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Which OIC countries are catching up? Time Series Evidences with Multiple Structural Breaks

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Abstract

In this paper, income per capita convergence hypothesis is tested in selected OIC countries. For this purpose, we use the time series model and univariate KPSS stationary test with multiple structural breaks (Carrion-i-Silvestre et al. (2005)) over the period 1950-2008. The results show that most OIC countries could not catch up toward USA. Although because of some positive term of trade shocks, they experienced catching up process in some sub- periods, they did not have appropriate infrastructure as, they could not use these opportunities and escape lag deadlock.

Keywords: Income convergence; Catching up; KPSS stationary test; Multiple structural breaks.
JEL Classification: O1**;** O47; C32; C33

1. Introduction

The convergence hypothesis is one of the neoclassical growth theory outcomes that is defined as a tendency of countries towards equalization over time in term of per capita income. This model predicts that the substitution possibility and diminishing return for factors to force the economy to converge to the equilibrium capital and income level (Islam, 2003). Endogenous growth theory, launched by Romer (1986) and Lucas

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(1988), has primarily focused on the convergence theory and challenged the strong cross-country implications of the neoclassical model. In the endogenous growth theory, investment embodies spillover effects which offset the tendency towards diminishing return. Therefore, initial differences may exist and grow without limits over time. In other words, the endogenous growth theory rejects the convergence hypothesis and hence it can be used to distinguish between the two leading approaches to economic growth, namely the neoclassical growth theory and endogenous growth theory (Huang, 2005). However, Romer (1996) finds that if income differentials result from technological differences, by following technological know-how from technologically advanced countries to developing countries, the poorer countries would grow faster than richer ones. Nevertheless, as noted by Aghion and Howitt (2009), only if the poor countries devote resource to innovation, they will be able to simply copy and adapt the new technology to local conditions and thus grow as fast as the rich countries. If a country fails to invest on innovation, it will stagnate while the rest of the world continues to advance.

As surveyed by Rassekh (1998) and Islam (2003), in empirical works on convergence hypothesis, researchers have used different notions of convergence such as absolute convergence, conditional convergence, and deterministic convergence. According to previously mentioned notions, three methodologies materialized which may be classified as follows: (a) cross-section approach, (b) time series approach, and (c) distribution approach. For example, cross-section and time series approaches investigate absolute and conditional notions of convergence hypothesis. Absolute convergence refers to the notion that economies will converge toward the same income per capita in the long run steady state, whereas, conditional convergence implies that the economies will converge to their own steady state. In most of the empirical works, in order to investigate the absolute and conditional convergence, researchers use convergence-growth or β-convergence equation. According to the convergence-growth equation, income per capita growth rate is regressed on initial income per capita using cross-section and/or panel data estimators and a negative (partial) correlation between these variables is interpreted as evidence of absolute (conditional) convergence. One of the most accepted results on convergence debate is that the absolute convergence hypothesis has been accepted only among more homogenous group of economies such as

OECD countries that have similar economic structures, while conditional convergence hypothesis has been accepted among a broader sample of economies. Due to the use of the cross-section dataset, Baumol (1986), Delong (1988), Barro (1991), and Barro and Sala-i-Maitin (1991, 1992, 1995) used the β-convergence equation. Nonetheless, the β-convergence equation has been widely criticized in the literature. For example, Quah (1993) discussed that a negative correlation between income per capita growth rate regress and initial income per capita may be Galton fallacy. Evans and Karras (1996) show that β-convergence equation is valid only if the economies have the identical first–order autoregressive dynamic structures and all permanent cross-country differences are completely controlled for, which are very restrictive assumptions. Bernard and Durlauf (1996) show that conditional convergence is a weaker notion of convergence than time series convergence. They find that cross-section tests tend to spuriously reject the null of no convergence when economics have different long–run steady states and the failure to reject the no convergence null using time series tests can be due to transitional dynamics in the data.

