Consumption	**thirstiness**	**enjoyment**	**nutrition**	**total**
Milk Beer	**0** **10**	**2** **8**	**6** **4**	**8** **22**

Drink Consumption	**thirstiness**	**enjoyment**	**nutrition**	**total**
Wine Beer	2 8	8 2	6 4	16 14

Beer P milk P wine in contradiction with wine P beer

Methods with Selection two by two and use of weights:

ELECTRE

PROMETHEE

AHP

They read the Response Matrix in an horizontal way

RESPONSE MATRIX

	Obj. 1	Obj. 2	…….	Obj. i	……..	Obj. n
Alternative 1	X_{11}	X_{21}	……	X_{i1}	……	X_{n1}
Alternative 2	X_{12}	X_{22}	……	X_{i2}	……	X_{n2}
……..	…….	……..	…….	…….	……	…….
Alternative j	X_{1j}	X_{2j}	……	X_{ij}	……	X_{nj}
…….	……	…….	…….	…….	……..	…….
Alternative m	X_{1m}	X_{2m}		X_{im}		X_{nm}

HOW TO READ THE RESPONSE MATRIX ?

1. HORIZONTAL WAY → weights
   weights duality
   1) normalization
   2) importance
   What is what?
2. VERTICAL WAY → dimensionless measures

MOORA
I) Ratio System of MOORA

$$x_{ij}$$

***i*=1,2,…,n as the objectives**
***j*=1,2,…,m as the alternatives.**

x_{ij} **as the response of alternative j on objective I**

$$x_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{j=i}^{m} x_{ij}^{2}}} \qquad (1)$$

x_{ij}^{*} **= number without dimensions response of alternative j on objective i.**

These responses belong to the interval [0; 1], but [-1; 1] remains possible.

_____

(1) The best ratio: Brauers-Zavadskas 2006

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MOORA
I) Ratio System of MOORA

$$y_j^* = \sum_{i=1}^{i=g} x_{ij}^* - \sum_{i=g+1}^{i=n} x_{ij}^* \qquad (2)$$

i = 1,2,…,g, objectives to maximized

i = g+1, g+2,…, n objectives to minimized

y_j^* **= alternative j concerning all objectives showing the final preference**

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MOORA
II) Second Part: the Method of the Reference Point

- Which Reference Point?
- 1) *Maximal Objective Reference Point*
- 2)*Utopian Objective Reference Point*
- 3)*Aspiration Objective Reference Point*

Maximal Objective Reference Point

Suppose 2 points: A(100,20) and B (50,100)

Dominating coordinates →

$R_m(100;100)$

matrix: $[x_{ik}]$

Maximal Objective Reference Point

$\{r_i\} = \{r_1, r_2, \ldots, r_n\}$

MOORA
Second Part: the Method of the Reference Point

Returning to (1) x_{ij}^*

as a function of a reference point r_i produces a matrix:

$$\left(r_i - x_{ij}^*\right)$$

r_i = Maximal Objective Reference Point (coordinates are existing)

Rectangular and Euclidean distance metrics do not satisfy consumer surplus, the Chebicheff Min-Max function does:

$$\min_{(j)} \left\{ \max_{(i)} \left(\left| r_i - x_{ij}^* \right| \right) \right\} \qquad (3)$$

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What about Importance of an Objective?

- To give importance to an objective by adding an additional objective of the same category
- Examples
- - Pollution importance of 3:
  - Min. consumption of energy on basis of equivalence in kg fuel per 1000€ GNP
  - Min. of solid emissions in kg per square km

    SO_2, NOx, dust, hydro carbon etc.
  - Min. the others
- - Employment importance of 2
  - direct and indirect employment

Who decide about importance?

- Pressure Groups: e.g. in the choice of a new fighter plane if the economists could advance till 4 objectives, the military will not be satisfied with military effectiveness but will ask to consider e.g. the speed of the plane, the action radius, refilling possibilities and cost of reparations
- All Stakeholders concerned, also the case for the choice of the objectives themselves.

