THE COMPARATIVE DEVELOPMENT OF ICT IN BRICS: A CLUSTER ANALYSIS

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Abstract

The development of Information Communication Technology (ICT) has been one of the main drivers of technological change and, hence, of economic growth in recent years. Brazil, Russia, India, China and South Africa, the so-called BRICS countries, are well known for their technological potential and they have therefore inspired many studies that examined their economies from various perspectives. However, only a few have specifically focused on ICT in BRICS. This study aims to contribute to the literature by determining the comparative development of ICT in each BRICS country relative to 200 countries during the period from 2005 to 2013. For that purpose, cluster analysis is used as a methodology. The clusters are defined by: fixed-broadband subscriptions, fixed-telephone subscriptions, mobile-cellular-telephone subscriptions, and percentage of individuals using the internet. There are five clusters: *very-low*, *low*, *medium*, *high* and *very-high*. Each corresponds to a comparative development level. The empirical findings indicate that, among 200 economies in 2005, Brazil, China and South Africa were clustered in the low development group, whereas India belonged in the very-low development cluster and Russia was included in the medium development cluster. Brazil, South Africa and Russia exhibited consistent comparative development during the examined period and, therefore, they are found to be in higher clusters in 2013. The findings also show that the comparative development of ICT in China has been volatile, whereas India's cluster has varied from low to very-low development relative to the examined economies.

Keywords: ICT, BRICS, cluster analysis

Introduction

Information Communication Technology (ICT) has become recognized as a key factor in bringing about social and economic development in recent decades. ICT is closely linked with technological accumulation and, therefore, developed countries are mostly very advanced in ICT (Garcia-Muniz and Vicente, 2014: 360). As for developing and emerging countries, development of ICT is important for fostering economic growth. However, this process is harder for them than it is for developed countries (Meng and Li, 2002: 275). Brazil, Russia, India, China and South Africa (BRICS), as major emerging countries, have assumed a significant place in the global economy recently and, as Thornton (2007) states, their role is expected to be greater in the near future. In addition to their strategic positions, they are also well known for their technological potential. Each country faces some deficiencies in terms of their technological development. These deficiencies may result in slower technological adoption and, hence, an economic growth slow-down; the examination of the subject is important from the point of sustainable development (Yao et al., 2009: 10).

BRICS, with their technological potential, have inspired many studies; however, there are few studies in the literature that focus specifically on their ICT development. The studies that examine the subject in BRICS mostly focus on the main ICT proxies, relevant policies, and their development in ICT through time. There are also some studies which take the issue from the point of view of one of the BRICS countries and evaluate the performance of the selected country versus the other BRICS. There is not any study that focuses on the relative

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position of ICT development in these economies among other countries, to the best to our knowledge. Hence, this study aims to contribute to the literature by determining the comparative development of ICT in each BRICS country relative to 200 countries during the period from 2005 to 013. In an effort to fill the gap from the comparative development of ICT aspect, cluster analysis is used as a methodology. The proxies that are includedin the analysis are the ones that are widely used to track the development of ICT in countries. These main proxies are: fixed broadband subscriptions, fixed telephone subscriptions, mobile-cellular telephone subscriptions, and percentage of individuals using the internet. Five clusters are determined in the analysis in order to define relative development of each BRICS country among other countries. Hence, these clusters correspond to the comparative development of the countries and they are, namely, *very low, low, medium, high* and *very high.* Since the importance of ICT development continues to hold a very significant place in economic growth, such a clustering analysis will help to define the positioning of each BRICS country among other countries. Most of the BRICS countries may make progress in the area, but the faster progress of other countries may lead a BRICS nation to lose its competitiveness and, hence, its relative development in ICT. This regard makes comparative development a more significant issue than development of ICT alone.

The rest of the study is organized as follows. Section 1 gives a brief summary of the literature review of the subject in BRICS and section 2 explains the most recent status of ICT in BRICS. Section 3 introduces the methodology, data and the variables of the empirical analysis; section 4 presents the empirical findings; and the final section concludes.

1. Literature Review

The importance of ICT in technological development has gradually increased in the recent years and, accordingly, there are a great number of studies concerning the subject in the literature. Some of the most recent existing works are by Gerami (2010), Huarng (2011) and Seki (2008). Gerami (2010) compared the rankings of 12 Middle Eastern countries by relying on the sub-indices of the ICT Development Index (IDI) of ITU for 2007 and 2008. The mentioned indices are: access sub-index, use sub-index and skill sub-index. Seki (2008) examined the subject from different perspective and studied productivity levels of selected OECD countries. For that purpose, he derived total factor productivity (TFP) first and then used Data Envelopment Analysis (DEA) in order to measure performance of ICT in selected OECD countries. Huarng (2011) studied ICT development by classifying 121 economies from 1999 to 2007. The countries were classified depending on two variables: a country's number of internet subscribers and its gross domestic product (GDP); the number of cluster were then defined as three: low, medium and high. This paper presents the findings depending on analysis throughout the time examined in the study and on analysis by economies. The estimation results by economies focus on the classification of countries which constitute several groups, such as the EU, OECD, and Four Little Dragons (Hong Kong, South Korea, Taiwan and Singapore) and BRICs.