Time series model of convergence hypothesis is examined by unit root tests. Hence, empirical validity of the hypothesis is dependent some how upon advances in econometrics of unit root tests. In empirical works, several unit root tests are used namely, Augmented Dicky Fuller (hereafter ADF), Phillips and Perron (1988) (hereafter PP), Zivot-Andrews (1992) (hereafter ZA), Lumsdaine and Papell (1997) (hereafter LP), Lee and Strazicich (2003), and Carrion-i-Silvestre *et al.* (2005) (hereafter CBL). In this paper, we used the CBL unit root test mainly due to its advantages compared to the other unit root tests for testing of convergence hypothesis. Whereas CBL stationarity test is KPSS type unit root test, hence, its null hypothesis is stationary, in other tests the null hypothesis is non-stationary. Thus, in CBL test, the convergence hypothesis is tested directly. In addition, in CBL test, we are able to control for structural breaks that affect on result of stationary tests.

As noted by Islam (2003), the distribution approach focuses on the dispersion of the per capita income among countries. Sigma convergence is one version of the distribution and calculated by the standard deviation. If the cross-country standard deviation of the per capita income decreases over time, it represents that there exists the sigma convergence.

In this paper, we are going to test the convergence hypothesis using

the CBL stationarity test among the Organization of the Islamic Conference (OIC hereafter). The OIC has a membership of 57 states spread over four continents and is the collective voice of the Muslim world. Whereas, all membership of OIC are classified as developing countries, is it important to determine which OIC countries are catching up? The objective of this paper is to empirically examine the convergence hypothesis across the OIC member countries. For this end, first, the time series approach of convergence hypothesis are selected. Second, the time series model is tested by using the univariate stationary test with multiple structural breaks. Third by selecting USA as a leader with high-income per capita level, the convergence theory is tested. In particular, convergence towards the USA is considered as catching up towards higher balanced growth path and divergence from USA is considered as falling into *poverty trap*. To the best of our knowledge, this study is the first of its kind to utilize the univariate stationary test with multiple structural breaks to investigate the time-series properties of per capita real GDP for the OIC countries. This empirical study contributes to the field of empirical research by determining the break dates that affected the OIC countries catching up process. Also, it is able to determine the catching up or divergence process that occurred after any break.

The remainder of paper is organized as follow. Section 2 describes data and the econometric methodology used. The empirical results are discussed in the section 3, and conclusion is presented in the final section.

2. Data and methodology

2.1 Data

The purpose of this paper is to investigate evidence on GDP per capita of the OIC countries catching up process toward USA using time series test of convergence hypothesis over the period 1950-2008. We use Maddison historical dataset (2010). The OIC member states under analysis are Afghanistan, Albania, Algeria, Bahrain, Bangladesh, Benin, Burkina Faso, Cameroon, Comoro Islands, Côte d'Ivoire, Djibouti, Egypt, Gabon, Gambia, Guinea, Guinea Bissau, Indonesia, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Malaysia, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia, Senegal, Sierra Leone, Somalia, Sudan, Syria, Togo, Tunisia, Turkey, Uganda, United Arab Emirates, and Yemen. We deleted other OIC member countries

because they do not have data for all years of the period 1950-2008.

2.2 Methodology

2.2.1 Empirical model

In this paper, in order to test the convergence hypothesis, we first apply the CBL stationarity test to the differences of the logarithm per capita GDP level of each country with respect to the USA. This is a necessary condition for convergence or catching up hypothesis. After we identified the break dates in linear trend using stationary test, we were able to investigate the sufficient condition for the catching up process. For this end, we follow Tomljanovich and Vogelsang (2002) and Carrion-i-Silvestre and German-Soto (2009) and estimate the following equation for the OIC member countries that the null of stationarity is not rejected for them.

$$RI_t = \sum_{k=1}^{m+1} \theta_k \, DU_{k,t} + \sum_{k=1}^{m+1} \rho_k \, DT_{k,t} + \varepsilon_t \qquad (1)$$

