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## Innovative Competitiveness: A Latent Factor Approach

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## **Abstract**

Competitiveness is one of the most quoted concepts in economic studies but its meaning and the way it can be measured are still a matter of lively debate. From a statistical point of view, competitiveness is a multidimensional and relative concept: it depends on the variables included in the analysis, on the disaggregation level, on the data sources. In this paper, we use a Factor Analysis approach to compare different competitiveness indices for European regions (NUTS 2). The latent variables approach allows to identify the variables that affect competitiveness and permits a simple and flexible interpretation of the most recent developments in the European economies. We devote particular attention to the role of innovation in creating the fertile context for competitiveness in international markets and we focus on the skills of the human capital in each region. We find that rankings are consistent with similar studies and that only some Italian regions benefit by the introduction of innovation proxies.

**KEY WORDS:** Latent Variable, Factor Analysis, Competitiveness, Innovation.

**JEL classification:** O57, O52, C1

# 1 Introduction

Policy makers all over the world express concern about national competitiveness. Such concern is not new; what seems new is its intensity and spread, a response to globalization, rapid technical change, shrinking economic distance and sweeping liberalization. The importance of competitiveness has spawned a significant impact in the economic literature, with a large audience in policy-making and corporate circles. Studies on this theme are diverse, ranging from productivity and cost studies for specific activities and institutional analysis to general strategy papers, development plans and cluster studies. The best-known measure, however, seems to be the competitiveness index, a composite indicator ranking countries against each other according to selected criteria and proxies of competitive ability. Competitiveness indices have become a significant part of the policy discourse. In view of their importance, surprisingly, little is known about the statistics of competitiveness indices: how soundly they are grounded in theory, how sensibly the variables are defined or how well they are measured and aggregated. In fact, competitiveness is a relative concept: it depends on the variables included in the analysis, on the disaggregation level, on the data sources.

This paper deals with competitiveness sensitivity and adapts a confirmatory factor analysis to study the characteristics of Europe using regional data from Eurostat. This approach is flexible and allows to identify the significant variables, instead of choosing them a-priori, to define the latent phenomenon called competitiveness. Focusing on the economic and innovative capacity of the European regions, we use factor analysis to show how the resulting ranking is influenced by the variables introduced.

The paper is structured as follows: in section 2 we briefly review the extended literature on competitiveness, in section 3 we present data and methods, in section 4 we discuss the results. Section 5 concludes.

## 2 Measures of Competitiveness

The official OECD definition of a nation's competitiveness is "the degree to which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the long term". Country competitiveness and openness to global business activity are inextricably linked to a country's standard of living.

Analyses of competitiveness may differ with respect to the level of investigation and studies can be carried out for various levels of product aggregation, across the entire economy, a specific sector, or for a single product (or aggregate of products). Another differentiation of competitiveness exists with regard to the spatial dimension of the analysis. Since it is a relative measure, the competitiveness between firms or regions within a country, or between countries, may be compared. The indicator used does not always reveal the spatial extension and the level of product aggregation of a given analysis and the quality of the results obtained depends to a considerable extent on the quality of the data available. Although this is common to all indexes, it affects some more than others. In fact, the quality, type and amount of data required varies between the measures; the choice of the index to be used is therefore often dictated by data availability and the resulting ranking is inevitably affected by this decision.

Several approaches can be used to analyze the past performance of competitiveness (for a detailed survey, see Buzzigoli, Viviani 2006). Frequently employed are export levels market share indicators, the real exchange rate and Foreign Direct Investment (FDI). These approaches differ widely in methodologies and data requirements and a host of different indicators have been developed to measure competitiveness based on market and trade information. Although designed for international comparison, they may also be used to contrast the competitiveness of different regions. Although this is not without problems, one advantage of using trade data is that demand and supply responses are considered simultaneously. Some of these indicators are very simple to be treated but at the same time their informative contribution is quite low. More sophisticated and comprehensive measures of international competitiveness are the Relative Export Advantage Index, the Relative Import Penetration Index and the Relative Trade Advantage Index (Balassa 1989; Scott, Vollrath 1992; Vollrath 1991).

