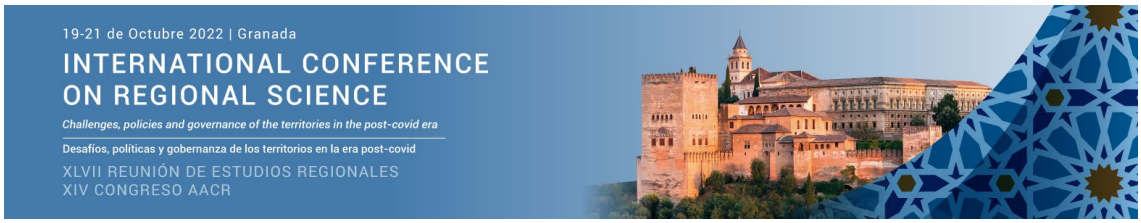

EXTENDED ABSTRACT

Title: New insights for measuring regional competitiveness. A preliminary approach

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Abstract:
It is widely accepted that one basic condition for the economic development of any region is its competitive capacity. For this reason, the design of a comprehensive measure of regional competitiveness has attracted the attention of many researchers. Having said that, obtaining a good measure of regional competitiveness is quite challenging, to the point that some authors even question the appropriateness of talking about competitiveness between countries or regions. Our opinion on this point, in line with others, is that the complications innate to its measurement should not, under any circumstances, lead to the disuse of the term "territorial competitiveness". This term is a sound concept from a theoretical perspective and interesting from an applied, or economic policy, perspective. Regions compete with each other through not only the degree of efficiency of their firms, but also through their institutional qualities, social and cultural factors, physical infrastructures, human capital, innovative capacity, externalities, and so on.

In this field, the well-known Regional Competitiveness Index (RCI) proposed and regularly computed by the European Commission is undoubtedly a reference. This index, which in its latest version (at the time of writing this paper, April 2022) examines the year 2019, employs 74 partial indicators/variables, grouped into 11 pillars/dimensions, which in turn are grouped into 3 sub-indices to finally merge into the RCI. For this purpose, data for 268 NUTS2 (based on the 2016 definition) regions are used

Against this background, our paper, using the same data made public by the European Commission, aims to contribute to the literature from two different but complementary angles. On the one hand, we want to test the robustness of the results obtained by the RCI by modifying the dimensionality reduction technique that is used. The original

index uses Principal Component Analysis (PCA), and in this paper we use the DP2 criterion, which has some advantages over PCA. On the other hand, and under the premise that not all regions compete with each other, this paper delves into the importance of two factors when analysing the competitive capacity of a region: geographical distance from the potential competitor, and technological specialisation. In the first case, we somewhat correct the index with the introduction of several distance measures, while in the second case we make a prior selection of regions that are expected to compete mostly in high or medium-low technology sectors, and re-compute the competitiveness index accordingly.

The results obtained, which are still very preliminary and subject to revision, show, first, that the RCI indicator appears to be quite robust to the variable reduction method employed, although some relevant changes are reported in the main text of the article. Table 1 lists the top 20 regions and the bottom 20 regions, as well as the value of the 'new' competitiveness index, which we call Modified Regional Competitiveness Index (hereafter, *MRCI*). To compare the results obtained here with the original ones, the last columns of the table show the ranking of the *RCI*; we do not report the values of the original index, as they are not comparable with those got in this paper.

Table 1
***MRCI* index. Comparison with the original one**

***MRCI* by using *DP2* method**				**Original *RCI***	
Top Regions	**Value**	**Bottom Regions**	**Value**	**Top Regions**	**Bottom Regions**
UK00	11.646	RO22	3.473	SE11	EL41
UKJ1	11.269	RO21	3.476	UK00	RO22
SE11	11.241	RO41	3.901	NL31	FRY3
NL31	11.186	BG31	3.905	UKJ1	EL51
DK01	11.185	RO12	3.997	UKJ2	FRY5
UKJ2	11.119	RO31	4.017	DK01	EL53
FR10	10.822	EL64	4.090	LU00	EL63
DE21	10.596	EL63	4.102	DE21	ES64
FI1B	10.506	EL51	4.117	NL00	BG31
NL00	10.445	EL65	4.125	FI1B	EL42
LU00	10.394	EL53	4.225	FR10	EL65
NL33	10.199	RO11	4.275	DE60	RO21
DE60	10.181	EL41	4.300	DE71	EL62
UKD6	10.138	BG34	4.353	NL33	EL64
DE71	10.122	FRY3	4.431	UKJ3	RO41
UKJ3	10.100	EL61	4.501	DE12	PT20
DE12	10.057	ITG1	4.510	UKD6	EL61
DE11	10.037	EL42	4.568	DE11	EL54
SE22	9.948	BG32	4.616	DEA2	EL43
NL41	9.941	ITF6	4.670	NL41	RO12