In equation (1), RI is logarithm of relative per capita real GDP, t and m are time and optimal number of breaks respectively. Respectively, DU and DT are dummy variables in order to control for structural breaks in intercept and slope of linear trend. The $DU_{k,t}$ and $DT_{k,t}$ are defined as the following:

$$DU_{kt} = \begin{cases} 1 & if \quad TB_{k-1} < t \leq TB_k \\ 0 & otherwise \end{cases}$$

$$DT_{kt} = \begin{cases} t - TB_{k-1} & if \quad TB_{k-1} < t \leq TB_k \\ 0 & otherwise \end{cases}$$

Where $TB_k$is k[th] break date. According to Carrion-i-Silvestre and German-Soto(2009)**,** there has been catching up process "when the coefficients of the parameters of each regime are significant at least at the 10% level of significance and have opposite sign" , *i.e.,* when $\theta_k < 0$ and

$\rho_k > 0$ or when $\theta_k > 0$ and $\rho_k < 0$. If both parameters of each regime have the same sign and are significant at least at the 10% level of significance, we conclude the divergence has occurred. If catching up process has occurred but both parameters are not significant, we have achieved the equilibrium growth. If catching up process occurred but only one of the parameters is significant, we conclude that weak catching up process has occurred and when both of them is same sign but only one of the parameters is significant, the weak divergence has occurred.

2.2.2 Econometric framework

The CBL stationarity test is adopted in the study due to its advantages that allows for break in intercept and trend. In this test, the data generation process under the null of stationary is based on following model:

$$RI_t = \alpha + \beta T + \sum_{k=1}^{m} \theta_k \, DU_{k,t} + \sum_{k=1}^{m} \rho_k \, DT_{k,t} + \varepsilon_t \qquad (2)$$

In equation (2), α, T and m are intercept, linear trend and number of breaks, respectively. The break dummy variables take the following values:

$$DU_{kt} = \begin{cases} 1 & if\ t > TB_k \\ 0 & otherwise \end{cases}$$

$$DT_{kt} = \begin{cases} t - TB_k & if\ t > TB_k \\ 0 & otherwise \end{cases}$$

The test statistic is computed as Kwiatkowski et al (1992) test with multiple breaks:

$$\mathrm{LM}(\lambda) = \hat{\omega} T^{-2} \sum_{t=1}^{T} \hat{S}_t^{\,2} \qquad (3)$$

Where $\hat{S}_t$ is the partial sum of the estimated OLS residuals from Eqn. (2). $\hat{\omega}$ denotes a heteroskedasticity and autocorrelation consistent estimate of the long –run variance of ε_t. λ is the location of the breaks relative to the entire time period (T). Since the test statistic is dependent

on the λ, hence that is important that we identify the location and the number of breaks correctly. CBL recommend using the Bai and Perron (1998) procedure that is based upon the global minimization of the sum of squared residuals (SSR) as follows:

$$\left(\widehat{TB}_1, \ldots, \widehat{TB}_m\right) = argmin_{\left(\widehat{TB}_1, \ldots, \widehat{TB}_m\right)} SSR\left(\widehat{TB}_1, \ldots, \widehat{TB}_m\right) \quad (4)$$

The optimal number of breaks is selected by CBL criterion of Liu, Wu, and Zidek (1997). In this paper, the finite sample critical values are computed by Monte Carlo simulations using 100000 replications.

3. Results

In order to examine the convergence hypothesis toward the USA, first we test the stationarity of GDP per capita gap series by CBL stationarity test with multiple structural breaks. The number of structural breaks has been selected using the modified BIC defined in Liu *et al* (1997). According to Carrion-i-Silvestre and German-Soto (2009) the initial maximum number of structural breaks that we allow in our set-up is m^{max}=5. However, in some cases this maximum is achieved, so that in order to ensure that there are no structural breaks left we increase m^{max} to 8.