Despite the existence of many studies on ICT, only a limited number focus on BRICS and some of those failed to include South Africa; hence, most only include four countries. Yao, Watanabe and Li (2009) examined three hypotheses of sustainable development in Brazil, Russia, India and China and one of these hypotheses focused on development of ICT in these four countries. This study includes three main proxies for ICT: utilization of personal computers, the internet, and mobile phones. It concludes that ICT has a "triggering role" in the interaction between innovation and institutional systems in BRICs. Simon (2011) analyzed three of the BRICS countries, namely, Brazil, India and

China. This report describes the characteristics of ICT in these countries by focusing on the size of their ICT markets and R&D expenditures in the sector. This report is complemented by two other reports, by Makarov et al. (2012) and Gillwald and Simon (2012), which respectively document the main structure of ICT sector of the remaining two BRICS countries, Russia and South Africa; the authors are respectively. Simon (2013) examines the general characteristics of ICT in BRICS countries from various perspectives. All these studies are significant since they represent the main features of the ICT sector in BRICS countries.

While the presence of limited studies on ICT in BRICS, there is no study that has focused on the relative development of ICT in BRICS compared to other countries, to the best to our knowledge. This study aims to fill this gap in the literature by examining the comparative development of each BRICS country among 200 economies with a very recent dataset from 2005 to 2013 by using cluster analysis. The findings show the position of each BRICS country in the estimated classification throughout the examined time period. In other words, the estimated classification displays relative development of ICT in each BRICS country compared to other economies.

II. ICT in BRICS

The significance of BRICS countries in the global economy has gradually increased and their development on ICT has been very remarkable in the last decade as well (Yao and Liu, 2011: 1068). BRICS are known for being capable in producing ICT goods and services, especially in services (Simon, 2011: 7) The most recent data from World Bank show that ICT goods exports from China is extremely high, amounting to 27.1% of the country's total goods exports in 2012. This ratio is very low in other BRICS countries and varies between 0.3% and 2.0%. Yet, ICT service exports represent the production capability of these countries better than ICT goods exports do. The highest ICT service exports as a percentage of total service exports among BRICS are of India and Brazil, and they are equal to 65.9% and 55.7% respectively in 2012. ICT service exports in China accounts for 34.9% of its total service exports and this value in Russia is very close to that of China with 31.9% in the same year. South Africa exports relatively lower percentage of its total services in ICT and it is computed as 10.6%. These statistics show that production capability of ICT goods and services in BRICS is mostly due to their competency in ICT services exports rather than ICT goods exports. The statistics on ICT goods and services exports for 2012 are represented in Table 1.

Table 1: ICT Goods and Services Exports in BRICS, 2012

	ICT goods exports (% total goods exports)	ICT service exports (% service exports)
Brazil	0.5	55.7
Russia	0.3	31.9
India	2.0	65.9
China	27.1	34.9
S. Africa	1.0	10.6

Source: The World Bank Data (http:data.worldbank.org)

Brazil has exhibited remarkable development in ICT since the 1990s and this sector accounted for 7% of Brazil's GDP as of 2011. As Simon (2011) notes, the largest share in the sector belonged to telecommunication sub-sector, which constituted 43.1% of

the total ICT sector. The development of ICT sector in India has been a major driver of economic development and the software services is known to be the main sub-sector in ICT. As it is presented in Table 1, China is competent to produce ICT products and, hence, its exports in both ICT goods and services are high. Its expenditures on ICT increased dramatically from 2000 to 2008. The sector grew 45% annually between 2000 and 2004, and 20% from 2004 to 2008. Manufacturing is the dominant ICT sub-sector in China (Simon, 2011). The ICT development is regarded as extremely significant in China. Projects on implementation of green ICT may be regarded as a proof of the manner (Zhang and Liang, 2012: 998).

The addition of South Africa to BRICs took place in 2010 and was criticized by some analysts. The main criticism pertained to South Africa's relatively small economy and lower macroeconomic indicators compared to the BRICs (Lesame, 2014: 285). The present regulatory system for ICT impedes the expansion of the sector in South Africa. However, it achieved significant growth in ICT, especially in recent years. The growth of the ICT sector is much higher than the growth of GDP in South Africa and the share of the sector accounted for 6% of GDP in 2012. The development of the ICT sector in the country is mostly due to the expansion of the mobile sector (Gillwald, Moyo and Stork, 2012).

III. Empirical Analysis

Empirical analysis of the study aims to examine comparative development of BRICS countries separately among other countries with a recent dataset from 2005 to 2013.

III.1. Methodology

The cluster analysis technique is used as a methodology in this study. Cluster analysis has a long history and it is used to determine different groupings in multivariate datasets (Jain, 2010: 653). There are different methods, but one of the most popular, k-means, was chosen in this study. K-means cluster analysis aims to generate k clusters by minimizing the difference between mean of that cluster and points in the cluster. "K" refers to the number of clusters and the method tries to place observations in k clusters in an optimal way. For that purpose, observations led to change clusters for the search of their most convenient clusters algorithmically. When all the observations are placed in the most convenient cluster depending on cluster means, the optimal grouping is reached (Hartigan and Wong, 1979: 100). K is set to 5 in this study and each cluster is defined depending on comparative development of ICT. These five clusters are *very low, low, medium, high* and *very high*.