Note: The list of regions, along with the NUTS2 nomenclature, is included in an Appendix.

As can be seen, the results obtained for the *MRCI* largely coincide with those of the *RCI* index, demonstrating the robustness of the latter. In the top regions, almost all differences are in the ranking (since 19 out of 20 regions coincide). The most

competitive region is now London and its commuting area (UK00), shifting Stockholm (SE11), while regions such as Île de France (FR10) and Cheshire (UKD6) move up whereas others, such as Luxembourg (LU00) lose positions. As for the bottom regions, here there are changes in the names apart from their ordering. Basically, eastern regions, Bulgarian (BG32- Severen tsentralen and BG34- Yugoiztochen) and Romanian (RO11- Nord-Vest and RO31- Sud-Muntenia), replace southern regions, mainly Greek (EL43- Kriti, EL54- Ipeiros and EL62- Ionia Nisia). In any case, the changes can by no means be considered quite remarkable. Overall, our results basically reinforce those obtained in the periodic *RCI* index published by the EC.

Moreover, by looking at the values rather than the ranking, the new *MRCI* allows us to highlight the important differences in competitiveness between European regions. Going to the extremes, it appears that London's degree of competitiveness is more than three times higher than that of Sud-Est (RO22). Averaged across the top and bottom 20 regions, the differences remain striking (2.5 times in this case).

Concerning the second contribution of the paper, and starting with geography, its inclusion does bring about significant changes. If we accept that competition is greater the closer the regions are to each other, our proposal is as follows. We have calculated, for each region, its spatial lag, defined as the weighted average of the rest of the regions, so that we weight nearby regions more heavily than distant regions. Specifically, the spatial lag adopts the following expression:

$$W\_MRCI_i = \sum_{k=1}^{n} w_{ik} MRCI_k$$

where *MRCI* denotes our Modified *RCI* index, and w_{ik} are the elements of the distance (spatial weights) matrix *W* between each region *i* and the remaining regions *k*. The role played by the distance matrix is to impose a penalty on distance, and its definition can be crucial.

Therefore, in this paper we propose two somewhat extreme distance matrices. On the one hand, a matrix that considers every single region and defines their weights as the inverse of the distance between each region *i* and the rest of regions *k* ($w_{ik} = 1/d_{ik}$ being d_{ik} the Euclidean distance between the two regions considered). On the other hand, a distance matrix with a not too large cut-off, so that only the regions within it are weighted in the computation of the spatial lag: specifically, and to limit the number of competitors, we use a cut-off of 1,000 km ($w_{ik} = 1/d_{ik}$ if $d_{ik} < 1{,}000$; 0 otherwise). In the two cases, and for the sake of comparison, distance matrices are row-standardised.

Thus, once the corresponding spatial lags have been computed, we calculate the ratio *MRCI/W_MRCI*, so that we directly compare the degree of competitiveness of each region with that of its neighbouring regions (with the nuances attached to the definition of *W* that is used). By doing so, a value above 1 indicates that the region is more competitive than its neighbouring ones, while a value less than one means that its competitive capacity is, in relative terms, low; obviously, the further the result is from 1, the greater the competitive strength or weakness, respectively.