The results of test are shown in Table 1. As can be seen, the stationarity hypothesis is not rejected for Albania, Algeria, Bangladesh, Benin, Burkina Faso, Cameroon, Comoro Islands, Côte d'Ivoire, Gambia, Iraq, Lebanon, Mauritania, Morocco, Mozambique, Niger, Nigeria, Oman, Pakistan, Senegal, Sierra Leone, Syria, Togo, Tunisia, and Turkey. For these countries, the CBL stationary test's statistic is statistically significance at the 10% level. For other countries, the CBL stationary test's statistic is greater than the critical value at the 10% level; hence, the stationary hypothesis is rejected for them.

Break dates show all countries experienced at least one statistically significant structural break. This implies the importance of accounting for structural breaks in conducting tests for unit root. Distribution of breaks shows that they have occurred in all decades. Most breaks occurred in 1970_s and 1980_s. Respectively, 12, 34, 36, 41, 33, and 11 break points are located around 1950s, 1960_s, 1970_s, 1980_s, 1990_s, and 2000_s. As can be seen, most break points occurred in 1980s and there is a high heterogeneity in the number and position of the break points among countries. As regards the number of breaks shown in table 1, the

procedure detects one country (Turkey) with one break, 12 countries with 2 breaks and respectively 3, 4, 5, 6, and 7 breaks for 10, 8, 6, 6, and 2 countries. Libya and Qatar present 7 break points in trending behavior.

Most of the OIC countries are highly specialized in the production and export of a few primary commodities. Hence, there is clear-cut evidence supporting the presence of clustering patterns of the break dates based on external shocks such as booms and busts of primary commodities prices. For example, the most oil exporting countries such as Iran, Iraq, Saudi Arabia, Bahrain, and Kuwait, experienced some breaks in level and slope of linear trend variable due to the oil booms of the period 1973-1974, 1979 and 2004 and a decrease in its price in the mid-1980_s and mid 1990_s.

As mentioned by Romero-Avila (2009, pp:1059-1060), favorable terms of trade over the periods 1976-1979 and 1993-1994 and negative terms of trade shocks over most of the 1980 and 1990 (except 1993-1994) caused countries specialized in coffee such as Cameroon, Côte d'Ivoire, Sierra Leone, Uganda, and Togo to experience some positive and negative shocks in above dates. Regarding countries specialized in Cocoa such as Cameroon, Côte d'Ivoire, Sierra Leone, and Togo; there are evidences of positive breaks associated moderate increase in its price over 1960s. Cotton boom in the early and mid-1970s and the falling of its prices over the early 1980s caused the main cotton producers such as Pakistan, Sudan, and Guinea Bissau to experience some positive and negative breaks in their GDP's trending behavior.

In addition to the structural breaks associated with the terms of trade fluctuations, the military conflicts and wars took place in Afghanistan(2001), Algeria (1961), Bangladesh (1971), Egypt (1956 and 1973), Lebanon (1982), Iran (1981-1988), Iraq (1991), Mozambique (1974 and 1984), Nigeria (1966), Senegal (1992), Syria (1982-1985), Uganda (1978), and Yemen (1970) and revolution in countries such as Iran and Mozambique caused a sudden drop in the level of GDP per capita.

