The Transforming Power of Scientific Knowledge: A Study of Human Development on a Global Scale in Terms of Academic Efficiency

Dr. Talip YİĞİT[1], Murat Dinçer[2]

[1]Asst. Prof, Faculty of Economics and Administrative Sciences, Department of Social Work, İstanbul 29 Mayıs University.

[2]Research Assistant, Faculty of Economics and Administrative Sciences, Department of Social Work, İstanbul 29 Mayıs University.

ABSTRACT

Knowledge, and especially scientific knowledge, is crucial in terms of transforming societies, and making social structures manageable and sustainable. This can be seen in the fact that the universities which are at the top of the global university rankings are mostly located in countries that are the center of attraction. The aim of this study is to examine the positive effects of academic productivity, which is of great importance in optimizing social conditions, on human development on a global scale with a statistically provable technique. In order to understand this relationship more clearly, our study has compared countries according to their academic productivity using the Multidimensional Scaling Analysis method and established a relationship between this and human development. As a result of the analysis carried out within the scope of the study, which used data from 178 countries from the time period of 1996-2019, it was concluded that the relationship between academic productivity and human development was only at a medium level. This suggests that, in addition to the need for scientific knowledge to be used for the improvement of social conditions, scientific knowledge is limited to certain organizations, which leads to the ***elitism of scientific knowledge****.*

Keywords: epistemology, academic efficiency, human development index, multidimensional scaling analysis, scientific knowledge

Introduction

Offering academic knowledge is one of the most fundamental elements in the development and progress of universities, societies, states, and humanity from a scientific point of view. At this point, the value of academic knowledge is quite high. This makes epistemological enquiries regarding to the quality of 'knowledge' necessary and meaningful.

Epistemology, which consists of the words *episteme*, meaning knowledge, and *logos*, meaning science and knowing in Ancient Greek, can be explained as the philosophy of knowledge. Epistemology, whose origin dates back to Ancient Greek philosophers, emerged as a field of philosophy in the 17th century, when positivism and similar philosophical approaches began to become widespread (Mooser, 2002). During the period of Ancient Greek philosophers, epistemology was considered in terms of philosophers who claimed knowledge was dogmatic, and of skepticism, which became common thanks to sophists. In epistemology, where the influence of religion began to be seen intensively along with the middle ages, there have been significant developments in 17th the century and afterwards. During this period, epistemology was separated into two groups: *Classical epistemology*, which contains the effects of positivist understanding and Kant philosophy, and *continental epistemology*, which sees knowledge as relative thanks to the influence of critical philosophical movements that became widespread during and after the Industrial Revolution (Martinich, 2020; Stanford Encyclopedia of Philosophy, 2005).

Today, epistemology is generally concerned with the nature, types, existence, source, boundaries, and accuracy of knowledge. In epistemology, knowledge is generally divided into *a priori*, which occurs without being based on experience, and *a posteriori*, which occurs thanks to experience. In addition to this distinction, it is possible to mention everyday, religious, and scientific knowledge. The point at which the scientific knowledge that is the subject of our study differs from everyday knowledge can be explained as it being immutable and continuous in terms of its content (Barreau, 1990; Audi, 1998; Dancy & Sosa, 1992).

From an epistemological point of view, the sources of knowledge are considered to be experiments, reason, and intuition. Those who argue that the source of knowledge is experiment emphasize the *a posteriori* aspect of knowledge. Those who define the source of knowledge as the mind refer to people's senses and perceptions. Those who argue that intuition is the source of knowledge note the subjectivity and integrity of intuition, emphasizing the limitations of reason and experiments (Jager & Löffler, 2012; Stroll, 2020). Today, in addition to these three approaches, there are those who argue that the source of knowledge is both experiments and reason. As a matter of fact, the emergence of *a posteriori* knowledge is considered to have become possible by turning to *a priori* knowledge. Here, it is argued that what causes experiment is the need to reveal and understand knowledge, as well as the need to test a number of intuitive outputs. Based on this understanding, it is possible to say that *a priori* and *a posteriori* knowledge complement each other rather than being kinds of knowledge that are separated by precise boundaries.

In these aspects, the knowledge at the center of epistemology can be defined, in short, as familiarity with or the awareness of a person or thing (Bengson & Moffett, 2011). This awareness is the starting point of manageability and sustainability. It is here that the importance of knowledge and scientific knowledge, which has become the focus today, can be seen. As a matter of fact, the goal in the production of scientific

knowledge is to be able to explain natural phenomena and social phenomena. These insights and explanations, which can be provided by obtaining scientific knowledge, are important for managing the situations encountered, and making the established systems sustainable. In addition, innovations such as the production of scientific knowledge, and the resulting technological developments affect social culture. Therefore, knowledge, which is the subject of epistemology, and scientific knowledge as a variant of it that is most commonly referenced today, are directly related to human life (Barreau, 1990).

University ranking studies on this issue provide important indicators. University ranking studies were applied for the first time in 1870 to inform the academicians and students of the period. In 1983, university ranking studies, which were brought to the agenda again with a report published in a journal called U.S. News and World Report, were carried out by comparing universities in terms of various characteristics (Dearden, Grewal, & Lilien, 2019). These studies, which are criticized in various aspects and various studies, ranging from the parameters used today to their impact on student preferences, are still in a very important position in terms of reflecting today's academic world (Derakhshan, Hassanzadeh, & Nekoofar, 2021; Selten, Neylon, Huang, & Groth, 2020). In these ranking studies, countries that are seen as attraction centers in the world and generally receiving migration can be said as leading. This situation proves the relationship of scientific knowledge with human and social welfare. For example, among the ranking conducted by Times Higher Education Supplement for 2020, only 7 countries in regions other than Europe, North America, Australia, and New Zealand are among the top 50 most successful universities in the world. This number is limited to 24 among the top 100 university rankings (Times Higher Education Supplement, 2020). The relevant statistics suggest a correlation between academic productivity and human development, and therefore social welfare.

Our study is carried out with the aim of evaluating the relationship between academic productivity and human development on a global scale. On this basis, our study focuses on the positive effects of academic productivity, which is crucial for optimizing social conditions by directly affecting the sociocultural and psychosocial development of individuals and communities, on human development with the help of a statistically provable technique.

Material and Method

As part of the study, data from 178 countries between the years of 1996 and 2019 was used to understand the impact of long-term academic development on human development. The data set used in the study was obtained from the database of the organization *SCImago Journal & Country Rank* (Scimago Journal & Country Rank, 2020). Descriptions of variables in this data set are as given in Table 1.

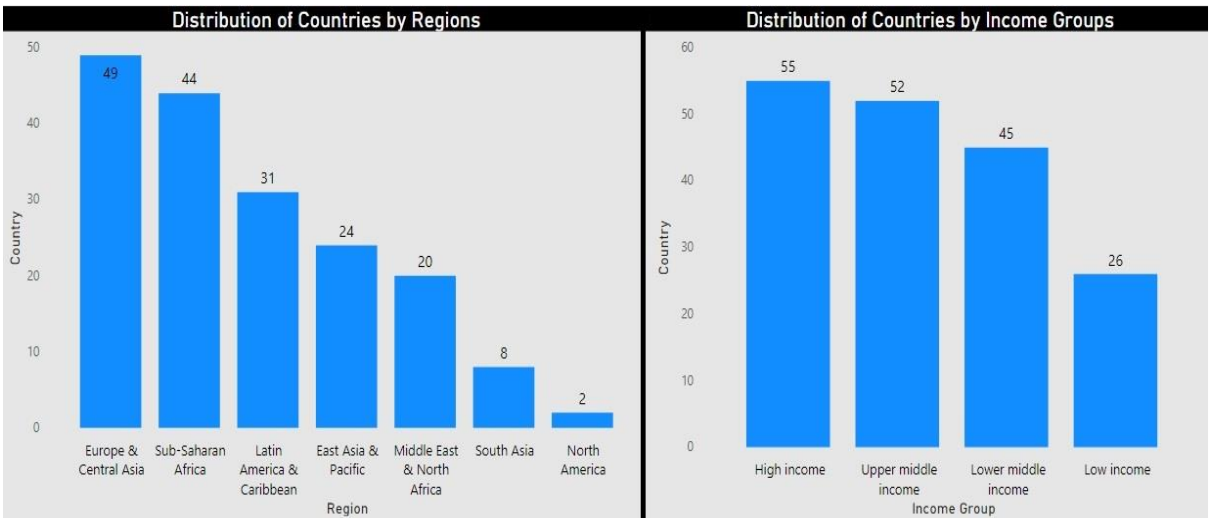
Table 1.: Explanation to Variables

Variable	Explanation
Documents	Published documents in 1996-2019
Citable Documents	Citable documents include: articles, reviews and conference papers
Citiations	Whole period citiations to documents published during 1996-2019
Self-Citiations	Whole period self-citiations to documents published during 1996-2019
Citiations per Documents	Avarage citations to documents published during 1996-2019
H – Index	Country's number of articles (h) that have received at least h citations

In this study, which examines data from 178 countries, the distribution of countries by geographical regions and income groups is presented in Figure 1.

As can be seen, the countries included in the data set used in our study show a balanced distribution according to their region and income groups, which allows the results to be generalizable.

Figure 1.: Distribution of Countries by Regions and Income Groups



The relationship of academic productivity with human development is based on the values of the 2019 Human Development Index. As part of the study, the ***R Studio*** software was used to perform Multidimensional Scaling Analysis.

Multidimensional Scaling Analysis

Multidimensional Scaling Analysis (MDS) is a multivariate statistical method used to create graphs that will provide the researcher with an overall assessment of observations based on similarities and differences between said observations (Li, Yin, Song, Gao, & Chen, 2019). In MDS, the distance values for these differences calculated between units are presented by the *Shepard* diagram (Wei & Lu, 2020). In this

analysis, the differences of *n* units calculated according to *p* variables are shown in a *k*- (usually two-) dimensional space (Muça & Dhame, 2019; Aviles, Montero, & Sanchis-Marco, 2020).

