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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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Abstract

The thesis of Keynes that public investment may act as a remedy in recession years is well-known. This thesis is examined on basis of the behavior of different criteria measuring the construction sector during the recession years 2008–2009 for 20 European Countries. During these recession years all these criteria showed a pro-cyclical movement instead of an anti-cyclical one. MULTIMOORA, a multi-objective optimization method, aggregated the different criteria. In addition knowing that public investments, in fact public works, take a long time between decision and execution one may conclude that they are not an anti-cyclical instrument in recession years. It would mean that the thesis of Keynes is wrong.

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Keywords: J. M. Keynes; construction sector; recession; criteria; MULTIMOORA

1. Introduction

It is the intention of the authors to study from a macroeconomic point of view the Construction Sector for a selection of European countries during the Recession 2008–2009. The economic recession, which is called the "Great Recession", compared to the Great Depression of 1929, lasted approximately from 2008 until 2009, Auerbach[1], Hall[2] and Mishkin[3]. The thesis of John Maynard Keynes[4] that public investment may act as a remedy in recession years is well-known, but will be looked at in this research.

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In fact, the construction sector in the European countries is a main provider of employment and contributes for a major part to the Gross capital of the European countries. In European Union countries gross investment in the building and construction sector accounted for approximately 66% of total investment in the economy and 12.8 % of GDP in 2009 (Department of the Environment[5]).

In this article MULTIMOORA developed by[6] Brauers and Zavadskas, will be applied in order to synthesize the different criteria of the construction sector of some European countries belonging to different groups: 9 EURO–countries, other 10 European Union Countries plus a European country outside the European Union: Norway. This heterogeneous composition can make the conclusions much more meaningful. The research is performed employing the statistical and analytical indicators of the European Commission[7, 8] and the databases of the Department of the Environment[5].

2. Development of a decision making matrix for the construction sector of twenty European countries

Table 1 introduces statistical indicators for the construction sector of twenty European countries, describing the decrease/increase of the particular objectives within the year (comparison of 2008–2009 data compared with the previous year).

In this case, seven substantial criteria were selected:

1. Total employment in construction sector. Rate represents employed persons in construction sector. It is a ratio of the total employed population over the total number of people aged 15-65;
2. Total construction. The production index number for construction which measures changes in the price adjusted output of construction (the indicators in this sector cover economic activities listed in section F of NACE (National Classification of Economic Activities);
3. Civil engineering. 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. Rehabilitation and maintenance. Investment in production of construction rehabilitation and maintenance;
5. Index number of building permits for new residential buildings – it is an authorization to start work on a building project, and as such is the final stage of authorization prior to the start of the work.
6. Index number of building permits for new office buildings – it is an authorization to start work on a building project, and as such is the final stage of authorization prior to the start of the work.
7. Construction cost index number shows the development of costs incurred by the contractor to carry out the construction process. Costs that constitute components of the construction costs include material costs, labor cost, plant and equipment costs, transport and energy costs.

The years 2007–2009 were critical for most European countries. No European country has been exempt from the economic crisis, and the construction sector is also included.

3. Multi–objective evaluation method MULTIMOORA

The ranking of the 7 criteria is ordinal and in addition are expressed in different units. Synthesis is necessary by a multi-criteria method, for which MULTIMOORA is chosen for its robustness and superiority from many points of view[9-13].

Once agreement reached about countries and criteria, a decision has to be taken how to read the Response Matrix, either horizontally or vertically. Vertical reading of the Response Matrix means that normalization is

not needed as each column is expressed in the same unit. In addition if each column is translated in ratios dimensionless measures can be created and the columns become comparable to each other. Indeed they are no more expressed in a unit. The MULTIMOORA method responses to this condition. MULTIMOORA is composed of 3 methods controlling each other: MOORA composed of the Ratio System and the Reference Point method and finally the MULTIPLICATIVE method.

3.1. Ratio system of MOORA

We go for a ratio system in which each response of an alternative on an objective is compared to a denominator, which is representative for all alternatives concerning that objective. We prefer a denominator consisting of the square root of the square sum of all responses of the alternatives on the objectives[14]:

$x_{ij}*=$ response of alternative j on objective (or criteria) i, but dimensionless:

$$x_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=i}^{m} x_{ij}^{\,2}}} \tag{1}$$

$$y_j* = \sum_{i=1}^{i=g} x_{ij*} \; - \; \sum_{i=g+1}^{i=n} x_{ij*} \tag{2}$$

$i = 1,...g,$ objectives to be maximized.
$i = g+1,\ldots n$ objectives to be minimized.
y_{j*} = the normalized assessment of alternative j with respect to all objectives.

