ICT in Emerging Countries and Turkey: Cluster Analysis Approach

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Abstract
Changes that came with the new economic order have affected the whole globe. Especially the developments in information and communication technologies (ICT) caused the nations to concentrate in this field to increase their competitiveness. The emphasis placed by emerging countries that have low income but a high development potential on ICT is increasing every passing day, similar to all other countries. In the present study, it was aimed to cluster and analyze emerging economy countries, for which data was available, based on similar macroeconomic variables and information and communications technologies variables and to determine the place Turkey would occupy in this cluster. 2013 data for twenty two countries and twelve variables were analyzed using hierarchical cluster analysis. The analysis based on macroeconomic variable demonstrated that the countries were organized in four clusters and Turkey and many European emerging countries are in the same cluster. Based on the analysis conducted with ICT variables, the countries were clustered in four groups and Turkey was in the same cluster with many European countries.

Key Words: Information and Communication Technologies, Emerging Economies, Cluster Analysis.

JEL Classification Code: O3, O38, C38.

INTRODUCTION

Information played a significant role in development and progress since the beginning of human history. Along with globalization and technological revolution, information became the key factor in competitiveness. Several developed countries adapted information and innovation policies to increase their growth and competitive powers, while certain developing countries search for ways to produce knowledge and transform this knowledge into welfare although they lack sufficient level of institutions that could keep up with the change. Today, Information and Communication Technology (ICT) play a key role in solving social and environmental solutions. Despite its intrinsic problems such as privacy, security and quality of service, ICT are extremely important for sustainable growth and employment.

Today, while developed economies and especially Europe struggles with economic recession, the countries called emerging economies, especially China and India, entered a rapid growth trend as a result of the impetus created by globalization, foreign capital and technological advances and started to change the global economy in a way never witnessed before. Thus, China and India are the most important examples that continue to grow and develop with ICT .

In the present study, 22 selected emerging economies were grouped based on similar ICT and selected macro-variables and it was aimed to determine the place of Turkey in this groups. In the second section of the paper, the significance of ICT in emerging economies was addressed, conducted literature review was detailed in the third section, methodology and dataset were explained in the fourth section, empirical data were discussed in the fifth section, and finally conclusions were given in the sixth section.

1. Importance of ICT in Emerging Economies

The new economic order created by globalization came with several changes. Especially changes in information and communication technologies expanded rapidly throughout the world. Furthermore, along with the developments experienced in economic and political structures, the roles of the players in the market were redefined (Çivi, 2001: 113). Undeveloped / developing countries that were accepted as economically weak in 1960 – 1970's, could not break their own shells, self-enclosed and do not permit internal development were highly affected by this rapid global change (Çivi, 2001: 127). These countries are called emerging economies. Although there is no clear definition for emerging economies, there are three common characteristics of these economies. The first characteristic is the absolute level of economic development, generally reflected with GDP per capita, or the relative balance of agricultural and industrial/commercial activity. This definition is similar to those that classify these countries as "less developed countries (LDCs) or "third world countries." Second characteristic is the relative rate of economic development, generally reflected with the growth rate in GDP. The third is the system of market governance, especially the level and stability and existence of free-market structure. When an economy is in the process of liberalization from an authoritarian economy, in certain cases it is called a "transitional economy" (Arnold, Quelch, 1998). Emerging

economies are usually the countries with low income and rapid growth that utilize economic liberation as the main impulse for growth.

Similar to all nations, the significance of ICT for emerging economies increases every day. Especially, realization of the economic growth that is one of the main objectives of countries with low income is based on formation of various infrastructures. Tridico reported that, explanation of economic growth was a complex issue that requires a positive interaction of several socio-economic and institutional factors. The economic growth literature attempted to define growth on the basis of four or five factors, sometimes considered individually; these were human capital, technology, natural resources, trade, and population density (Tridico, 2007: 3). The most significant factor that affects economic growth is the use of new technologies. Especially the use of information and communication (ICT) technologies is a significant factor that defines the development level of the countries. Effective use of ICT is crucial in improving productivity or creating new markets. Continuously decreasing technology prices and the accompaniment of these price reductions with a growing range of applications demonstrate that they provide further opportunities for economic growth (Steinmueller, 2001: 193).