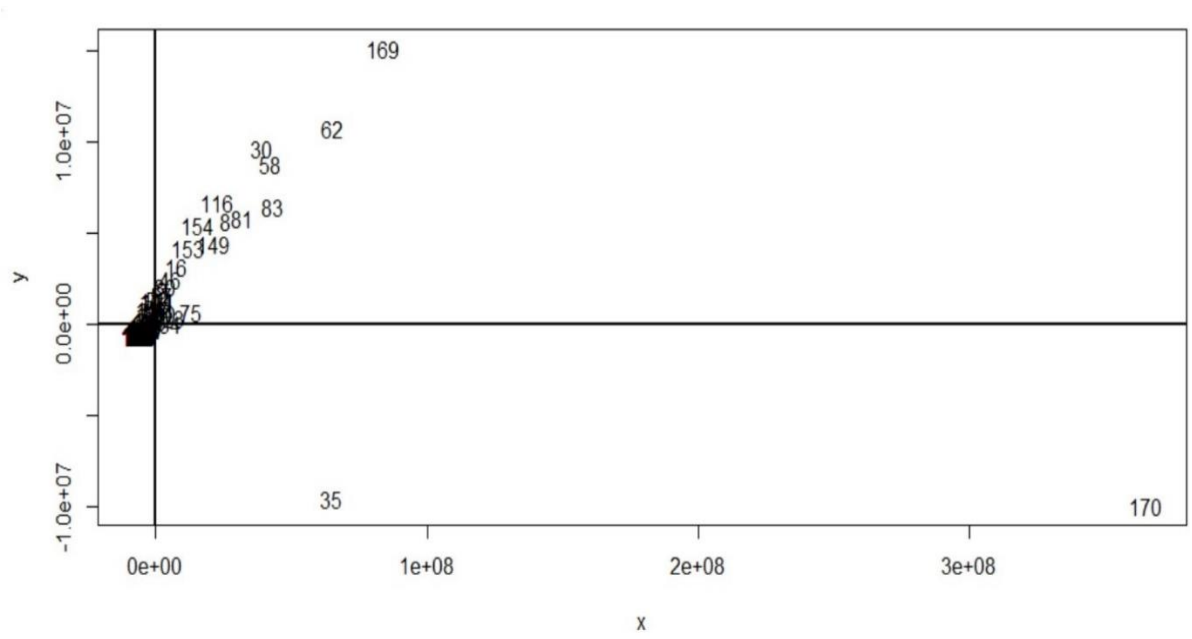
MDS is generally divided into Metric MDS and Non-Metric MDS. This distinction relates to the property of the data set to be used in the analysis. Metric MDS is more suitable for use in cases where data is collected proportionally, while Non-Metric MDS is used more in cases where data is collected according to the order in the context of some characteristics (Muça & Dhame, 2019; Aviles, Montero, & Sanchis-Marco, 2020).

One of the success criteria in MDS is the *stress* value, which indicates the difference between the actual and estimated offsets. At this point, the degree of adaptation of the value >=20 stress is weak, and the degree of adaptation of the value 0,00 stress is considered a state of complete compatibility. Another success criterion in this analysis is the GOF (goodness of fit), which refers to how much of the reality in the data set used by the analysis performed is explained. At this point, the GOF value is expected to be high, unlike the stress value. Especially GOF values of 0.9 and above are acceptable. Both values can be used in analyses (Muça & Dhame, 2019; Aviles, Montero, & Sanchis-Marco, 2020)

Analysis and Findings

In this section, Metric MDS analysis outputs for all academic fields and social sciences will be presented based on the variables mentioned in Table 1 for all academic fields regarding the 178 countries mentioned above.

Figure 2.: MDS Analysis Output (All Subject Areas)



In relation to this, the analysis output representation in two-dimensional space for all academic fields is as presented in Figure 2. The graph is based on the alphabetical order of the countries in the data set. Regarding this, the numbers of countries can be seen in Appendix 1.

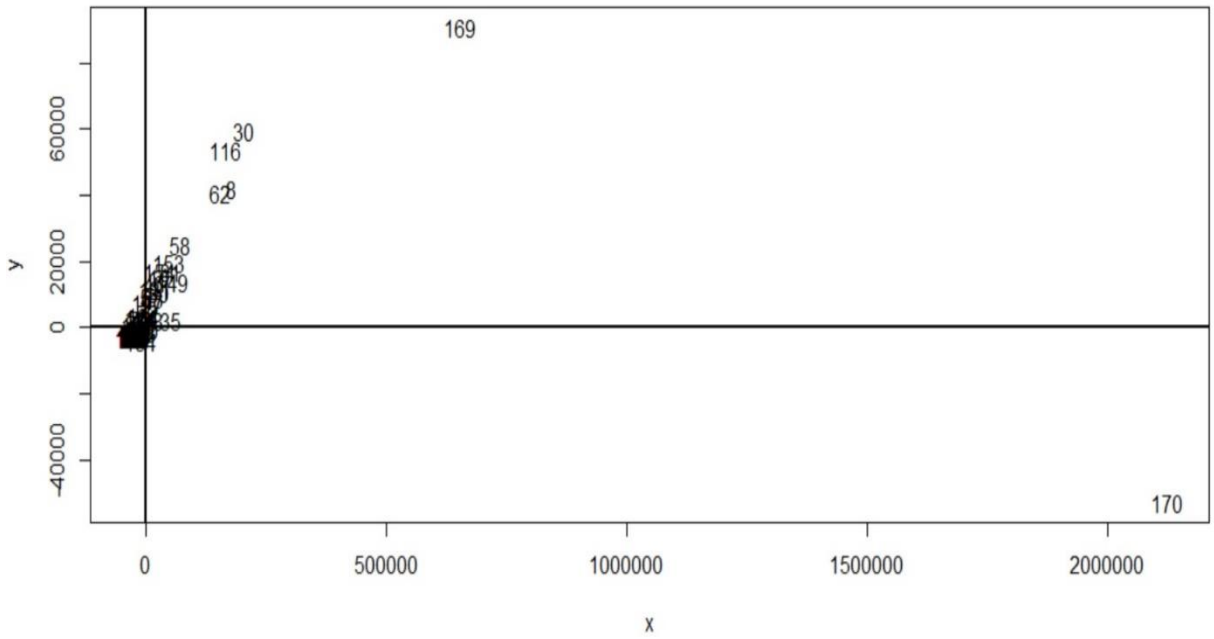
Here it can be seen that the United States (170) is located separately from all other countries. In the graph, China (35) is closer to the origin than the United States. Another country that differs significantly from

other countries is the United Kingdom (169). This is followed by Germany (62). As can be seen from the graph, Canada (30) and France (58) are closer to the origin than Germany and have quite similar characteristics. Unlike countries that are behind these countries, and are around the origin, Japan (83) is slightly different from the Netherlands (116), Italy (81), and Australia (8), respectively. Switzerland (154), Spain (149), and Sweden (153) are again among the countries that show similar characteristics to one another. Belgium (16) and India (75) can also be said to differ from other countries. The GOF value for this graph was calculated as 99.97%.

After the observation of all academic fields, our study will try to measure the academic development of the same countries in the fields of social sciences. A graph of the relevant analysis drawn in two-dimensional space is as in Figure 3.

As can be seen from the figure, the United States (170) and the United Kingdom (169) again differ significantly from other countries. Canada (30) and the Netherlands (116), and Australia (8) and Germany (62) are again countries that diverge from other countries and are similar to each other. France (58) is considered quite close to the countries at the origin. Spain (149), Sweden (153), and Switzerland (154), along with China (35) in particular, are more similar to other countries in terms of social sciences among all academic fields. For the corresponding graph, the GOF value was calculated as 99.99%.

Figure 3.: MDS Analysis Output (Social Sciences)



Based on these demonstrations, it is possible to say that the differentiation between countries in all academic fields does not apply to social sciences. According to the results of both assessments, the United States and the United Kingdom differ significantly from other countries. In addition, there are few factors that can be discerned from the graph. China and India cannot be differentiated from the rest of the world with regards to academic development in all fields of social sciences, Canada is more differentiated than other countries in all fields according to the output of the study on social sciences, and Japan, France and Belgium are similar to other countries regarding the social sciences.

In addition, a total of 178 countries whose data were used were analyzed separately according to their geographical region and income groups. Accordingly, the distribution of 24 countries in the South Asia and Pacific region is as follows in Appendix 2 for all academic fields, and in Appendix 3 for social sciences fields. As can be seen from the relevant distributions, China (4) significantly differs from other countries, while Japan (8) and Australia (1) are similarly separated from other countries. In terms of development of social sciences, Australia (1) and China (4) differ from all countries in this group, while Malaysia (10), Hong Kong (6), Japan (8), New Zealand (14), and Singapore (18) are similar to one another, and differ from the countries at the origin.

The distribution of 49 countries in the European and Central Asian region is as follows in Appendix 4 for all academic fields, and in Appendix 5 for social sciences fields. Examining the countries in this group according to the distribution of all academic fields, a few factors can be observed. The United Kingdom (48) and Germany (18) significantly differ from other countries, France (16) is positioned separately, while Switzerland (43) and the Netherlands (32), and Spain (41) and Italy (23) are similar to each other and differ from the countries at the origin. In terms of development in the social sciences, it seems that the United Kingdom (48) is significantly different, while the Netherlands (32) and Germany (18) are similar to each other.

Distributions for 31 countries in the Latin American and Caribbean region are as follows in Appendix 6 and Appendix 7. When the distribution of the countries in this group in all academic fields is examined, it can be seen that Brazil (6) differs from all countries, Argentina (1) and Mexico (21) show similar characteristics, and Chile (7) and Colombia (8) differ from the countries at the origin. In terms of development in the social sciences, it is understood that Brazil (6) and Mexico (21) again differ from all countries, Colombia (8) and Argentina (1) are very similar to each other, and Chile (7) is located separately from other countries. The output of the analyses carried out with the inclusion of Canada and the United States in this group is as in Appendix 8 and Appendix 9. As can be seen from these distributions, the United States (31) and Canada (7) differ significantly from other countries in both assessments.

The distributions for the 20 countries in the Middle East and North Africa regions are as in Appendix 10 for all academic fields, and in Appendix 11 for the social sciences. When these distributions are examined, on the basis of all academic fields, Israel (6) and Iran (4) are significantly different from other countries, while Egypt (3) and Saudi Arabia (16) are similarly separated from the countries at the origin. From the point of view of the social sciences, again, in addition to Israel (6) and Iran (4), Jordan (7) also appears to be partially separated from the countries at the origin.

The distributions of the 8 countries in the South Asian region are as in Appendix 12 for all academic fields, and in Appendix 13 for social sciences. Accordingly, India (4) and Pakistan (7) differ significantly from other countries in both distributions, meanwhile Bangladesh (2), Sri Lanka (8), and Nepal (6) show similar characteristics in the distribution of all fields.

The distributions for the 44 countries in the sub-Saharan Africa region are as in Appendix 14 for all academic fields, and in Appendix 15 for the social sciences. South Africa (38) and Nigeria (33) differ significantly from other countries in both distributions, while Kenya (22) and Ghana (19) seem to differ more from other countries in terms of development in the social sciences than in all fields.

In terms of distribution by income group, the distributions for 55 countries in the high income group are as follows in Appendix 16 for all fields, and Appendix 17 for the social sciences. Accordingly, the United States (54) and the United Kingdom (53) differ significantly from other countries in both distributions. In the distribution of all fields, Germany (18) is close to the origin and differs from other countries, while France (17) and Canada (9) are located close to the origin and are very similar to each other. From the point of view of the social sciences, it seems that Canada (9), The Netherlands (34), Germany (18), and Australia (2) are situated quite similarly to one another, while the other countries are positioned around the origin.

Distributions for 52 countries in the high-middle income group in terms of distribution by income are as in Appendix 18 for all fields, and in Appendix 19 for the social sciences. In both distributions, it is seen that countries show similar characteristics, and Brazil (9), Russia (41), and Turkey (50) differ from other countries in terms of academic development in all fields. In terms of social sciences, it can be said that Brazil (9), Malaysia (33), Russia (41), South Africa (46), and Turkey (50) show similar characteristics, and differ from other countries.

Distributions for 45 countries in the low-middle income group in terms of distribution by income are as in Appendix 20 for all fields, and in Appendix 21 for the social sciences. In both distributions, India (17) has differed significantly from other countries. In terms of all academic fields, Egypt (13) is different from other countries. In terms of social sciences, the difference between countries was relatively greater. Nigeria (29) and Pakistan (30) show similar characteristics, and are located separately from other countries, while Kenya (18) shows different characteristics from the countries at the origin.