A second approach to competitiveness is related to investments in other countries. Foreign Direct Investment (FDIs), both inward and outward, represent a good proxy together with export for competitiveness. Several attempts have been made to incorporate FDIs in the indices of competitiveness (see Traill, Gomes Da Silva 1996, for a detailed discussion). On the other hand, the amount of FDIs a foreign country attracts is also frequently seen as a sign of competitiveness of that nation as a whole, or of the sector or region attracting the investment. FDIs are then interpreted as the capability of the foreign country to pull in mobile international resources in the form of physical capital and know-how. In such a case, it is assumed that a country will attract FDIs if it has the advantage of production conditions that the country making such investments is lacking. This kind of in-

formation is available at firm and country level but it is not available at regional level.

Gross Domestic Product as a proxy of the richness of a country (or region) is also very useful in the calculation of a competitiveness index but it is only related to production of goods and services and it does not include any information on innovative capacity or education level attained by the region or country which can also be considered good proxies of the richness of a country. A significant contribution in this perspective is represented by Furman, Porter and Stern (2002) that develop the National Innovative Capacity Index. The Index is calculated using statistical modelling to examine how some measures affect innovative output across countries (of 17 OECD economies since 1973 and eight emerging economies since 1990) and over time. Innovative output is measured by international patenting, or patents filed in the United States (as well as another country). The statistical analysis yields a weighting of the relative importance of the measures (all statistically significant). This weighting is applied to each country's actual resource and policy choices to determine its index value. The index measures innovative capacity on a per capita basis, rather than its absolute level, highlighting that the intensity of innovative investment in a country that is more meaningful for future prosperity. From a statistical point of view, this approach helps reducing the a-priority problem in creating a competitiveness index: only variables that significantly affect the richness of a country are considered in the calculation and rankings reflect it.

### **3 Data and Methods**

As we showed in the previous section, competitiveness is one of the most quoted concepts in the economic literature but its meaning and the way it can be measured are still a matter of lively debate. Following Porter (2003a, 2003b, 2005), to understand competitiveness the starting point must be the sources of a country's prosperity: a country's standard of living is determined by the productivity of its economy, measured by the value of goods and services produced per unit of the country's human, capital and natural resources (Porter, Ketels 2003). Hence, a good measure of competitiveness has to include both the economic prosperity and the innovative capacity of the people living in a given area. In this perspective, we need an approach focussed on improving skills, stimulating innovation and fostering firms to invest in international markets in the long run.

Following this approach, we use data at regional level (NUTS2) from REGIO database (Eurostat) for 232 regions on the economic prosperity (GDP pro-capite

and labor productivity), the innovative capacity (patents) and the human capital endowment of the region (employment with high education and human resources in science and technology sectors). The factor analysis is then conducted to find evidence of a latent relationship between these variables and to rank European regions on the basis of the weights estimated. Two analyses are run: firstly, only economic prosperity proxies will be introduced, secondly also the innovative capacity variables are included. The aim is to show how the introduction of innovative capability affects the EU regions ranking and how the results and policies developed on those results can be influenced by the choice of the variables included.

Factor analysis is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). Hence, factor analysis is used to uncover the latent structure (dimensions) of a set of variables. It reduces attribute space from a larger number of variables to a smaller number of factors and as such is a "non-dependent" procedure (that is, it does not assume a dependent variable). The statistical approach involving finding a way of condensing the information contained in a number of original variables into a smaller set of dimensions (factors) with a minimum loss of information (Hair, 1992). This family of techniques uses an estimate of common variance among the original variables to generate the factor solution. Because of this, the number of factors will always be less than the number of original variables.

A model is specified on how latent variables depend upon or are indicated by the observed variables

$$y = \Delta_y \eta + \varepsilon$$

where  $\eta$  is a  $m \times 1$  random vector of latent dependent variables,  $y$  is a  $p \times 1$  vector of observed indicators of the dependent latent variables  $\eta$  and  $\varepsilon$  is a  $p \times 1$  vector of measurement errors in  $y$ .

The goal of estimation is to produce a covariance matrix  $s(q)$  that converges upon the observed population covariance matrix,  $s$ , with the residual matrix (the difference between  $s(q)$  and  $s$ ) being minimized. The general form of the minimization function is:

$$Q = (s - s(q))'W(s - s(q))$$

where  $s$  is the vector containing the variances and covariances of the observed variables,  $s(q)$  is the vector containing corresponding variances and covariances as predicted by the model and  $W$  is the weight matrix, chosen to minimize  $Q$ . The weight matrix corresponds to the estimation method chosen (maximum like-

likelihood, unweighted least squares, generalized least squares).<sup>1</sup> Factor analysis generates a table in which the rows are the observed raw indicator variables and the columns are the factors or latent variables which explain as much of the variance in these variables as possible. The cells in this table are factor loadings, and the meaning of the factors must be induced from seeing which variables are most heavily loaded on which factors.