In advanced economies, an increasingly significant share in economic growth is provided by the ICT industry and ICT-enabled innovation in non-ICT industries and services. The ICT sector was the focus of EU Lisbon Objectives, and also occupied an important part in Europe 2020 Strategy. (European Commission, 2010: 1).

It is the consensus among leading academics, global organizations and industry analysts that the use of ICT is directly correlated with the use of ICT and positive macroeconomic growth (World Economic Forum, 2009: 4). During the last quarter of the 20th century, advances in information and communication technologies promoted an information age with widespread, deepened and transformed economic and social activity (Chandrasekhar: 1). ICT plays a role as a multiplier of economic growth. This could be observed clearly in the area of trade. By creating more efficient supply chains, richer collaboration, faster financial transactions, dynamic pricing and transparent processes, ICT could speed the flow of goods and services across national borders. Creating effective competition, ICT triggers and enhances trade by connecting people and places the way never occurred before and by bringing speeding the production of new ideas (World Economic Forum, 2009: 5). ICT investments have contributed to "capital deepening" by improving capital input per worker, enabling more efficient production which in turn increases labor productivity. Pervasive use of ICTs throughout the value chain has contributed to better performance in firms, increasing their efficiency in combining capital and labor (OECD, 2005: 7).

ICT could be a powerful tool to increase productivity, create jobs, generate economic growth and improve international cooperation in finance, trade, and Foreign Direct Investment (FDI), etc. (Shirazi et.al , 2009: 426).

ICT is a forerunner of productivity and growth, particularly in developing nations as expressed in Telenor Group's study of "Socio-Economic Impact

of Internet in Emerging and Developing Economies" which predicted the impact of the internet on the economy and society in three countries over the next ten-year period; Bangladesh, Serbia and Thailand. It is determined that an increase in internet density has the potential to produce economic benefits of significance in terms of overall GDP in 2020. Internet penetration will also stimulate entrepreneurship and increasing number of new business activities, which in turn would serve as a key driver of job creation. Increased economic activity would also benefit government tax revenues (Telenor Group, Towards a Connected World: 5-6). Experience shows that access to broadband networks has had a positive effect on income in rural areas in developing countries. For example, computers provide farmers better access to local weather forecast, crop price list and the latest sowing technique information in India. Added together, these improvements caused productivity gains for the farmers (World Bank, 2009: 6).

Service industry is one of the leading sectors that benefited from ICT. The service industry became a major component in the global economy, especially in most developed countries. Findings demonstrated over the last decade that this sector has accounted for around two-thirds of employment and value added in most industrialized countries. Thus, the attention paid to discovering the driving force behind the successful growth of (most) service industries has increased in recent years (Sapprasert, 2007: 1). The services sector accounts for 70 percent of employment and 73 percent of gross domestic product (GDP) in developed countries and for 35 percent of employment and 51 percent of GDP in developing countries (UNCTAD, 2008). Developing countries were very successful in IT services sector. Without doubt, India is the global leader. However, China, Mexico, and the Philippines are also emerging as potential players in this field. In addition, transitional economies in Central and Eastern Europe (the Czech Republic, Hungary, Moldova, Poland, Romania, and the Russian Federation) developed their capacity in IT services (World Bank, 2009: 7).

Turkey is a net importer of ICT products and services. ICT industry product and services international trade volume in Turkey is 7.6 billion dollars and its effect on current deficit is 2.5 billion dollars. Investments in the sector would result in the growth of the industry and decrease in the current deficit, while positively affecting the industries that are "close" to the sector (Yased, 2012: 5).

Although share of both population and economy of Turkey, 17th largest economy in the world, is over 1% in the worldwide economy, its share in the global ICT market is 0.75%, which signals the growth potential of the industry in Turkey.

2. Literature Review

There are several studies in the literature that scrutinized the correlation between information and communication technologies and the factors that affect the development of these technologies.

