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## **Structural Breakage and Long-term Cointegration Analysis for Economic Growth in G-7, BRICS and MATIK Countries**

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**Abstract:** In this article, long term data is analysed for the total growth of the world economy and the growth of developed (G7) and of the rapid developing economies. The total population of BRICS and MATIK countries generate 49,16% of the world's population, and their economic size generates 26,46% of total world economy. Especially, the basic hypotheses of this study is that BRICS+MATIK countries whose economic shares slowly increase are compared with G-7 and the global economy, i) help of BRICS+MATIK economies rapidly increase the growth rate of global economy: ii) BRICS+MATIK economies cause structural breakage in the growth rate of world economy. In this way, it may be possible that the help of G-7 is compared with the help of BRICS+MATIK economies for the growth of world economy. The study uses the annual data for the 1962-2012 periods. The most important finding is that BRICS+MATIK economies affect the growth rate of world economy, and it constantly increases according to the help of G-7 in post-cold war era. The result has been acquired that World, G-7, and BRICS+MATIK economies cointegrated in the long term.

**Keywords:** BRICS, MATIK, Economic Growth, World Economy, Structural Breakage

**JEL Classification Number:** O40, O57, C22

### **1. Introduction**

Goldman Sachs has used the abbreviation of BRIC (Brazil, Russia, India, China) for the first time to mean "rapid developing economies" in 2001 (Singh, 2013). After the regional economic cooperation organisation begin to increase in last 40 years, in the final period, BRIC economies became the main topic as structuring beyond the regional samples in 2006. These economies have partially become official with the meeting that was made by foreign affairs ministers of the 4 national rapid developing economies. Brazil, Russia, India and China leaders have reached a consensus for meeting once a year in order to discuss economical and political issues. So, some kind of unity that have formed with the initials (BRIC) of these 4 countries. In 2011, when South Africa was invited to the third meeting in China, the group had a new addition and have been called BRICS ever since (Schmalz and Ebenau, 2012; Khan, 2011; Yao and Liu, 2011). MATIK includes Mexico, Argentina, Turkey, Indonesia and Korea, and while I do my analysis through BRICS, I also do it for MATIK. Moreover, I include (BRICS+MATIK) into the analysis by

combining these two rapidly developing country groups that generate a great majority of the world's population and economy. In addition, I include BRICS+MATIK economies into the analysis by comparing them with the world and the G-7 economies.

According to January data of 2014, while world population is 7.145 billion, G-7 countries are 747.914 million; BRICS+MATIK countries population is 3.512.958 million. Proportionately, BRICS+MATIK generate 49,16% of world population, and G-7 countries generate 10,46% of world population.

**Table 1: Countries, BRICS and MATIK Rates for World Total**

	<b>GDP (\$) (000.000)</b>	<b>Rate</b>	<b>Population</b>	<b>Rate</b>
G-7	34.552.917	47,69	747.914	10,46
BRICS	14.720.561	20,32	2.981.897	41,73
MATIK	4.450.527	6,14	531.061	7,43
BRICS+MATIK	19.171.088	26,46	3.512.958	49,16
G7+BRICS+MATIK	53.724.005	74,16	4.260.872	59,63
World	72.440.448	100	7.145.000	100

Note: The data was taken from the World Bank. The population data belongs to January 2014, and GDP data is belongs to 2012.

According to the data in Table-1, (G7+BRICS+MATI, shortly GBM) countries that are added to the analysis, generate 59,63%; generate 74,16% of world economy. According to 1962-2012 years, G-7 countries show the average 2,9% ; BRICS countries show the average 3,7%, and MATIK countries show the average 4,8% for the growth performance. The average growth rate is 3,8% for GBM. In the same period, while world economy has the average growth 3,45%, the average growth rate of OECD has realised as 3,13%. The basic researched hypothesis in this study: is about increasing of shares of BRICS+MATIK (BM) countries in the world economy.

There are several studies that analyse this structuring after the BRICS meeting in 2008. It is emphasised that the activities of the developing countries that don't have activity by themselves, are increasing with their cooperation attempts (Keukeleire and Hooijmaijers, 2013). On the other hand, BRICS structuring has cooperated and has begun to take more common position about their positions in international organisations (e.g. G20) (Luckhurst, 2013). According to "rapid developing economies" category, even if there isn't a formal cooperation between MATIK countries, they follow closely BRICS economies. Therefore, it may be assumed that the definition of MATIK will represent the results of researches in question for BRICS economies. For rapid developing economies, literature is extremely gathered at main subjects such as FDI, NFL, technology transfer, labour force and sensibility against shocks.

