# Economic Centrality:

# How Much is Economics and How Much is Geography?

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**Abstract**: Proximity to the markets is a key determinant of the location of firms because distance still matters, as recently reported in the literature. In this paper, based on an adapted version of the most standard centrality index we propose a decomposition method which allows isolating the influence of: (i) internal and external factors; (ii) economic and geographical aspects. In order to illustrate our methodology, we consider data for 171 countries. This empirical example leads to the conclusion that the centrality level of the countries derives from different sources, requiring therefore different policy interventions in order to improve it.

**Keywords:** centrality, peripherality, economic geography, distance.

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**1. Introduction**

Globalization is one of the most remarkable trends of the last decades (Head and Mayer, 2013) with trade growing faster than GDP since 1980 (Berthelon and Freund, 2008). Is this equivalent to say that the friction of distance is not so important now as it was in the past? Recent empirical studies on this topic provide a clear negative answer to this question. Rather, as shown by Disdier and Head (2008), the influence of distance on trade is consistently high since the middle of the last century. The average result emerging from their meta-analysis points to the fact that a 10% increase in distance has a negative impact of 9% on bilateral trade. In this context, the advantage of centrality (or the penalization of peripherality) is obvious and can be grounded on at least four main reasons.

First, firms want to locate where the markets are. In fact, proximity to the markets is one of the location determinants traditionally included in the empirical studies. However, in most cases, only the demand that is specific to the region/country under analysis is considered, i.e., the importance of neighbouring spaces is ignored (Head and Mayer, 2004). On the contrary, the concept of centrality explicitly incorporates and quantifies the external influence.

Second, also at the theoretical level, the importance of the proximity to the markets is for long considered by the location theory. Since the beginning of the 1990’s, the new economic geography approach brings this kind of considerations to the mainstream economics, discussing alternative mechanisms through which agglomeration may occur. In this group of models the location of production depends on the relative strength of centrifugal and centripetal forces. Increasing returns and decreasing trade costs are key elements that generate an uneven spatial distribution of economic activity (Fujita et al., 1999). This perspective highlights therefore that, behind first nature aspects, also second nature dimensions matter for final location configurations. As stated by Krugman (1993, p. 131), “firms that have an incentive to concentrate production at a limited number of locations prefer, other things equal, to choose locations with good access to markets; but access to markets will be good precisely where a large number of firms choose to locate”. Trade costs also play an important role in the heterogeneous firms models. In this context, the reduction of trade costs will force the least productive firms to exit and will generate a reallocation of market shares from less productive to more productive firms (Melitz, 2003).

Third, the centrality theme has extremely important implications for economic policy, namely in the areas of transports and economic and social cohesion (Ottaviano, 2008). In fact, the centrality of the spaces depends critically on accessibility and, as Spiekermann and Neubauer (2002, p. 7) affirm, “accessibility is the main ‘product’ of a transport system. It determines the locational advantage of an area (…). Indicators of accessibility measure the benefits that the households and the firms in an area enjoy from the existence and use of the transport infrastructure relevant for their area”. Different interventions can be requested in order to minimize the disadvantage associated with peripherality. Therefore, a clear understanding of the factors that constitute an obstacle to an easier access to the markets is valuable knowledge for policy actors.

Fourth, economic centrality has been the subject of an intense debate not only due to the negative impact of remoteness from the markets but also to the positive relationship between centrality and per capita income (Redding and Venables, 2004).[[1]](#footnote-1)

Given the importance of the centrality concept, it is not surprising the emergence of a broad range of measures aiming its empirical materialization. This group of indicators has its origin in the pioneering contributions by Keeble et al. (1982, 1988) and include, among others, the indexes suggested by Gutiérrez and Urbano (1996), Linneker (1996), Copus (1999), or Schürmann and Talaat (2000) (for a discussion of some of these measures see Spiekermann and Neubauer, 2002).

These centrality measures differ in their methodological options. However, a common shortcoming is the fact that they do not allow for identifying the relative contribution of geographical and economic components to the overall level of centrality. The present study addresses this specific issue by proposing an adaptation of the most commonly used centrality index and, based on that, a simple decomposition method that allow to identify the contribution of economics and geography both at internal and external levels.

The remainder of the paper is structured as follows. Section 2 presents the index and the decomposition method that we propose. Section 3 provides an empirical example of the methodology proposed. Section 4 presents some final remarks.

**2. Decomposing Centrality**

As we discussed in the Introduction, from the literature on economic centrality/peripherality several measures have emerged. The most commonly used index was proposed by Keeble et al. (1982, 1988). Using for the country under analysis and for other countries, the index can be expressed as:

(1)

where is a mass variable for country and the distance from to .

Taking this index as inspiration we propose a new centrality measure:

(2)

where and are the shares of countries and in the total value of the mass variable taken as reference, and is the internal distance of country .

Equation (2) makes clear that the level of centrality exhibited by country depends on four dimensions, covering geographical and economic aspects both at internal and external levels. However, it does not allow us to identify how much each component contributes to the global score of the country. Before the discussion of this topic, we consider five methodological options necessary to calculate .

The first aspect regards the distance function considered. Despite the existence of other formulations and significant study on this issue, the use of a linear function is the simplest and the most common choice. The second question is how to evaluate inter-country distances. Several options are available including great circle distances, distances by road, time distances, or transport costs. Of course, the choice is strongly conditioned by the availability of the data. The third aspect to be taken into account also concerns the measurement of the distance between countries and it is related to what location should be considered as reference? Two options are commonly used: a dimensional criterion (population, economic activity) or an institutional criterion. However, usually the two possibilities do not imply significantly different results. Fourth, what variable should be used to capture the economic dimension of the countries? GDP, population, employment, or some other variable related to the distribution of economic activity are among the most common choices.

The question that has been submitted to more intense debate, namely in the context of the so-called “border effect” literature, is the one concerned with the measurement of the internal distance (Anderson and van Wincoop, 2003). Following the proposal of Head and Mayer (2002), we can consider three types of measures (for a discussion on the influence of considering different measures see Chen, 2004). The first group of measures was suggested by Wolf (1997, 2000) and associate to a proportion () of the distance to neighborhood countries. Wolf (2000) considers only the distance to the closest country and assumes . In turn, Wolf (1997) considers and calculates the average distance from the countries with a common frontier. The second type of measures is supported on infra-national distance measures, i.e., in the distribution of economic activity inside the national space. In general terms, these indicators require a much more demanding set of information for their construction. An exception is Wolf (1997) who considers only the distance between the two largest cities of the country. Alternatively, Wolf (2000) proposes to multiply that distance by the double of the weight of the second largest city on the sum of the two cities. Chen (2004) uses the weighted average of the geographical distance between the major cities considering regional GDP’s as weights. The indicators suggested by Head and Mayer (2000) and Helliwell and Verdier (2001) can also be classified in this group but are more complex. For example, in the measure proposed by Helliwell and Verdier (2001), the internal distance is expressed as the “weighted average of intra-city distances, intercity distances, the average distance between cities and rural areas, and the average distance from one rural area to another” (Helliwell and Verdier, 2001, p. 1026). The third group of indicators associates the internal distance with the area of the country, being therefore easy to calculate. Representing the area of country as , Nitsch (2000) and Melitz (2007) consider the radius of a hypothetical disk, i.e., . Other studies follow alternative ways. For example, Keeble et al. (1982, 1988) and Brülhart (2001, 2006) multiply the previous expression by while Head and Mayer (2000) and Redding and Venables (2004) multiply by , aiming to obtain “the average distance between two points in a circular country” (Redding and Vanables, 2004, p. 62).

The next step in our discussion (and the main contribution of the study) is to propose a simple method to decompose the global index into four parcels with specific interpretation. This is obtained as follows:

(3)

where is the average internal distance and the total number of countries.

The *internal geographical component* assumes an equal distribution of the economic activity (i.e., each country capturing a fraction of total economic activity). Thus, the values obtained by each country only depend (negatively) on its geographical dimension, evaluated through its area, as commonly done in this type of measures. If the same portion of economic activity is located in a smaller country then we will say that this country is more central than another one with a larger dimension, where the economic activity is more dispersed in space.

In turn, the *internal economic component* is measured through , being a *pure internal economic component* and a *geographical adjustment factor*. assumes a positive value when an above-average share of economic activity is located in that country, indicating that its centrality level benefits from a favorable position in economic terms. A negative value occurs when the country captures a below-average fraction of economic activity. Given that we fixed the internal distance at its average, the differences between countries are fully attributable to this economic effect. Regarding , it registers a value above 1 when the country is (geographically) smaller than the average and below 1 in the opposite case. The global effect captures the internal economic component adjusted by the dimension of the country.

The centrality level of a given country depends not only of what happens at the internal level (the aspects analyzed so far) but also of external dimensions.

The *external geographical component* - - is at the heart of the centrality concept. It assumes, once again, as in , the equal distribution of economic activity in space and analyzes how far country is from the remaining countries. More remote countries suffer from a “tyranny of distance” (Battersby and Ewing, 2005), an expression, inspired by the tittle of the Geoffrey Blainey’s (1983) book, that became popular to summarize the idea that a negative position in this aspect is difficult to minimize and impossible to overcome in its full extension.