Distributions for 26 countries in the low income group in terms of distribution by income are as in Appendix 22 for all fields, and in Appendix 23 for the social sciences. Of the countries in this group, Uganda (25) and Ethiopia (8) showed distinct characteristics compared to the other countries in both distributions. In terms of all fields, Malawi (15) differs from other countries, while Burkina Faso (2), Sudan (21), Syria (22), Mozambique (17), and Gambia (9) show similar characteristics to each other and differ from the countries at the origin. In terms of social sciences, Burkina Faso (2) and Malawi (15) are different from countries at the origin, while Haiti (12), Mali (16), and Sudan (21) are located close to the origin and show similar characteristics to one another.

Here, the relationship of academic productivity with human development, which is the main topic of our study, will be examined through the correlation between the variables of the two parameters. In this comparison, data on the academic productivity of countries will be included proportional to their population for this analysis (World Bank).

Table 2.: Academic Efficiency and Human Development Relationship (All Subject Areas)

Variable	HDI	Life Exp.	Schooling	GNI
Pop. / Doc.	0,6876333	0,6000272	0,601517163	0,69253
Pop. / C. Doc.	0,6902187	0,6018751	0,605060868	0,693126
Pop. / Cit.	0,6038429	0,5338432	0,525999252	0,620875
Pop. / S. Cit.	0,5826324	0,507375	0,519373858	0,568891
Pop. / Cit. Doc.	0,1305021	0,1252403	0,135870618	0,19365
H index	0,5579083	0,4958116	0,488925024	0,470911

In this regard, the correlation of academic productivity variables and human development index value (HDI) (as well as values related to the parameters of this index) was studied first (United Nations Development Programme, 2019). According to the output presented in Table 2 and Table 3 as a correlation matrix, it can be said that human development parameters have a medium-level relationship with academic productivity variables, excluding the number of citations per journal. It is possible to say that this relationship is especially between HDI and Gross national Income per capita (GNI) value.

Table 3.: Academic Efficiency and Human Development Relationship (Social Sciences)

Variable	HDI	Life Exp.	Schooling	GNI
Pop. / Doc.	0,636327864	0,550044267	0,561632791	0,603344
Pop. / C. Doc.	0,63316172	0,546984023	0,559736257	0,597892
Pop. / Cit.	0,549277094	0,470775182	0,471476474	0,539507
Pop. / S. Cit.	0,485240467	0,412346594	0,43608799	0,460908
Pop. / Cit. Doc.	0,051946807	0,042856121	0,03522932	0,019492
H index	0,506999458	0,444604263	0,443942176	0,443057

After this general view, the relationship between human development parameters and academic productivity will be discussed according to the number of citations, the different regions, and the income groups. As can be seen in Table 4, in all regions with regards to all academic fields, it can be said that academic productivity is related to human development on a middle level, and this relationship is most often established with the help of GNI and HDI variables.

Table 4.: Academic Efficiency and Human Development Relationship by Regions (All Subject Areas)

Region	HDI	Life Exp.	Schooling	GNI
East Asia & Pasific	0,613052	0,5441699	0,532857683	0,624475
Europe & Central Asia	0,6031382	0,5323846	0,526394521	0,616572
Latin America & Caribbean	0,6096671	0,5433635	0,527439618	0,623996
North & Latin America & Caribbean	0,6096671	0,5433635	0,527439618	0,623996
Middle East & North Africa	0,6047186	0,5353969	0,526859482	0,618665
South Asia	0,6091681	0,5307506	0,525497639	0,612396
Sub-Saharan Africa	0,6109877	0,5438678	0,52898511	0,627269

It seems possible to make a similar interpretation when Table 5, which examines the relationship between academic productivity and human development on a regional basis regarding the social sciences, is observed. Accordingly, academic productivity in terms of social sciences is again related to the parameters of human development for all regions at a medium level, and this relationship is most relevant for the values of GNI and HDI.

Table 5.: Academic Efficiency and Human Development Relationship by Regions (Social Sciences)

Region	HDI	Life Exp.	Schooling	GNI
East Asia & Pasific	0,558264496	0,480264564	0,478745008	0,541715
Europe & Central Asia	0,548075653	0,468699988	0,471268622	0,534589
Latin America & Caribbean	0,554202588	0,478692932	0,472138476	0,54151
North & Latin America & Caribbean	0,554202588	0,478692932	0,472138476	0,54151
Middle East & North Africa	0,549754266	0,471615136	0,471918284	0,537012
South Asia	0,531214082	0,449421285	0,446690653	0,509826
Sub-Saharan Africa	0,555819786	0,479875386	0,47402498	0,545178

The results of the analysis, which examines the relationship between academic productivity and human development according to income groups for all academic areas, are presented in Table 6. When the values in the table are examined, it can be seen that academic productivity is related to the parameters of human development for all income groups at a medium level, and this relationship is most relevant for the values of GNI and HDI.

Table 6.: Academic Efficiency and Human Development Relationship by Income Groups (All Subject Areas)

Income Group	HDI	Life Exp.	Schooling	GNI
High Income	0,606653	0,538065	0,532377	0,615308
Upper - Middle Income	0,603294	0,532634	0,525037	0,61766
Lower - Middle Income	0,605933	0,536306	0,527474	0,619929
Low Income	0,602647	0,532955	0,525414	0,619649

The output of the relationship between academic productivity and human development according to income groups is presented in Table 7 for the social sciences. The relationship that occurs here is similar to other analysis results.

Table 7.: Academic Efficiency and Human Development Relationship by Income Groups (Social Sciences)

Income Group	HDI	Life Exp.	Schooling	GNI
High Income	0,55113	0,473701	0,476536	0,533127
Upper - Middle Income	0,548367	0,469047	0,47011	0,535896
Lower - Middle Income	0,551007	0,472771	0,472603	0,538424
Low Income	0,548045	0,469646	0,470822	0,538135

All these analyses have shown that academic productivity parameters are in relation to human development parameters, excluding the number of citations per journal. The results of the analysis conducted on the basis of region and income groups based on the number of citations show that the relationship between academic productivity and human development is at a medium level for both all academic fields and social sciences. Here, it can be said that the relationship of academic productivity is higher with HDI and GNI variables for all analyses. Furthermore, analyses of the social sciences found a relatively weaker relationship.

Table 8 shows the values of academic productivity and human development for countries that were found to significantly differ from other countries within the scope of the study. As can be seen from the table, countries that differ from other countries in terms of academic productivity are at the forefront of the human development ranking. But here, it is important to note that the United States and the United Kingdom, which differ the most, especially in terms of academic productivity, rank 15th in the human development ranking. It is also noteworthy that China and India, which were among the top 20 out of 178 countries in terms of social sciences, ranked relatively low in terms of human development.

Table 8.: Countries by Academic Efficiency and Human Development Values

Observation Number	Country Name	HDI Value	HDI Rank	All S. Areas	Social Sciences
170	USA	0.920	15	1	1
169	United Kingdom	0.920	15	3	2
30	Canada	0.922	13	8	3
62	Germany	0.939	4	4	4
8	Australia	0.938	6	10	5
149	Spain	0.893	25	11	6
58	France	0.891	26	6	7
116	Netherlands	0.933	10	14	8
35	China	0.758	85	2	9
81	Italy	0.883	29	7	10
83	Japan	0.915	19	5	14
153	Sweden	0.937	8	18	16
75	India	0.647	129	9	18
16	Belgium	0.919	17	22	20
154	Switzerland	0.946	2	16	21

Among the countries, it is crucial to understand the difference in the relationship between academic productivity and human development. It is possible to say that one of the issues that makes the difference is the institutionalization of the institutional structures that produce scientific knowledge.

As a matter of fact, the university was born in Europe with the working groups formed by the teachers and students who carried out joint studies at the beginning of the millennia. The work carried out by students

and teachers together has led to the formation of a specialized university structure in certain fields such as theology, medicine and law (Wissema, 2009). These developments have enabled 15 of the universities that are in the ranking list of the oldest 20 universities in the world to be found in the UK, Italy and Spain countries, which differ significantly from other countries in academic efficiency today (Phillpot, 2019). Moreover, it is known that structures such as think thanks that are public or independent other than the higher education institutions, have an important past, especially in Europe. These structures had an important role in USA during World War II and spread rapidly in mos European contruies especially in the UK, Germany and France and various scientific field in 1980's (Abelson, 2014).

This demonstrates the importance of having institutionalized structures that produce scientific knowledge in terms of academic efficiency and human development.

Population is seen as another element that reveals the difference in terms of academic productivity and human development. As a matter of fact, countries that are more densely-populated will have more potential for training qualified people when they have the necessary structural mechanisms. This suggests that the population will create a significant difference among the countries with the necessary structural mechanisms.

Factors that do not make a difference in terms of academic productivity and human development can be evaluated as the level of income and geography, based on the analysis carried out in the study. Of course, providing financial resources, especially for higher education institutions and organizations that produce independent scientific knowledge, is important for these organizations to continue their studies. But analyses conducted as part of our study has shown that countries with relatively low income per capita, such as China and India, differ significantly from other countries in terms of academic productivity. This finding also suggests that countries such as China and India use their resources on specific fields that they prioritize, and they develop through these fields. In addition, the results of correlation analysis performed according to level of income show that the relationship between academic productivity and human development does not change significantly compared to the income group. In terms of geography, region-based analyses show that this factor does not determine the relationship between academic productivity and human development. Indeed, the presence of countries in each region that significantly differ from other countries, and again, the correlation output that reveals the relationship of academic productivity and human development on the basis of regions presented in the study supports this idea.

Another aspect is that as a result of the analyses carried out in our study, it was shown that there is of 50% - 70% relationship between the parameters of academic productivity and human development. This indicates a medium-level relationship between the two parameters. Based on this, it can be said that the value that can arise with scientific knowledge cannot be reflected in the improvement of social conditions over time. In particular, it seems that the US and the UK have failed to demonstrate a difference in human development compared to other countries, unlike their difference in academic productivity. In addition, recent social events in the United States, Europe, and the Middle East can be interpreted in the light of these data.

Table 9: Ideal approaches according to the relationship between academic productivity and human development

Category	Ideal Approaches
Relationship Between Academic Productivity and Human Development Developed Countries	In this group of countries, the relationship between academic productivity and human development is weakening. Time is running out for this group of countries. In the medium and long term, institutions offering scientific knowledge in these countries can be expected to weaken increasingly, as well as to become fully dependent on foreign countries in terms of qualified human resources. **Approach**: Using the scientific knowledge produced by institutional structures, and the values produced, human resources, and social conditions for improvement.
Relationship Between Academic Productivity and Human Development Developing Countries	In this group of countries, there is a moderate relationship between academic productivity and human development. **Approach**: Increasing scientific knowledge production and revising existing institutional structures with a focus on efficiency and vision.
Relationship Between Academic Productivity and Human Development Undeveloped Countries	In this group of countries, the relationship between academic productivity and human development is weak. **Approach**: Revising institutions engaged in scientific knowledge production and their human resource policies.

A study conducted by Bar-Yam et al. (2011) reveals the relationship between food prices and social events. It is clear that the result of this analysis, conducted on some African and Middle Eastern countries, can be generalized when evaluated in the context of the similarity of human needs. As a matter of fact, when the scientific knowledge produced is not reflected as a value in social life, societies, face various negative situations in many different aspects, especially economy.