Generally, FDI make a positive result about developments for the economic development, globalisation and science and technology in the developing economies (Das, 2013). This effect also shows a high level for the BRICS economies. Especially, it slowly increases in the field of innovation. Wang and Ying (2014) have concluded on patent applications. In addition, they state that foreign domination decreased in field of novelty, and especially China became prominent in this field. In the same time, particularly, these relations deeply affect and transform labour and marketing habits (Beggemann and Fam, 2011) at a level of firm in Russia and China. This effect also develops competitive advantages with developments in the field of technology, communication and infrastructure (Stone and Ranchhod, 2006). When the development in human resources is added, it provides a basis that the growth performance of BRICS economies also continues in the future (Yao and Liu, 2011). Moreover, Lotz et al.(2013) that test the causality relations between scientific research and economic growth, has confirmed the causality relation for 4 other economies except India. The BRICS economies and exchanges have the continuous increase trend for the mutual dependence on each other, and are also in a cointegration relation for long term (Gambhir and Bhandari, 2011). With the 2008 financial crisis, the relation between the BRICS economies and the stock market of developed economies has had a change. Correlation relation between India and China has grown stronger (Zhang and Yu, 2013). In the same time, the relation between the USA and BRICS slowly grew stronger (Aloui et al., 2011), and dependence increased. This dependence strengthened price-earning relation with growth rates with regards to developed countries (Bao, 2009; Gambhir and Bhandari, 2011). The banking system also had strengthened financial relations beside this interaction in exchanges, and this situation has provided that foreign direct capital investments increased between countries (Kaur et al. 2013). In the same time, the widest foreign investment were to Africa, India and China (Aggarwal. 2011). Also, the BRICS economies investeted in low-income countries, and established commercial and financial ties (Sarnake and Yang, 2014; Holtbrügge and Kreppel, 2012), and these ties have growth potential for both sides. So, they have slowly began to play an important role on global growth (Schrooten, 2011), and the growth centered BRICS economies changed the traditional domination of USA, Europe and Japan (Pillania, 2009). In the same time, it strengthened the production relations of countries. For example, Vries (et al. 2012) has analysed productivity through 35 sectors, and has concluded that total productivity increased for 4 countries except Brazil in the study.

Haq and Mailke (2010) concluded that import-demand elasticity of India is lower than the 4 other countries in trade relation between BRICS economies and high income economies. Jadhav (2012) has acquired statistical results about that the efficient factors of BRICS economies are market size, trade liberalisation, accountability and foreign direct capital investment on economic growth. It is seen that applied monetary policies by the BRICS

economies (Mallick and Sousa, 2013) are sensitive to shocks, and a monetary tightening is also efficient on total output growth with financial markets (Mallick and Sousa, 2013). According to the effects of inflation for the growth, Manamperi (2014) has determined an unidirectional relation in other countries, while a positive and long term relation is a question in India. According to PPP data, while Chang et al. (2010) couldn't determine long term relations in E-G test, Enders and Siklon have determined that there is a relation in cointegration test. In another study, according to different cointegration tests, different results were reached (Chang et al., 2012).

**3. Data and Method**

Current data in the study has been acquired by the annual data base of World Bank from 1962 to 2012. 1990 pre-data of Russian Federation belongs to the USSR, and has been taken from Harrison (1993). German data is only from the Federal Republic Germany (West Germany) until 1990, before the re-unification with East Germany. Analysis has been realised in three stages. Principally, curvilinear trends have been acquired by using 6 degree polynomial functions of data sets. Moreover, correlation relation has been calculated between country groups. In the second stage, data sets have been subjected to CUSUM, CUSUM-SQ and Chow structural breakage analyses. In the last stage, regression equation estimates have been principally presented between the world economy and country groups. After that, Engle-Granger (EG) two-staged cointegration test and Johansen-Juselius (JJ) long termed cointegration test have been made to determine long term relations. Also, the stability of the preconditioned data sets have been tested with Dickey-Fuller (ADF), Phillips-Perron (PP) and KPSS unit root tests.