Finally, we should also consider the distribution of economic activity by the other countries. In this case, however, it is important to note that, by opposition to the preceding components, we cannot isolate a pure external economic component. The reason for that is straightforward. Obviously, the share of economic activity located outside is but this does not give us any new insight. What really matters is the spatial distribution of that part of the total economic activity and, more specifically, its closeness to . Therefore, is influenced both by economic and geographical aspects, assuming a positive value when economic advantages are obtained by countries closer to . Its minimum value is reached, for , when all the economic activity is concentrated in the farthest country.

One of the most important insights allowed by this decomposition methodology is that it offers guidance for policy interventions aiming to improve the centrality level of a country. Effectively, distinct policy measures can be recommended depending on the main weaknesses detected. Let us consider then each specific component. The improvement on the internal geographical component can be obtained through better infrastructures, allowing a reduction on transport costs and times. In turn, if a country shows a low score on the internal economic component , interventions should be devoted to the attraction of more economic activity to the country, for instance through favorable conditions to FDI. For its part, rapid access to external countries is vital to improve centrality through component . The creation and/or improvement of infrastructures that connect the country to foreign countries are adequate interventions to improve centrality. Component is the only one that is out of control of national authorities. It depends on the distribution of economic activity across the remaining countries, an aspect that national policymakers do not influence in a direct way. Nevertheless, an indirect aspect may contribute to improve this component, namely the formation of regional integration blocks, with the elimination (or, at least, reduction) of trade barriers between the members of the block. This may attract more economic activity for the whole block, which is commonly composed by adjacent countries.

Until now we presented a simple procedure to identify the components that contribute to the level of economic centrality of each country. An obvious shortcoming of the method presented is nevertheless the fact that considering the equal distribution of economic activity across all countries as reference is not a realistic assumption since the countries differ substantially in spatial terms. In fact, an equal distribution presupposes that a country as small as Luxembourg should locate the same share of economic activity as a much larger country as China. This can only be accepted as a first approximation. In order to overcome this problem, we suggest an adjustment to the baseline decomposition method in which, instead of using as reference, we consider the share of each country in spatial terms. This can be seen as a topographic adaptation, somewhat in line with the approach followed by Brülhart and Traeger (2005) to measure the level of specialization. This new version can be therefore expressed as:

(4)

in which and are the shares of the internal distances of and in the sum of all the internal distances, respectively.

Component is similar to in equation (3) but instead of we assume as reference the share of in terms of its internal distance (), which means that we are using internal distance as a proxy for area. Considering , we can verify that, in , the countries are ranked according with the excess they exhibit vis-à-vis their share in spatial terms. A positive value is thus obtained when the country captures a higher proportion of economic activity than that it has in terms of area. The interpretation of is also different from in equation (3). Now, the distances to the remaining countries are not equally weighted. Instead, each destination country is weighted by . Finally, evaluates the geographical adjusted external economic effect. This component assumes a positive value if the countries closer to have a higher share of economic activity than they have in spatial terms.

**3. An Empirical Example**

In order to illustrate the method discussed in the previous section, we calculate the centrality level for a group of 171 countries. Using data from World Bank, we consider information on GDP for 2011. Internal and external distances are obtained from CEPII. Thus, the following methodological options are considered: (i) geodesic distances; (ii) external distances between the largest cities; (iii) internal distances calculated as (Mayer and Zignago, 2011). Table 1 shows the aggregate centrality index () for each of these countries.

[Insert Table 1 here]

Let us retain four main results from this evidence. First, there is an accentuated difference between the centrality levels of the most central countries and the remaining ones. In fact, only the sixth first countries exhibit a centrality index above 70% of the maximum value (Belgium). Second, in aggregate terms, it is evident a much central position of the countries of the north hemisphere. Third, Europe clearly shows the most favorable situation in what regards proximity to the markets, with seven countries in the best 10 (and 24 in the best 30) of the index. Fourth, Africa and Oceania show the worst positions in terms of centrality, being penalized in their capacity to reach the markets.

The next step of our empirical example is to decompose the aggregate index aiming to verify the sources of centrality/peripherality in each specific case. The evidence is also shown in Table 1. Several interesting conclusions can be highlighted. The central idea to keep in mind is the fact that a high/low centrality level can be the derived from very distinct sources. Regarding component we verify, obviously, that the smallest countries register the highest values, meaning that the same amount of economic activity located in a more confined space corresponds to a better access to that economic activity and therefore a higher level of centrality. A second and very important source of centrality is the internal economic component. Considering, more specifically, the component we verify that the countries with the highest scores are, in this order: USA, China, Japan, Germany, France, UK, and Brazil. This group contains some of the most powerful economic countries, all of them members of the G20. As we emphasize above, component is critical to understand the concept of centrality, indicating the proximity to all the other countries. This proximity has an exclusive geographic dimension. The five countries that benefit the most from their location are from Africa (Republic of Congo and Democratic Republic of Congo) and Europe (Slovakia, Austria, Croatia, and Hungary). Finally, component corresponds to the external economic component representing the degree by which a significant amount of economic activity locates close to the country under study. In this regard, Belgium, Canada, Netherlands, Luxembourg, and Korea constitute the group at the top of the classification.

The best way to make clear the crucial idea that the sources of centrality are very different is by providing a classification of the different countries according to the specific combination they show in the main components that contribute to their centrality score. Four criteria are used, leading to a total of 16 possible combinations:

(i) above or below average . The case of occurs for the smallest countries, while for the largest countries.

(ii) with a positive or negative value. occurs when the country capture a proportion of total GDP above that associated with an equal distribution by all countries. In the opposite case, takes a negative value.

(iii) above or below average . occurs in the case of the countries that benefit the most from their geographical position, i.e., that, in a pure geographical sense, are closer to the markets. Countries that locate far away from the markets have .

(iv) with a positive or negative value. occurs if there is a concentration of economic activity in countries close to the country under consideration. corresponds to the case in which the largest part of economic activity is located far from the country considered.

Additionally, in order to establish the association between and the four components mentioned, the names of the countries are presented:

1. In bold and with an \* if (see Table 1);
2. In bold if ;
3. With an \* if ;
4. Without any specific mention in the remaining cases.

The results from this exercise are presented in Table 2.

[Insert Table 2 here]

While Table 3 explores in a qualitative way the results emerging from the decomposition method discussed, a quantitative analysis is also important, aiming to provide a more comprehensive perspective on the centrality sources. That analysis was already initiated in Table 1 but we can now move forward, exploring those results further (Table 3).

[Insert Table 3 here]

The column (1) of Table 3 compares the centrality level of each country with the mean value in relative terms. The first four countries exhibit a centrality level above 200% of the mean of the 171 countries. Belgium and Netherlands – the two countries at the top of the ranking – have values corresponding to 283.8% and 275.5% above the mean of . The results also show that the first 16 countries in the centrality ranking present a value that exceeds the mean in more than 100%. The case of Bahamas, 54th of the ranking corresponds exactly to the mean while 117 countries have with a negative gap vis-à-vis .

How much of the differentials in the centrality index should be attributed to the differentials founded in each specific component? The answer to this question is provided in columns (2) to (5) of Table 3. Let us consider the case of Luxembourg (ranked 3rd as regards ) as example. The positive gap from the average revealed by this country is due to its favorable situation in , , and . The first is explained by its small dimension in geographical terms, the case of by its central position regarding the remaining countries, namely its proximity to several markets of central Europe and the case of by the fact that some economically important countries are located close to Luxembourg. The advantage in is the most relevant in the explanation of the overall performance of the country in terms of centrality, accounting for 69.0% of the gap. On the negative side, Luxembourg shows an insufficient result regarding the internal economic component . Looking for the results in a broader perspective, we can easily infer the strong heterogeneity among the distinct countries in what concerns the components that contribute the most for their centrality score.

The empirical analysis conducted so far only considered the decomposition that assumes as reference an equal distribution by all countries. However, as we discussed in section 2, it is interesting to contrast the results from this case with the ones emerging from an analysis in which the spatial dimension of each country is taken as reference. This analysis was also developed in this study, following equation (4). The full range of results cannot be presented here due to space restrains but the classification of the countries according with criteria similar to those above discussed (with the necessary adaptation in terms of interpretation) is presented in Table 4.[[2]](#footnote-2)

[Insert Table 4 here]

In this case, we only consider three components, namely , , and . Regarding the classification according with , we follow the procedure already used in Table 2. Of course, the results show significant differences when compared with the first decomposition method above reported. This derives directly from the concept inherent to each one of the decomposition methods proposed in this study (equations (3) and (4)), reinforcing the advantage of their joint consideration.

**4. Final Remarks**

Based on an adjusted version of a standard index of economic centrality, the main contribution of this paper was the proposal of a decomposition method that allows to retain the influence of: (i) factors that are internal or external to the country under study; (ii) economic and geographic aspects. This is an important issue because very different policy interventions can be executed in order to overcome each specific weakness.