In Table 1 we give a brief definition of the variables and in Table 2 we show the descriptive statistics across regions.

Table 1: Description of Variables

Variable Name	Patents	GDP	Labor Productivity	Human Resources	Employment Higher Education
	PATENTS	GDPPC	LPROD	HRST	EMPLHE
Description	Biotechnology and ICT patent applications to the EPO (per million of inhabitants)	Gross domestic product (euro per inhabitant)	GDP/Employment (euro per person employed)	Human Resources in Science and Technology (% of active population)	Employment with secondary and tertiary education (% of total employment)
Year	2003	2004	2004	2004	2004

Table 2 shows that on average the labor productivity in Europe is quite low (especially when compared to the U.S.) while the GDP pro-capite is relatively high. Concerning the role of human capital, we can observe that workers with higher education (second and tertiary) is a very small portion of the employment (on average only 0.175 %) but that from this point of view, European regions are very different (ranging from close to 0% to 22%). The percentage of employment in Science and Technology sectors is quite low even if, also for this variable, human resources in S&T in the European regions range from 0.58 % to 2.38% of the active population. The number of patent applications to the European Patent Office is high, still with strong differences among regions. Following Furman, Porter and Stern (2002) this variable is considered with a lag due to the time needed for an innovation to affect the economy.

<sup>1</sup>In the following analysis we use the generalized least squares.

Table 2: Descriptive Statistics

Variable	Mean	ST. Dev.	Skewness	Kurtosis	Minimum	Maximum
LPROD	45.274	19.651	-0.558	-0.554	4.21	89.28
HRST	1.42	0.355	-0.038	0.046	0.58	2.38
EMPLHE	0.175	0.267	12.802	183.747	0.001	4
PATENTS	129.643	136.497	1.871	4.304	1.3	748.37
GDPPC	19072.11	11813.41	-0.145	0	80.919	59554.5

Table 3: Scores (Varimax Rotation). Competitiveness Index

LPROD	0.959
EMPLHE	0.144
GDPPC	0.137

## 4 The Empirical Analysis

In the following analysis we run two factor analyses (focussing on the first factor only) on 232 European regions (NUTS2): firstly, we use economic performance proxies deriving a Competitiveness Index and, secondly, we add innovative capacity proxies obtaining the Innovative Competitiveness Index. Of course, the variance explained by the two is different and, in particular, the loss of information is lower in the latter but we show that the links are significant in both and that the fitness of the model tested by RSMA is good. The aim is to stress the difference in the rankings due to the introduction of innovative capacity. Table 3 reports the Varimax rotation scores from the analysis on the economic performance of EU regions<sup>2</sup>. Confirming recent debates emerged both in economic and political circles, the labor productivity turns out to be the most important variable in stimulating the latent factor called Competitiveness Index. High skill employment and GDP per capite are significant but their weight is lower. The path diagram is shown in Figure 1 while Tables 4 and 5 show the ranking of EU regions.

European regions ranking derived using the factor scores from the analysis above is coherent with ranking proposed using different approaches (see for example Porter, Delgado, Ketels 2006). The most competitive regions in Europe are Luxembourg, Bruxelles, Hamburg, Stockolm, Ile de France, Wien while the least

<sup>2</sup>Rotation serves to make the output more understandable and is usually necessary to facilitate the interpretation of factors.



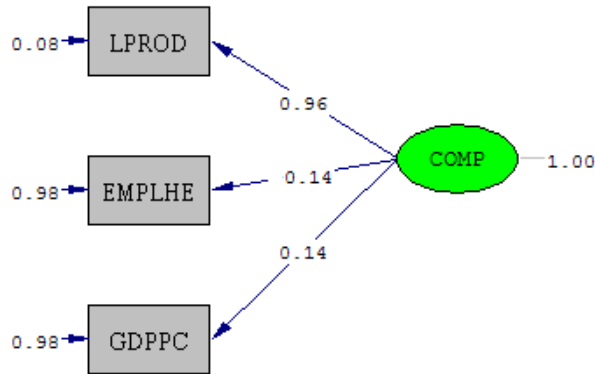
Table 4: Ranking of the European Regions with Competitiveness Index