**4. Empirical Results**

World, G-7, BRICS, and MATIK have been acquired for the first stage of analysis, and 6 degree polynomials have been acquired and have shown a curvilinear trend for the BM data. Polynomials are like that:

**Table 2: 6 Degree Polynomial Functions**

	Polinom	R <sup>2</sup>
[1]	$-9E-09x^6 + 2E-06x^5 - 0.0001x^4 + 0.0047x^3 - 0.0766x^2 + 0.335x + 5.3488$	0.3796
[2]	$-3E-09x^6 + 1E-06x^5 - 0.0001x^4 + 0.0043x^3 - 0.0728x^2 + 0.2707x + 5.6745$	0.5132
[3]	$7E-08x^6 - 1E-05x^5 + 0.0007x^4 - 0.0198x^3 + 0.2284x^2 - 0.9047x + 6.0837$	0.6016
[4]	$-7E-08x^6 + 1E-05x^5 - 0.0008x^4 + 0.0259x^3 - 0.4114x^2 + 2.8589x + 0.0856$	0.1954
[5]	$-8E-09x^6 + 1E-06x^5 - 0.0001x^4 + 0.0049x^3 - 0.1199x^2 + 1.1413x + 2.8513$	0.397

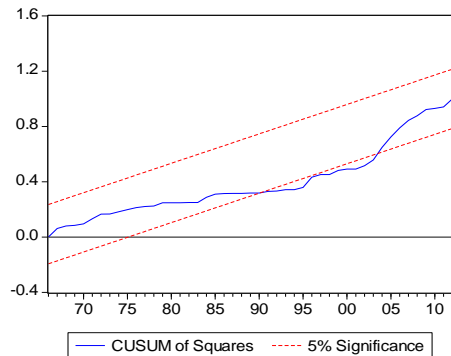
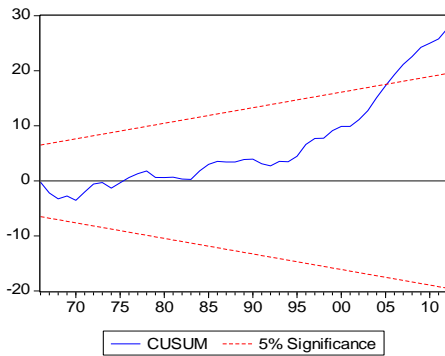
Note: [1] World, [2] G-7, [3] BRICS, [4] MATIK, [5] BM.

Graphs have been given as No. 1 for polynomials. First coefficients in each polynomial inform the way and intensity of observed fluctuations in No.1 graph.

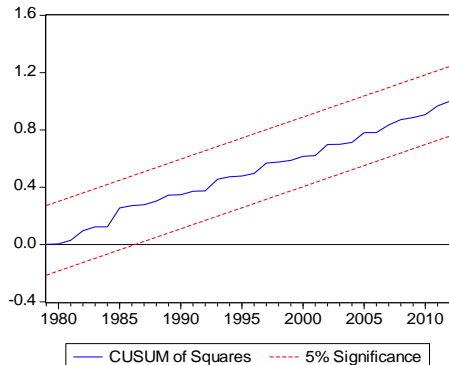
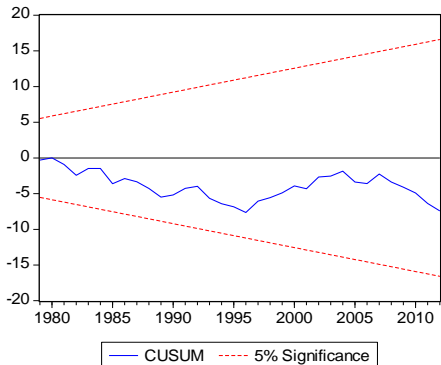
As the second stage of analysis, according to world economy and country groups, structural breakage analysis has been made. In this stage, structural breakage asset has been tested by principally applying to CUSUM test. CUSUM-SQ test has been applied due to CUSUM test doesn't give time for structural breakage. The acquired CUSUM and CUSUM-SQ test results are given in Graph 1.

**Graph 1: CUSUM and CUSUM-SQ Tests**

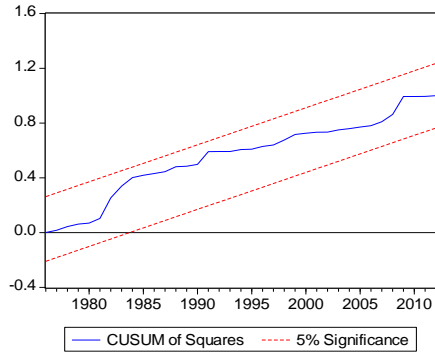
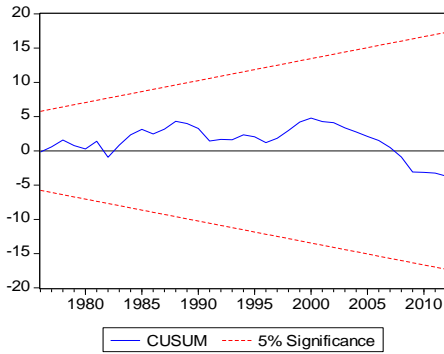
**a) World=G7-BRICS+MATIK**