Behind the methodological contribution, we provide an empirical illustration considering data for 171 countries. This empirical analysis makes clear that the roots of the centrality level of each country are very different, with positive and negative impacts of both economic and geographical factors. The final centrality score is therefore the net effect of a complex range of causes.

Based on the methodology discussed in this paper, several research avenues can be traced. First, it is important, of course, to extend the empirical exercise in order to improve our knowledge about the level and the sources of economic centrality of the countries. In this context, the analysis over a long-term period is certainly a fruitful way aiming to capture the main historical trends. Second, the existence of studies conducted at regional level for some countries is also useful to deepen our understanding of the phenomenon. Third, some methodological improvements can also be emphasized for future research. Especially important, in our perspective, is the possibility to adjust the decomposition method proposed in this study in order to capture the concept of sectoral centrality. In fact, we may argue that the level of centrality may be very different across sectors, pointing to the interest of obtaining the centrality level of country i in each sector and studying the correspondent determinants. Still at the sectoral level, we can also conceive an extension of the decomposition method that associate centrality not only with the spatial distribution of the sector but also with the distribution of vertically-linked sectors.

Finally, the empirical analysis conducted in the present study should be understood as a preliminary exercise. Its development aimed essentially an illustrative purpose but several refinements (for example regarding the methodological options on the measurement of distance) are welcomed.

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**Table 1:** The centrality index and its four components – 1st method

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |  |  |  |
| 1 | Belgium | 0.00091 | 1.000 | 0.000085 | 0.000018 | 0.000006 | 3.096168 | 0.000413 | 0.000394 |
| 2 | Netherlands | 0.00089 | 0.978 | 0.000076 | 0.000070 | 0.000026 | 2.753691 | 0.000392 | 0.000353 |
| 3 | Luxembourg | 0.00080 | 0.878 | 0.000306 | -0.000262 | -0.000024 | 11.079399 | 0.000407 | 0.000348 |
| 4 | Germany | 0.00072 | 0.793 | 0.000026 | 0.000195 | 0.000206 | 0.942538 | 0.000409 | 0.000093 |
| 5 | UK | 0.00067 | 0.737 | 0.000031 | 0.000160 | 0.000140 | 1.140349 | 0.000330 | 0.000150 |
| 6 | France | 0.00064 | 0.702 | 0.000021 | 0.000116 | 0.000152 | 0.761774 | 0.000358 | 0.000145 |
| 7 | Switzerland | 0.00062 | 0.681 | 0.000077 | 0.000044 | 0.000016 | 2.772799 | 0.000367 | 0.000132 |
| 8 | Macau | 0.00059 | 0.650 | 0.003110 | -0.002772 | -0.000025 | 112.683509 | 0.000245 | 0.000008 |
| 9 | Singapore | 0.00057 | 0.627 | 0.000612 | -0.000193 | -0.000009 | 22.167367 | 0.000159 | -0.000007 |
| 10 | Canada | 0.00054 | 0.588 | 0.000005 | 0.000017 | 0.000098 | 0.178381 | 0.000145 | 0.000368 |
| 11 | Japan | 0.00053 | 0.583 | 0.000025 | 0.000351 | 0.000383 | 0.916640 | 0.000121 | 0.000034 |
| 12 | Slovakia | 0.00052 | 0.567 | 0.000070 | -0.000054 | -0.000021 | 2.544327 | 0.000527 | -0.000026 |
| 13 | Hong Kong | 0.00051 | 0.560 | 0.000470 | -0.000162 | -0.000009 | 17.049785 | 0.000244 | -0.000043 |
| 14 | Czech Rep | 0.00049 | 0.538 | 0.000055 | -0.000028 | -0.000014 | 2.006277 | 0.000408 | 0.000055 |
| 15 | Austria | 0.00049 | 0.535 | 0.000054 | 0.000000 | 0.000000 | 1.945621 | 0.000521 | -0.000088 |
| 16 | Denmark | 0.00048 | 0.525 | 0.000075 | -0.000016 | -0.000006 | 2.714076 | 0.000336 | 0.000084 |
| 17 | Slovenia | 0.00045 | 0.500 | 0.000109 | -0.000097 | -0.000024 | 3.958709 | 0.000452 | -0.000009 |
| 18 | Italy | 0.00045 | 0.499 | 0.000028 | 0.000114 | 0.000111 | 1.026394 | 0.000354 | -0.000042 |
| 19 | Croatia | 0.00043 | 0.476 | 0.000065 | -0.000056 | -0.000024 | 2.369519 | 0.000467 | -0.000043 |
| 20 | Korea | 0.00043 | 0.471 | 0.000049 | 0.000090 | 0.000050 | 1.786298 | 0.000135 | 0.000155 |
| 21 | Ireland | 0.00042 | 0.466 | 0.000059 | -0.000028 | -0.000013 | 2.125196 | 0.000263 | 0.000131 |
| 22 | Hungary | 0.00042 | 0.458 | 0.000051 | -0.000035 | -0.000019 | 1.847201 | 0.000454 | -0.000053 |
| 23 | Poland | 0.00039 | 0.432 | 0.000028 | 0.000006 | 0.000006 | 1.007574 | 0.000373 | -0.000014 |
| 24 | Bosnia & Herzeg | 0.00038 | 0.414 | 0.000069 | -0.000066 | -0.000026 | 2.489175 | 0.000437 | -0.000063 |
| 25 | Norway | 0.00038 | 0.413 | 0.000027 | 0.000007 | 0.000007 | 0.990203 | 0.000288 | 0.000054 |
| 26 | Estonia | 0.00037 | 0.404 | 0.000073 | -0.000069 | -0.000026 | 2.649302 | 0.000372 | -0.000008 |
| 27 | Sweden | 0.00037 | 0.401 | 0.000023 | 0.000007 | 0.000009 | 0.839927 | 0.000319 | 0.000016 |
| 28 | Serbia & Monten | 0.00036 | 0.400 | 0.000049 | -0.000044 | -0.000025 | 1.762634 | 0.000439 | -0.000079 |
| 29 | Spain | 0.00036 | 0.396 | 0.000022 | 0.000052 | 0.000065 | 0.792091 | 0.000266 | 0.000021 |
| 30 | Lithuania | 0.00036 | 0.393 | 0.000061 | -0.000054 | -0.000025 | 2.204823 | 0.000373 | -0.000022 |
| 31 | Latvia | 0.00035 | 0.388 | 0.000061 | -0.000057 | -0.000026 | 2.216926 | 0.000354 | -0.000005 |
| 32 | Belarus | 0.00034 | 0.378 | 0.000034 | -0.000029 | -0.000023 | 1.236579 | 0.000361 | -0.000022 |
| 33 | USA | 0.00034 | 0.376 | 0.000005 | 0.000192 | 0.001052 | 0.182517 | 0.000152 | -0.000007 |
| 34 | Albania | 0.00034 | 0.371 | 0.000092 | -0.000089 | -0.000027 | 3.322971 | 0.000410 | -0.000076 |
| 35 | Macedonia | 0.00033 | 0.368 | 0.000097 | -0.000095 | -0.000027 | 3.513613 | 0.000433 | -0.000101 |
| 36 | Bulgaria | 0.00033 | 0.365 | 0.000047 | -0.000041 | -0.000024 | 1.691144 | 0.000416 | -0.000090 |
| 37 | Finland | 0.00033 | 0.365 | 0.000027 | -0.000010 | -0.000010 | 0.971131 | 0.000358 | -0.000043 |
| 38 | Romania | 0.00033 | 0.360 | 0.000032 | -0.000018 | -0.000016 | 1.153946 | 0.000380 | -0.000066 |
| 39 | Ukraine | 0.00032 | 0.347 | 0.000020 | -0.000011 | -0.000015 | 0.725150 | 0.000331 | -0.000024 |
| 40 | Rep Moldova | 0.00031 | 0.343 | 0.000085 | -0.000083 | -0.000027 | 3.069131 | 0.000350 | -0.000039 |
| 41 | Tunisia | 0.00031 | 0.340 | 0.000038 | -0.000034 | -0.000024 | 1.390625 | 0.000303 | 0.000002 |
| 42 | Portugal | 0.00031 | 0.338 | 0.000051 | -0.000024 | -0.000013 | 1.853618 | 0.000243 | 0.000037 |
| 43 | Malta | 0.00030 | 0.334 | 0.000875 | -0.000856 | -0.000027 | 31.694714 | 0.000305 | -0.000020 |
| 44 | Greece | 0.00030 | 0.330 | 0.000043 | -0.000016 | -0.000010 | 1.552987 | 0.000332 | -0.000058 |
| 45 | Algeria | 0.00030 | 0.328 | 0.000010 | -0.000005 | -0.000013 | 0.365076 | 0.000275 | 0.000018 |
| 46 | Turkey | 0.00029 | 0.322 | 0.000018 | 0.000017 | 0.000027 | 0.637709 | 0.000335 | -0.000076 |
| 47 | China | 0.00026 | 0.283 | 0.000005 | 0.000098 | 0.000539 | 0.182104 | 0.000145 | 0.000010 |
| 48 | Russian Fed | 0.00025 | 0.279 | 0.000004 | 0.000015 | 0.000111 | 0.136347 | 0.000267 | -0.000032 |
| 49 | Morocco | 0.00025 | 0.277 | 0.000018 | -0.000014 | -0.000021 | 0.668254 | 0.000239 | 0.000008 |
| 50 | Lebanon | 0.00025 | 0.271 | 0.000152 | -0.000136 | -0.000025 | 5.511003 | 0.000372 | -0.000142 |
| 51 | Mongolia | 0.00024 | 0.269 | 0.000012 | -0.000012 | -0.000027 | 0.450302 | 0.000148 | 0.000097 |
| 52 | Cyprus | 0.00024 | 0.267 | 0.000162 | -0.000152 | -0.000026 | 5.857821 | 0.000319 | -0.000085 |
| 53 | Iceland | 0.00024 | 0.262 | 0.000048 | -0.000047 | -0.000027 | 1.757089 | 0.000185 | 0.000052 |
| 54 | The Bahamas | 0.00024 | 0.260 | 0.000132 | -0.000129 | -0.000027 | 4.772156 | 0.000172 | 0.000062 |
| 55 | Puerto Rico | 0.00023 | 0.258 | 0.000163 | -0.000122 | -0.000021 | 5.904924 | 0.000234 | -0.000040 |
| 56 | Syrian Arab Rep | 0.00023 | 0.251 | 0.000036 | -0.000030 | -0.000023 | 1.313460 | 0.000369 | -0.000148 |
| 57 | Georgia | 0.00022 | 0.243 | 0.000059 | -0.000057 | -0.000027 | 2.134096 | 0.000288 | -0.000069 |
| 58 | Jordan | 0.00022 | 0.241 | 0.000051 | -0.000047 | -0.000025 | 1.858927 | 0.000321 | -0.000105 |
| 59 | Armenia | 0.00022 | 0.240 | 0.000090 | -0.000088 | -0.000027 | 3.263790 | 0.000290 | -0.000074 |
| 60 | Egypt | 0.00021 | 0.233 | 0.000016 | -0.000006 | -0.000010 | 0.563010 | 0.000276 | -0.000074 |