This Ratio System ranks the results in a descending order.

3.2. Reference Point Approach

For the second part of MOORA the Reference Point Approach is chosen with the Min-Max Metric of Tchebycheff[15] as given by the following formula:

(3)

$$\min_{(j)} \left\{ \left(\max_{(i)} r_i \; - \; x_{ij*} \right) \right\}$$

r_i = Maximal Objective Reference Point with as coordinates the optimal coordinates from the alternatives

The results are ranked in an ascending order (for more details on MOORA, see Brauers 2004[12], Brauers, 2008[14] and Brauers et al. 2012[16]. For more details on European Construction, see Brauers et al.[17]):

Table 1. Twenty European Countries construction positions (x_{ij}) [(a)]

Alternatives	Objectives													
	1. Total Employment in construction sector, per cent variation on previous year		2. Total Construction, per cent variation of production in real terms on previous year		3. Civil Engineering, per cent variation of production in real terms on previous year		4. Rehabilitation and maintenance, per cent variation of production in real terms on previous year		5. Index number of building permits – square meters of useful floor area, new residential buildings (growth rates, %)		6. Index number of building permits – square meters of useful floor area, new office buildings (growth rates, %)		7. Index number of construction costs, new residential buildings	
Optima	*max*		*max*		*max*		*max*		*max*		*max*		*min*	
Compared with the previous year	*2008*	*2009*	*2008*	*2009*	*2008*	*2009*	*2008*	*2009*	*2008*	*2009*	*2008*	*2009*	*2008*	*2009*
Austria	0.4	–1.1	–3.0	–3.3	8.7	1.5	–3.7	2.7	–10.8	–9.3	–33.5	–46.3	5.2	0.6
Belgium	0.4	–0.8	1.2	–2.2	3.6	0.9	5.3	2.1	–2.8	–11.8	3.9	–19.6	2.5	–1.1
Bulgaria	23.7	–3.1	73.2	–36.9	83.5	–20.6	28.8	20.8	–16.6	–59.1	44.6	–40.5	12.3	10.9
Cyprus	18.9	–4.7	3.1	–9.5	6.6	13.2	–6.0	4.9	–0.9	–14.8	70.4	–18.9	8.0	0.8
Czech Republic	–2.2	–7.6	0.7	–3.2	12.0	0.3	5.3	–10.0	1.2	–15.6	–2.9	–39.2	5.1	–0.3
Denmark	–3.8	–13.1	–5.1	–10.1	–2.6	–1.3	–4.6	–2.5	–29.3	–42.5	17.7	–10.8	2.9	–0.4
Estonia	–1.5	–6.0	–16.0	–30.5	–1.6	–15.7	–4.1	–32.6	–39.4	–54.9	–58.8	–16.4	3.5	–8.5
Finland	3.9	–5.7	1.6	–12.3	4.2	–2.0	4.4	0.0	–21.9	–9.7	–39.5	–43.1	2.5	–1.1
France	2.2	–2.0	–2.6	–6.8	–6.2	–6.3	0.8	–1.5	–17.7	–15.9	4.2	–20.7	5.5	0.4
Germany	–0.7	0.3	3.2	–0.8	1.3	–0.9	6.3	0.3	–4.30–	2.8	17.7	–10.8	2.9	0.1
Ireland	–9.1	–26.1	–6.3	–23.5	24.9	–20.7	16.9	–44.9	–19.4	–39.9	12.8	–26.8	–7.7	–9.9
Lithuania	–3.0	–21.8	0.8	–46.1	8.3	–38.1	–3.6	24.2	–16.2	–42.8	–31.1	–74.4	9.5	–14.5
Netherlands	1.7	–1.9	5.7	–4.8	3.1	0.4	5.3	–2.3	–1.0	–19.5	12.1	–21.5	4.3	0.3
Portugal	–2.8	–8.8	–3.1	–9.0	3.0	5.0	–10.3	–22.0	–25.1	–37.6	71.5	–5.6	5.2	–0.7
Romania	0.0	–9.0	25.8	–14.2	25.9	15.3	7.1	–18.1	–24.1	–41.0	0.9	10.0	16.2	1.5
Spain	–10.0	–24.9	–5.1	–11.4	4.5	2.5	–7.0	–7.0	–56.1	–49.1	–6.4	–46.2	4.7	1.0
Sweden	5.5	–4.2	1.7	–6.6	3.5	9.4	7.7	2.3	–11.6	–18.0	63.6	–36.4	4.9	2.0
Slovenia	12.8	–2.3	15.1	–20.6	14.2	–17.8	54.5	3.9	–18.8	–25.8	–4.0	–8.5	6.3	–2.8
Norway	0.3	–6.2	1.6	–2.7	8.0	8.4	–2.0	–0.6	–21.0	–10.5	21.1	–38.2	5.7	2.3
United Kingdom	0.3	–12.2	1.0	–14.2	6.1	–4.3	1.6	–8.6	–35.2	–9.6	–6.0	–26.9	0.2	–7.5

(a) This table was composed on basis of data from the European Construction Industry Federation[18] and the European Commission [7,8].