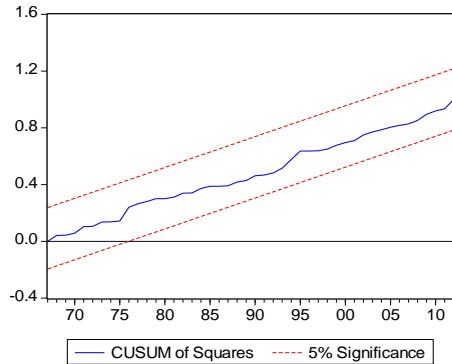
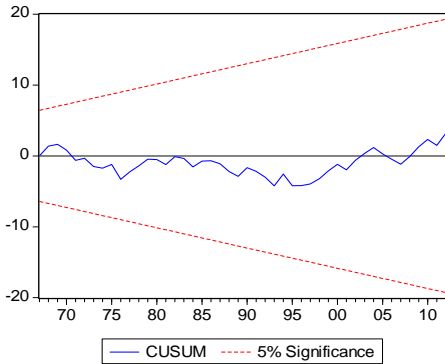
**b) G7= One by One Countries**



**c) BRICS= One by One Countries**



**d) MATIK=One by One Countries**



According to CUSUM and CUSUM-SQ results, it has been analysed that country groups didn't have a structural breakage but when the world economy and country groups meshed together, there was a structural breakage. Chow test has been applied and the acquired results has been shown in Table 3 to analyse that two great crisis (1962-2012) (1973 and 2008) caused whether or structural breakage in growth data of world economy and country groups.

**Table 3: Chow Tests, World = G7+BRICS+MATIK**

	<b>1973</b>	<b>2008</b>	<b>1999</b>
Chow Breakpoint	1,102684 (0,367598)	2,000950 (0,111426)	10,66235 (0,000004)
Chow Forecast	0,892661 (0,628620)	1,573666 (0,188450)	2,889057 (0,006067)

According to the data in Table 3, a structural breakage couldn't be determined in 1974 and 2008 global crisis for the world economy, and when the Eastern Bloc collapsed and the activities of developing economies increase in world economy, a structural breakage has determined in 1999. The third and last stage of the time series analysis has been made. Principally, unit root test has been made for countries and country groups, and the acquired results have been given in Table 4 for three different tests.

**Table 4: ADF, PP, KPSS Tests for Each Country and Country Groups**

Countries	ADF	PP	KPSS
US	-4,968570	-4,777360	0,488812
Japane	-3,817369	-3,705292	0,770795
Germany	-5,226733	-5,482024	0,497372
France	-3,642872	-3,463503	0,756672
UK	-3,918814	-4,845889	0,150834*
Italy	-4,207755	-4,308738	0,857270
Canada	-4,576745	-4,488227	0,621845
China	-5,787338	-6,356772	0,339688*
Brazil	-4,110792	-4,106973	0,378128**
Russian	-3,423396	-3,320657	0,199162*
India	-6,410930	-6,443327	0,794216
S. Africa	-4,137492	-4,047447	0,387757*
Mexico	-4,863668	-4,846252	0,635691
Argentina	-5,704851	-5,636213	0,130419*
Turkey	-7,136390	-7,138531	0,143208*
Indonesia	-4,781327	-4,736514	0,124384*
Korea	-5,583535	-5,669962	0,632966
G-7	-3,860671	-3,860671	0,768075
BRICS	-3,348596	-3,279095	0,291542*
MATIK	-5,632110	-5,627512	0,398362**
BRICSMATIK	-5,185523	-4,848011	0,384846
World	-4,388411	-4,286518	0,695902

Note: MacKinnon Critical Values at 5% meaning level have been calculated as -2,921175 in ADF test for other countries and country groups except Germany (-2,935001), UK (-2,925169) and the Russian Federation. (-2,933158). MacKinnon critical value at 5% meaning level has been calculated as -2,921175 for PP test in all countries and country groups. Asymptotic Critical Values at 5% meaning level has been calculated as 0,463000 for KPSS test in all countries and country groups. The results with \* sign hasn't been constant in KPSS test results. \*\* is constant at 1% meaning level.