Main results are presented in Table 2 (20 top and bottom regions for both distance matrices). With regard to the list of the most competitive regions, it can be seen that the simple inclusion in the calculations of a weighting according to geographical distance causes some regions to appear (disappear). Thus, capital regions such as AT00- Wien and its commuting area and SK01- Bratislavský Kraj show up, highlighting the fact that,

although they do not generally deserve to be considered top regions, they are leading regions in terms of their geographical location. Something similar happens with some Swedish regions (SE12- Östra Mellansverige and SE23- Västsverige). On the contrary, there are Dutch (NL33- Zuid-Holland and NL41- Noord-Brabant) and British (UKD6- Cheshire and UKJ3- Hampshire and Isle of Wight) regions which, in a stricter comparison with their environment, are no longer leading regions in competitive terms. The most important changes occur, however, and as expected, when a cut-off is established in the distance matrix, so that, while maintaining the distance penalty, only the competitive situation of a region is assessed with the regions that fall within it. In this case, only half of the regions remain, so the first thing we want to stress is that the competitive capacity of some regions could be considered 'global', but not 'local'. We are talking, for example, about German regions such as DE11- Stuttgart, DE12- Karlsruhe, and DE71- Darmstadt. As for the regions that replace them, and which therefore have a very high competitive capacity if only compared to geographically close regions, country regions such as CY00- Cyprus and MT00- Malta stand out, joined by country capitals such as RO32- București - Ilfov, EL30-Attiki, ES30- Madrid, PT17- Área Metr. de Lisboa, BG41- Yugozapaden, and PL91- Warszawski stołeczny.

Table 2
***MRCI* index: Insights from the inclusion of geographical distance**

Distance matrix with all regions				**Distance matrix with regions in 1,000km**			
Top regions	**Value**	**Bottom regions**	**Value**	**Top regions**	**Value**	**Bottom regions**	**Value**
SE11	1.383	RO21	0.489	CY00	1.506	RO21	0.596
DK01	1.354	RO22	0.499	RO32	1.435	RO22	0.643
DE21	1.310	RO41	0.565	EL30	1.417	RO41	0.677
FI1B	1.308	BG31	0.570	MT00	1.344	RO11	0.684
FR10	1.298	RO12	0.573	ES30	1.329	PL43	0.690
NL31	1.275	FRY3	0.574	SE11	1.329	RO12	0.691
UK00	1.273	RO31	0.586	PT17	1.293	RO31	0.694
UKJ1	1.240	RO11	0.601	DK01	1.285	PL62	0.703
LU00	1.232	EL65	0.607	DE21	1.281	BG31	0.706
AT00	1.215	EL51	0.609	BG41	1.258	ITG2	0.709
DE60	1.212	EL64	0.612	FI1B	1.238	PL42	0.714
UKJ2	1.212	EL63	0.612	FR10	1.232	PL61	0.715
SE22	1.205	ITG1	0.618	NL31	1.225	HU31	0.726
DE11	1.201	PT20	0.619	AT00	1.213	HU23	0.726
DE12	1.199	EL53	0.623	SK01	1.208	ITC2	0.732
DE71	1.198	EL41	0.625	UK00	1.207	RO42	0.754
SK01	1.196	ES64	0.626	PL91	1.205	HU32	0.754
NL00	1.193	FRY5	0.638	LU00	1.190	ES64	0.755
SE12	1.191	BG34	0.645	UKJ1	1.175	ITG1	0.768
SE23	1.187	ITF6	0.655	DE60	1.165	PL72	0.776

Note: The list of regions, along with the NUTS2 nomenclature, is included in an Appendix.

Concerning the list of bottom regions, changes are not so intense. When the standard inverse distance matrix is applied, there are no noteworthy changes. When the cut-off is imposed, however, some changes should be highlighted. Basically, Bulgarian and Greek

regions are replaced by Poland and Hungarian ones, so our approach unveils the existence of 'local' competitive problems in regions such as PL43- Lubuskie, PL62- Warmińsko-mazurskie, HU31- Észak-Magyarország, and HU23- Dél-Dunántúl.

As for the level of technology, regions tend to specialise and therefore compete in different products/sectors. Thus, taking advantage of the approach used for the construction of the competitiveness index (showed in the main text of the paper), we believe that it can be said, without doubt, that only the leading regions in the last two sub-indices compete with each other in technological sectors. With this in mind, we have chosen those regions that exceed the average in both and, exclusively for them, we have constructed a new competitiveness index but only with the indicators included in these two sub-indices. Our idea is, we insist, to outline a group of regions that are expected to compete with each other given that, most likely, their factor endowments bias their production towards medium-high/high-tech products.