3.3. The Full Multiplicative Form and MULTIMOORA

The following *n*-power form for multi-objectives is called from now on a Full-Multiplicative Form:

$$U_j = \prod_{i=1}^{n} x_{ij} \tag{4}$$

with: $j = 1,2,...,m$; m the number of alternatives.
$i = 1,2,\ldots,n$; n being the number of objectives.
x_{ij} = response of alternative j on objective *i*.
U_j = overall utility of alternative *j*.

The overall utilities (U_j), obtained by multiplication of different units of measurement, become dimensionless.

Objectives moving in a different direction

How is it possible to combine a minimization problem with the maximization of the other objectives? Therefore, the objectives to be minimized are denominators in the formula:

(5)

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

g = the number of objectives to be maximized.

with: $$B_j = \prod_{i=g+1}^{n} x_{ij} \quad (6)$$

n-g = the number of objectives to be minimized.

with: Uj' – the utility of alternative j with objectives to be maximized and objectives to be minimized.

In the Full Multiplicative Form a problem may arise for zero and negative values making the results senseless. Therefore the index number 100 replaces the zero number. At that moment for instance 96.6 substitutes the negative value of minus 3.4. Consequently, 103.4 represents the positive value of 3.4.

4. The theory of Dominance

In the most of the not too complicated cases a synthesis of ranking of the three MULTIMOORA methods was made by sight. For very large matrices Brauers et al. [9] developed a Theory of Dominance.

Axioms on Ordinal and Cardinal Scales

1. A deduction of an Ordinal Scale, a ranking, from cardinal data is always possible [19] Arrow.
2. An Ordinal Scale can never produce a series of cardinal numbers[19] Arrow.
3. An Ordinal Scale of a certain kind, a ranking, can be translated in an ordinal scale of another kind.

In application of axiom 3 we shall translate the ordinal scale of the three methods of MULTIMOORA in another one based on Dominance, being Dominated, Transitivity and Equability.

Dominance, being Dominated, Transitiveness and Equability

Dominance

Absolute Dominance means that an alternative, solution or project is dominating in ranking all other alternatives, solutions or projects which are all being dominated. This absolute dominance shows as rankings for MULTIMOORA: (1-1-1).

General Dominance in two of the three methods with a P b P c Pd (P preferred to)

is for instance of the form:

(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 on transitiveness plays fully.

Transitiveness

If a dominates b and b dominates c than also a will dominate c.

Overall Dominance of one alternative on another

For instance (a-a-a) is overall dominating (b-b-b) which is overall being dominated by (a-a-a).

Equability

Absolute Equability has the form: for instance (e-e-e) for 2 alternatives.

Partial Equability of 2 on 3 exists e. g. (5-e-7) and (6-e-3).

Circular Reasoning

Despite all distinctions in classification some contradictions remain possible in a kind of Circular Reasoning.

We can cite the case of:

Object A (11-20-14) dominates generally object B. (14-16-15).

Object B. (14-16-15) dominates generally 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.

5. Evaluation by the MULTIMOORA Method of the Construction Sector in twenty European Countries

Table 2 shows the final results for the European States on basis of Dominance Theory.

Table 2. The Ranking of the Construction Sector compared to the national GDP and Strategy Europe 2020 per Country