Boskin and Lau (2000) analyzed post-Second World War data for G-7 countries with econometric methods and determined that progress in technology is the most significant source of economic growth in their study. Pohjola (2000) studied the effects of investments in information technology

on economic growth. The results demonstrated that physical capital was a key factor in economic growth for both developed and developing countries. In a study by Jin and Cho (2015), it was identified that the effects of ICT capacity on economic development were statistically verified. Dholakia and Norlam (1994) concluded that there is a strongly positive correlation between investment in telecommunications infrastructure and economic development in their study, while returns on investment were more attractive for countries with lower levels of economic development. According to a recent World Bank econometrics analysis conducted with 120 country data, it was determined that for every 10-percentage-point increase in the penetration of broadband services, there is 1.3 percentage point increase in economic growth. This growth effect of broadband is significant and stronger in developing countries than in developed economies, and it is higher than the effects of telephony and Internet (World Bank, 2009: 5).

Shirazi et.al. (2009) investigated the effect of expansion in ICT sector on economic freedom in the Middle East. The findings demonstrated that ICT expansion in the Middle East was effective both in bridging the digital divide and in promoting economic freedom in a region that was vulnerable to political, social, and global conflict. However, differences between countries, such as the educational achievement of their citizens and institutional resistance to the acceptance of technologies, both enhanced and restricted the relationship between ICT and economic freedom. In an empirical study conducted by Wong (2002) aimed to determine whether Asian countries were slow to adapt ICT compared to other countries despite the fact that they had a higher share of global ICT production. The study answered the hypothetical question with a positive response and based on their current level of development (per capita GDP) and competitiveness (world competitiveness index), they had rather low rates of adaptation to ICT products.

There are significant differences between developed and developing countries in terms of the levels of access and use of ICTs. This is called the global digital divide (Acılar, 2011: 231) Developments in the field of communications show how the knowledge gaps between the information-rich and the information-poor have deepened over time, resulting in the exclusion of certain parts of the world from enjoying the fruits of what is called a Global Village (Iskandarani, 2008: 316). James (2007) indicated in his study that digital divide should be considered as an entirely new and unique aspect of the technological relationship between the rich and the poor countries. The digital divide between developed and developing countries was viewed as an important issue for the researchers interested in global IT development due to its impact on economic development and quality of life (Lu, 2001: 3). Quibria et. al (2003) found that income, education, and infrastructure play a critical role in formation of the digital divide. Chinn and Fairlie (2006) examined panel data for 161 countries over the 1999-2004 period. They explored the role of a comprehensive set of economic, demographic, infrastructural, institutional and financial factors in the global digital divide. They found evidence which indicated that income, human capital, the youth dependency ratio, telephone density, legal quality and

banking sector development were all associated with technology penetration rates. Billon et al. (2010) concluded that countries' income level was a significant factor for the development of information and communication technologies in their study, which scrutinized 142 developed and developing countries. The factors that determine the distribution of Internet across countries were investigated by Kiiski and Pohjola (2002). GDP per capita and the cost of internet access were determined to be the key factor for the growth in computer hosts per capita in OECD countries. Education was a significant factor for both developed and developing countries.

In a separate study, the impacts of internet and cellular phone penetration levels were examined in several countries (Andonova, 2006). It was identified that internet access was strongly dependent on the institutional environment in particular countries. However, mobile phone networks, which are less site-dependent and are easily re-deployable, were less dependent on institutional features. Beilock and Dimitrova (2003) developed a model to explain the differences in internet usage rates (IURs) measured as users per capita between global nations. It was found that the most significant determinant was per capita income. Openness of a society and the infrastructure were found to be the other important factors where telephone and personal computer densities were utilized as proxies. Liu and San (2006) sought to shed light on how effectively and rapidly the digital divide across countries can be bridged in their study. The results showed that political stability and the absence of violence, human capital, urbanization and the popularity of traditional media played a critical role in determination of the speed of information technology penetration.

The ability of ICT to deliver an economic growth dividend is motivating. For every dollar invested in broadband (fixed and wireless), the U.S. economy is expected to experience a tenfold return. Faster broadband deployment in Europe could create one million jobs and growth of up to €850 billion through 2015. Increasing broadband penetration in emerging markets to currently existing levels in Western Europe could add $300 to $420 billion in GDP and create 10 to14 million new jobs (World Economic Forum, 2009: 2).