CHAKRABORTY (2011) Decision Making in Manufacturing

(Springer "International Journal Advanced Manufacturing Technology)

Comparative Performance of some popular MODM Methods

MODM method	Computational time	Simplicity	Mathematical calculation involved	Stability	Information Type
MOORA	Very less	Very simple	Minimum	Good	Quantitative
AHP	Very high	Very critical	Maximum	Poor	Mixed
TOPSIS	Moderate	Moderately critical	Moderate	Medium	Quantitative
VIKOR	Less	Simple	Moderate	Medium	Quantitative
ELECTRE	High	Moderately critical	Moderate	Medium	Mixed
PROMETHEE	High	Moderately critical	Moderate	Medium	Mixed

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Some more Restrictions

- 1) AHP, Electre and Promethee can not be used for large matrices
- 2) TOPSIS and VIKOR are restricted to Reference Point Theory whereas MOORA is composed of 2 methods controlling each other
- 3) In addition a third dimensionless method is added to MOORA: the Full Muliplicative Method. MULTIMOORA is the name of these 3-components.

Why not including all dimensionless measures methods? By Multiplicative form?

- Reads response matrix horizontally
- Multiplication not considering units
- Not absolute value counts but the ranking
- Ends with comparing 3 methods
- We call it then MULTIMOORA

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The Full-Multiplicative Form

$$U_j = \prod_{i=1}^{n} x_{ij}$$

i* = 1,2,…,*n*; *n **the number of objectives;** ***j* = 1,2,...,*m*; *m*** **the number of alternatives;** ***xij*** **= response of alternative *j* on attribute *i* of objective *i***

Uj **= overall utility of alternative *j*. *Uj* is a dimensionless indicator.**

(4)

$$U'_j = \frac{A_j}{B_j}$$

$$A_j = \prod_{i=1}^{g} x_{ij}$$

g = the number of objectives to be maximized

$$B_j = \prod_{i=g+1}^{n} x_{ij}$$

n-g = the number of objectives to be minimized

Uj' : the utility of alternative *j* with objectives to be maximized or to be minimized.