III.II. Data and Variables

The analysis covers 200 countries[‡] and four main ICT proxies: fixed broadband subscriptions per 100 inhabitants *(FBS)*; fixed telephone subscriptions per 100 inhabitants *(FTS)*; mobile-cellular telephone subscriptions per 100 inhabitants *(MTS)*; and the percentage of individuals using the internet *(PIU)*. The data on proxies is collected from the International Telecommunication Union (ITU) Database and they represent countries' level of development in ICT. The analysis covers recent annual values from 2005 to 2013.

[‡] Countries are listed in Appendix B.

IV. Empirical Findings

Table 2 shows the descriptive statistics on five clusters for the first and the last year covered in the analysis. These statistics are for the total of 200 countries covered in the analysis. The descriptive statistics on all the years are presented in Appendix A.

Table 2: Descriptive Statistics for Clusters (2005 and 2013)

2005						2013			
		FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU
Very Low	Mean	0.11	4.70	10.29	3.69	0.70	3.82	52.69	13.74
	St. Dev.	0.41	6.95	7.92	4.20	1.30	5.95	19.15	12.02
	Min.	0	0.02	0	0	0	0	5.6	0.9
	Max.	3.26	48.07	30.06	17.1	7.09	29.43	86.3	39
Low	Mean	1.03	16.65	46.81	12.16	5.56	12.25	108.24	33.10
	St. Dev.	1.07	7.91	11.28	6.57	5.31	8.65	14.99	17.36
	Min.	0.01	2.84	25.49	2.96	0.01	0.35	73.74	2.3
	Max.	4.32	32.14	70.4	26.45	17.33	38.33	140.4	64.5
Medium	Mean	3.31	28.60	74.47	30.47	11.64	22.01	199.35	47.96
	St. Dev.	3.03	8.88	9.08	10.65	12.65	18.72	43.49	25.46
	Min.	0.41	11.89	58.7	12.8	0.53	1.15	160.6	9.2
	Max.	12.73	48.73	88.21	55.19	30.75	63	304.1	75.46
High	Mean	10.90	40.93	108.78	38.10	16.23	25.38	149.45	66.34
	St. Dev.	6.06	8.46	10.53	11.37	8.65	11.65	11.92	14.70
	Min.	0.95	24.37	92.31	24	2.62	5.2	127.1	41.8
	Max.	24.06	57.16	132.5	61.45	34.8	62.83	171.9	93.78
Very High	Mean	17.79	57.80	84.43	66.82	28.83	46.89	108.83	78.14
	St. Dev.	7.50	13.96	18.98	11.68	10.44	19.84	15.59	13.17
	Min.	0	40.41	25.9	42.87	4.11	17.74	76.05	50.8
	Max.	28.82	100.5	111.4	87	61.37	123.8	144.3	96.9
All	Mean	4.54	22.27	47.86	22.29	11.77	20.74	105.73	44.87
	St. Dev.	7.45	21.12	36.86	23.83	12.89	20.35	42.87	29.24
	Min.	0	0.02	0	0	0	0	5.6	0.9
	Max.	28.82	100.5	132.5	87	61.37	123.8	304.1	96.9

Table 2 shows that mean values of fixed broad-band subscriptions *(FBS)*, mobile-telephone subscriptions *(MTS)*, and percentage of individuals using the internet *(PIU)* in 2005 had increased significantly by 2013 for each cluster. On the contrary, fixed telephone subscriptions *(FTS)* declined in all clusters from 2005 to 2013.

Table 3 indicates the findings of the analysis and shows the clusters in which BRICS countries belong in each year.[§] The findings show that Brazil, China and South

[§] The clusters in which all the 200 countries were members is presented in Appendix B.

Africa belonged to the low development cluster in 2005 because of their comparative development in ICT relative to the 200 countries included in the analysis. In the same year, Russia was found to be involved in the medium development cluster, whereas India was classified in the very low development cluster, which is the least developed cluster of all.

The findings of the years after 2005 show that the comparative development of ICT in Brazil and Russia exert a continuing trend which placed them in higher clusters up to 2013. By the year 2007, the cluster in which Brazil belong had changed from the low development to the medium development cluster. It then became a member of the high development cluster for the first time in 2013. The findings for Brazil show that ICT development has exerted a stable amelioration and this progress has increased the country's competitiveness in ICT. Russia was estimated to belong in the high development cluster in 2007 and its comparative development in ICT had remained stable up to 2013. The findings indicate that Russia is the most developed in ICT among BRICS countries.

Table 3: Findings for Cluster Analysis

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	*Low*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*
Russia	*Medium*	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*	*High*
India	*Very Low*	*Very Low*	*Very Low*	*Very Low*	*Very Low*	*Low*	*Low*	*Low*	*Very Low*
China	*Low*	*Very Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
S. Africa	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*High*

Notes: There are 5 clusters. Each cluster corresponds to comparative development of ICT among 200 economies.

The findings for India show that the comparative development of ICT had improved by 2010 and this progress meant India now belonged to the low development cluster. However, this progress did not take long time and it was clustered again in the very low development cluster by the year 2013. These results for India exert a relative recovery in ICT, yet the recovery was insufficient to keep India in low development cluster.