The results of a study by Ssewanyana and Busler (2007) indicated that the adoption of ICT by developing country corporations follows a pattern similar to developed countries, and the only difference is observed in the level of usage and adoption.

3. Methodology

Cluster analysis could be defined as a group of methods that is used to cluster units or variables in X data matrix whose natural groups are unknown into similar groups. This analysis, which is a multivariate statistical method is commonly used in scientific fields where uncertain conditions and complex formations are observed such as medicine, biology, engineering sciences, agriculture, psychology, sociology and archeology (Özdamar, 2004: 279-281).

Cluster could be likened to clouds formed by individuals in juxtaposition in the multi dimensional space. As could be understood from the above definition, the concept of cluster is closely related to the concepts of similarity and distance. In cluster analysis, several distance measures are utilized in multidimensional calculation of the distances between units or variables. Distance measures such as Minkowski distance, Euclidean and square Euclidean distance, Pearson and square Pearson distance, Manhattan distance (city-block), correlation coefficient and correlation distance, cosine measure, Chebyshev, gamma measure, hoteling T2, Canberra and Jaccard measures could be listed among these.

Cluster analysis with the general aim of classification and numerical taxonomy could also be used for special purposes such as the determination of the real types, facilitation of model improvisation, pre-estimating groups, testing hypotheses, clarification of the data structure, finding outliers and data reduction (assessment of clusters instead of data) (Tatlıdil, 2002: 329-330).

Cluster analysis aims to separate observations into clusters in a way that when clustering variables are concerned, the cluster would be as homogenous as possible. In cluster analysis, initially a similarity measure is selected. In the next step, the type of clustering technique that would be used in the analysis needs to be decided. In the third step, the type of clustering method based on the selected techniques is selected. In the fourth step, the number of clusters to be made is decided. And finally in the last step, the cluster analysis is interpreted (Sharma, 1996: 187).

In cluster analysis, there are several methods that could be used to assign units or variables into homogenous and heterogeneous groups using the distance and similarity analysis. These methods could be divided into two main topics of hierarchical and non-hierarchical clustering methods. The most frequently used hierarchical clustering methods are single-linkage method (nearest-neighbor method), complete-linkage method (farthest-neighbor method), average-linkage method, centroid-linkage method, median-linkage method and ward-linkage method. On the other hand, the most frequently used non-hierarchical clustering methods are k-means method, medoid clustering method, fuzzy clustering and hill climbing methods.

3.1. Data Set and Variables

Data used in the present study are obtained from "The Global Information Technology Report 2015" published by World Economic Forum and the World Bank. The objective of the present study is to group twenty two emerging economies based on similar macroeconomic and information economy variables and to determine the status of Turkey in this categorization. The study was conducted with 2013 data for twenty two emerging economies, namely Bulgaria, China, Hungary, Indonesia, India, Lithuania, Malaysia, Poland, Romania, Turkey, Thailand, Brazil, Chile, Colombia, Czech Republic, Egypt, Greece, South Africa, Latvia, Slovak Republic, Korea Republic and Estonia. In this study, data for 5 macroeconomic and 7 information technology variables were collected to be

used in categorization of the countries. Variables used in the analysis are presented in Table 1. In the following part, the detailed information about these variables are given.

Table 1: ICT and Macroeconomic Variables for Emerging Economy Countries

Information Economy Variables	Macroeconomic Variables
Mobile Cellular Subscription (per 100 people)	Economic Growth (%)
R&D expenditure (% of GDP)	Per Capita Income (PER US $)
Scientific and technical journal (number)	Uneployment rate (%)
Regulatory quality (%)	Inflation Rate (%)
Ict good exports (% of total goods export)	Foreign direct investment (% of GDP)
Ict service exports (% of total service export)	
Quality education	

Mobile cellular subscription (MCS): Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the Public Switched Telephone Network (PSTN) using cellular technology.