Exponents can give importance to the objectives

DIAGRAM OF MULTIMOORA

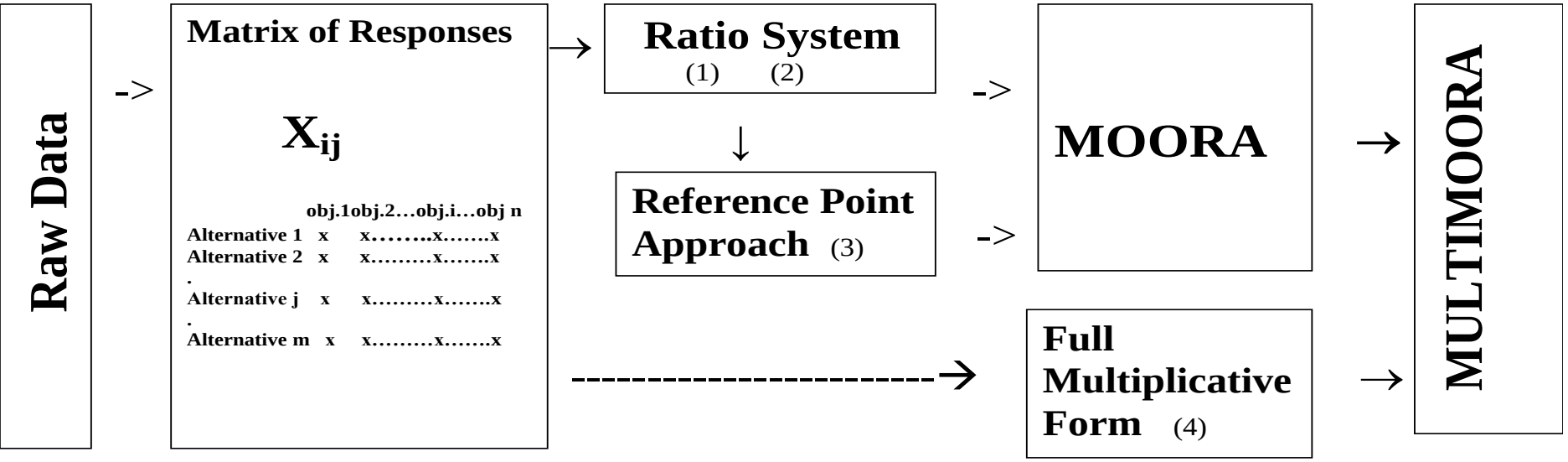

Fig. I Diagram of MULTIMOORA

The figures between brackets refer to the formulas on next pages.

MULTIMOORA

An approach composed of three methods is more robust than this one with 1 or 2 methods.

The same importance is assumed for the three methods ending with 3 rankings each time

Adding is not allowed!

The ranks of the three methods are compared and summarized by a DOMINANCE THEORY as the four essential operations of arithmetic: adding, subtracting, multiplication and division are only reserved for cardinal numbers (Arrow against Spearman, Kendall, Saaty and Lootsma).

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AXIOMS ON ORDINAL AND CARDINAL SCALES

- 1. *A deduction of an Ordinal Scale, a ranking, from cardinal data is always possible* (Arrow).
- 2. *An Ordinal Scale can never produce a series of cardinal numbers* (Arrow).
- 3. *An Ordinal Scale of a certain kind, a ranking, can be translated in an ordinal scale of another kind.*

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The Rank Correlation Method

- Kendall 1948: “we shall often operate with these numbers as if they were the cardinals of ordinary arithmetic, adding them, subtracting them and even multiplying them”
- but he never gave a proof of this statement.
- Ordinal versus cardinal: comparing the price of one commodity

	Ordinal	*Cardinal*
	1	
	2	
	3	
	4	
A	5	6.03$
	6	6.02$
	7	6.01$
B	8	6$

For Kendal B is far away from A as it has 7 ranks before and A only 4

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Ranking Scenarios Belgian Regions by the Full-Multiplicative Method (1996)

1	**Scenario IX**	**Optimal Economic Policy in Wallonia and Brussels**	**203,267**
2	**Scenario X**	**Optimal Economic Policy in Wallonia and Brussels even agreeing on the Partition of the National Public Debt**	**196,306**
3	**Scenario VII**	**Flanders asks for the Partition of the National Public Debt**	**164,515**
4	**Scenario VIII**	**No Solidarity at all**	**158,881**
5	Scenario II	Unfavorable Growth Rate for Flanders	90
6	Scenario IV	an Unfavorable Growth Rate for Flanders and at that moment asks also for the Partition of the National Public Debt	87
7	Scenario III	Partition of the National Public Debt	54
8	Scenario I	the Average Belgian	51
9	Scenario V	Average Belgian but as compensation Flanders asks for the Partition of the National Public Debt	49
10	Scenario O	Status Quo	43
11	Scenario VI	Flanders asks for the Partition of the National Public Debt	42

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DOMINANCE THEORY

- **Absolute Dominance:** an alternative dominates in each ranking all other alternatives, This absolute dominance shows as rankings for MULTIMOORA: (1-1-1).
- **General Dominance in two of the three methods** is of the form with a < b < c <d:
  (d-a-a) is generally dominating (c-b-b)
- (a-d-a) is generally dominating (b-c-b)
- (a-a-d) is generally dominating (b-b-c) and further transitiveness plays fully.
- **Transitiveness**
- If *a* dominates *b* and *b* dominates *c* than also *a* will dominate *c*.
- **Overall Dominance of one alternative on the next one:**
  - (a-a-a) is overall dominating (b-b-b)
- **Equability**
- **Absolute Equability :** e.g. (e-e-e) for 2 altern.
- **Partial Equability** e. g. (5-e-7) and (6-e-3).
- **Circular Reasoning:** Object A (11-20-14) dom. generally object B (14-16-15)
- Object B. (14-16-15) dom. Object C (15-19-12) but Object C (15-19-12) dominates generally Object A (11-20-14).