China was mostly found to fall within the low development cluster during the examined period. Its comparative development in ICT led it to be clustered in the least developed cluster, namely the very low cluster in 2006. However, the country dropped to the low development group again in 2007 and kept that level of comparative development until 2012. In that year, the proxies of China exert a slight improvement which classified the country in the medium development cluster. By the year 2013, it was involved in low development cluster. The findings for China show that, although the country has is mostly been clustered in the low development group, it showed relative progress in its main proxies for ICT by 2012 and China may reach the higher clusters if this progress continues in the ensuing years.

South Africa was clustered in the low development group at the beginning of the period under examination but, except for the year 2009, it showed continuous development throughout. The cluster in which it was grouped changed from the low to medium in 2007 and it was clustered in the medium group, aside for 2009, up to 2013. By the year 2013, South Africa was included in a higher cluster, namely, the high development cluster. Comparative development of ICT in South Africa shows that, the country made a

considerable progress on ICT, most of which originate from mobile telecommunication industry, during the examined period.

Conclusion

ICT development of has been considered to be a quite significant factor in technological development in recent decades. BRICS, with their technological potential, have been the subject of many studies in development economics, but only few of them have focused on ICT development relative to other economies. This study aims to contribute to the literature by determining the comparative development of ICT of each BRICS country among 200 countries between 2005 and 2013. Cluster analysis is used as a methodology and the clusters are defined by four main ICT proxies: fixed broadband subscriptions, fixed telephone subscriptions, mobile-cellular telephone subscriptions and percentage of individuals using the internet. The number of clusters in the analysis is defined as five clusters, namely, *very low, low, medium, high* and *very high*. These clusters correspond to comparative development levels. The findings indicate that, among 200 economies, Brazil, China and South Africa were clustered in the low development group in the year 2005. In the same year, India was found to belong in the low group whereas Russia was included in the medium cluster. Brazil and Russia exerted continuous comparative development during the period examined and, consequently, were clustered in the high development cluster in 2013. South Africa as well exhibited continuous comparative development in ICT. Its cluster membership rose from low to medium in 2007 and, aside from 2009, remained classified in that cluster up to 2013. By the year 2013, it was clustered in the high development cluster, having displayed considerable improvement, mostly due to expansion of its mobile telecommunication industry. The findings also show that the cluster in which China belonged usually was the low development cluster. Finally, India's cluster varied between low, very low and medium in the analyzed period, and ending in the very-low cluster in 2013.

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Appendix A: Descriptive Statisitics for Clusters (All Years)

		2005				2006				2007				2008				2009			
		FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU
Very Low	Mean	0.11	4.70	10.29	3.69	0.27	6.17	16.47	5.27	0.12	3.22	14.77	3.98	0.19	3.42	19.33	3.81	0.37	3.52	23.44	4.24
	St. Dev.	0.41	6.95	7.92	4.20	0.77	8.45	11.11	5.26	0.39	7.28	9.27	4.28	0.75	8.00	11.59	4.40	1.52	8.65	13.29	4.93
	Min.	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.06	0.00	0.00
	Max.	3.26	48.07	30.06	17.10	4.66	48.94	38.36	20.70	2.77	50.76	30.50	18.57	5.10	52.05	40.40	18.82	9.62	54.24	44.31	20.00
Low	Mean	1.03	16.65	46.81	12.16	2.13	17.42	62.00	16.82	1.14	12.73	45.38	11.81	1.74	13.09	59.95	14.70	1.60	11.65	68.26	16.23
	St. Dev.	1.07	7.91	11.28	6.57	1.94	8.11	13.27	8.44	1.63	8.89	10.54	8.06	2.64	10.99	12.51	9.88	2.39	10.71	14.54	10.50
	Min.	0.01	2.84	25.49	2.96	0.09	2.58	32.87	3.27	0.00	0.36	27.42	1.43	0.00	0.23	34.09	1.87	0.00	0.29	42.39	2.00
	Max.	4.32	32.14	70.40	26.45	7.07	35.01	89.51	34.50	7.34	33.19	64.52	34.80	11.43	57.13	87.67	42.00	12.92	54.90	96.02	41.50
Medium	Mean	3.31	28.60	74.47	30.47	6.55	33.91	94.22	36.33	3.35	19.48	84.48	22.63	5.29	21.57	101.98	28.74	9.11	24.82	106.33	39.42
	St. Dev.	3.03	8.88	9.08	10.65	5.20	11.48	11.46	12.36	2.75	10.04	13.26	11.49	3.48	9.02	14.62	12.48	5.16	9.71	13.60	15.01
	Min.	0.41	11.89	58.70	12.80	0.91	16.49	73.93	4.51	0.14	1.83	63.34	4.02	0.21	5.94	78.55	8.30	1.12	8.11	78.47	9.30
	Max.	12.73	48.73	88.21	55.19	17.85	60.65	116.52	56.08	9.18	58.72	118.41	55.70	13.67	43.07	138.80	55.80	20.69	54.07	131.13	70.00
High	Mean	10.90	40.93	108.78	38.10	15.89	41.92	125.72	50.20	13.38	36.65	126.28	48.02	16.14	36.32	145.93	51.47	13.24	29.59	161.69	44.29
	St. Dev.	6.06	8.46	10.53	11.37	6.46	9.85	13.59	13.86	7.29	9.87	18.28	14.14	8.50	12.71	22.50	14.11	10.06	15.69	21.91	15.86
	Min.	0.95	24.37	92.31	24.00	1.85	24.46	103.78	27.88	2.61	20.60	102.30	24.66	3.98	15.55	119.20	26.83	1.06	9.54	138.27	10.80
	Max.	24.06	57.16	132.45	61.45	25.99	55.84	152.94	72.51	27.38	60.70	178.97	78.92	33.13	67.60	198.16	82.23	33.71	66.61	208.94	69.40
Very High	Mean	17.79	57.80	84.43	66.82	22.75	57.72	89.59	70.08	26.64	56.09	96.55	72.50	27.18	51.88	103.54	73.13	29.31	54.20	109.75	75.62
	St. Dev.	7.50	13.96	18.98	11.68	7.80	14.95	15.56	11.99	8.01	14.84	17.57	11.33	8.33	15.16	16.38	10.91	8.26	16.71	18.58	10.33
	Min.	0.00	40.41	25.90	42.87	4.91	36.26	53.27	46.87	5.26	32.88	57.61	46.90	9.60	23.80	61.65	50.08	17.74	26.76	63.34	54.21
	Max.	28.82	100.53	111.39	87.00	36.75	99.94	107.63	89.51	44.64	99.11	121.10	90.60	52.51	98.08	128.42	92.96	61.72	118.90	144.54	95.84
All	Mean	4.54	22.27	47.86	22.29	6.33	23.69	59.39	26.11	7.03	21.91	67.20	26.89	8.42	22.34	77.71	29.99	9.54	22.92	85.09	33.21
	St. Dev.	7.45	21.12	36.86	23.83	9.13	21.01	39.45	24.96	10.17	20.25	42.36	25.60	11.15	20.17	44.24	26.76	11.93	21.24	44.11	27.41
	Min.	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.06	0.00	0.00
	Max.	28.82	100.53	132.45	87.00	36.75	99.94	152.94	89.51	44.64	99.11	178.97	90.60	52.51	98.08	198.16	92.96	61.72	118.90	208.94	95.84