R&D expenditure (RDE): Expenditures for R&D are current and capital expenditures (both public and private) on creative work undertaken systemically to increase knowledge, including knowledge of humanity, culture and society and the use of knowledge for new applications.

Scientific and technical journal (STJ): Scientific and technical journal articles refer to the number of scientific and enginnering articles published in the following fields: Phisiycs, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.

Regulatory Quality (RQ): Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Ict good exports (ICTGE): Information and communication technology goods exports include telecommunications, audio and video, computer and related equipment; electronic components; and other information and communication technology goods. Software is excluded.

Ict service exports (ICTSE): Information and communication technology service exports include computer and communication services and information services.

Quality education (QE): How well does the educational system in your country meet the needs of a competitive economy (1= not well at all, 7= extremely well)

Economic Growth (EG): Annual percentage growth rate of GDP at market prices based on constant local currency.

Per Capita Income (PCI): Per capita income is gross domestic product divided by midyear population.

Uneployment rate (UR): Unemployment refers to the share of the labor force that is without work but available for and seeking employment.

Inflation Rate (IR): Inflation as measured by the consumer price ındex reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.

Foreign direct investment (FDI): Foreign direct investment refers to direct investment equity flows in the economy.

4. Empiricial Findings

In the present study, data was collected for twenty two emerging economies. Cluster analysis was conducted using collected macroeconomic and information economy variables based on the similar characteristics of these countries. In the study, where 2013 data were used, several hierarchical clustering model and related distance measures were used and the findings of the model that met the expectations better was interpreted and presented. Centroid hierarchical clustering method was used in the study. Agglomeration schedule obtained with the analysis applied to the macroeconomic variable data for the countries scrutinized in the study is presented in Table 2.

When the first line of the cluster combined column in examined, it could be observed that Malaysia and Turkey are the initial countries with similar values. Second stage line in the table shows that countries with closer values are Lithuania and Chile. In the third stage, countries with close values are China and South Africa and Hungary and Poland are the similar countries in the fourth stage. It could be observed that the closest countries in the fifth stage are Indonesia and Egypt. It was observed that the stage after the next stage column in the stage 1 was the 11th stage. This means that Malaysia and Turkey will form a cluster with another country that will join them in the 11th stage. The stage 11 line in the table demonstrates that these two countries formed a cluster with Brazil.

Table 2: Macroeconomic Variables Agglomeration Schedule

Cluster Combined				Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficient	Cluster 1	Cluster 2	Next stage
1	7	10	8,203	0	0	11
2	6	13	108,325	0	0	9
3	2	18	113,845	0	0	8
4	3	8	191,116	0	0	14
5	4	16	363,595	0	0	15
6	1	14	373,434	0	0	10
7	15	22	600,007	0	0	12
8	2	11	678,527	3	0	10
9	6	19	718,938	2	0	14
10	1	2	879,883	6	8	18
11	7	12	1123,558	1	0	13
12	15	20	1250,016	7	0	16
13	7	9	1511,359	11	0	17
14	3	6	1590,793	4	9	17
15	4	5	1895,771	5	0	18
16	15	17	2388,953	12	0	19
17	3	7	2882,530	14	13	19
18	1	4	3545,773	10	15	20
19	3	15	4735,949	17	16	20
20	1	3	6293,466	18	19	21
21	1	21	11314,297	20	0	0

It is possible to observe the results obtained in Table 2 visually in a dendrogram that exhibits the distances and association levels between the units or variables. Country clusters based on macroeconomic variables are displayed in Figure 1.

In the dendrogram depicted in Figure 1, rescale distance cluster is shown in the horizontal axis and countries and country codes are presented in the vertical axis. It could be observed in the figure that the distances between the countries decreased from right to left and more clusters are formed. At this point, the number of adequate clusters that would provide homogeneity within clusters and heterogeneity between the clusters should be determined.