Indeed, scientific knowledge is of great importance for a society in obtaining economic power. A study by Czarnitzki and Toole has put forward that scientists' human capital is highly correlated with their innovation performance (Czarnitzki & Toole, 2009). In another study conducted by Kuo et al., it was revealed that scientific knowledge has a positive effect on industrial activities (Kuo, Wu, & Lin, 2019). These examples illustrate the importance of scientific knowledge in the ability of societies to produce and improve. Considering the positive socioeconomic effect of production on societies, the relationship of scientific knowledge with social welfare can be understood more clearly.

The important question here is for whom this progress is happening. Research findings revealing that academic efficiency is not highly correlated with human development show that the aforementioned

progress does not exist for the general society as it should be. These results suggest that scientific knowledge has become a commodity monopolized by certain classes. Berman defines this situation as "the transformation of academic science to an economic engine". Berman argues that universities, especially in the last century, are an engine for turning the wheels of the economy and producing 'necessary' information rather than a source.

Drawing attention to the increasing scientific research funds and the number of patents by the industry on the subject, Berman argues that the industry closed this gap with the decrease in the budget transferred by the public to the universities, especially since the 1960s, and points out that this transformed universities into an economic engine that only produced information suitable for the interests of the industry. Berman also declares that the financing transferred by the industry to universities in the USA today is 9 times the financing of the 1970s. In addition, Berman noted that issuing patents, which was an unacceptable practice until the 1950s and 1960s, transformed with the industry's support for university studies, and noted that today, approximately ten thousand patent applications are made to US universities annually. These transfers show how academic knowledge production has transformed in the last 50-60 years. When considered in terms of research findings, this change has a negative meaning in terms of social welfare (Berman, 2012).

Therefore, it is clear that a new paradigm is needed to use academic efficiency, and the scientific knowledge produced within the framework of this efficiency in order to improve social conditions directly, and thus to ensure human development. At this point, different approaches are needed today for societies whose academic productivity and human development differ, societies in which this relationship is developing, and societies in which this relationship is undeveloped.

Conclusion, Evaluation and Recommendations

As part of our study, the academic productivity of 178 countries included in the analysis was examined in terms of all academic fields and of social sciences, and the similarities between countries were presented with graphs with the help of MDS analysis. Then, in order to determine the relationship between academic productivity variables and human development parameters, their correlations were calculated, and it was concluded that there was a medium-level relationship.

In conclusion, our study has examined the relationship between academic productivity and human development and deduced that academic efficiency is not used to directly contribute to the improvement of social dynamics today. At this point, it is necessary for countries to correctly analyze the relationship between academic productivity and human development, and, as a result, to develop policies appropriate to their position. Furthermore, the findings obtained in the study suggest that scientific knowledge is limited to certain organizations, which in turn leads to the elitism of scientific knowledge.

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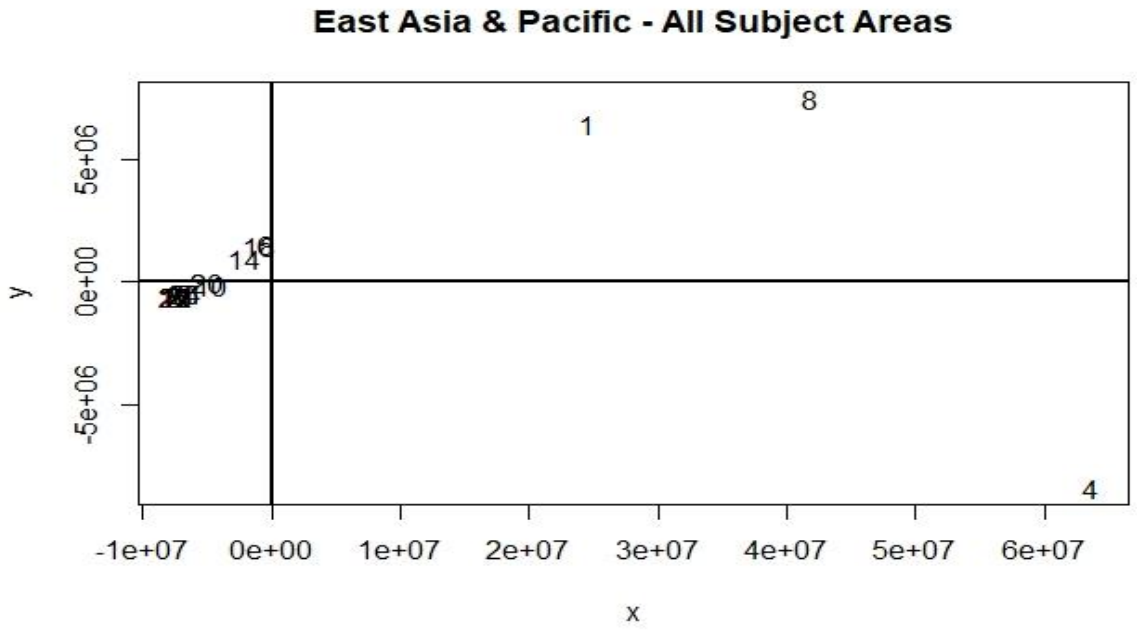
APPENDIXES

Appendix – 1.: Country Names and Numbers

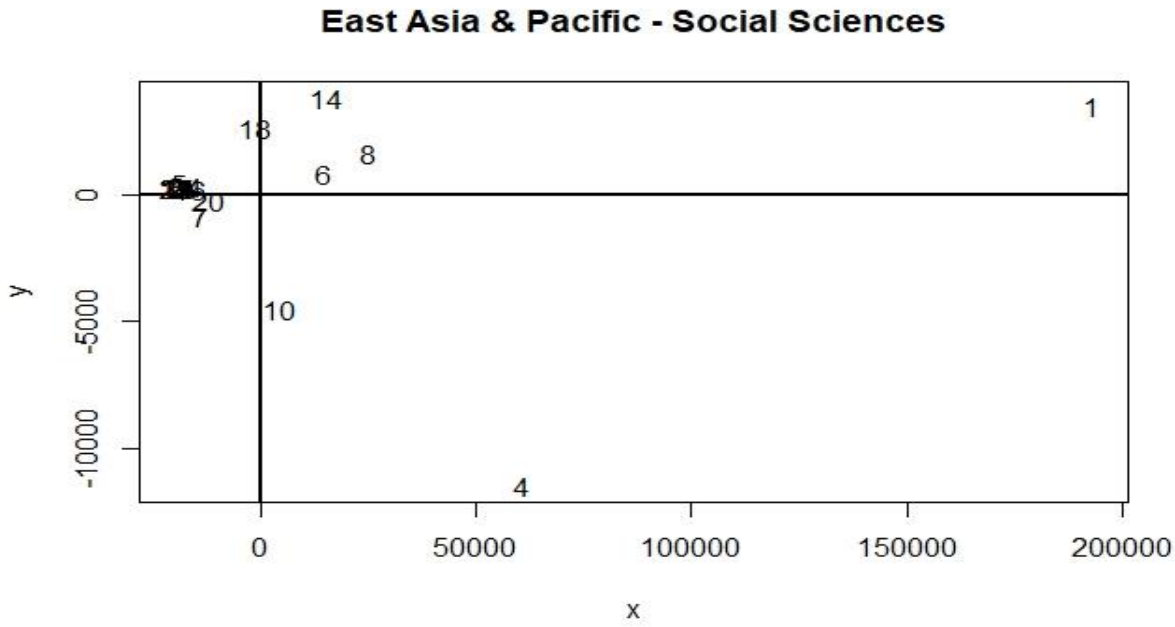
Nu	Country	Nu	Country	Nu	Country	Nu	Country
1	Afghanistan	46	Denmark	91	Lebanon	136	Saint Kitts and Nevis
2	Albania	47	Dominica	92	Lesotho	137	Saint Lucia
3	Algeria	48	Dominican Republic	93	Liberia	138	Samoa
4	Andorra	49	Ecuador	94	Libya	139	Saudi Arabia
5	Angola	50	Egypt	95	Liechtenstein	140	Senegal
6	Argentina	51	El Salvador	96	Lithuania	141	Serbia
7	Armenia	52	Equatorial Guinea	97	Luxembourg	142	Seychelles
8	Australia	53	Eritrea	98	Madagascar	143	Sierra Leone
9	Austria	54	Estonia	99	Malawi	144	Singapore
10	Azerbaijan	55	Ethiopia	100	Malaysia	145	Slovakia
11	Bahamas	56	Fiji	101	Maldives	146	Slovenia
12	Bahrain	57	Finland	102	Mali	147	Solomon Islands
13	Bangladesh	58	France	103	Malta	148	South Africa
14	Barbados	59	Gabon	104	Marshall Islands	149	Spain
15	Belarus	60	Gambia	105	Mauritania	150	Sri Lanka
16	Belgium	61	Georgia	106	Mauritius	151	Sudan
17	Belize	62	Germany	107	Mexico	152	Suriname
18	Benin	63	Ghana	108	Moldova	153	Sweden
19	Bhutan	64	Greece	109	Mongolia	154	Switzerland
20	Bolivia	65	Grenada	110	Montenegro	155	Syrian Arab Republic
21	Bosnia and Herzegovina	66	Guatemala	111	Morocco	156	Tajikistan
22	Botswana	67	Guinea	112	Mozambique	157	Tanzania
23	Brazil	68	Guinea-Bissau	113	Myanmar	158	Thailand
24	Brunei Darussalam	69	Guyana	114	Namibia	159	Timor-Leste
25	Bulgaria	70	Haiti	115	Nepal	160	Togo
26	Burkina Faso	71	Honduras	116	Netherlands	161	Tonga
27	Burundi	72	Hong Kong	117	New Zealand	162	Trinidad and Tobago
28	Cambodia	73	Hungary	118	Nicaragua	163	Tunisia
29	Cameroon	74	Iceland	119	Niger	164	Turkey
30	Canada	75	India	120	Nigeria	165	Turkmenistan
31	Cape Verde	76	Indonesia	121	Norway	166	Uganda
32	Central African Republic	77	Iran	122	Oman	167	Ukraine

33	Chad	**78**	Iraq	**123**	Pakistan	**168**	United Arab Emirates
34	Chile	**79**	Ireland	**124**	Palestine	**169**	United Kingdom
35	China	**80**	Israel	**125**	Panama	**170**	United States
36	Colombia	**81**	Italy	**126**	Papua New Guinea	**171**	Uruguay
37	Comoros	**82**	Jamaica	**127**	Paraguay	**172**	Uzbekistan
38	Congo	**83**	Japan	**128**	Peru	**173**	Vanuatu
39	Costa Rica	**84**	Jordan	**129**	Philippines	**174**	Venezuela
40	Côte d'Ivoire	**85**	Kazakhstan	**130**	Poland	**175**	Viet Nam
41	Croatia	**86**	Kenya	**131**	Portugal	**176**	Yemen
42	Cuba	**87**	Kuwait	**132**	Qatar	**177**	Zambia
43	Cyprus	**88**	Kyrgyzstan	**133**	Romania	**178**	Zimbabwe
44	Czech Republic	**89**	Laos	**134**	Russian Federation		
45	Democratic Republic of the Congo	**90**	Latvia	**135**	Rwanda		