Appendix A: Descriptive Statisitics for Clusters (All Years) - Continued

		2010				2011				2012				2013			
		FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU	FBS	FTS	MTS	PIU
Very Low	Mean	0.57	3.75	28.85	6.55	1.04	4.51	30.62	6.97	0.72	4.91	28.72	7.84	0.70	3.82	52.69	13.74
	St. Dev.	2.15	9.58	14.40	6.86	3.71	11.19	15.91	8.28	1.78	12.85	14.00	10.63	1.30	5.95	19.15	12.02
	Min.	0.00	0.02	0.00	0.21	0.00	0.02	0.00	0.70	0.00	0.00	0.00	0.80	0.00	0.00	5.60	0.90
	Max.	12.65	56.06	49.15	25.00	19.06	57.72	51.09	33.00	6.79	61.18	49.86	37.60	7.09	29.43	86.30	39.00
Low	Mean	1.65	9.12	71.20	15.39	1.32	7.20	73.99	16.17	0.89	5.60	74.43	16.07	5.56	12.25	108.24	33.10
	St. Dev.	2.59	9.13	13.04	10.18	2.38	8.29	13.17	10.65	1.23	7.68	15.20	10.73	5.31	8.65	14.99	17.36
	Min.	0.01	0.33	52.16	1.26	0.01	0.28	52.60	0.90	0.00	0.00	53.21	0.91	0.01	0.35	73.74	2.30
	Max.	9.42	34.67	103.46	43.68	11.44	36.81	103.79	41.08	4.42	37.63	106.04	43.40	17.33	38.33	140.39	64.50
Medium	Mean	6.71	20.15	107.90	37.91	7.29	17.87	109.75	38.18	7.29	16.55	110.16	40.04	11.64	22.01	199.35	47.96
	St. Dev.	4.67	9.60	15.57	14.21	4.97	9.06	16.79	13.94	5.05	7.98	16.69	15.24	12.65	18.72	43.49	25.46
	Min.	0.01	6.98	79.09	6.00	0.28	1.41	77.19	8.00	0.03	3.61	80.76	4.94	0.53	1.15	160.64	9.20
	Max.	17.55	52.49	133.01	69.00	22.19	44.53	148.69	69.00	18.92	38.37	153.79	69.30	30.75	63.00	304.08	75.46
High	Mean	16.29	30.73	166.88	51.81	15.89	29.52	166.24	56.28	15.06	25.76	164.46	60.69	16.23	25.38	149.45	66.34
	St. Dev.	10.16	15.00	21.11	17.53	10.03	14.06	25.89	16.15	9.36	13.84	29.35	16.13	8.65	11.65	11.92	14.70
	Min.	1.21	8.71	138.04	14.00	1.15	7.26	136.99	14.00	0.31	1.38	137.08	8.62	2.62	5.20	127.09	41.80
	Max.	33.96	67.29	209.92	86.89	33.24	65.77	247.71	88.71	33.57	64.95	289.78	89.88	34.80	62.83	171.87	93.78
Very High	Mean	28.60	50.76	110.05	75.21	26.88	48.10	110.95	75.25	29.43	47.93	113.27	77.60	28.83	46.89	108.83	78.14
	St. Dev.	9.01	17.64	15.16	11.50	9.37	17.68	14.59	12.04	7.22	17.21	13.61	12.44	10.44	19.84	15.59	13.17
	Min.	12.78	20.22	63.55	44.40	4.23	19.41	79.41	49.60	14.66	17.90	80.05	46.91	4.11	17.74	76.05	50.80
	Max.	61.74	116.46	143.14	95.84	42.73	119.41	148.15	96.38	43.26	121.72	145.36	96.92	61.37	123.84	144.32	96.90
All	Mean	10.17	22.36	92.46	36.60	10.75	22.13	98.48	39.82	11.09	20.91	101.62	42.09	11.77	20.74	105.73	44.87
	St. Dev.	12.21	20.77	42.81	27.49	11.98	20.34	42.10	27.59	12.26	19.97	42.98	28.49	12.89	20.35	42.87	29.24
	Min.	0.00	0.02	0.00	0.21	0.00	0.02	0.00	0.70	0.00	0.00	0.00	0.80	0.00	0.00	5.60	0.90
	Max.	61.74	116.46	209.92	95.84	42.73	119.41	247.71	96.38	43.26	121.72	289.78	96.92	61.37	123.84	304.08	96.90