Ranking	Regions	Ranking	Regions	Ranking	Regions
1	Luxembourg (Grand-Duché)	31	Niederbayern	61	Östra Mellansverige
2	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	32	Tirol	62	Derbyshire and Nottinghamshire
3	Hamburg	33	Reunión (FR)	63	Overijssel
4	Stockholm	34	Prov. Vlaams Brabant	64	Herefordshire, Worcestershire and Warks
5	Île de France	35	Provincia Autonoma Bolzano-Bozen	65	Oberfranken
6	Wien	36	Provence-Alpes-Côte d'Azur	66	Friuli-Venezia Giulia
7	Southern and Eastern Ireland	37	Languedoc-Roussillon	67	Kassel
8	Oberbayern	38	Övre Norrland	68	Toscana
9	Aland	39	Sydsverige	69	Prov. West-Vlaanderen
10	Utrecht	40	Piemonte	70	Comunidad de Madrid
11	Darmstadt	41	Mellersta Norrland	71	Border, Midland and Western
12	Denmark	42	Valle d'Aosta/Vallée d'Aoste	72	Länsi-Suomi
13	Bremen	43	Provincia Autonoma Trento	73	Gelderland
14	Groningen	44	Schwaben	74	Pohjois-Suomi
15	Noord-Holland	45	Småland med Gärna	75	Alsace
16	Etelä-Suomi	46	Tübingen	76	Hannover
17	Tees Valley and Durham	47	Köln	77	Veneto
18	Stuttgart	48	Martinique (FR)	78	Rheinessen-Pfalz
19	Prov. Antwerpen	49	Oberpfalz	79	Emilia-Romagna
20	Salzburg	50	Zeeland	80	Saarland
21	Mittelfranken	51	West Midlands	81	Prov. Oost-Vlaanderen
22	Lombardia	52	Lazio	82	Guyane (FR)
23	Karlsruhe	53	Greater Manchester	83	Stietmark
24	Zuid-Holland	54	Norra Mellansverige	84	Champagne-Ardenne
25	Cheshire	55	Limburg (NL)	85	Comunidad Foral de Navarra
26	Vorarlberg	56	West Yorkshire	86	Arnsberg
27	Unterfranken	57	Oberösterreich	87	Braunschweig
28	Düsseldorf	58	Prov. Brabant Wallon	88	Pais Vasco
29	Västsvrige	59	East Anglia	89	Friesland
30	Leicestershire, Rutland and Northants	60	Freiburg	90	Liguria

Table 5: Ranking of the European Regions with Competitiveness Index (cont.d)