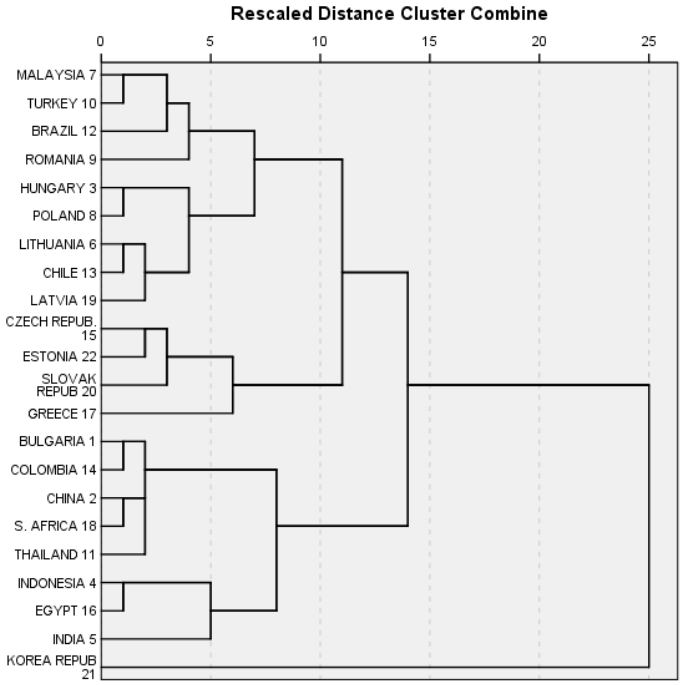

Figure 1: Dendrogram Based on Macroeconomic Variables

Agglomeration schedule and dendrogram results demonstrated that the adequate cluster count should be four or five. Thus, cluster membership for a minimum 2 and maximum 5 clusters were determined in the statistical software and displayed in Table 3.

According to the results in Table 3, it was determined that the ideal number of clusters was four based on in-cluster homogeneity and between-clusters heterogeneity and country clusters are presented in Table 4. It seemed appropriate that the first cluster to include Bulgaria, China, Indonesia, India, Thailand, Colombia, Egypt and South Africa, the second cluster to include Hungary, Lithuania, Malaysia, Poland, Romania, Turkey, Brazil, Chile and Latvia, the third cluster to include Czech Republic, Greece, Slovak Republic and Estonia and finally the fourth cluster to include Korea Republic.

Table 3: Cluster Membership Based on Macroeconomic Variables

Case	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1: BULGARIA	1	1	1	1
2: CHINA	1	1	1	1
3: HUNGARY	2	2	2	1
4: INDONESIA	3	1	1	1
5: INDIA	3	1	1	1
6: LITHUANIA	2	2	2	1
7: MALAYSIA	2	2	2	1
8: POLAND	2	2	2	1
9: ROMANIA	2	2	2	1
10: TURKEY	2	2	2	1
11: THAILAND	1	1	1	1
12: BRAZIL	2	2	2	1
13: CHILE	2	2	2	1
14: COLOMBIA	1	1	1	1
15: CZECH REPUBLIC	4	3	2	1
16: EGYPT	3	1	1	1
17: GREECE	4	3	2	1
18: SOUTH AFRICA	1	1	1	1
19: LATVIA	2	2	2	1
20: SLOVAK REPUBLIC	4	3	2	1
21: KOREA REPUBLIC	5	4	3	2
22: ESTONIA	4	3	2	1

Table 4: Clusters Based on Macroeconomic Variables

Cluster Number	Cluster Member
1	1: BULGARIA, 2: CHINA, 4: INDONESIA,
1	5: INDIA, 11: THAILAND, 14: COLOMBIA,
1	16: EGYPT, 18: S.AFRICA
2	3: HUNGARY, 6: LITHUANIA, 7: MALAYSIA,
2	8: POLAND, 9: ROMANIA, 10: TURKEY,
2	12: BRAZIL, 13: CHILE, 19: LATVIA
3	15: CZECH REP., 17: GREECE, 20: SLOVAK REP.,
3	22: ESTONIA
4	21: KOREA REP.

In the study, secondly the same technique was used to analyze the clustering of the related countries based on ICT variables and resulting agglomeration schedule is presented in Table 5.