Ranking by Dominance of Δ Constr. Sector in 2008	Country (a)	Ranking of Δ GDP in 2008	Ranking by Dominance of Δ Constr. Sector in 2009	Ranking of Δ GDP in 2009 (b)
1	Bulgaria	2 (6.2%)	19	13 (-4.9%)
2	Slovenia	3 (3.7%)	11	18 (-8.1%)
3	Cyprus	4 (3.6%)	3	2 (-1.7%)
4	Sweden	17 (-0.6)	7	14 (-5.1%)
5	Netherlands	8 (1.9%)	4	7 (-3.9)
6	Ireland	19 (-3.5)	20	17 (-7.6%)
7	Germany	9 (1%)	1	10 (-4.7%)
8	Romania	1 (7.3%)	13	15 (-7.1%)
9	Belgium	9 (1%)	2	5 (-2.8)
10	Czech Republic	6 (2.5%)	14	9 (-4.1%)
11	Norway	13 (0.7%)	8	1 (-1.4)
12	Portugal	14 (0.0%)	15	3 (-2.6)
13	UK	15 (-0.1%)	9	12 (-5%)
14	Finland	9 (1%)	10	16 (-8%)
15	France	15 (-0.1)	5	3 (-2.6%)
16	Austria	7 (2.2%)	6	7 (-3.9)
17	Denmark	18 (-1.1)	12	10 (-4.7%)
18	Lithuania	5 (2.9%)	18	20 (-14.7%)
19	Spain	12 (0.9%)	16	6 (-3.7%)
20	Estonia	20 (-5.1)	17	19 (-13.9%)

(a) EU Countries not included: 1) Luxemburg 2) Latvia 3) Italy 4) Greece 5) Hungary 6) Slovakia 7) Poland 8) Malta.
(b) Cf. for 2009 the EURO zone: -4.3%.
(c) Norway is not an EU Member State.

Comments on the Ranking of the Construction Sector per Country

On basis of table 2 following comments can be made.

- The real dip of the recession comes in 2009. Bulgaria ranked relatively the highest in construction increase in 2008, but regained its more normal position in 2009. Nevertheless Bulgaria is the less advanced country of the twenty. In 2008 even the GDP went up significantly, but some activities may have swollen the

economic activity, whereas the opening of some construction sites could be sufficient to boast the entire construction. Typical is also that the increase in construction is mainly situated in civil engineering, office buildings and in total employment but not at all in residential construction.

- Over the whole period 2008-2009 Germany construction sector (7-1) 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?

Different scenarios were 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.

2. The governments applied Keynes' Theory but without success. Belgian construction had a pro-cyclical influence on its declining national economy instead of anti-cyclical one, even despite the fact that the government lowered the Value Added Tax on some construction activities. The downturn in 2009 for Belgian construction came mainly from building permits for residential and office buildings.

The construction sector usually reacts to economic changes with some delay, as current activity is based on orders made months/years earlier. Building permits take mostly a long time. Anyway against Keynes' Theory plays the fact that public investments takes a very 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. In that way loosing time will make public investment pro-cyclical instead of anti-cyclical as in the mean time the bussiness cycle went upward.

In addition knowing that public investments, in fact public works, take a long time between decision and execution one may conclude that they are not an anti-cyclical instrument in recession years. It would mean that the thesis of Keynes is wrong. On the contrary in his General Theory[20] Keynes stresses the importance of an increase in the propensity to consume, a point not much mentioned. One has to notice that in the time of Keynes VAT had not the general influence it has today. It is even possible that by decreasing the VAT rates the economy will be influenced in a positive way, even without lowering government revenue due to a Laffer Curve influence. In this sense one could conclude that the reasoning of Keynes is out of date.

6. Conclusion

Conducting research on basis of statistical indicators for the construction sector during a recession was the topic of this research. After the availability of statistical data 19 EU-Countries of the 27 plus Norway were considered.

Following indicators were used: total construction, total employment in the construction sector, civil engineering, rehabilitation and maintenance, index number of building permits for new residential buildings, index number of building permits for new office buildings and index number of construction costs for new residential buildings.

The evaluation of the construction sector is made by a method called MULTIMOORA. Multi-Objective Optimization by Ratio Analysis (MOORA), composed of two methods, namely Ratio System and Reference Point Theory, the last one starting from the previous found ratios, solves the difficult problem of normalization whereas the importance of the objectives is treated separately. If MOORA is joined with the Full Multiplicative Form for Multiple Objectives, also with the importance of the objectives treated separately, a total of three methods is formed under the name of MULTIMOORA. The MULTIMOORA method can consider all the

attributes along with their relative importance, and hence, it can provide a better accurate evaluation of the alternatives. Finally, Dominance Theory is applied to evaluate and to rank the situation of the construction sector in the twenty European countries during the recession 2008-2009.

During the 2008-2009 recession the construction sector in the 20 European countries did not stimulate the declining different national economies. Even worse, Belgian construction had a pro-cyclical influence on its national economy despite the fact that the government lowered Value Added Tax on some construction activities.

In addition, the construction sector in each European country was not a forerunner to anticipate on the relative economic upturn of 2010-2011.

Finally there is little evidence for Keynes' Theory that public investment can support a declining economy in a recession period.

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