Ranking	Regions	Ranking	Regions	Ranking	Regions	Ranking	Regions	Ranking	Regions
91	Kärnten	121	Picardie	151	Brandenburg - Nordost	181	Voreto Aigato	211	Kujawsko-Pomorskie
92	Pays de la Loire	122	Itä-Suomi	152	Molise	182	Malta	212	Východné Slovensko
93	Northumberland, Tyne and Wear	123	La Rioja	153	Ciudad Autónoma de Melilla	183	Norte	213	Malopolskie
94	Schleswig-Holstein	124	Nord - Pas-de-Calais	154	Cypro	184	Anatoliki Makedonia, Thraki	214	Warmińsko-Mazurskie
95	Haute-Normandie	125	Aragón	155	Principado de Asturias	185	Dytiki Ellada	215	Larvia
96	Gießen	126	Languedoc-Roussillon	156	Basilicata	186	Nyugat-Dunántúl	216	Świętokrzyskie
97	Lancashire	127	Dresden	157	Região Autónoma da Madeira (PT)	187	Sredni Čechy	217	Podlaskie
98	Centre	128	Corse	158	Región de Murcia	188	Közép-Dunántúl	218	Podkarpackie
99	Marche	129	Prov. Liège	159	Guadeloupe (FR)	189	Jihovýchod	219	Lubelskie
100	Cataluña	130	Attiki	160	Galicia	190	Jihovýchod	220	Yugozapaden
101	Niederösterreich	131	Burgenland	161	Puglia	191	Moravskoslezsko	221	Vest Ro
102	Bretagne	132	Leipzig	162	Stereia Ellada	192	Severovýchod	222	Centru Ro
103	Bourgogne	133	Brandenburg - Südwest	163	Castilla-la Mancha	193	Severozápad	223	Nord-Vest Ro
104	Berlin	134	Lüneburg	164	Calabria	194	Estonia	224	Sud-Est Ro
105	Franche-Comté	135	Halle	165	Campania	195	Sredni Morava	225	Yugoiztochen
106	Shropshire and Staffordshire	136	Prov. Namur	166	Andalucia	196	Slaskie	226	Sud - Muntenia Ro
107	Extremadura	137	Prov. Luxembourg (B)	167	Sicilia	197	Del-Dunántúl	227	Sud-Vest Oltenia
108	Weser-Ems	138	Lisboa	168	Kriti	198	Západné Slovensko	228	Severoztochen
109	Prov. Limburg (B)	139	Cantabria	169	Bratislavský kraj	199	Wielkopolskie	229	Severen isentralen
110	Umbria	140	Abruzzo	170	Algarve	200	Dolnoslaskie	230	Severozapaden
111	Auvergne	141	Chemnitz	171	Slovenia	201	Del-Alföld	231	Yuzhen isentralen
112	Cumbria	142	Castilla y León	172	Közép-Magyarország	202	Észak-Magyarország	232	Nord-Est Ro
113	Basse-Normandie	143	Notio Aigato	173	Alentejo	203	Pomorskie		
114	Flevoland	144	Comunidad Valenciana	174	Peloponnisos	204	Észak-Alföld		
115	South Yorkshire	145	Prov. Hainaut	175	Kentriki Makedonia	205	Zachodniopomorskie		
116	Illes Balears	146	Mecklenburg-Vorpommern	176	Ipeiros	206	Sredné Slovensko		
117	Koblenz	147	Sardagna	177	Região Autónoma dos Açores	207	Lubuskie		
118	Lorraine	148	Canarias (ES)	178	Thessalia	208	Lituanija		
119	Lincolnshire	149	Praha	179	Centro (PT)	209	Opołskie		
120	Limousin	150	Ciudad Autónoma de Ceuta	180	Dytiki Makedonia	210	Bucuresti - Ilfov		

Figure 1: Path Diagram for Competitiveness Index



Chi-Square=0.00, df=0, P-value=1.00000, RMSEA=0.000

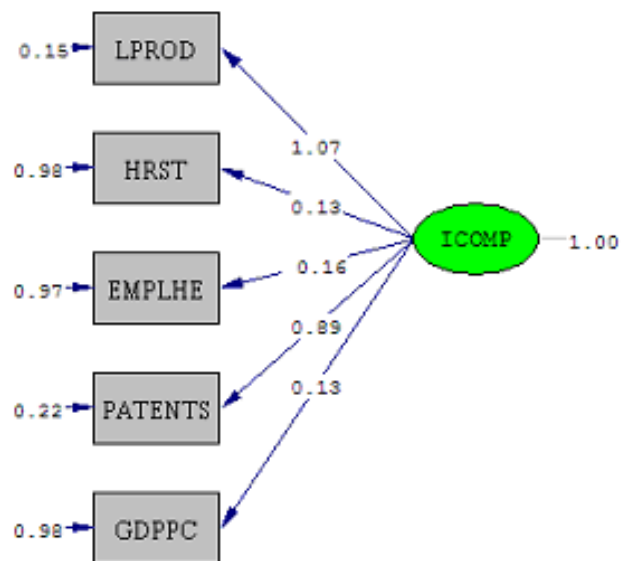
Table 6: Scores (Varimax Rotation). Innovative Competitiveness Index

LPROD	1.073
HRST	0.13
EMPLHE	0.158
PATENTS	0.886
GDPPC	0.125

competitive regions are those from countries that only recently joined the EU. Italian regions are ranked between 22th. and 167th. position with evident differences between northern and southern regions. The best Italian region turns out to be Lombardia (22th.) while the worse is Sicilia (167th.). This result is coherent with several studies showing that Italian regions have different performance but when compared to other European regions they tend to cluster in three macro-regions, North, Center and South. In particular, even if Italy is the 7th. richest economy in the world, it emerges that Italian best performers are not among the European best performers.

Results from the factor analysis with Innovative Competitiveness factor (ICOMP) are shown in Table 6 and the path diagram is reported in Figure 2.