Table 5: ICT Variables Agglomeration Schedule

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficient	Cluster 1	Cluster 2	Next stage
1	3	11	36,857	0	0	3
2	4	6	193,851	0	0	5
3	3	7	197,334	1	0	10
4	9	22	208,693	0	0	6
5	1	4	239,228	0	2	12
6	9	22	268,787	4	0	10
7	14	23	271,695	0	0	9
8	19	21	481,063	0	0	13
9	13	14	498,261	0	7	15
10	3	9	665,014	3	6	12
11	8	10	766,742	0	0	13
12	1	3	1041,535	5	10	15
13	8	19	1182,494	11	8	14
14	8	20	2255,913	13	0	16
15	1	13	2839,585	12	9	17
16	8	18	4043,768	14	0	17
17	1	8	5756,920	15	16	19
18	12	24	10244,118	0	0	20
19	1	5	15399,101	17	0	21
20	2	12	33611,007	0	18	21
21	1	2	47942,475	19	20	0

It could be observed in Table 5 that Hungary and Thailand are the countries with similar values in the first stage. In the second stage, countries with closer values are Indonesia and Lithuania. In the third stage, countries with close values are Hungary and Thailand and Malaysia and Romania are the similar countries in the fourth stage forming a cluster. The same interpretations could be made about the dendrogram given in Figure 2.

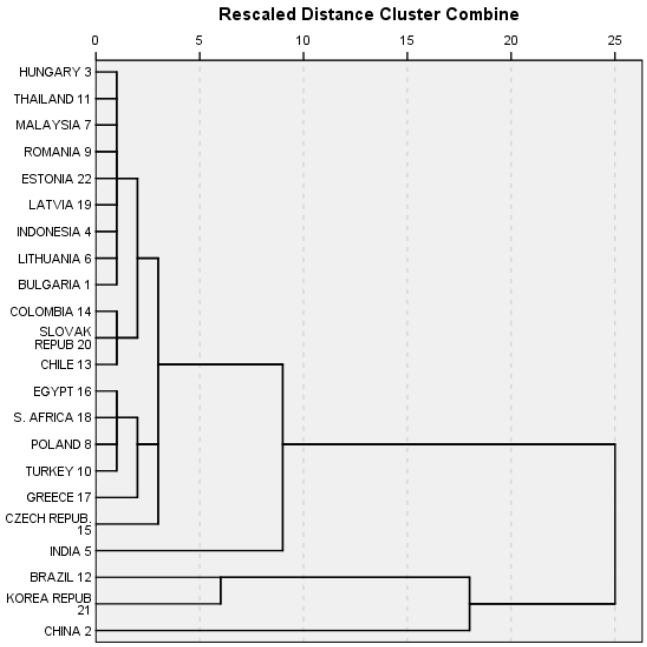

Figure 2: Dendrogram Based on ICT Variables

When the agglomeration schedule in Table 5 and the dendrogram in Figure 2 are considered in conjunction, it was understood that the adequate cluster count should be four or five. Cluster memberships determined for at least 2 and at most 5 clusters are presented in Table 6 below.

Table 6: Cluster Membership Based on ICT Variables

Case	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1: BULGARIA	1	1	1	1
2: CHINA	2	2	2	2
3: HUNGARY	1	1	1	1
4: INDONESIA	1	1	1	1
5: INDIA	3	3	1	1
6: LITHUANIA	1	1	1	1
7: MALAYSIA	1	1	1	1
8: POLAND	1	1	1	1
9: ROMANIA	1	1	1	1
10: TURKEY	1	1	1	1
11: THAILAND	1	1	1	1
12: BRAZIL	4	4	3	2
13: CHILE	1	1	1	1
14: COLOMBIA	1	1	1	1
15: CZECH REPUBLIC	1	1	1	1
16: EGYPT	1	1	1	1
17: GREECE	1	1	1	1
18: SOUTH AFRICA	1	1	1	1
19: LATVIA	1	1	1	1
20: SLOVAK REPUBLIC	1	1	1	1
21: KOREA REPUBLIC	5	4	3	2
22: ESTONIA	1	1	1	1

Based on Table 6, when there are 4 clusters, it is observed that China and India separate form a cluster. This finding is a significant one that overlaps with the theoretical expectations. Considering the clusters formed by other countries, it was decided that the ideal cluster count would be four and countries were grouped as shown in Table 7.