**Table 1 (cont.):** The centrality index and its four components – 1st method

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |  |  |  |
| 61 | Azerbaijan | 0.00021 | 0.232 | 0.000053 | -0.000044 | -0.000023 | 1.914571 | 0.000253 | -0.000051 |
| 62 | Dominican Rep | 0.00021 | 0.229 | 0.000070 | -0.000060 | -0.000024 | 2.552198 | 0.000226 | -0.000029 |
| 63 | Pakistan | 0.00021 | 0.228 | 0.000017 | -0.000007 | -0.000012 | 0.599627 | 0.000202 | -0.000003 |
| 64 | Kyrgyzstan | 0.00021 | 0.225 | 0.000035 | -0.000034 | -0.000027 | 1.264591 | 0.000226 | -0.000021 |
| 65 | Iraq | 0.00020 | 0.223 | 0.000024 | -0.000011 | -0.000013 | 0.852224 | 0.000252 | -0.000061 |
| 66 | Haiti | 0.00020 | 0.221 | 0.000093 | -0.000092 | -0.000027 | 3.382197 | 0.000217 | -0.000018 |
| 67 | Jamaica | 0.00020 | 0.217 | 0.000148 | -0.000143 | -0.000027 | 5.374174 | 0.000195 | -0.000002 |
| 68 | India | 0.00020 | 0.215 | 0.000009 | 0.000031 | 0.000099 | 0.310736 | 0.000189 | -0.000032 |
| 69 | Uzbekistan | 0.00020 | 0.215 | 0.000023 | -0.000020 | -0.000024 | 0.842330 | 0.000226 | -0.000033 |
| 70 | Tajikistan | 0.00019 | 0.214 | 0.000041 | -0.000040 | -0.000027 | 1.489423 | 0.000224 | -0.000030 |
| 71 | Nepal | 0.00019 | 0.214 | 0.000041 | -0.000039 | -0.000026 | 1.468603 | 0.000188 | 0.000004 |
| 72 | Kazakhstan | 0.00019 | 0.213 | 0.000009 | -0.000005 | -0.000014 | 0.341792 | 0.000217 | -0.000027 |
| 73 | Vietnam | 0.00019 | 0.211 | 0.000027 | -0.000017 | -0.000018 | 0.979133 | 0.000173 | 0.000010 |
| 74 | St. Kitts & Nevis | 0.00019 | 0.209 | 0.000948 | -0.000946 | -0.000028 | 34.352177 | 0.000300 | -0.000111 |
| 75 | Turkmenistan | 0.00019 | 0.209 | 0.000022 | -0.000020 | -0.000025 | 0.806447 | 0.000221 | -0.000032 |
| 76 | Antigua & Barbuda | 0.00019 | 0.207 | 0.000740 | -0.000737 | -0.000028 | 26.799039 | 0.000305 | -0.000119 |
| 77 | Bhutan | 0.00019 | 0.206 | 0.000072 | -0.000072 | -0.000027 | 2.609422 | 0.000187 | 0.000000 |
| 78 | Bangladesh | 0.00019 | 0.205 | 0.000041 | -0.000029 | -0.000020 | 1.484746 | 0.000181 | -0.000007 |
| 79 | Mexico | 0.00018 | 0.200 | 0.000011 | 0.000021 | 0.000053 | 0.401703 | 0.000132 | 0.000017 |
| 80 | Trinidad & Tobago | 0.00018 | 0.199 | 0.000217 | -0.000204 | -0.000026 | 7.866323 | 0.000267 | -0.000098 |
| 81 | Dominica | 0.00018 | 0.199 | 0.000567 | -0.000567 | -0.000028 | 20.559399 | 0.000307 | -0.000127 |
| 82 | Philippines | 0.00018 | 0.198 | 0.000028 | -0.000011 | -0.000010 | 1.028655 | 0.000141 | 0.000022 |
| 83 | Benin | 0.00018 | 0.198 | 0.000046 | -0.000045 | -0.000027 | 1.678877 | 0.000348 | -0.000168 |
| 84 | Lao People Dem Rep | 0.00018 | 0.197 | 0.000032 | -0.000031 | -0.000027 | 1.157816 | 0.000178 | 0.000001 |
| 85 | Venezuela | 0.00018 | 0.196 | 0.000016 | -0.000001 | -0.000001 | 0.589997 | 0.000215 | -0.000052 |
| 86 | St. Lucia | 0.00018 | 0.196 | 0.000626 | -0.000624 | -0.000028 | 22.682336 | 0.000337 | -0.000160 |
| 87 | El Salvador | 0.00018 | 0.195 | 0.000107 | -0.000101 | -0.000026 | 3.884161 | 0.000218 | -0.000047 |
| 88 | Thailand | 0.00018 | 0.194 | 0.000022 | -0.000002 | -0.000002 | 0.786544 | 0.000173 | -0.000016 |
| 89 | Guatemala | 0.00018 | 0.194 | 0.000047 | -0.000041 | -0.000024 | 1.707413 | 0.000197 | -0.000026 |
| 90 | St. Vincent & Grenad | 0.00018 | 0.194 | 0.000788 | -0.000787 | -0.000028 | 28.566404 | 0.000340 | -0.000165 |
| 91 | Grenada | 0.00018 | 0.194 | 0.000837 | -0.000835 | -0.000028 | 30.333380 | 0.000308 | -0.000133 |
| 92 | Honduras | 0.00017 | 0.192 | 0.000046 | -0.000044 | -0.000026 | 1.682871 | 0.000217 | -0.000044 |
| 93 | Malaysia | 0.00017 | 0.188 | 0.000027 | -0.000007 | -0.000007 | 0.981144 | 0.000162 | -0.000011 |
| 94 | Panama | 0.00017 | 0.186 | 0.000057 | -0.000051 | -0.000025 | 2.048479 | 0.000187 | -0.000022 |
| 95 | Costa Rica | 0.00017 | 0.186 | 0.000069 | -0.000061 | -0.000024 | 2.492998 | 0.000192 | -0.000031 |
| 96 | Nicaragua | 0.00017 | 0.185 | 0.000043 | -0.000042 | -0.000027 | 1.558628 | 0.000210 | -0.000042 |
| 97 | Cambodia | 0.00017 | 0.183 | 0.000037 | -0.000035 | -0.000027 | 1.324187 | 0.000168 | -0.000002 |
| 98 | Mauritania | 0.00016 | 0.180 | 0.000015 | -0.000015 | -0.000027 | 0.554963 | 0.000233 | -0.000069 |
| 99 | Colombia | 0.00016 | 0.178 | 0.000015 | -0.000001 | -0.000002 | 0.527285 | 0.000178 | -0.000029 |
| 100 | Niger | 0.00016 | 0.177 | 0.000014 | -0.000014 | -0.000027 | 0.500544 | 0.000252 | -0.000092 |
| 101 | Togo | 0.00016 | 0.177 | 0.000065 | -0.000065 | -0.000027 | 2.364360 | 0.000328 | -0.000168 |
| 102 | Burkina Faso | 0.00016 | 0.173 | 0.000030 | -0.000029 | -0.000027 | 1.075962 | 0.000256 | -0.000099 |
| 103 | Senegal | 0.00016 | 0.172 | 0.000035 | -0.000034 | -0.000027 | 1.270293 | 0.000271 | -0.000115 |
| 104 | Cape Verde | 0.00016 | 0.171 | 0.000245 | -0.000244 | -0.000027 | 8.871891 | 0.000204 | -0.000050 |
| 105 | Sudan | 0.00016 | 0.171 | 0.000010 | -0.000008 | -0.000024 | 0.355923 | 0.000226 | -0.000072 |
| 106 | Mali | 0.00016 | 0.170 | 0.000014 | -0.000014 | -0.000027 | 0.505935 | 0.000245 | -0.000090 |
| 107 | The Gambia | 0.00015 | 0.170 | 0.000146 | -0.000146 | -0.000028 | 5.301359 | 0.000286 | -0.000131 |
| 108 | Guyana | 0.00015 | 0.170 | 0.000034 | -0.000033 | -0.000027 | 1.215182 | 0.000205 | -0.000050 |
| 109 | Brunei Darussalam | 0.00015 | 0.169 | 0.000205 | -0.000196 | -0.000026 | 7.420459 | 0.000140 | 0.000005 |
| 110 | Chad | 0.00015 | 0.169 | 0.000014 | -0.000013 | -0.000027 | 0.497218 | 0.000234 | -0.000080 |
| 111 | Nigeria | 0.00015 | 0.169 | 0.000016 | -0.000006 | -0.000010 | 0.586204 | 0.000325 | -0.000182 |
| 112 | Rep Congo | 0.00015 | 0.168 | 0.000027 | -0.000026 | -0.000027 | 0.963424 | 0.000778 | -0.000626 |
| 113 | Eritrea | 0.00015 | 0.168 | 0.000045 | -0.000044 | -0.000027 | 1.617574 | 0.000225 | -0.000073 |
| 114 | Ghana | 0.00015 | 0.167 | 0.000032 | -0.000029 | -0.000025 | 1.153591 | 0.000291 | -0.000142 |
| 115 | Guinea-Bissau | 0.00015 | 0.166 | 0.000082 | -0.000082 | -0.000028 | 2.964330 | 0.000277 | -0.000126 |
| 116 | Suriname | 0.00015 | 0.165 | 0.000038 | -0.000038 | -0.000027 | 1.392024 | 0.000190 | -0.000040 |
| 117 | Yemen | 0.00015 | 0.165 | 0.000021 | -0.000019 | -0.000025 | 0.761623 | 0.000212 | -0.000063 |
| 118 | Ecuador | 0.00015 | 0.164 | 0.000030 | -0.000023 | -0.000022 | 1.072999 | 0.000159 | -0.000016 |
| 119 | Equat Guinea | 0.00015 | 0.162 | 0.000093 | -0.000089 | -0.000026 | 3.364002 | 0.000274 | -0.000131 |
| 120 | Guinea | 0.00015 | 0.161 | 0.000031 | -0.000031 | -0.000027 | 1.136290 | 0.000259 | -0.000113 |