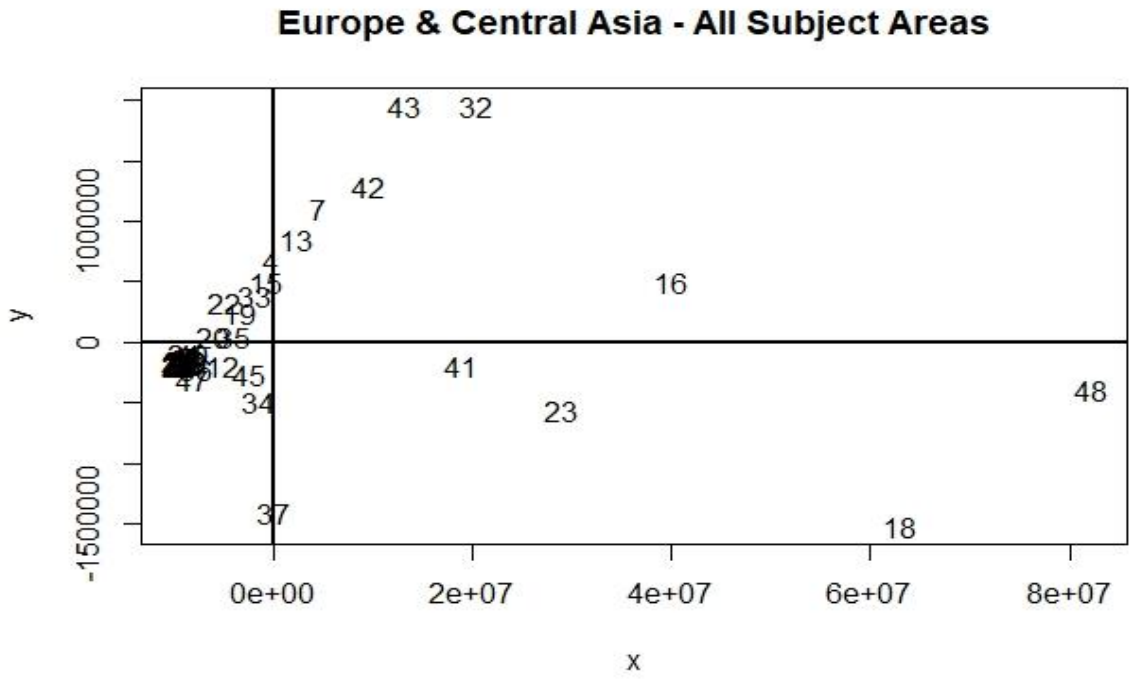
Appendix – 2.: Distribution of Countries by Academic Efficiency (East Asia & Pasific – All Subject Areas)



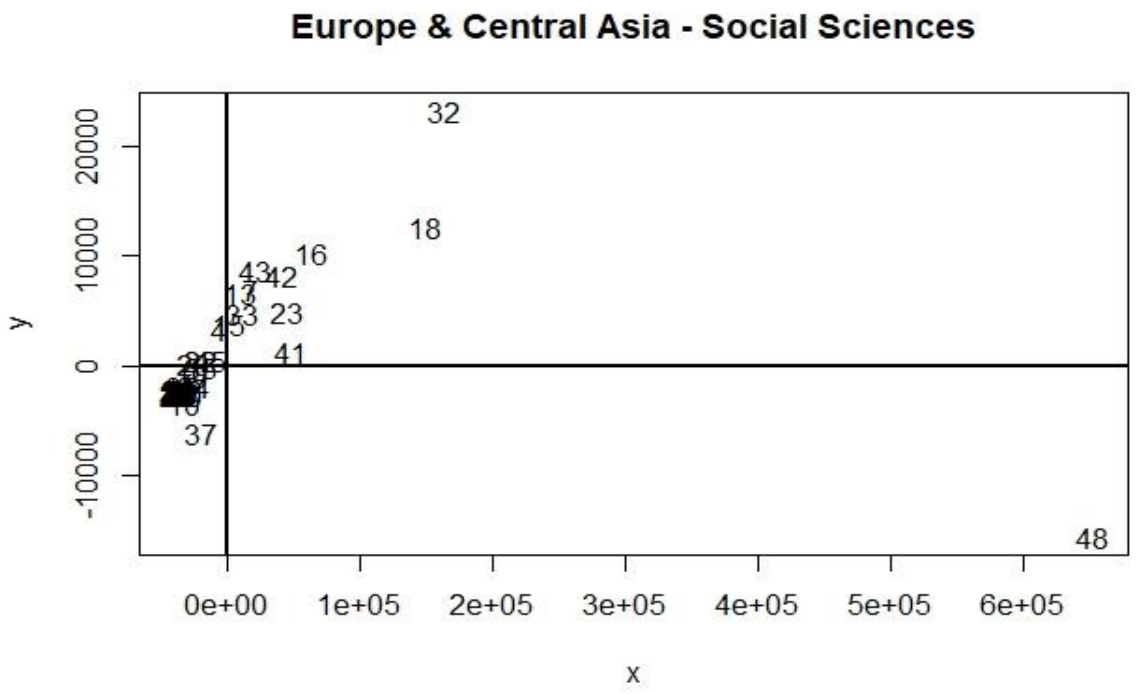
Appendix – 3.: Distribution of Countries by Academic Efficiency (East Asia & Pasific – Social Sciences)



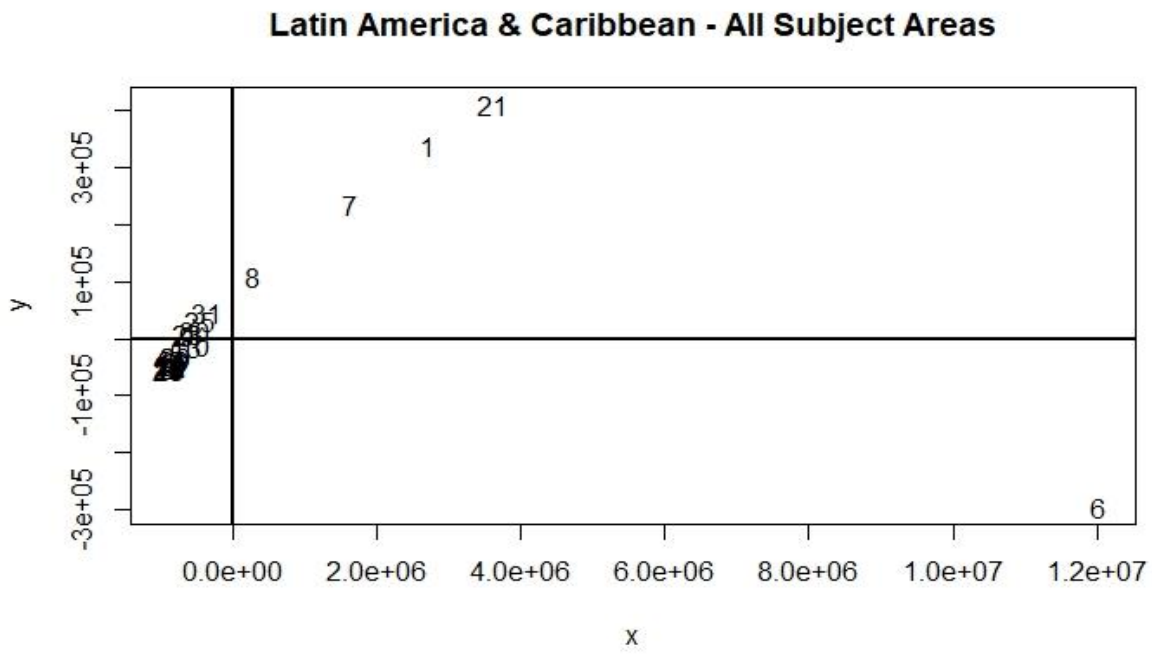
Appendix – 4.: Distribution of Countries by Academic Efficiency (Europe & Central Asia – All Subject Areas)



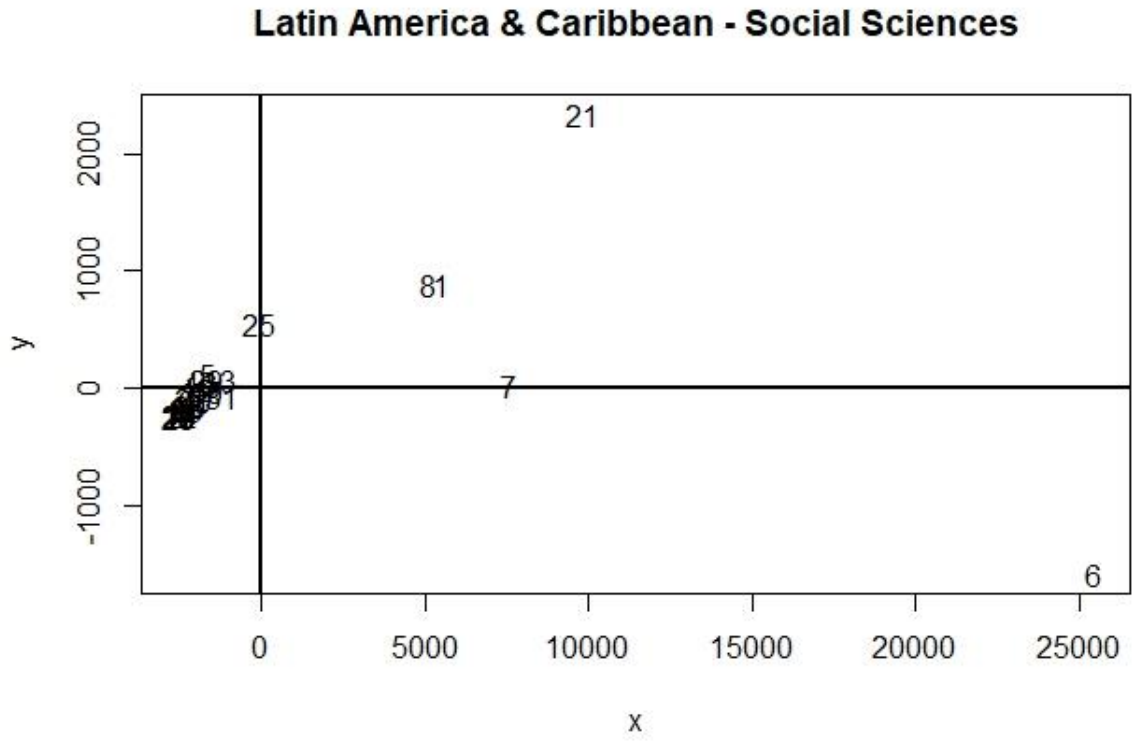
Appendix – 5.: Distribution of Countries by Academic Efficiency (Europe & Central Asia – Social Sciences)