Table 7: Clusters Based on ICT Variables

Cluster Number	Cluster Member
1	1: BULGARIA, 3: HUNGARY, 4: INDONESIA,
1	6: LITHUANIA, 7: MALAYSIA, 8: POLAND,
1	9: ROMANIA, 10: TURKEY, 11: THAILAND,
1	13: CHILE, 14: COLOMBIA, 15: CZECH REP.,
1	16: EGYPT, 17: GREECE, 18: S. AFRICA,
1	19: LATVIA, 20: SLOVAK REP., 22: ESTONIA
2	2: CHINA
3	5: INDIA
4	12: BRAZIL, 21: KOREA REP.

As could be observed in Table 7, Bulgaria, Hungary, Indonesia, Lithuania, Malaysia, Poland, Romania, Turkey, Thailand, Chile, Colombia, Czech Republic, Egypt, Greece, South Africa, Latvia, Slovak Republic and Estonia were considered as the first cluster, China was considered as the second cluster, India was considered as the third cluster, and Brazil and Korea Republic were considered as the fourth cluster.

CONCLUSION

Today, global economy is in a period of great change and transformation. The balance between the developed and developing countries rapidly change in this period and information and communication technologies (ICT) fundamentally change developmental strategies and growth targets of the countries. ICT has become indispensable for increase in wealth, employment and economic growth. The post-1995 10-year period called the period of productivity miracle where the output per employee difference between the US and Europe increased from 1.8% to 9.8% demonstrated the effect of ICT on economy clearly (YASED, 2012: 10).

Also emerging markets that have a rapid growth trend and increase in significance in global economy try to improve their infrastructure. The ICT market in emerging economies in the Asia-Pacific such as China, Korea Republic and India, albeit being smaller than the EU market in the past, have surpassed Europe as of 2008. The increasing demand of the dense population in this region for communication services, the abilities and expertise of countries that had invested heavily in ICT industries such as India and the competitiveness of Asian countries became the driving force behind this rapid growth. Furthermore, the investments by multinationals, especially the research and development centers established by European corporations in these countries resulted in an unbelievable development in ICT sector.

Unfortunately, ICT industries in European emerging economies and especially Turkey are behind these countries. Turkey is behind both European and Asian bright economies in indicators such as ICT service exports, number of patents, scientific articles, number of researchers in research centers. Although the country has similar rates with the countries included in the present study in R&D expenditures, this amount includes

only government spending, while in countries where foreign investments dominate, the share of the private sector in R&D investments is quite high, contrary to the situation in Turkey.

In the present study, the clustering of twenty two emerging economies based on macroeconomic and ICT variables and the status of Turkey in these clusters were determined. Thus, hierarchical cluster analysis was conducted on the collected data. Analysis results demonstrated that the countries were clustered in four groups based on macroeconomic variables and Turkey was in the same cluster with many European emerging countries, while countries successful in economic growth such as China and India were in the same cluster.

Analysis results conducted with ICT variables showed that there were a total of four clusters when both China and India formed in a separate cluster, Korea Republic and Brazil formed in a same cluster. Other emerging countries including Turkey formed in a separate cluster.

Although clustering based on macroeconomic variables, China and India formed in a same cluster, clustering based on ICT, these countries were in a separate cluster. These results can be explained that, India is a leader in the ICT service export whereas China is a leader in the ICT good export.

Thus, it is possible to argue that Turkey, which is in a relatively good position based on economic growth and development, was not able to meet the same level of development in the field of ICT. Although Turkey has advantages such as a young and dynamic population, tendency of growth in the ICT sector, factors such as low level of R&D investments, lower level of education when compared to developed countries, lack of sufficient foreign investments, and macroeconomic uncertainties experienced during recent years, prevent the sufficient development of the ICT industry. Consideration and development of policies that would be implemented in ICT sector as a whole in Turkey would improve the share of the country in ICT industry.

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