**Table 1(cont.):** The centrality index and its four components – 1st method

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |  |  |  |
| 121 | Dem Rep Congo | 0.00015 | 0.161 | 0.000010 | -0.000010 | -0.000026 | 0.367893 | 0.000778 | -0.000632 |
| 122 | Uruguay | 0.00015 | 0.161 | 0.000037 | -0.000033 | -0.000024 | 1.342175 | 0.000145 | -0.000004 |
| 123 | Sierra Leone | 0.00015 | 0.160 | 0.000057 | -0.000057 | -0.000027 | 2.080662 | 0.000255 | -0.000110 |
| 124 | Côte d'Ivoire | 0.00015 | 0.160 | 0.000027 | -0.000026 | -0.000026 | 0.992180 | 0.000249 | -0.000106 |
| 125 | Sri Lanka | 0.00014 | 0.158 | 0.000061 | -0.000052 | -0.000024 | 2.199608 | 0.000156 | -0.000021 |
| 126 | Indonesia | 0.00014 | 0.158 | 0.000011 | 0.000013 | 0.000033 | 0.405173 | 0.000132 | -0.000013 |
| 127 | Liberia | 0.00014 | 0.157 | 0.000047 | -0.000046 | -0.000027 | 1.688294 | 0.000238 | -0.000096 |
| 128 | Cameroon | 0.00014 | 0.156 | 0.000023 | -0.000021 | -0.000026 | 0.817112 | 0.000264 | -0.000123 |
| 129 | Ethiopia | 0.00014 | 0.154 | 0.000015 | -0.000013 | -0.000025 | 0.530694 | 0.000215 | -0.000076 |
| 130 | Central Afric Rep | 0.00014 | 0.152 | 0.000020 | -0.000020 | -0.000027 | 0.713825 | 0.000233 | -0.000095 |
| 131 | S. Tomé & Príncipe | 0.00014 | 0.151 | 0.000501 | -0.000500 | -0.000028 | 18.146463 | 0.000258 | -0.000121 |
| 132 | Palau | 0.00014 | 0.151 | 0.000705 | -0.000704 | -0.000028 | 25.530890 | 0.000118 | 0.000019 |
| 133 | Gabon | 0.00014 | 0.151 | 0.000030 | -0.000029 | -0.000026 | 1.089013 | 0.000265 | -0.000129 |
| 134 | Maldives | 0.00013 | 0.148 | 0.000901 | -0.000896 | -0.000027 | 32.637904 | 0.000156 | -0.000027 |
| 135 | Paraguay | 0.00013 | 0.147 | 0.000024 | -0.000023 | -0.000026 | 0.883416 | 0.000134 | -0.000002 |
| 136 | Brazil | 0.00013 | 0.144 | 0.000005 | 0.000025 | 0.000127 | 0.193115 | 0.000133 | -0.000032 |
| 137 | Uganda | 0.00013 | 0.143 | 0.000032 | -0.000030 | -0.000026 | 1.147592 | 0.000233 | -0.000105 |
| 138 | Rwanda | 0.00013 | 0.141 | 0.000096 | -0.000094 | -0.000027 | 3.471674 | 0.000252 | -0.000126 |
| 139 | Peru | 0.00013 | 0.139 | 0.000014 | -0.000007 | -0.000014 | 0.496984 | 0.000132 | -0.000012 |
| 140 | Kenya | 0.00013 | 0.139 | 0.000020 | -0.000018 | -0.000025 | 0.738122 | 0.000219 | -0.000095 |
| 141 | Burundi | 0.00013 | 0.138 | 0.000093 | -0.000093 | -0.000027 | 3.377089 | 0.000246 | -0.000122 |
| 142 | Bolivia | 0.00012 | 0.136 | 0.000015 | -0.000014 | -0.000026 | 0.537544 | 0.000135 | -0.000012 |
| 143 | Angola | 0.00012 | 0.136 | 0.000014 | -0.000010 | -0.000020 | 0.504603 | 0.000215 | -0.000095 |
| 144 | Argentina | 0.00012 | 0.135 | 0.000009 | 0.000002 | 0.000005 | 0.338715 | 0.000146 | -0.000034 |
| 145 | Seychelles | 0.00012 | 0.130 | 0.000729 | -0.000727 | -0.000028 | 26.413423 | 0.000166 | -0.000049 |
| 146 | Tanzania | 0.00012 | 0.130 | 0.000016 | -0.000015 | -0.000026 | 0.579554 | 0.000206 | -0.000088 |
| 147 | F.S Micronesia | 0.00012 | 0.129 | 0.000585 | -0.000584 | -0.000028 | 21.189502 | 0.000107 | 0.000010 |
| 148 | Chile | 0.00012 | 0.129 | 0.000018 | -0.000006 | -0.000009 | 0.647587 | 0.000117 | -0.000012 |
| 149 | East Timor | 0.00012 | 0.128 | 0.000127 | -0.000127 | -0.000028 | 4.619729 | 0.000114 | 0.000002 |
| 150 | Comoros | 0.00011 | 0.124 | 0.000360 | -0.000360 | -0.000028 | 13.056915 | 0.000189 | -0.000077 |
| 151 | Malawi | 0.00011 | 0.123 | 0.000045 | -0.000045 | -0.000027 | 1.636818 | 0.000208 | -0.000096 |
| 152 | Zambia | 0.00011 | 0.123 | 0.000018 | -0.000017 | -0.000026 | 0.649448 | 0.000211 | -0.000099 |
| 153 | Mauritius | 0.00011 | 0.122 | 0.000344 | -0.000335 | -0.000027 | 12.459012 | 0.000147 | -0.000045 |
| 154 | Zimbabwe | 0.00011 | 0.121 | 0.000025 | -0.000024 | -0.000027 | 0.901314 | 0.000210 | -0.000100 |
| 155 | Marshall Islands | 0.00011 | 0.119 | 0.001156 | -0.001155 | -0.000028 | 41.878498 | 0.000107 | 0.000001 |
| 156 | Namibia | 0.00011 | 0.119 | 0.000017 | -0.000017 | -0.000027 | 0.620108 | 0.000177 | -0.000069 |
| 157 | South Africa | 0.00011 | 0.119 | 0.000014 | -0.000001 | -0.000001 | 0.510113 | 0.000152 | -0.000057 |
| 158 | Papua New Guinea | 0.00011 | 0.118 | 0.000023 | -0.000022 | -0.000027 | 0.828161 | 0.000106 | 0.000000 |
| 159 | Botswana | 0.00011 | 0.117 | 0.000020 | -0.000019 | -0.000027 | 0.727143 | 0.000195 | -0.000089 |
| 160 | Swaziland | 0.00011 | 0.116 | 0.000118 | -0.000117 | -0.000027 | 4.275683 | 0.000219 | -0.000114 |
| 161 | Madagascar | 0.00010 | 0.115 | 0.000020 | -0.000020 | -0.000027 | 0.735353 | 0.000167 | -0.000063 |
| 162 | Lesotho | 0.00010 | 0.114 | 0.000089 | -0.000089 | -0.000027 | 3.233816 | 0.000183 | -0.000080 |
| 163 | Mozambique | 0.00010 | 0.114 | 0.000017 | -0.000017 | -0.000027 | 0.629295 | 0.000214 | -0.000112 |
| 164 | Kiribati | 0.00010 | 0.113 | 0.000581 | -0.000580 | -0.000028 | 21.041219 | 0.000109 | -0.000006 |
| 165 | Solomon Islands | 0.00010 | 0.112 | 0.000090 | -0.000090 | -0.000028 | 3.264612 | 0.000108 | -0.000007 |
| 166 | Australia | 0.00010 | 0.111 | 0.000006 | 0.000016 | 0.000077 | 0.203215 | 0.000092 | -0.000012 |
| 167 | Samoa | 0.00009 | 0.104 | 0.000292 | -0.000291 | -0.000028 | 10.568623 | 0.000114 | -0.000020 |
| 168 | Vanuatu | 0.00009 | 0.104 | 0.000128 | -0.000128 | -0.000028 | 4.637063 | 0.000111 | -0.000016 |
| 169 | Tuvalu | 0.00009 | 0.104 | 0.003049 | -0.003049 | -0.000028 | 110.495263 | 0.000105 | -0.000011 |
| 170 | Fiji | 0.00009 | 0.100 | 0.000115 | -0.000114 | -0.000027 | 4.161152 | 0.000107 | -0.000018 |
| 171 | Tonga | 0.00009 | 0.096 | 0.000568 | -0.000568 | -0.000028 | 20.600590 | 0.000097 | -0.000010 |
|  | Average | 0.00024 |  | 0.000157 | -0.000133 | 0.000000 | 5.705117 | 0.000251 | -0.000039 |