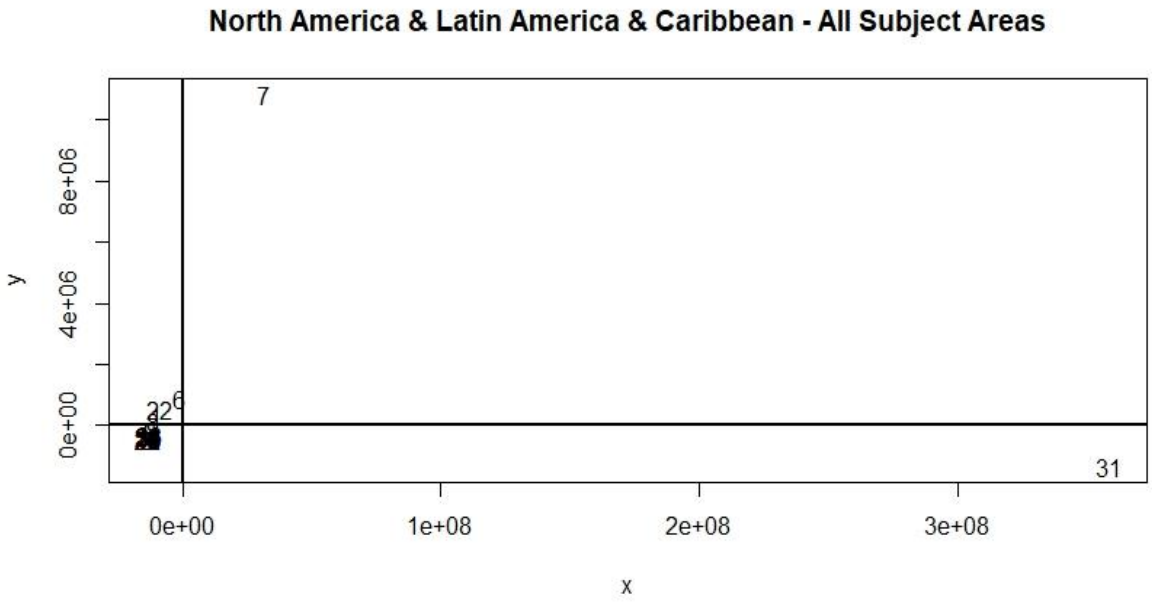
Appendix – 6.: Distribution of Countries by Academic Efficiency (L. America and Carribean – All Subject Areas)



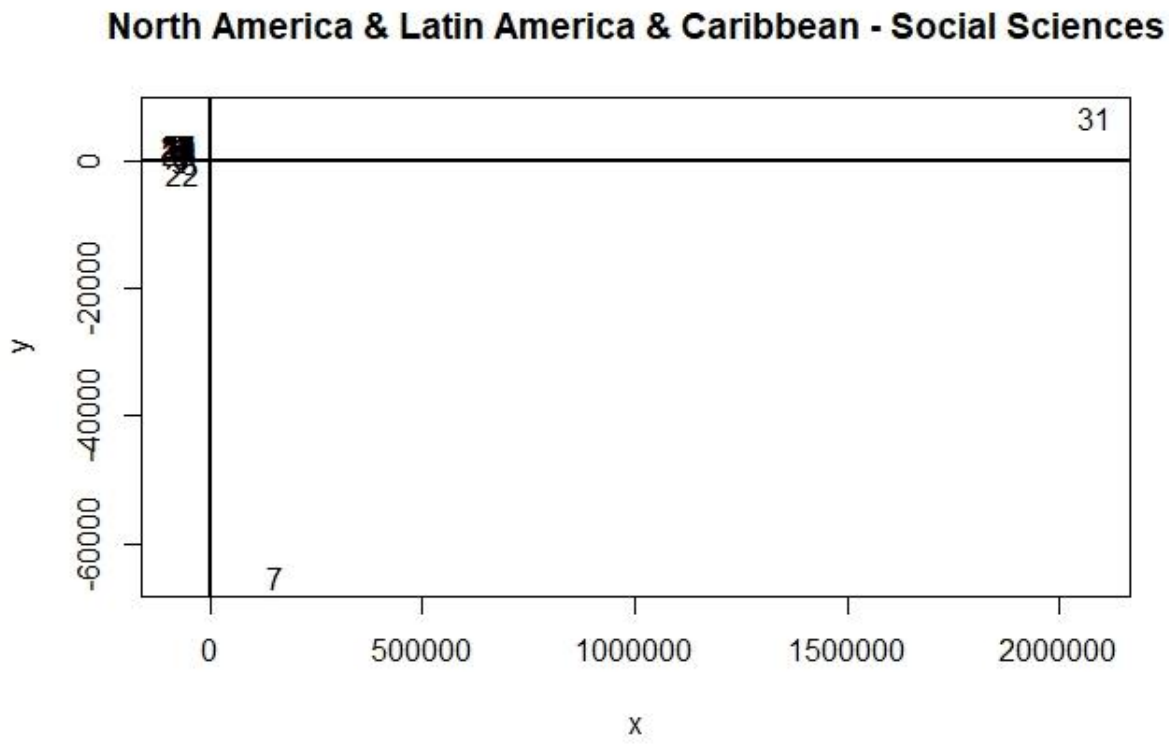
Appendix – 7.: Distribution of Countries by Academic Efficiency (L. America and Carribean – Social Sciences)



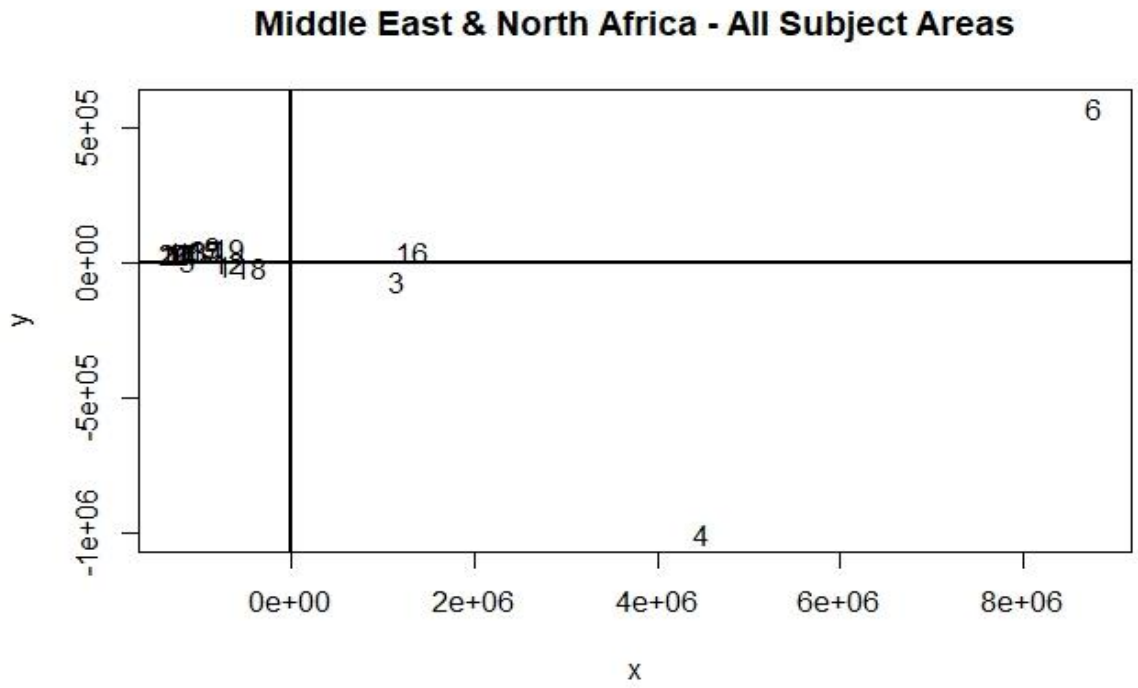
Appendix – 8.: Distribution of Countries by Academic Efficiency (L. America, Carribean & North America – All Subject Areas)



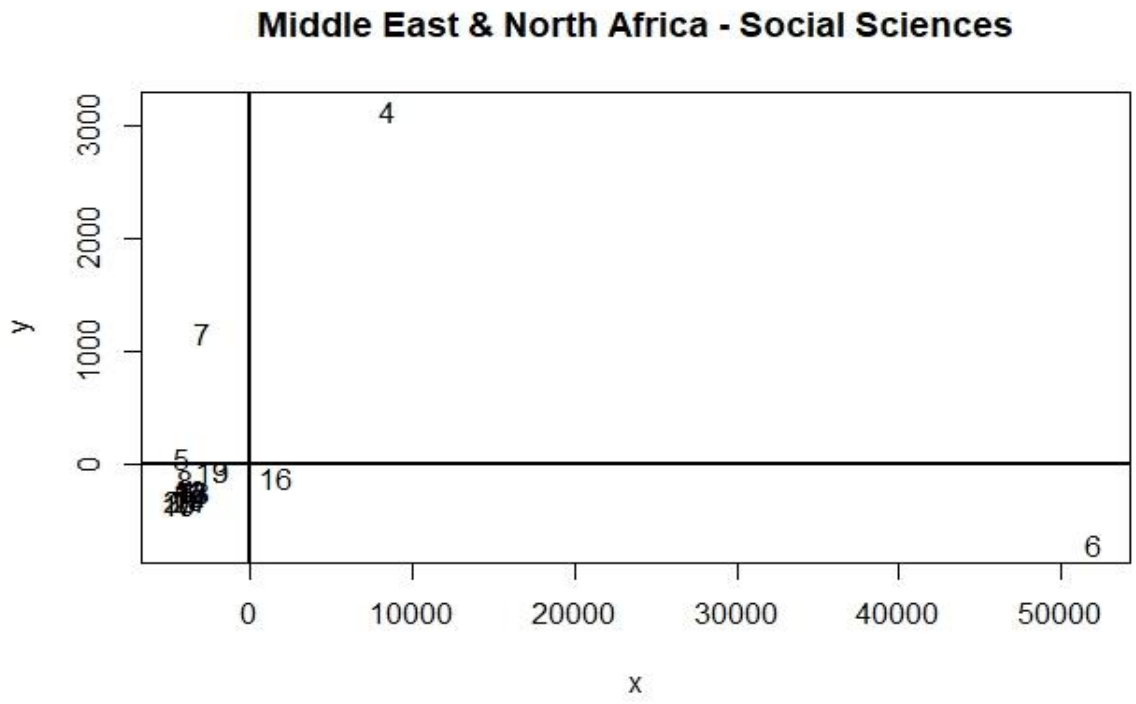
Appendix – 9.: Distribution of Countries by Academic Efficiency (L. America, Carribean & North America – Social Sciences)



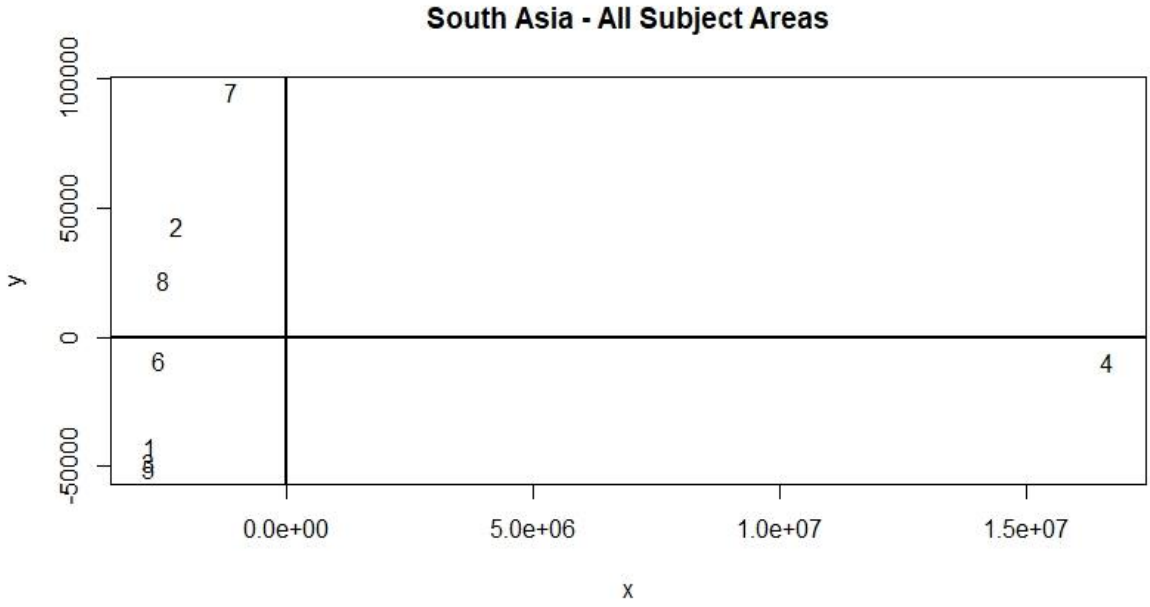
Appendix – 10.: Distribution of Countries by Academic Efficiency (Middle East & North Africa – All Subject Areas)