Table 1: CBL stationary test with multiple structural breaks

Country	Unit root stat and critical values					Break dates (Decades)					
	KPSS stat	Finite sample critical values				1950s	1960s	1970s	1980s	1990s	2000s
		90	95	97.5	99						
Afghanistan	0.073	0.037	0.043	0.050	0.060		1963		1981	1994	2001
Albania *	0.021	0.030	0.034	0.037	0.041	1957		1973		1990	
Algeria *	0.024	0.035	0.040	0.045	0.051		1961		1981	1996	
Bahrain	0.189	0.019	0.021	0.023	0.026	1957	1966	1974	1981	1990	2000
Bangladesh*	0.035	0.066	0.083	0.100	0.123			1971		1990	2000
Benin *	0.032	0.107	0.138	0.168	0.212			1979	1987		
Burkina Faso*	0.037	0.038	0.044	0.050	0.058		1962	1972		1993	
Cameroon *	0.019	0.037	0.044	0.051	0.060		1963		1980 1986	1993	
Comoro Islands *	0.038	0.070	0.085	0.099	0.119			1970 1979			
Côte d'Ivoire*	0.022	0.037	0.043	0.048	0.056		1962		1982	1994	
Djibouti	0.069	0.029	0.034	0.040	0.047		1961 1969	1976	1983	1998	
Egypt	0.043	0.021	0.022	0.024	0.027	1955	1965	1974	1981	1994	
Gabon	0.059	0.047	0.059	0.071	0.086		1967	1977	1986	1998	
Gambia *	0.055	0.078	0.098	0.117	0.143			1973	1983		
Guinea	0.041	0.040	0.047	0.053	0.061		1962	1974	1984		
Guinea Bissau	0.068	0.065	0.078	0.091	0.109		1969			1997	
Indonesia	0.043	0.025	0.029	0.034	0.041		1967 1960	1973 1979	1986	1997	
Iran	0.025	0.019	0.021	0.023	0.025	1956	1967	1976	1981 1989		2002
Iraq *	0.024	0.034	0.039	0.044	0.050	1954		1978		1990	
Jordan	0.133	0.018	0.020	0.022	0.024	1955	1964	1972	1981 1988		2002
Kuwait	0.078	0.020	0.022	0.025	0.028	1957	1969		1980 1989	1999 1994	
Lebanon *	0.053	0.133	0.172	0.211	0.264				1983	1990	
Libya	0.022	0.016	0.017	0.018	0.020	1954	1962 1969	1974	1980 1987	1999	
Malaysia	0.111	0.024	0.028	0.031	0.036	1959	1968		1981 1987	1997	
Mali	0.028	0.027	0.030	0.032	0.036	1957		1974	1980	1993	
Mauritania *	0.026	0.067	0.083	0.100	0.122			1971		1992	
Morocco *	0.025	0.043	0.052	0.061	0.073		1965		1981	1998	
Mozambique*	0.046	0.079	0.101	0.124	0.153			1974	1984	1994	
Niger*	0.022	0.033	0.039	0.045	0.053		1962	1972	1983		2000
Nigeria*	0.017	0.044	0.055	0.065	0.079		1966	1973	1983	1998	
Oman*	0.023	0.057	0.067	0.078	0.093		1967		1982		
Pakistan*	0.093	0.107	0.137	0.170	0.213			1979		1997	
Qatar	0.083	0.022	0.025	0.029	0.035	1959	1965	1972 1979	1986	1996	2003

Country	Unit root stat and critical values					Break dates (Decades)					
	KPSS stat	Finite sample critical values				1950s	1960s	1970s	1980s	1990s	2000s
		90	95	97.5	99						
Saudi Arabia	0.100	0.052	0.067	0.082	0.101		1968	1973	1982 1987	1992	2000
Senegal *	0.043	0.052	0.060	0.068	0.078		1963			1993	
Sierra Leone*	0.039	0.056	0.070	0.085	0.104		1969		1980	1995	2000
Somalia	0.084	0.046	0.054	0.062	0.071		1963	1974			2001
Sudan	0.059	0.031	0.037	0.044	0.052		1962	1972 1977	1984	1996	
Syria *	0.040	0.051	0.059	0.068	0.079		1965		1983		
Togo*	0.034	0.059	0.071	0.083	0.099		1968		1982		
Tunisia *	0.039	0.064	0.078	0.094	0.114			1970	1985		
Turkey *	0.035	0.253	0.331	0.412	0.523				1998		
Uganda	0.083	0.061	0.077	0.094	0.115			1970 1978	1983	1992	
United Arab Emirates	0.129	0.033	0.039	0.045	0.053		1962	1973 1979	1985		2002
Yemen	0.057	0.022	0.025	0.027	0.030	1957	1969	1977	1983	1994	

Notes: The finite sample critical values are computed by Monte Carlo simulation using 100000 replications. * denotes the stationarity hypothesis is not rejected at the 10% level.