**Table 2:** Countries’ typology according to the four components – 1st method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | |  | |  | |
|  |  |  |  |
|  |  | **Canada**, China\*, **Japan**, Korea\*, Mexico | **Belgium**\*, **Switzerland**,  **Germany**\*, Spain\*, **France**, **UK**, **Netherlands**\*, Norway\*, Sweden\* |  |  |
|  | Argentina, Australia,  Brazil, Indonesia,  India, USA\* | Italy\*, Poland\*, Russian Fed\*, Turkey\* |  |  |
|  |  | The Bahamas\*, Iceland\*, Lao People Dem Rep, Morocco\*, Mongolia\*, Nepal, Philippines, Papua New Guinea, Portugal\*, East Timor, Vietnam | **Czech Rep**,  **Denmark**, Algeria\*, Ireland\*, Tunisia\* | Brunei Darussalam, F.S. Micronesia, **Macau**, Marshall Islands, Palau | **Luxembourg**\* |
|  | Angola, Burundi, Bangladesh, Bolivia, Bhutan, Botswana, Central Afric Rep, Chile, Côte d'Ivoire, Colombia, Costa Rica, Dominican Rep, Ecuador, Eritrea, Ethiopia, Fiji, Guatemala, Guyana, Honduras, Haiti, Jamaica, Kazakhstan, Kenya, Kyrgyzstan, Cambodia, Liberia, Sri Lanka, Lesotho, Madagascar, Mali, Mozambique, Mauritania, Malawi, Malaysia, Namibia, Nicaragua, Pakistan, Panama, Peru, Paraguay, Sudan, Solomon Islands, El Salvador, Suriname, Swaziland, Chad, Thailand, Tajikistan, Turkmenistan, Tanzania, Uganda, Uruguay, Uzbekistan, Venezuela, Vanuatu, Yemen, South Africa, Zambia, Zimbabwe | Albania\*, Armenia,  **Austria**, Azerbaijan,  Benin, Burkina Faso,  Bulgaria\*, Bosnia & Herzeg\*, Belarus\*, Cameroon,  Dem Rep Congo, Rep Congo, Egypt, Estonia\*, Finland\*, Gabon, Georgia, Ghana, Guinea, The Gambia, Guinea-Bissau, Equat Guinea, Greece\*, Croatia\*, Hungary\*, Iraq, Jordan, Lebanon\*, Lithuania\*, Latvia\*, Rep Moldova\*, Macedonia\*, Niger,  Nigeria, Romania\*, Rwanda, Senegal,  Sierra Leone, **Slovakia**, Slovenia\*, Syrian Arab Republic\*, Togo, Ukraine\*, Serbia & Monten\* | Comoros, Cape Verde, **Hong Kong**, Kiribati, Maldives, Mauritius, Puerto Rico\*, **Singapore**, Seychelles, Tonga, Tuvalu, Samoa | Antigua & Barbuda, Cyprus\*, Dominica, Grenada, St. Kitts & Nevis, St. Lucia, Malta\*,  S. Tomé & Príncipe, Trinidad & Tobago, St. Vincent & Grenad |

**Table 3:** Contribution of the four components to the centrality index – 1st method

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |
|  |  | (1) | (2) | (3) | (4) | (5) |
| 1 | Belgium | 283.8 | -10.7 | 22.3 | 24.0 | 64.4 |
| 2 | Netherlands | 275.5 | -12.5 | 31.1 | 21.4 | 60.0 |
| 3 | Luxembourg | 236.8 | 26.4 | -23.1 | 27.7 | 69.0 |
| 4 | Germany | 204.4 | -27.1 | 67.5 | 32.4 | 27.2 |
| 5 | UK | 182.9 | -29.0 | 67.4 | 18.0 | 43.7 |
| 6 | France | 169.5 | -33.9 | 61.8 | 26.4 | 45.7 |
| 7 | Switzerland | 161.3 | -21.1 | 46.2 | 30.2 | 44.7 |
| 8 | Macau | 149.4 | 833.0 | -744.6 | -1.7 | 13.3 |
| 9 | Singapore | 140.8 | 136.1 | -17.9 | -27.7 | 9.6 |
| 10 | Canada | 125.8 | -51.1 | 50.3 | -35.6 | 136.4 |
| 11 | Japan | 123.8 | -45.0 | 164.6 | -44.5 | 24.9 |
| 12 | Slovakia | 117.7 | -31.2 | 28.1 | 98.5 | 4.6 |
| 13 | Hong Kong | 115.1 | 114.7 | -10.6 | -2.6 | -1.5 |
| 14 | Czech Rep | 106.4 | -40.5 | 41.3 | 61.9 | 37.2 |
| 15 | Austria | 105.2 | -41.6 | 53.1 | 108.0 | -19.5 |
| 16 | Denmark | 101.7 | -34.2 | 48.3 | 35.1 | 50.9 |
| 17 | Slovenia | 91.8 | -22.1 | 16.4 | 91.9 | 13.8 |
| 18 | Italy | 91.4 | -59.6 | 113.8 | 47.3 | -1.5 |
| 19 | Croatia | 82.6 | -47.0 | 39.0 | 110.1 | -2.1 |
| 20 | Korea | 80.9 | -56.4 | 115.8 | -60.5 | 101.0 |
| 21 | Ireland | 79.0 | -52.7 | 55.9 | 6.0 | 90.9 |
| 22 | Hungary | 75.9 | -59.1 | 54.2 | 112.4 | -7.5 |
| 23 | Poland | 66.0 | -82.9 | 88.7 | 77.8 | 16.4 |
| 24 | Bosnia & Herzeg | 58.9 | -63.5 | 47.9 | 132.9 | -17.2 |
| 25 | Norway | 58.6 | -93.6 | 100.3 | 26.6 | 66.8 |
| 26 | Estonia | 55.2 | -64.4 | 48.5 | 92.2 | 23.7 |
| 27 | Sweden | 53.9 | -105.0 | 109.3 | 52.4 | 43.2 |
| 28 | Serbia & Monten | 53.7 | -85.4 | 69.9 | 146.9 | -31.4 |
| 29 | Spain | 51.9 | -110.1 | 149.6 | 12.0 | 48.5 |
| 30 | Lithuania | 50.7 | -80.4 | 65.1 | 101.3 | 14.0 |
| 31 | Latvia | 48.8 | -83.1 | 65.4 | 88.1 | 29.6 |
| 32 | Belarus | 45.2 | -115.0 | 96.9 | 102.1 | 16.0 |
| 33 | USA | 44.3 | -145.1 | 309.1 | -94.7 | 30.8 |
| 34 | Albania | 42.2 | -65.6 | 43.9 | 158.2 | -36.5 |
| 35 | Macedonia | 41.1 | -62.0 | 39.0 | 186.0 | -63.0 |
| 36 | Bulgaria | 40.0 | -116.9 | 96.9 | 173.5 | -53.6 |
| 37 | Finland | 39.9 | -138.0 | 129.4 | 112.8 | -4.2 |
| 38 | Romania | 38.0 | -139.2 | 126.7 | 142.1 | -29.5 |
| 39 | Ukraine | 33.2 | -174.7 | 154.3 | 101.3 | 19.0 |
| 40 | Rep Moldova | 31.8 | -96.4 | 65.6 | 130.1 | 0.8 |
| 41 | Tunisia | 30.5 | -164.6 | 136.4 | 70.8 | 57.5 |
| 42 | Portugal | 29.6 | -151.2 | 154.4 | -12.2 | 108.9 |
| 43 | Malta | 28.2 | 1071.7 | -1080.3 | 79.6 | 29.0 |
| 44 | Greece | 26.5 | -182.4 | 185.3 | 127.3 | -30.2 |
| 45 | Algeria | 25.8 | -240.5 | 208.5 | 38.0 | 94.0 |
| 46 | Turkey | 23.5 | -250.9 | 268.6 | 149.1 | -66.8 |
| 47 | China | 8.7 | -738.5 | 1118.0 | -516.7 | 237.2 |
| 48 | Russian Fed | 7.1 | -909.6 | 874.7 | 90.2 | 44.7 |
| 49 | Morocco | 6.2 | -949.3 | 810.2 | -84.8 | 323.9 |
| 50 | Lebanon | 4.0 | -56.4 | -33.3 | 1273.7 | -1084.0 |
| 51 | Mongolia | 3.2 | -1883.3 | 1565.2 | -1345.9 | 1764.0 |
| 52 | Cyprus | 2.4 | 72.6 | -340.5 | 1162.8 | -794.9 |
| 53 | Iceland | 0.6 | -7106.1 | 5595.5 | -4359.0 | 5969.6 |
| 54 | The Bahamas | 0.0 | 44437.8 | -6232.2 | 136790.1 | -174895.7 |
| 55 | Puerto Rico | -1.1 | -210.9 | -418.1 | 686.4 | 42.6 |
| 56 | Syrian Arab Rep | -3.7 | 1367.9 | -1163.0 | -1331.7 | 1226.8 |
| 57 | Georgia | -6.7 | 620.6 | -479.0 | -232.0 | 190.4 |
| 58 | Jordan | -7.3 | 612.9 | -492.7 | -401.7 | 381.5 |
| 59 | Armenia | -7.8 | 363.8 | -241.8 | -210.2 | 188.3 |
| 60 | Egypt | -10.6 | 562.3 | -503.5 | -97.5 | 138.7 |