Series are constant from the same level, and according to their level values, they don't include unit root. Therefore, they are useable for long termed analysis. Granger 2 staged cointegration test has been made for country groups. Accordingly, it is expected that the creating regressions are constant through the level values of error terms. If this hypothesis occurred, it may be concluded that two variables are cointegrated in the long term. The acquired results have been shown in Table 5.

**Table 5: Engle-Granger Cointegration Test**

(a) Regressions	coefficient	Std. Deviation	t-Stat.	
world = f(g7)	0,795126	0,032763	24,26884 (0,921627)	
world = f(brics)	0,482453	0,082326	5,860245 (0,400066)	
world = f(matik)	0,376096	0,092245	4,077134 (0,238072)	
world = f(bricsmatik)	0,631602	0,094272	6,699803 (0,467447)	
g7 = f(brics)	0,491985	0,109058	4,511231 (0,279032)	
g7 = f(matik)	0,385385	0,116660	3,303494 (0,165458)	
g7 = f(bricsmatik)	0,640346	0,128441	4,985507 (0,323000)	
(b) Results of unit root test for error correction		ADF	PP	KPSS
world = f(g7) → u		-3,514472	-3,601427	0,481206
world = f(brics) → u		-4,539303	-4,462983	0,436764
world = f(matik) → u		-4,583706	-4,594367	0,373402
world = f(bricsmatik) → u		-4,335192	-4,335192	0,452198
g7 = f(brics) → u		-3,738986	-3,620175	0,560138
g7 = f(matik) → u		-3,822667	-3,679439	0,700990
g7 = f(bricsmatik) → u		-3,949427	-3,841395	0,547498

**Note:** Critical Values at 5% meaning level in unit root tests are: MacKinnon critical value for ADF: 2,921175; MacKinnon critical value for PP : -2,921175 and critical value for KPSS : 0,463000. Values at in brackets are critical values for 5% meaning level. T-stat in bracket beside fixed  $r_2$

The results belonging to unit root tests are presented for error terms of regressions in “a” panel for “b” panel of Table 5. Error terms are constant for each three unit root test, and include unit root. Therefore, it is concluded that there is a long term cointegrated between variable binaries for the regressions in “a” panel. However, due to EG test isn't enough for more than 2 variables, JJ test has been applied for more than 2 variables. While the world economy is a dependent variable, JJ test results that country groups are independent variables, are given in Table 6.

**Table 6: Results of Johansen-Juselius (JJ) Cointegration Test**

$H_0$	$H_1$	Eigenvalue	Trace Stat.	0,05	Max-Eigen Stat.	0,05
$r = 0$	$r \geq 1$	0,474644	59,02384	55,24578	30,89663	30,81507
$r = 1$	$r \geq 2$	0,264908	28,12721	35,01090	14,77245	24,25202
$r = 2$	$r \geq 3$	0,206129	13,35476	18,39771	11,08006	17,14769

Trace and Max-Eigen statistics are compared with calculated values for 0,05 meaning level to determine how many cointegrated vectors. According to Akaike and Schwarz information criterion, the values have been calculated for 2 lags.  $H_0$  hypothesis will be rejected for Trace Stat. > 0,05 meaningfulness critical value.  $H_0$  hypothesis will be rejected for Max-Eigen Stat. > 0,05 meaningfulness critical value. Accordingly, it is concluded that  $H_1$  hypothesis will be accepted in the first line, and there is “maximal 1 cointegrated vector”.

**5. Conclusion**

Individual countries and the world economies have fluctuations that mostly cannot be doped and sometimes cause the structural changes. These fluctuations rise as domestic to economies on a global scale like in 1929 and 1974, and it can be determined from the noneconomic developments as World War 2. So, even if the fluctuations are domestic and external, they can leave the lasting impressions on economic structurings. This study analyses that it depends on a political development on global scale created the differences in country economies in 1990, it affects world economy to what extent. These economies are defined as the developing countries, and expand and make deep economic relations between each other, have begun quite effective in world economy. The most commonly known BRICS from these country groups have begun to be example for the developing countries. In this study, it has been determined that when MATIK countries begin to be integrated to world economy in 1990, it statistically creates a structural breakage in the world economy. It has been seen that these country groups that show a faster growth performance than the average growth rate of the world economy, slowly increase their activities in the world economy growth rate. On the other hand, G7 countries have a lower average growth rate than either the world economy or the growth rate of the BRICS+MATIK countries. In the same time, it is seen that depth and width also increase in economic relations between the G7 and the BRICS+MATIK economies, and support the world economy. It is expected that developing countries have fast and effective growth process and integrated to world economy, it has reached that country group as G7 provides the help to the world economy in future years with its condition.

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