On the other hand, the rest of the regions probably compete more in less advanced sectors and via prices. Therefore, for these regions only, we have computed a new competitiveness index, in this case with the partial indicators included in the first sub-index. Furthermore, in line with the premise that they compete more through prices, we have added in the calculation of the competitiveness index another partial indicator: the per capita GDP as a proxy for wages in each region (it was reversed to maintain the positive polarity, since in this case it is considered that low wages improve the competitiveness of these regions).

Starting with the group of high-technology (Table 3), our analysis unmasks the competitive strength of some regions that, in the more general approach, did not stand out. We are referring to important regions, among others DE14- Tübingen, DE91- Braunschweig, SE12- Östra Mellansverige, SE23- Västsverige, UKH1- East Anglia, and UKK1- Gloucestershire, Wiltshire and Bristol/Bath area. More importantly, the list of bottom regions points to the potential competitive problems of, for example, many French regions which, although in principle well equipped to face technological competition, would not seem to be very successful in that task given the capabilities of their potential competitors. The same happens with some Belgian and Spanish regions, among others. The complete list of bottom regions is included in Table 3; since it is completely new, we prefer not to include names here for the sake of space.

Regarding the low-technology group, the most important fact here concerns the group of leading regions, as all of them are regions which, in the overall indicator, have many competitive shortcomings. Obviously, in the division we have made, the situation changes, as these are regions that could be successful in certain market segments; as has been pointed out, in low-tech and price-competitive sectors. Thus, it is mainly Spanish and French regions that emerge for their relatively high degree of competitiveness; again, the list can be seen in Table 3.

Finally, we would like to conclude by acknowledging the limitations of this preliminary work, particularly about the last point. A search for region-niche market pairs would allow us to be much more precise when talking about competitiveness. This search constitutes, on the other hand, a challenging line of future research, as it certainly requires forgetting the RCI index as a reference, the use of different data sources, and tackling a new and exciting study from scratch.

Table 3
***MRCI* index: Insights from the inclusion of technological level**

High-technology sectors				Low-technology sectors			
Top regions	**Value**	**Bottom regions**	**Value**	**Top regions**	**Value**	**Bottom regions**	**Value**
UKJ1	45.165	FRI3	17.552	UKN0	21.961	BG31	4.610
SE11	43.687	FRD2	17.890	FRE2	21.486	BG34	6.121
DK01	43.024	FRD1	19.338	BE33	21.064	RO22	6.316
UKJ2	42.730	FRF3	19.404	FRE1	20.822	RO11	6.458
UK00	41.876	ES21	19.921	FRF2	20.196	EL42	6.496
NL31	41.108	BE35	20.803	BE32	19.770	RO41	6.768
DE21	40.998	BE34	20.932	ES24	19.738	EL54	6.815
UKJ3	39.233	FRC2	21.047	ES51	19.546	EL53	6.895
FI1B	39.134	FRB0	21.126	IE04	19.455	EL51	6.913
UKK1	38.603	FRK1	21.180	ES42	18.804	BG33	6.928
DE60	38.290	FRL0	22.405	FRC1	18.026	RO12	6.936
DE12	38.056	FRH0	22.503	FRJ1	17.767	RO42	6.937
DE11	37.781	FRI1	22.924	FRI2	17.493	BG32	7.002
UKD6	37.548	PT17	23.070	ES13	17.491	EL63	7.009
DE14	37.187	FRF1	23.165	PT11	17.119	RO21	7.042
NL00	37.010	ES30	23.491	ES52	16.940	EL43	7.247
DE91	36.165	FRG0	23.627	ES62	16.836	EL65	7.353
SE12	36.043	CZ06	24.280	ES12	16.705	BG42	7.535
SE23	36.036	AT11	24.292	ES22	16.660	EL52	7.753
UKH1	35.793	EE00	24.465	ES41	16.644	EL64	7.772

Note: The list of regions, along with the NUTS2 nomenclature, is included in an Appendix.

Keywords: competitiveness; European regions; DP2 index; distance; technology
JEL codes: O18, P50, R11