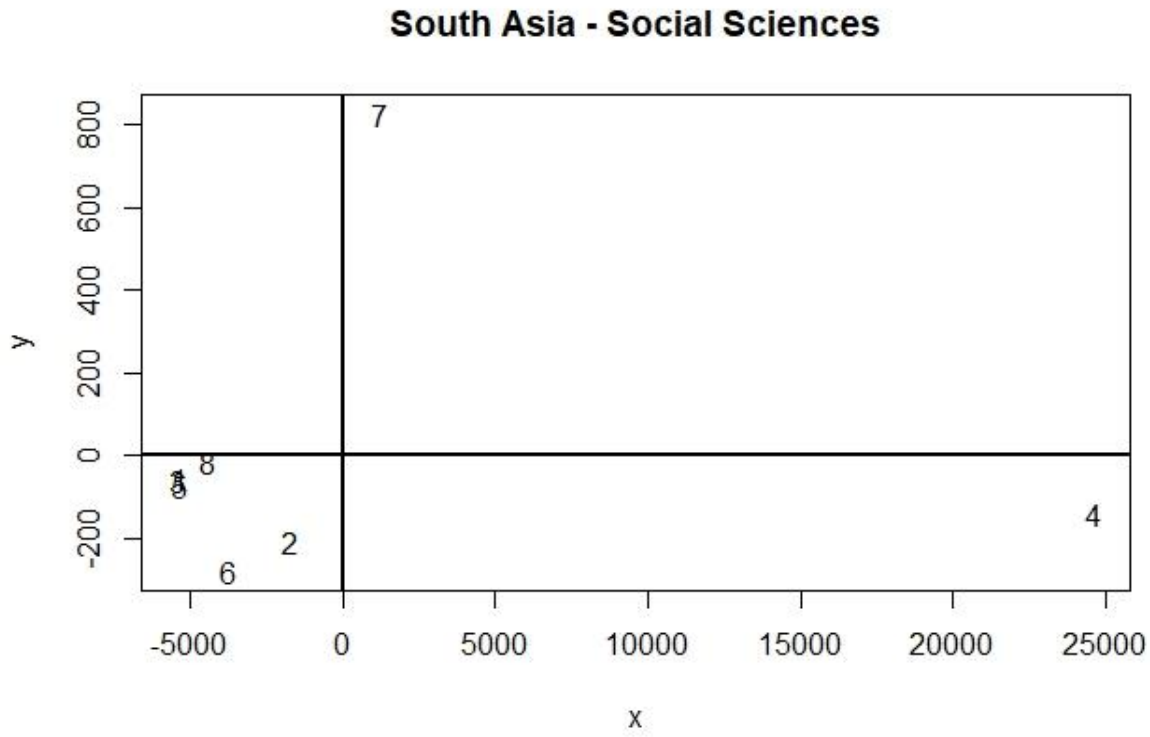
Appendix – 11.: Distribution of Countries by Academic Efficiency (Middle East & North Africa – Social Sciences)



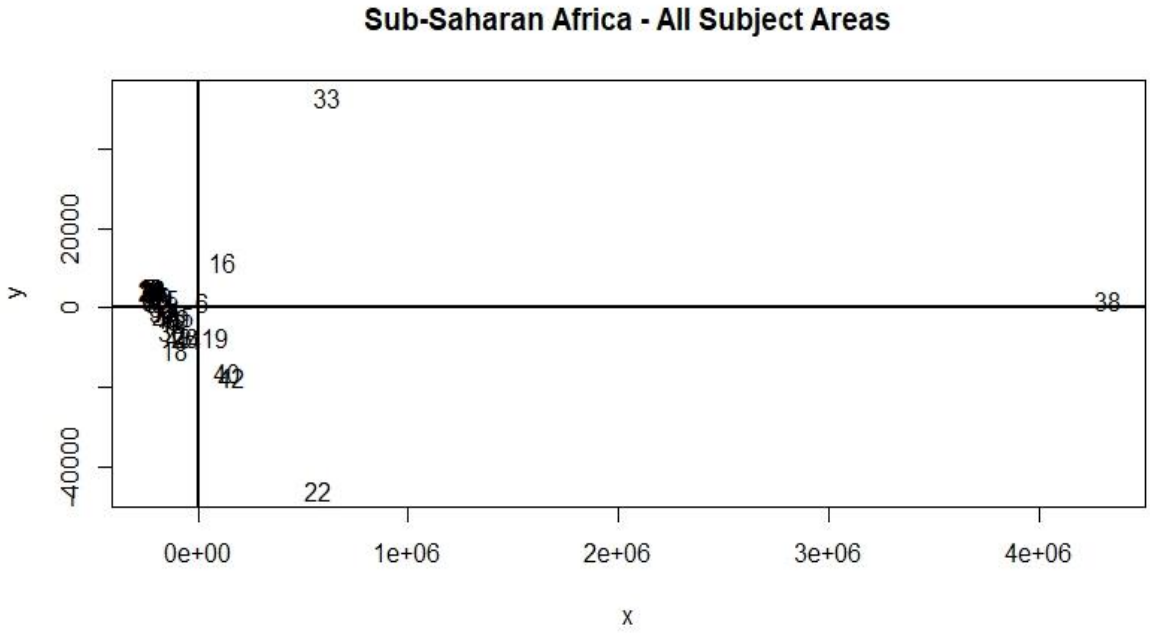
Appendix – 12.: Distribution of Countries by Academic Efficiency (South Asia – All Subject Areas)



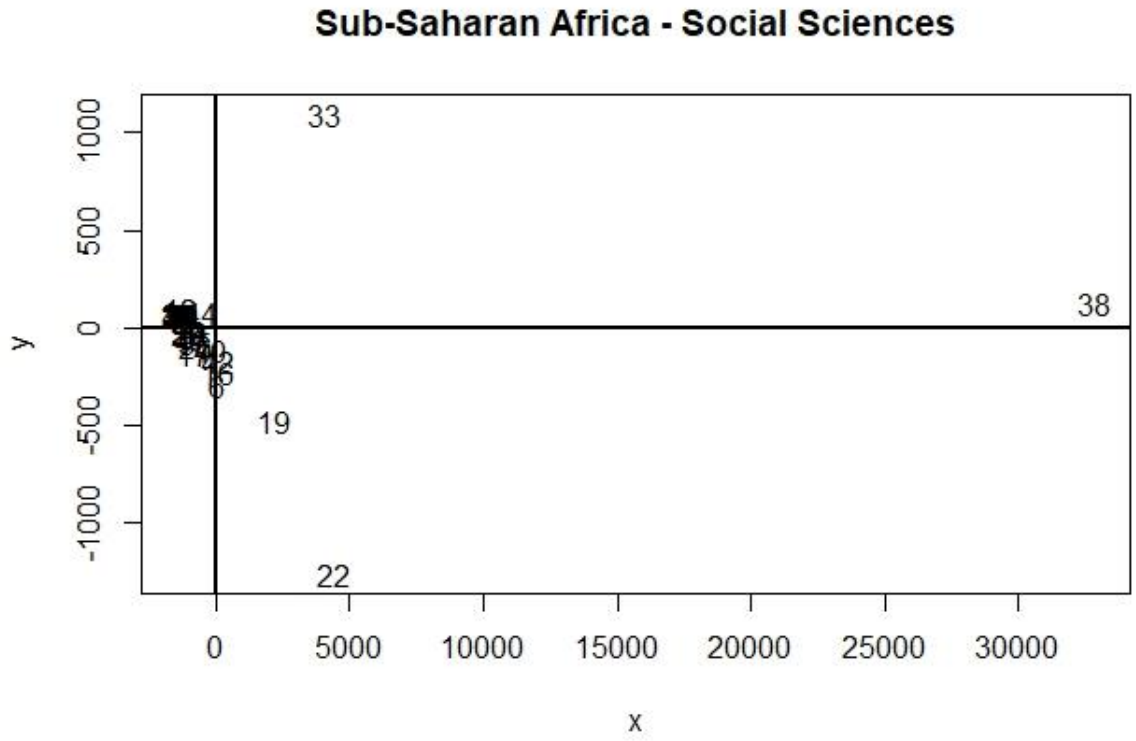
Appendix – 13.: Distribution of Countries by Academic Efficiency (South Asia – Social Sciences)



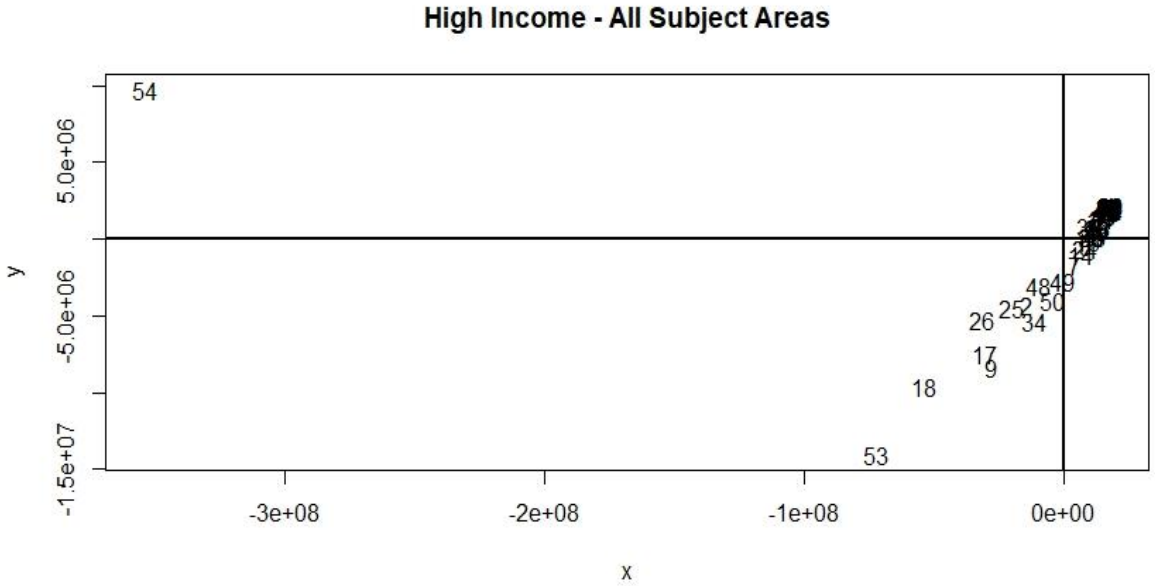
Appendix – 14.: Distribution of Countries by Academic Efficiency (Sub-Saharan Africa – All Subject Areas)