Figure 2: Path Diagram for Innovative Competitiveness



Chi-Square=6.29, df=5, P-value=0.27894, RMSEA=0.033

Adding innovative capacity to economic prosperity proxies, rankings change accordingly; Table 7 and Table 8 show that using this definition, the most competitive regions in Europe are still Luxembourg, Bruxelles, Hamburg, Stockholm, Ile de France, Wien, Denmark and Groninger and the least competitive regions are still the Eastern Europe regions that only recently joined the Union but in between there is a strong reshuffling. This result is also coherent with the National Innovative Capacity Index ranking (Furman, Porter, Stern, 2002) showing, using country data, that the most competitive countries are those having both economic prosperity human capital and innovative capacity. Focussing on Italy, the effect of the introduction of innovative capacity and human capital variables is twofold: a group of 7 regions is negatively affected (by comparison of relative positions in ranking) by it, while a more numerous second group (14 over 21 regions) strongly benefits from its introduction. Comparing the two rankings, in the first group we find Lombardia, Regione Autonoma di Trento e di Bolzano, Piemonte, Val d'Aosta and Molise, while Friuli Venezia Giulia has almost the same rank. All remaining regions benefit from innovation and human capital, showing that their ranking in Europe is better than that described using only economic performance proxies. Among the latter, the best performer are Lazio, Veneto and Emilia Romagna. In particular, Lazio jumps from 52th. to 24th. rank thanks to very high levels of R&D expenditures and number of patents application (and, hopefully, following registration). However, several Italian regions show good performance: Lombardia is ranked 25th and Toscana, Emilia Romagna, Friuli Venezia Giulia and Veneto are grouped between 66th and 72th positions. On the contrary, South of Italy shows a negative performance and several southern regions are ranked between 154th and 164th position, close to Greece, South of Spain and East Europe regions that recently joined the European Union (especially Romanian and Bulgarian regions).

## **5 Conclusion**

Competitiveness is a relevant topic in the economic literature but its meaning and the way it can be measured are still a matter of lively debate. Following a recent literature, competitiveness is strictly related to the sources of a country's prosperity. In this perspective, several authors suggest an approach focussed on improving skills, stimulating innovation and fostering firms. It is only by building such capacity, that developed and less developed countries will be able to move to the next stage of improving competitiveness and achieve sustained high levels of

Table 7: Ranking of the European Regions with Innovative Competitiveness Index

Rank	Regions	Rank	Regions	Rank	Regions
1	Luxembourg (Grand-Duché)	31	Mellieria Norrland	61	Kassel
2	Région de Bruxelles-Capitale	32	Zuid-Holland	62	Herefordshire, Worcestershire and Warks
3	Hamburg	33	Düsseldorf	63	Prov. Brabant Wallon
4	Stockholm	34	Tirol	64	Limburg (NL)
5	Ile de France	35	Provence-Alpes-Côte d'Azur	65	East Anglia
6	Wien	36	Languedoc-Roussillon	66	Toscana
7	Oberbayern	37	Provincia Autonoma Bolzano-Bozen	67	Friuli-Venezia Giulia
8	Southern and Eastern Ireland	38	Schwaben	68	Alsace
9	Darmstadt	39	Leicestershire, Rutland and Northants	69	Länsi-Suomi
10	Åland	40	Oberösterreich	70	Veneto
11	Bremen	41	Syddsvenska	71	Overijssel
12	Utrecht	42	Övre Norrland	72	Emilia-Romagna
13	Denmark	43	Prov. Vlaams Brabant	73	Prov. West-Vlaanderen
14	Groningen	44	Oberpfalz	74	Pohjois-Suomi
15	Noord-Holland	45	Martinique (FR)	75	Kärnten
16	Stuttgart	46	Småland med Årna	76	Saarland
17	Etelä - Suomi	47	Provincia Autonoma Trento	77	Hannover
18	Mittelfranken	48	Valle d'Aosta	78	Champagne-Ardenne
19	Tees Valley and Durham	49	Piemonte	79	Comunidad de Madrid
20	Unterfranken	50	West Midlands	80	Border, Midland and Western
21	Karlsruhe	51	Östra Mellansverige	81	Guyane (FR)
22	Prov. Antwerpen	52	Tübingen	82	Steiermark
23	Salzburg	53	Köln	83	Gelderland
24	Lazio	54	Norra Mellansverige	84	Pays de la Loire
25	Lombardia	55	Zeeland	85	Haute-Normandie
26	Niederbayern	56	West Yorkshire	86	Berlin
27	Västsvenska	57	Derbyshire and Nottinghamshire	87	Rheinlenses-Pfalz
28	Vorarlberg	58	Greater Manchester	88	Liguria
29	Cheshire	59	Freiburg	89	Comunidad Foral de Navarra
30	Reunion (FR)	60	Oberfranken	90	Prov. Ost-Vlaanderen