In order to investigate the sufficient condition for the catching up process, we estimate the equation (1) for countries that the null of stationarity is not rejected for them. As mentioned in section 2.2.1, we denote respectively catching up, divergence, weak catching up, weak divergence, and equilibrium growth by C, D, c, d, and E hereafter. Table 2 reports the estimated coefficients of each of the m+1regimes and summarizes the different situations corresponding to each regime. In general, the results show that catching up process has taken part during the analyzed period, but the process has not been uniform in all regimes. For the first regime, there was catching up and divergence in 8 and 16 countries respectively. After first regime or first break, there was catching up process in 10 countries and divergence in 14 of 24 countries. For the third regime, there was catching up and divergence for 9 and 14 OIC member states respectively. There were six countries that show catching up process and six countries that show divergence process over forth regime. For the final regime, there was convergence process in three countries and one country that was diverged from the USA.

Table 2: Parameter estimates and convergence and divergence

classification of OIC member countries

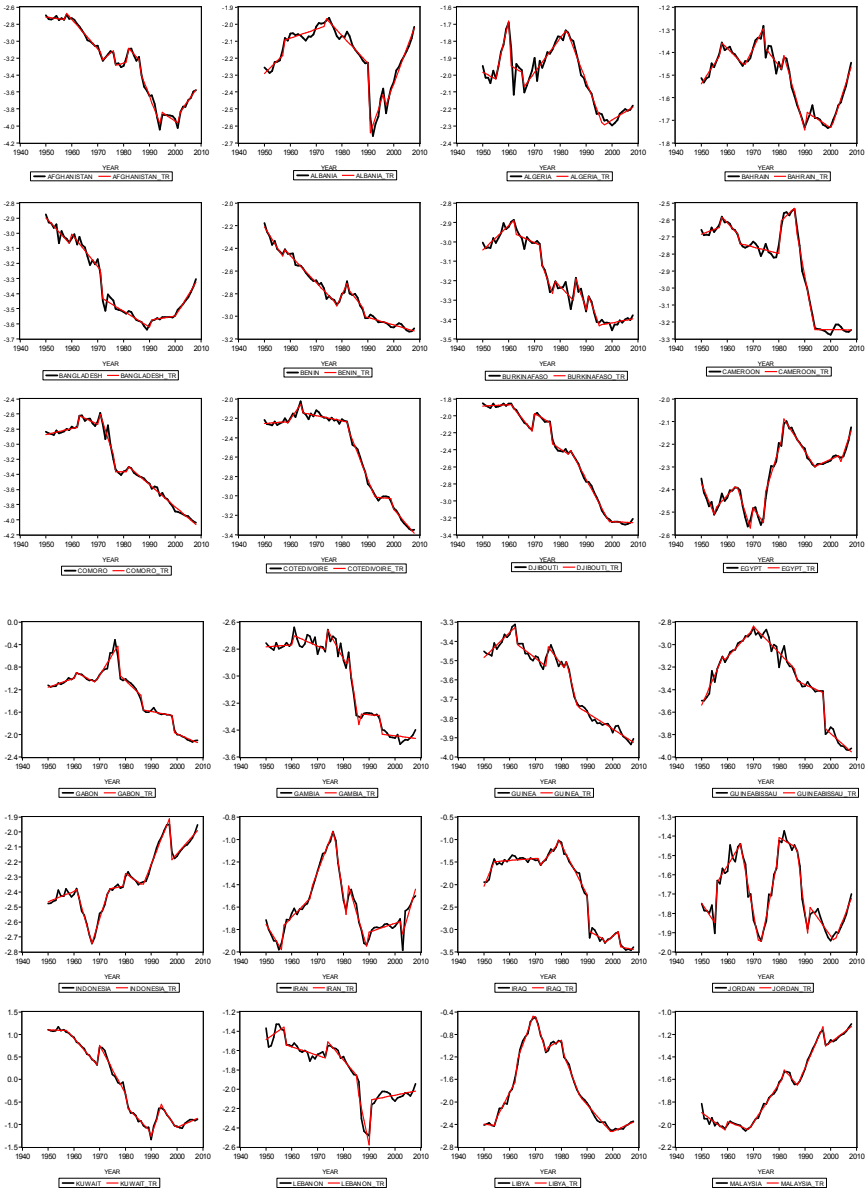
Country	$\hat{\theta}_1$	$\hat{\rho}_1$	$\hat{\theta}_2$	$\hat{\rho}_2$	$\hat{\theta}_3$	$\hat{\rho}_3$	$\hat{\theta}_4$	$\hat{\rho}_4$	$\hat{\theta}_5$	$\hat{\rho}_5$
Albania	0.015	-2.306	-2.098	0.005	-1.953	-0.016	-2.669	0.034		
	0.005	0.000	0.000	0.006	0.000	0.000	0.000	0.000		
	C		C		D		C			
Algeria	0.026	-2.082	-2.084	0.015	-1.681	-0.040	-2.304	0.010		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.028		