Note: Columns (1) to (5) are in percentage.

**Table 3 (cont.):** Contribution of the four components to the centrality index – 1st method

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |
|  |  | (1) | (2) | (3) | (4) | (5) |
| 61 | Azerbaijan | -10.9 | 404.0 | -342.4 | -5.6 | 44.0 |
| 62 | Dominican Rep | -12.3 | 298.9 | -249.2 | 86.6 | -36.2 |
| 63 | Pakistan | -12.5 | 476.9 | -425.2 | 169.2 | -120.9 |
| 64 | Kyrgyzstan | -13.5 | 381.8 | -306.2 | 80.3 | -55.8 |
| 65 | Iraq | -14.3 | 396.0 | -359.1 | -2.7 | 65.8 |
| 66 | Haiti | -15.1 | 179.1 | -114.9 | 95.9 | -60.1 |
| 67 | Jamaica | -16.5 | 23.3 | 26.0 | 144.9 | -94.2 |
| 68 | India | -17.4 | 361.6 | -397.0 | 152.5 | -17.0 |
| 69 | Uzbekistan | -17.7 | 320.4 | -268.2 | 61.8 | -13.9 |
| 70 | Tajikistan | -17.9 | 273.8 | -217.1 | 65.5 | -22.2 |
| 71 | Nepal | -18.0 | 273.7 | -220.2 | 147.5 | -101.0 |
| 72 | Kazakhstan | -18.1 | 345.7 | -298.8 | 80.7 | -27.6 |
| 73 | Vietnam | -19.0 | 289.0 | -255.2 | 174.5 | -108.3 |
| 74 | St. Kitts & Nevis | -19.7 | -1690.7 | 1740.0 | -103.4 | 154.2 |
| 75 | Turkmenistan | -19.8 | 287.7 | -238.9 | 65.7 | -14.6 |
| 76 | Antigua & Barbuda | -20.6 | -1189.6 | 1235.9 | -108.6 | 162.4 |
| 77 | Bhutan | -21.0 | 171.3 | -122.2 | 128.7 | -77.8 |
| 78 | Bangladesh | -21.5 | 228.6 | -203.1 | 138.6 | -64.1 |
| 79 | Mexico | -23.3 | 264.8 | -278.8 | 216.5 | -102.5 |
| 80 | Trinidad & Tobago | -23.5 | -107.0 | 128.3 | -27.2 | 106.0 |
| 81 | Dominica | -23.8 | -727.2 | 770.0 | -99.0 | 156.2 |
| 82 | Philippines | -24.1 | 225.7 | -213.3 | 193.7 | -106.1 |
| 83 | Benin | -24.1 | 194.2 | -152.4 | -167.9 | 226.0 |
| 84 | Lao People Dem Rep | -24.2 | 218.7 | -176.7 | 128.7 | -70.6 |
| 85 | Venezuela | -24.7 | 241.2 | -225.3 | 62.2 | 21.9 |
| 86 | St. Lucia | -24.9 | -793.5 | 832.4 | -144.4 | 205.5 |
| 87 | El Salvador | -25.2 | 84.2 | -53.3 | 56.2 | 12.9 |
| 88 | Thailand | -25.4 | 224.9 | -216.6 | 130.3 | -38.6 |
| 89 | Guatemala | -25.5 | 182.6 | -151.4 | 89.8 | -21.0 |
| 90 | St. Vincent & Grenad | -25.5 | -1041.5 | 1080.2 | -146.9 | 208.2 |
| 91 | Grenada | -25.7 | -1114.8 | 1152.8 | -92.1 | 154.1 |
| 92 | Honduras | -26.4 | 177.3 | -141.0 | 55.7 | 8.0 |
| 93 | Malaysia | -27.9 | 197.3 | -190.8 | 135.5 | -42.0 |
| 94 | Panama | -28.6 | 149.0 | -119.9 | 95.9 | -24.9 |
| 95 | Costa Rica | -28.8 | 129.9 | -104.9 | 86.6 | -11.6 |
| 96 | Nicaragua | -29.0 | 166.5 | -132.1 | 61.0 | 4.6 |
| 97 | Cambodia | -29.6 | 172.2 | -138.7 | 119.5 | -53.0 |
| 98 | Mauritania | -30.9 | 193.8 | -160.2 | 25.0 | 41.4 |
| 99 | Colombia | -31.5 | 191.4 | -176.1 | 98.8 | -14.0 |
| 100 | Niger | -32.2 | 188.1 | -155.9 | -1.3 | 69.1 |
| 101 | Togo | -32.2 | 120.7 | -89.0 | -100.3 | 168.6 |
| 102 | Burkina Faso | -33.4 | 161.2 | -130.9 | -6.1 | 75.7 |
| 103 | Senegal | -34.0 | 151.8 | -122.5 | -23.6 | 94.4 |
| 104 | Cape Verde | -34.4 | -107.1 | 136.1 | 58.1 | 12.9 |
| 105 | Sudan | -34.4 | 180.9 | -152.2 | 31.2 | 40.2 |
| 106 | Mali | -34.6 | 174.7 | -144.9 | 8.0 | 62.2 |
| 107 | The Gambia | -34.7 | 13.5 | 16.2 | -41.5 | 111.7 |
| 108 | Guyana | -34.7 | 150.5 | -120.7 | 56.9 | 13.3 |
| 109 | Brunei Darussalam | -34.9 | -57.1 | 76.6 | 134.0 | -53.5 |
| 110 | Chad | -35.0 | 173.4 | -143.9 | 21.2 | 49.3 |
| 111 | Nigeria | -35.1 | 169.5 | -152.4 | -88.0 | 171.0 |
| 112 | Rep Congo | -35.4 | 155.9 | -127.4 | -627.6 | 699.1 |
| 113 | Eritrea | -35.7 | 133.4 | -104.4 | 31.1 | 39.9 |
| 114 | Ghana | -35.9 | 147.3 | -122.0 | -46.4 | 121.1 |
| 115 | Guinea-Bissau | -36.2 | 88.2 | -59.5 | -29.6 | 100.9 |
| 116 | Suriname | -36.5 | 137.5 | -109.4 | 71.1 | 0.7 |
| 117 | Yemen | -36.7 | 156.7 | -130.3 | 45.9 | 27.7 |
| 118 | Ecuador | -37.0 | 145.8 | -124.6 | 105.7 | -26.9 |
| 119 | Equat Guinea | -37.9 | 71.8 | -48.8 | -24.6 | 101.6 |
| 120 | Guinea | -38.0 | 139.8 | -112.8 | -8.5 | 81.6 |

Notes: Columns (1) to (5) are in percentage.