Table 8: Ranking of the European Regions with Innovative Competitiveness Index (cont.d)

Rank	Regions	Rank	Regions	Rank	Regions	Rank	Regions	Rank	Regions
91	Braunschweig	121	Koblenz	151	Comunidad Valenciana	181	Notre	211	Jihovýchod
92	Pais Vasco	122	Limousin	152	Prov. Hautaut	182	Voreio Aigiao	212	Bucuresti - Ilfov
93	Northumberland, Tyne and Wear	123	Nord - Pas-de-Calais	153	Ciudad Autonoma de Ceuta	183	Malta	213	Severovýchod
94	Prov. Namur	124	Burgundland	154	Basilicata	184	Anatoliki Makedonia, Thraci	214	Macroregiunea doi (N-E)
95	Amsberg	125	La Rioja	155	Molise	185	Yugoizrochen	215	Macroregiunea unu (N-V)
96	Centre	126	Languedoc-Roussillon	156	Ciudad Autonoma de Melilla	186	Severozapaden	216	Podlaskie
97	Gießen	127	Picardie	157	Principado de Asturias	187	Severen isentraten	217	Sud-Vest Oltenia
98	Manche	128	Brandenburg - Südwest	158	Puglia	188	Severozitrochen	218	Macroregiunea unu (centru)
99	Friesland	129	Libbia	159	Calabria	189	Stredni Cechy	219	Dytiki Ellada
100	<i>Niederösterreich</i>	130	Praha	160	Região Autónoma da Madeira (PT)	190	Warmnisko-Mazurskie	220	Macroregiunea doi (S-E)
101	Bourgogne	131	Corse	161	Guadeloupe (FR)	191	Yuzhen isentraten	221	Dél-Dunántúl
102	Lancashire	132	Aragón	162	Sicilia	192	Jihozápad	222	Malopolskie
103	Weser-Ems	133	Dresden	163	Bratislavský kraj	193	Opolskie	223	Slaskie
104	Lorraine	134	Prov. Liège	164	Campania	194	Wielkopolskie	224	Estonia
105	Schleswig-Holstein	135	Prov. Luxembourg (B)	165	Galicja	195	Zachodniopomorskie	225	Közép-Dunántúl
106	Franche-Comté	136	Aitiki	166	Castilla-la Mancha	196	Nyugat-Dunántúl	226	Észak-Alföld
107	Bretagne	137	Abruzzo	167	Stereia Ellada	197	Kujawsko-Pomorskie	227	Dél-Alföld
108	<i>Cataluña</i>	138	Lüneburg	168	Andalucia	198	Moravskoslezsko	228	Észak-Magyarország
109	Umbria	139	Leipzig	169	Algarve	199	Lubuskie	229	Świętokrzyskie
110	Shropshire and Staffordshire	140	Cantabria	170	Kriti	200	Stredné Slovensko	230	Podkarpackie
111	Extremadura	141	Halle	171	Aleantejo	201	Severozápad	231	Latria
112	Prov. Limburg (B)	142	Sardegna	172	Slovenia	202	Lithuania	232	Lubelskie
113	Auvergne	143	Brandenburg-Nordost	173	<i>Közép – Magyarország</i>	203	Dolnoslaskie		
114	Basse-Normandie	144	Canarias (ES)	174	Ipereos	204	Pomorskie		
115	Cumbria	145	Región de Murcia	175	Peloponnisos	205	Stredni Morava		
116	Lincolnshire	146	Cyprus	176	Kentriki Makedonia	206	Východnie Slovensko		
117	South Yorkshire	147	Chemnitz	177	Centro (PT)	207	Macroregiunea patru (V)		
118	<i>Itä – Suomi</i>	148	Castilla y León	178	Regiao Autonoma dos Açores	208	Sud-Muntenia		
119	Flevoland	149	Mecklenburg-Vorpommern	179	Thessalia	209	Yugoizrochen		
120	Iles Balears	150	Notio Aigiao	180	Dytiki Makedonia	210	Západné Slovensko		

prosperity.