Appendix B: Clusters for All Countries (All Years)

	2005	2006	2007	2008	2009	2010	2011	2012	2013		2005	2006	2007	2008	2009	2010	2011	2012	2013
Albania	L	NC	M	L	L	M	M	M	L	Greece	H	M	H	H	M	VH	VH	VH	VH
Algeria	L	L	M	L	L	L	L	L	L	Greenland	VH	VH	H	VH	VH	VH	VH	VH	VH
Andorra	M	M	VH	VH	VH	VH	VH	VH	VH	Grenada	L	L	L	L	M	M	M	M	L
Angola	VL	VL	VL	VL	VL	VL	L	L	VL	Guatemala	L	L	M	M	M	M	NC	M	L
Anguilla	H	H	H	H	H	H	H	H	M	Guinea	VL	NC	VL	VL	NC	VL	VL	VL	VL
Antigua & Barbuda	H	H	H	H	H	H	H	H	H	Guyana	NC	NC	M	L	L	L	L	L	VL
Argentina	L	L	M	M	M	H	H	H	H	Honduras	VL	VL	L	L	NC	M	M	L	L
Armenia	VL	NC	L	L	L	M	M	M	L	Hong Kong, China	H	H	H	H	H	H	H	H	M
Aruba	H	M	H	H	M	VH	NC	NC	H	Hungary	H	M	H	H	M	VH	VH	VH	VH
Australia	VH	VH	NC	VH	VH	VH	VH	VH	VH	Iceland	VH	VH	VH	VH	VH	VH	VH	VH	VH
Austria	H	H	H	H	VH	H	H	H	H	India	VL	VL	VL	VL	VL	L	L	L	VL
Azerbaijan	VL	VL	L	L	L	M	M	M	L	Indonesia	VL	VL	L	L	L	L	M	M	L
Bahamas	M	M	H	M	M	M	VH	NC	VH	Iran (I.R.)	NC	VL	L	L	L	L	L	L	L
Bahrain	M	M	M	H	M	M	VH	H	H	Ireland	H	H	H	VH	VH	VH	VH	VH	VH
Bangladesh	VL	NC	VL	VL	VL	VL	L	L	VL	Israel	H	H	H	H	VH	VH	VH	VH	VH
Barbados	VH	VH	VH	VH	VH	VH	VH	VH	VH	Italy	H	H	H	H	H	H	H	H	H
Belarus	NC	L	M	M	M	M	M	VH	VH	Jamaica	M	L	M	M	M	M	M	M	L
Belgium	VH	VH	VH	VH	VH	VH	VH	VH	VH	Japan	VH	VH	VH	VH	VH	VH	VH	VH	VH
Belize	L	L	L	L	L	L	L	L	VL	Jordan	L	L	M	M	M	M	M	M	H
Benin	VL	VL	VL	VL	L	L	L	L	L	Kazakhstan	L	L	M	M	M	M	H	H	M
Bermuda	VH	VH	VH	VH	VH	VH	NC	NC	VH	Kenya	VL	VL	VL	L	L	L	L	L	VL
Bhutan	VL	VL	VL	VL	L	L	L	L	VL	Kiribati	VL	VL	VL	VL	VL	VL	VL	VL	VL
Bolivia	VL	VL	L	L	L	L	L	M	L	Korea (Rep.)	VH	VH	VH	VH	VH	VH	VH	VH	VH
Bosnia and Herz.	L	L	M	M	M	M	M	M	VH	Kuwait	M	L	L	L	M	M	H	H	M
Botswana	VL	L	L	L	L	M	M	M	M	Kyrgyzstan	VL	VL	L	L	L	M	M	M	L
Brazil	L	L	M	M	M	M	M	M	H	Lao P.D.R.	VL	VL	VL	VL	L	L	L	L	VL
Brunei Darussalam	M	M	M	M	M	M	M	M	L	Latvia	M	M	H	VH	M	VH	VH	VH	H
Bulgaria	M	M	H	H	H	H	H	H	H	Lebanon	VL	VL	L	L	L	L	M	M	VH
Burkina Faso	VL	VL	VL	VL	VL	VL	VL	L	VL	Lesotho	VL	NC	VL	VL	VL	VL	L	L	VL
Burundi	VL	VL	VL	VL	VL	VL	VL	VL	VL	Liberia	NC	NC	NC	VL	VL	VL	VL	L	VL
Cambodia	VL	VL	VL	VL	VL	L	L	M	L	Libya	NC	NC	NC	M	H	H	H	NC	M
Cameroon	VL	VL	VL	VL	VL	VL	VL	L	VL	Liechtenstein	VH	VH	VH	VH	VH	VH	VH	VH	VH
Canada	VH	VH	VH	VH	VH	VH	VH	VH	VH	Lithuania	H	H	H	H	H	H	H	H	H
Cape Verde	VL	VL	L	L	L	L	L	L	L	Luxembourg	VH	H	H	H	VH	VH	VH	VH	H
Cayman Islands	NC	NC	NC	H	H	H	H	H	H	Macao, China	H	H	H	H	H	H	H	H	M
Central African Rep.	VL	NC	NC	NC	VL	VL	VL	VL	VL	Madagascar	VL	VL	VL	VL	VL	VL	VL	VL	VL