**Table 3 (cont.):** Contribution of the four components to the centrality index – 1st method

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank | Country |  |  |  |  |  |
|  |  | (1) | (2) | (3) | (4) | (5) |
| 121 | Dem Rep Congo | -38.1 | 163.1 | -136.1 | -582.9 | 656.0 |
| 122 | Uruguay | -38.4 | 132.3 | -110.0 | 116.7 | -39.0 |
| 123 | Sierra Leone | -38.5 | 109.6 | -83.0 | -4.1 | 77.5 |
| 124 | Côte d'Ivoire | -38.7 | 141.7 | -116.5 | 2.3 | 72.5 |
| 125 | Sri Lanka | -39.2 | 104.1 | -87.1 | 102.7 | -19.7 |
| 126 | Indonesia | -39.3 | 156.9 | -156.6 | 127.8 | -28.1 |
| 127 | Liberia | -39.9 | 117.2 | -91.2 | 14.0 | 60.0 |
| 128 | Cameroon | -40.0 | 142.1 | -117.4 | -13.1 | 88.5 |
| 129 | Ethiopia | -40.7 | 147.8 | -123.7 | 37.5 | 38.4 |
| 130 | Central Afric Rep | -41.7 | 139.3 | -114.3 | 18.7 | 56.3 |
| 131 | S. Tomé & Príncipe | -42.0 | -344.4 | 368.9 | -6.5 | 81.9 |
| 132 | Palau | -42.1 | -548.4 | 572.8 | 133.6 | -58.0 |
| 133 | Gabon | -42.1 | 127.6 | -104.2 | -13.7 | 90.3 |
| 134 | Maldives | -43.2 | -725.9 | 745.3 | 92.9 | -12.3 |
| 135 | Paraguay | -43.7 | 128.3 | -105.8 | 113.1 | -35.5 |
| 136 | Brazil | -44.8 | 143.1 | -147.9 | 111.9 | -7.0 |
| 137 | Uganda | -45.2 | 117.3 | -95.6 | 17.0 | 61.3 |
| 138 | Rwanda | -46.0 | 56.5 | -35.3 | -0.7 | 79.5 |
| 139 | Peru | -46.5 | 130.2 | -113.9 | 108.1 | -24.5 |
| 140 | Kenya | -46.6 | 124.0 | -103.2 | 29.1 | 50.1 |
| 141 | Burundi | -47.1 | 57.5 | -35.8 | 4.5 | 73.8 |
| 142 | Bolivia | -47.7 | 126.0 | -105.0 | 102.9 | -24.0 |
| 143 | Angola | -47.9 | 126.4 | -108.0 | 32.4 | 49.3 |
| 144 | Argentina | -48.2 | 129.7 | -117.6 | 92.7 | -4.7 |
| 145 | Seychelles | -50.0 | -482.3 | 501.6 | 72.2 | 8.4 |
| 146 | Tanzania | -50.0 | 119.2 | -99.3 | 38.5 | 41.5 |
| 147 | F.S. Micronesia | -50.5 | -356.9 | 377.2 | 120.4 | -40.8 |
| 148 | Chile | -50.6 | 116.4 | -105.6 | 111.9 | -22.7 |
| 149 | East Timor | -50.8 | 24.9 | -4.6 | 114.0 | -34.3 |
| 150 | Comoros | -52.6 | -162.7 | 182.2 | 49.8 | 30.7 |
| 151 | Malawi | -52.6 | 90.0 | -70.5 | 35.1 | 45.4 |
| 152 | Zambia | -52.6 | 111.8 | -92.6 | 32.6 | 48.3 |
| 153 | Mauritius | -53.1 | -147.9 | 160.4 | 82.7 | 4.7 |
| 154 | Zimbabwe | -53.7 | 104.2 | -85.2 | 32.8 | 48.2 |
| 155 | Marshall Islands | -54.2 | -776.8 | 795.7 | 112.4 | -31.3 |
| 156 | Namibia | -54.2 | 109.1 | -90.2 | 57.8 | 23.4 |
| 157 | South Africa | -54.4 | 111.2 | -102.4 | 77.3 | 14.0 |
| 158 | Papua New Guinea | -54.6 | 103.9 | -85.4 | 112.1 | -30.5 |
| 159 | Botswana | -55.2 | 104.9 | -86.5 | 43.3 | 38.3 |
| 160 | Swaziland | -55.6 | 29.9 | -11.9 | 24.9 | 57.1 |
| 161 | Madagascar | -55.8 | 103.7 | -85.3 | 63.6 | 18.1 |
| 162 | Lesotho | -56.3 | 51.1 | -32.9 | 51.2 | 30.6 |
| 163 | Mozambique | -56.4 | 104.8 | -86.7 | 27.8 | 54.1 |
| 164 | Kiribati | -56.7 | -314.7 | 332.9 | 106.3 | -24.6 |
| 165 | Solomon Islands | -57.1 | 49.7 | -31.6 | 105.8 | -23.9 |
| 166 | Australia | -57.4 | 111.5 | -108.9 | 117.3 | -19.9 |
| 167 | Samoa | -60.1 | -94.2 | 111.3 | 96.2 | -13.2 |
| 168 | Vanuatu | -60.2 | 20.7 | -3.4 | 98.8 | -16.0 |
| 169 | Tuvalu | -60.2 | -2024.5 | 2041.7 | 102.4 | -19.6 |
| 170 | Fiji | -61.6 | 29.2 | -12.9 | 98.6 | -14.8 |
| 171 | Tonga | -63.0 | -275.0 | 291.2 | 103.3 | -19.4 |

Notes: Columns (1) to (5) are in percentage.

**Table 4:** Countries’ typology according to the four components – 2nd method

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  | China\*, **Hong Kong**, **Japan**, Korea\*, **Macau**, Mexico, Puerto Rico\* | **Austria**, **Belgium\***, **Switzerland**, **Germany\***, **Denmark**, Spain\*, **France**, **UK**, Ireland\*, Italy\*, **Luxembourg\***, **Netherlands\***, Norway\*, Poland\*, Sweden\* |
|  | Brazil, India, **Singapore**, USA\* | Turkey\* |
|  |  | Antigua & Barbuda, The Bahamas\*, Brunei Darussalam, **Canada**, Dominica, Dominican Rep, Fiji, F.S. Micronesia, Guatemala, Haiti, Indonesia, Iceland\*, Jamaica, Cambodia, Kiribati, St. Kitts & Nevis, Lao People Dem Rep, Morocco\*, Marshall Islands, Mongolia\*, Malaysia, Philippines, Palau, Papua New Guinea, Russian Fed\*, Solomon Islands, East Timor, Tonga, Tuvalu, Venezuela, Vietnam, Vanuatu, Samoa | Albania\*, Algeria\*, Bosnia & Herzeg\*, Croatia\*, **Czech Rep**, Finland\*, Hungary\*, Malta\*, Portugal\*, Latvia\*, **Slovakia**, Slovenia\*, Tunisia\*, Serbia & Monten\* |
|  | Angola, Argentina, Australia, Bangladesh, Bolivia, Bhutan, Botswana, Chile, Colombia, Comoros, Cape Verde, Costa Rica, Ecuador, Ethiopia, Guinea, Grenada, Guyana, Honduras, Kazakhstan, Kenya, Liberia, St. Lucia, Sri Lanka, Lesotho, Madagascar, Maldives, Mali, Mozambique, Mauritania, Mauritius, Malawi, Namibia, Nicaragua, Nepal, Pakistan, Panama, Peru, Paraguay, Sudan, El Salvador, Suriname, Seychelles, Thailand, Turkmenistan, Trinidad & Tobago, St. Vincent & Grenad, Tanzania, Uruguay, Yemen, South Africa, Zambia, Zimbabwe | Armenia, Azerbaijan, Burundi, Benin, Burkina Faso, Bulgaria\*, Belarus\*, Central Afric Rep, Chad, Côte d'Ivoire, Cameroon, Dem Rep Congo, Rep Congo, Cyprus\*, Egypt, Eritrea, Estonia\*, Gabon, Georgia, Ghana, The Gambia, Guinea-Bissau, Equat Guinea, Greece\*, Iraq, Jordan, Kyrgyzstan, Lebanon\*, Lithuania\*, Rep Moldova\*, Macedonia\*, Niger, Nigeria, Romania\*, Rwanda, Senegal, Sierra Leone, S. Tomé & Príncipe, Swaziland, Syrian Arab Rep\*, Togo, Tajikistan, Uganda, Ukraine\*, Uzbekistan |

1. Crespo and Fontoura (2006) confirm this causal link at regional level using data from Portugal. Additionally, Redding and Schott (2003) establish a theoretical relationship between centrality and education attainment, reinforcing the advantage of a central position in terms of economic development. [↑](#footnote-ref-1)
2. All the results are available upon request. [↑](#footnote-ref-2)