In such a case the same ranking is given to the three objects.

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Construction Criteria for 20 countries:19 EU + Norway

- 1. Total employment:
- 2. Production index number for construction
- 3. The production index number for civil engineering
- 4. Investment in production of construction rehabilitation and maintenance;
- 5. Index number of building permits for new residential buildings
- 6. Index number of building permits for new office buildings.
- 7. Construction cost index number

Recession Year 2008

- Not planned anti-cyclical construction sector as a consequence of previous years growth
- Unusual classification with Bulgaria ranking first, economically the less advanced EU-country

Construction SWOT in 2008

Ranking by Dominance of Δ or (-) Constr. Sector	Country	Ranking of Δ GDP
1	Bulgaria	6.2%
2	Slovenia	3.7%
3	Cyprus	3.6%
4	Sweden	-0.6%
5	Netherlands	1.9%
6	Ireland	-3.5
7	Germany	1%
8	Romania	7.3%
9	Belgium	1%
10	Czech Republic	2.5%
11	Norway	0.7%
12	Portugal	0.0%
13	UK	-0.1%
14	Finland	1%
15	France	-0.1
16	Austria	2.2%
17	Denmark	-1.1
18	Lithuania	2.9%
19	Spain	0.9%
20	Estonia	-5.1

Recession Year 2009

- Over the whole period 2008–2009 Germany construction sector ranked the best.
- • The construction sector shows cyclical characteristics, which was also the case for the general economy in the period 2007–2009. Compared to the evolution of the Gross Domestic Product the Construction Sector behaves Pro-cyclical and certainly not Anti-Cyclical.
- • In addition, the construction sector in each European country was not a forerunner to anticipate on the relative economic upturn of 2010–2011.
- Which are the consequences for Keynes' Theory on Public Investment?
- Different scenarios are possible:
- The governments did not follow Keynes by lack of interest or even being negatively inclined. At that moment no conclusion can be drawn about the effects of a Keynesian application.
- The governments applied Keynes' Theory but without success. Belgian construction had a pro-cyclical influence on its declining national economy instead of an anti-cyclical one, even despite the fact that the government lowered the Value Added Tax on some construction activities.

Construction SWOT in 2009

Ranking by Dominance of Δ or (-) Constr. Sector	Country	Ranking of Δ GDP
1	Germany	-4.7%
2	Belgium	-2.8
3	Cyprus	-1.7%
4	Netherlands	-3.9
5	France	-2.6%
6	Austria	-3.9
7	Sweden	-5.1%
8	Norway	-1.4
9	UK	-5%
10	Finland	-8%
11	Slovenia	-8.1%
12	Denmark	-4.7%
13	Romania	-7.1%
14	Czech Republic	-4.1%
15	Portugal	-2.6
16	Spain	-3.7%
17	Estonia	-13.9%
18	Lithuania	-14.7%
19	Bulgaria	-4.9%
20	Ireland	-7.6%

Can Keynes do it?

1) “Public Works” have no more the same meaning as in Keynes’ time
2) Even then Keynes theory is no more valuable

   The Construction Sector reacts to economic changes with some delay, as current activity is based on orders made months/years earlier and building permits take mostly a long time.

   Even worse for public investments taking a long time from intention to project, from project to decision, from decision to public subscription with sometimes appeal to a higher court or to a referendum.

3) Therefore loosing time will make public investment pro-cyclical instead of anti-cyclical as in the mean time the economic cycle went upward again.

Recession Remedies caeteris paribus Monetary Policy

1) Private Consumption (mentioned Keynes General Theory 1936)

   with the general introduction of VAT much more valuable

2) Exports: “Beggar-They- Neighbor” Policy of the Thirties

3) Public Consumption: Members of Government have always a Desiderata Book on public consumption at their disposable