Chad	VL	VL	VL	VL	VL	VL	VL	VL	VL	Malawi	VL	NC	VL	VL	VL	VL	VL	VL	VL
Chile	M	L	M	M	M	M	M	H	H	Malaysia	M	M	M	M	M	M	M	H	H
China	L	VL	L	L	L	L	L	M	L	Maldives	L	L	M	M	H	H	H	H	M
Colombia	L	L	M	M	M	M	M	M	L	Mali	VL	VL	VL	VL	VL	L	L	L	L
Comoros	VL	VL	VL	VL	VL	VL	VL	VL	VL	Malta	M	M	VH	VH	VH	VH	VH	VH	VH
Congo	VL	VL	L	L	L	L	L	L	L	Mauritania	VL	VL	L	L	L	L	L	L	L
Congo (Dem. Rep.)	VL	VL	VL	VL	VL	NC	NC	VL	VL	Mauritius	L	L	M	M	M	M	M	M	L
Costa Rica	L	L	L	L	L	L	M	M	H	Mexico	L	L	L	L	L	L	L	M	L
Côte d'Ivoire	VL	VL	L	L	L	NC	NC	L	L	Micronesia	VL	VL	VL	NC	NC	VL	NC	NC	VL
Croatia	M	M	H	M	M	VH	VH	VH	VH	Moldova	L	L	L	L	L	L	M	M	L
Cuba	VL	VL	VL	VL	VL	VL	VL	VL	VL	Monaco	VH	VH	VH	VH	VH	VH	VH	VH	VH
Cyprus	M	M	M	M	M	M	VH	VH	VH	Mongolia	NC	NC	L	L	L	L	M	M	L
Czech Republic	H	H	H	H	M	VH	VH	VH	H	Montenegro	M	NC	H	H	H	H	H	H	H
D.P.R. Korea	VL	VL	VL	VL	VL	NC	NC	NC	NC	Montserrat	NC	M	M	L	L	M	VH	NC	VH
Denmark	VH	VH	VH	VH	VH	VH	VH	VH	VH	Morocco	L	L	M	L	L	M	M	M	L
Djibouti	VL	VL	VL	VL	VL	VL	VL	VL	VL	Mozambique	VL	NC	VL	VL	VL	VL	VL	VL	VL
Dominica	M	M	H	H	H	H	H	H	H	Myanmar	VL	VL	VL	VL	VL	VL	VL	VL	VL
Dominican Rep.	L	L	L	L	L	M	M	M	L	Namibia	VL	VL	L	L	L	L	L	L	L
Ecuador	L	L	M	L	L	M	M	M	L	Nepal	VL	VL	VL	VL	VL	VL	VL	L	VL
Egypt	VL	VL	L	L	L	M	M	M	L	Netherlands	VH	VH	VH	VH	VH	VH	VH	VH	VH
El Salvador	L	L	M	M	M	M	M	M	L	New Caledonia	M	L	M	M	M	M	M	M	VH
Equatorial Guinea	VL	VL	VL	VL	VL	L	L	L	VL	New Zealand	VH	VH	VH	VH	VH	VH	VH	VH	VH
Eritrea	NC	NC	VL	VL	VL	VL	VL	VL	VL	Nicaragua	VL	VL	L	L	L	L	L	L	L
Estonia	H	H	H	VH	VH	VH	H	H	H	Niger	VL	VL	VL	VL	VL	VL	VL	VL	VL
Ethiopia	VL	VL	VL	VL	VL	VL	VL	VL	VL	Nigeria	VL	NC	VL	L	L	L	NC	L	VL
Falkland (Malvinas)	VH	VH	VH	VH	VH	VH	VH	VH	VH	Norway	VH	VH	VH	VH	VH	VH	VH	VH	VH
Faroe Islands	VH	VH	VH	VH	VH	VH	VH	VH	VH	Oman	L	L	M	M	H	H	H	H	H
Fiji	VL	VL	L	L	L	L	L	M	L	Pakistan	VL	VL	L	L	L	L	L	L	VL
Finland	VH	VH	VH	VH	VH	H	H	H	H	Palestinian Aut.	VL	VL	L	NC	NC	NC	L	L	L
France	VH	VH	VH	VH	VH	VH	VH	VH	VH	Panama	L	L	M	M	H	H	H	H	H
French Polynesia	L	L	M	L	M	M	M	M	L	Papua New Guinea	VL	VL	VL	VL	VL	VL	VL	VL	VL
Gabon	L	L	M	L	L	L	M	H	M	Paraguay	L	L	M	M	L	L	M	M	L
Gambia	VL	NC	L	L	L	L	L	L	L	Peru	VL	VL	L	L	L	M	M	M	L
Georgia	VL	VL	L	L	L	M	M	M	L	Philippines	L	L	L	L	L	L	M	M	L
Germany	VH	VH	VH	VH	VH	VH	VH	VH	VH	Poland	M	M	H	M	M	M	M	H	H
Ghana	VL	VL	L	L	L	L	L	L	L	Portugal	H	H	H	H	M	VH	VH	VH	VH
Gibraltar	NC	NC	NC	NC	VH	VH	VH	VH	NC	Puerto Rico	L	L	M	L	L	M	M	M	VH