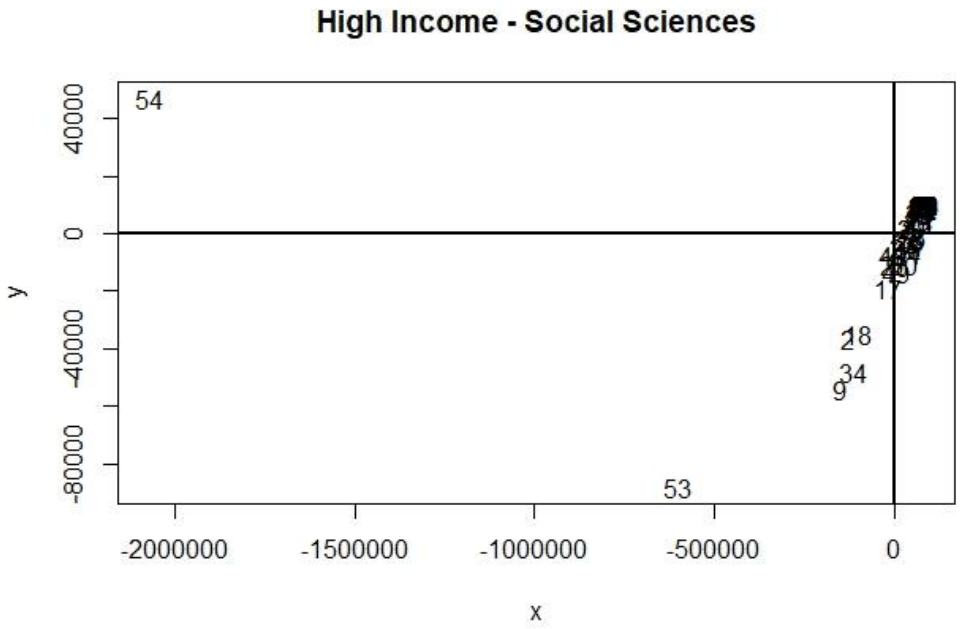
Appendix – 15.: Distribution of Countries by Academic Efficiency (Sub-Saharan Africa – Social Sciences)



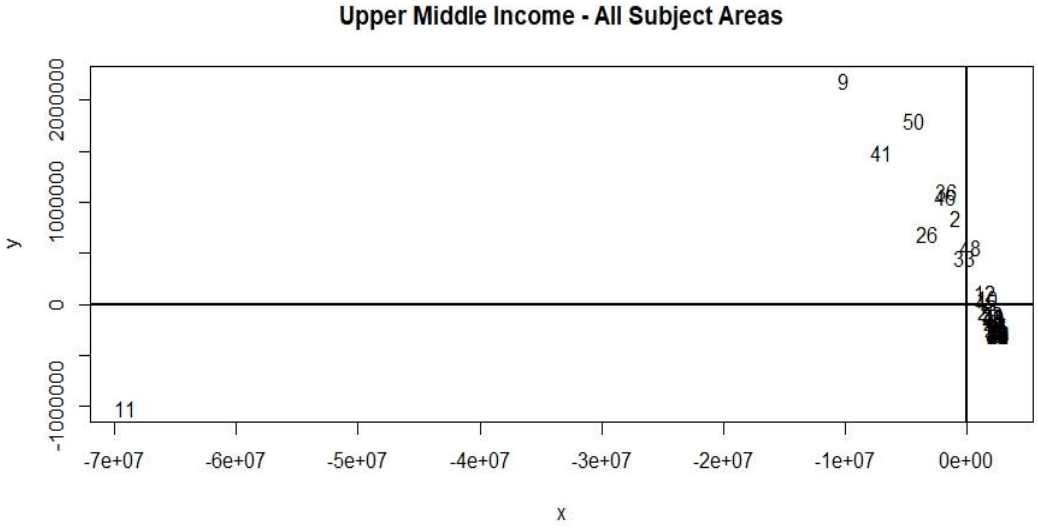
Appendix – 16.: Distribution of Countries by Academic Efficiency (High Income – All Subject Areas)



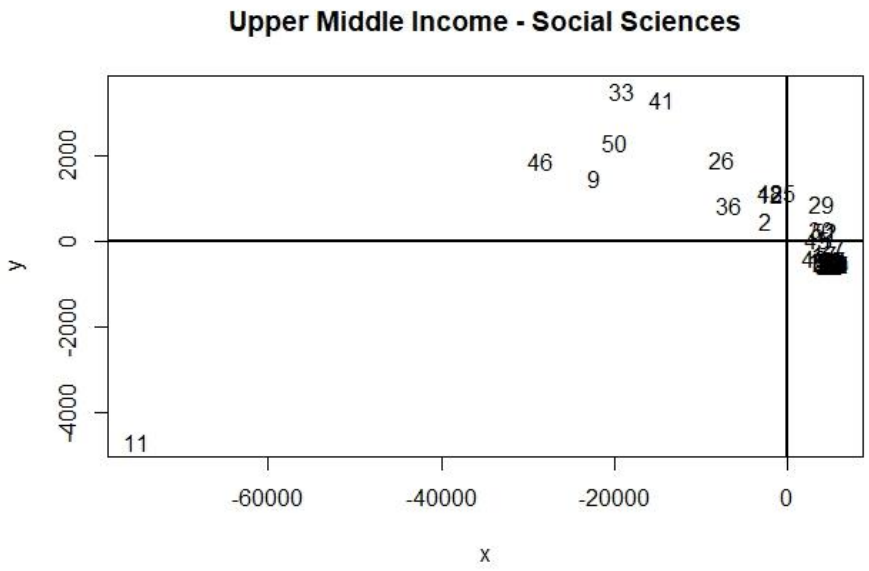
Appendix – 17.: Distribution of Countries by Academic Efficiency (High Income – Social Sciences)



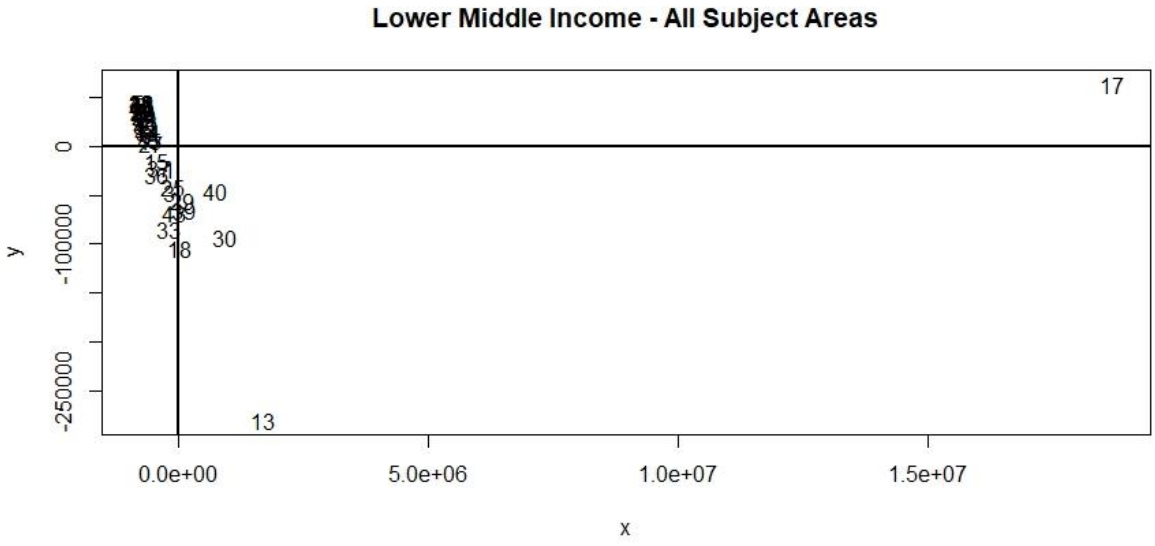
Appendix – 18.: Distribution of Countries by Academic Efficiency (Upper Middle Income – All Subject Areas)



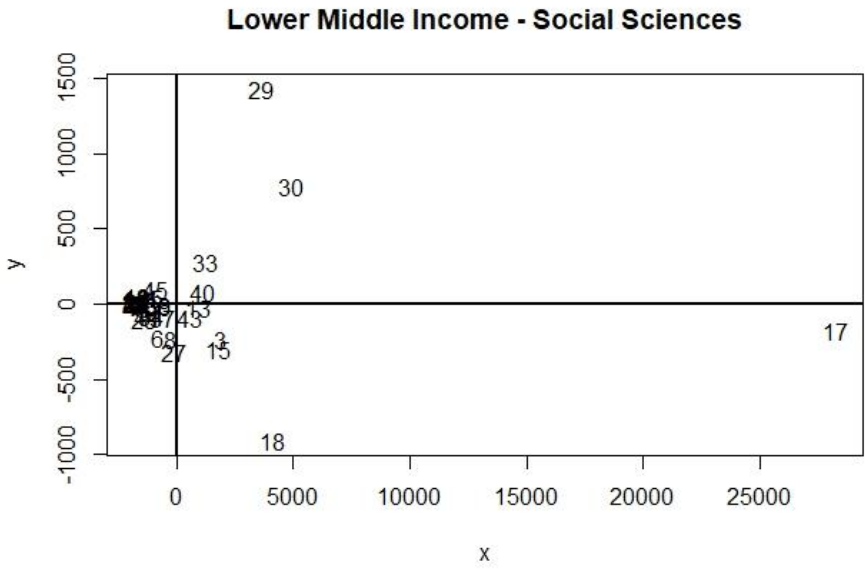
Appendix – 19.: Distribution of Countries by Academic Efficiency (Upper Middle Income – Social Sciences)



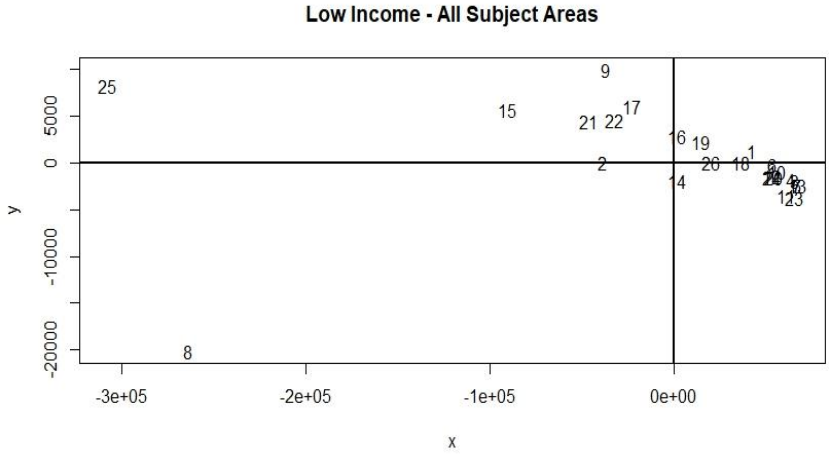
Appendix – 20.: Distribution of Countries by Academic Efficiency (Lower Middle Income – All Subject Areas)



Appendix – 21.: Distribution of Countries by Academic Efficiency (Lower-Middle Income – Social Sciences)



Appendix – 22.: Distribution of Countries by Academic Efficiency (Low Income – All Subject Areas)



Appendix – 23.: Distribution of Countries by Academic Efficiency (Low Income – Social Sciences)