From the empirical side, the most used measure in literature is represented by the competitiveness index, a composite indicator ranking countries against each other according to selected criteria and proxies of competitive ability. Competitiveness indices have become a significant part of the policy discourse even if only few contributions focus on the statistics of competitiveness indices. In fact, competitiveness is a relative concept: it depends on the variables included in the analysis, on the disaggregation level, on the data sources. Hence, policy measures strongly depend on these variables.

This paper deals with competitiveness indices and use confirmatory factor analysis to study the characteristics of European regions using data from Eurostat Regio database. Focusing on the economic and innovative capacity of the European regions, the factor analysis is conducted to find evidence of a latent relationship between these variables and to rank European regions on the basis of the weights estimated. Two analyses are run: firstly, only economic prosperity proxies will be introduced, secondly the innovative capacity variables are also included. We show how the introduction of innovative capability affects the EU regions ranking and how the results and policies developed on those results can be influenced by the choice of the variables included.

From the confirmatory factor analysis some conclusions can be drawn. Firstly, the most important variables in stimulating innovative competitiveness is the labor productivity and patenting application. Secondly, the most competitive regions in Europe are Luxembourg, Bruxelles, Hamburg, Stockholm, Ile de France, Wien while the least competitive Bulgarian and Romanian regions, independently of the index considered. This result is coherent with Porter analyses showing that the most competitive countries are those having both economic prosperity human capital and, especially, innovative capacity. Thirdly, the analysis shows that rankings are strongly affected by the variables included. In particular, best and worst performers are large regions with capital and regions that recently joined the EU, respectively and independently of the variables included but, all remaining regions show very different positions. This result shows how sensitive rankings are and that policy measures based on competitiveness indices should be taken with care because they strongly rely on relative indicators. Finally, focussing economic performance only, Italian regions perform quite well and show the well known differences between northern and southern regions. The introduction of innovative and human capital proxies, instead, has a composite effect on Italian regions. A group of 7 regions is negatively affected by it, while a more numerous second group (14 over 21 regions) strongly benefits from it. In particular, Lazio shows



the biggest jump thanks to very high levels of R&D expenditures and number of patents application and several other regions show good performance: Lombardia, Toscana, Emilia Romagna, Friuli Venezia Giulia and Veneto. Southern regions, instead have low ranking close to Greece, South of Spain and East Europe regions that recently joined the European Union.

## References

- [1] Balassa, B. (1989), *Comparative Advantage, Trade Policy and Economic Development*, New York and London
- [2] Buzzigoli, L., Viviani, A. (2007), Firm and system competitiveness: problems of definition, measurement and analysis, mimeo, University of Florence
- [3] Furman J.L., Porter M.E., Stern S. (2002), The determinants of national innovative capacity, *Research Policy*, Vol. 31, Issue 6, pp. 899-933
- [4] Hair, J.F. (1992), *Multivariate data analysis* (3rd ed.). New York: Macmillan.
- [5] Porter M.E. (1990), *The Competitive Advantage of Nations*, The Free Press, New York.
- [6] Porter M.E. (2003a), The Economic Performance of Regions, *Regional Studies*, 37 (6&7), pp.549-578.
- [7] Porter M.E. (2003b), Building the Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index, in *The Global Competitiveness Report 2003-2004*, Palgrave Macmillan, World Economic Forum, New York.
- [8] Porter M.E. (2005), *The Business Competitiveness Index*, Interview with M.E. Porter, World Economic Forum, available on <http://www.weforum.org/en/initiatives/gcp/GCR20052006VideoInterviews/index.htm>
- [9] Porter, M., Ketels, C.H.M. (2003), *UK Competitiveness: Moving to the Next Stage*, Management Research Forum, Summary Report 6. London : Advanced Institute of Management Research, London
- [10] Porter, M.E., Delgado, M., Ketels, C., (2006), The Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index,

in *World Economic Forum, The Global Competitiveness Report*, Palgrave MacMillan.

- [11] Scott, L., Vollrath, T.L. (1992), Global Competitive Advantage and Overall Bilateral Complementarity in Agriculture: A Statistical Review, United States Department of Agriculture, Economic Research Service, *Statistical Bulletin*, No. 850, Washington D.C
- [12] Traill, B., Gomes Da Silva, J. (1996), Trade, Foreign Direct Investment and Competitiveness in the European Food Industries, *International Business Review*, Vol. 5, Issue 2, pp. 151-166
- [13] Vollrath, T.L. (1991), A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage, *Weltwirtschaftliches Archiv*, Vol. 127, No. 2, pp. 265-280.

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