Appendix B: Clusters for All Countries (All Years) – Continued

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Qatar	M	M	H	M	M	M	M	M	H
Romania	L	L	M	M	M	M	M	M	L
Russia	M	M	H	H	H	H	H	H	H
Rwanda	VL	NC	VL	VL	VL	VL	VL	VL	VL
S. Tomé & Principe	VL	VL	VL	VL	L	L	L	L	VL
San Marino	VH	VH	VH	VH	VH	NC	VH	VH	VH
Saudi Arabia	L	L	M	H	H	H	H	H	M
Senegal	VL	VL	VL	L	L	L	L	L	L
Serbia	M	M	H	M	M	M	M	M	VH
Seychelles	M	M	M	M	NC	M	M	H	H
Singapore	VH	H	H	H	VH	H	H	H	H
Slovak Republic	M	M	H	VH	M	VH	VH	VH	VH
Slovenia	VH	VH	VH	VH	VH	VH	VH	VH	VH
Solomon Islands	VL	VL	VL	VL	VL	VL	VL	L	VL
Somalia	VL	VL	VL	VL	NC	NC	NC	VL	VL
South Africa	L	L	M	M	L	M	M	M	H
Spain	H	M	H	VH	VH	VH	VH	VH	VH
Sri Lanka	VL	VL	L	L	L	L	L	L	L
St. Helena	VL	VL	VL	VL	VL	VL	VL	VL	NC
St. Kitts and Nevis	H	M	H	H	H	H	H	VH	H
St. Lucia	M	L	M	M	M	M	M	M	L
St.Vincent&Gren.	L	L	M	M	M	M	M	M	L
Sudan	VL	NC	VL	NC	NC	VL	L	L	VL
Suriname	L	L	M	M	H	M	M	M	L
Swaziland	VL	VL	L	L	L	L	L	L	VL
Sweden	VH	VH	VH	VH	VH	VH	VH	VH	VH
Switzerland	VH	VH	VH	VH	VH	VH	VH	VH	VH
Syria	VL	VL	L	VL	L	L	L	L	VL
Taiwan	VH	VH	VH	VH	VH	VH	VH	VH	VH
Tajikistan	NC	NC	VL	L	L	L	L	L	L
Tanzania	VL	VL	VL	VL	VL	VL	L	L	VL
TFYR Macedonia	L	L	M	M	M	M	M	M	L
Thailand	L	L	M	M	M	M	M	M	L
Timor-Leste	VL	VL	VL	VL	VL	VL	L	L	VL
Togo	VL	VL	VL	VL	VL	VL	VL	VL	VL
Tonga	L	VL	L	L	L	L	L	L	VL
Trinidad&Tobago	M	M	H	H	H	H	H	H	H
Tunisia	L	L	M	M	M	M	M	M	L
Turkey	M	L	M	M	M	M	M	M	L
Turkmenistan	NC	NC	NC	VL	VL	L	L	M	L
Tuvalu	NC	NC	VL	NC	VL	VL	VL	VL	VL
Uganda	VL	VL	VL	VL	VL	VL	VL	VL	VL
Ukraine	L	M	M	M	M	M	M	M	H
United Arab Emrt.	H	H	H	H	H	M	VH	H	H
United Kingdom	VH	H	VH	VH	VH	VH	VH	VH	VH
United States	VH	VH	VH	VH	VH	VH	VH	VH	VH
Uruguay	L	L	M	M	M	M	H	H	H
Uzbekistan	VL	VL	VL	L	L	L	L	L	VL
Vanuatu	VL	VL	VL	VL	L	L	L	L	VL
Venezuela	L	L	M	M	M	M	M	M	L
Viet Nam	NC	VL	L	M	M	M	M	H	L
Yemen	VL	VL	VL	VL	VL	VL	VL	L	VL
Zambia	VL	VL	VL	VL	VL	VL	L	L	VL
Zimbabwe	VL	VL	VL	VL	VL	L	L	L	L

Notes: VL=Very Low, L=Low, M=Medium, H=High,
VH=Very High, NC=Not Clustered.