	C		C		D		C			
Bangladesh	-0.015	-2.889	-3.423	-0.010	-3.577	0.003	-3.550	0.028		
	0.000	0.000	0.000	0.000	0.000	0.359	0.000	0.000		
	D		D		c		C			
Benin	-0.023	-2.227	-2.735	-0.016	-2.979	-0.007				
	0.000	0.000	0.000	0.002	0.000	0.000				
	D		D		D					
Burkina Faso	0.013	-3.055	-2.956	-0.006	-3.166	-0.008	-3.426	0.002		
	0.000	0.000	0.000	0.086	0.000	0.000	0.000	0.346		
	C		D		D		c			
Cameroon	0.004	-2.679	-2.719	-0.005	-2.620	0.015	-2.598	-0.082	-3.246	0.000
	0.018	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.000	0.971
	C		D		C		D		c	
Comoro Islands	0.011	-2.887	-2.498	-0.108	-3.237	-0.028				
	0.000	0.000	0.000	0.000	0.000	0.000				
	C		D		D					
Côte d'Ivoire	0.006	-2.274	-2.102	-0.007	-2.299	-0.065	-2.932	-0.032		
	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
	C		D		D		D			
Gambia	0.000	-2.767	-2.632	-0.032	-3.227	-0.011				
	0.845	0.000	0.000	0.000	0.000	0.000				
	c		D		D					
Iraq	0.136	-2.174	-1.528	0.008	-0.903	-0.110	-3.032	-0.022		
	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000		
	C		C		D		D			
Lebanon	-0.009	-1.422	-1.669	-0.130	-2.116	0.005				
	0.000	0.000	0.000	0.000	0.000	0.118				
	D		D		c					
Mauritania	0.021	-3.109	-2.723	-0.024	-3.246	0.003				
	0.000	0.000	0.000	0.000	0.000	0.239				
	C		D		c					
Morocco	-0.024	-1.862	-2.304	0.010	-2.097	-0.012	-2.381	0.017		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
	D		C		D		C			
Mozambique	-0.004	-2.144	-2.463	-0.046	-3.090	0.002	-3.213	0.037		
	0.011	0.000	0.000	0.000	0.000	0.685	0.000	0.000		
	D		D		c		C			
Niger	0.009	-2.797	-2.578	-0.039	-3.227	0.005	-3.479	-0.036	-4.089	-0.008
	0.001	0.000	0.000	0.000	0.000	0.148	0.000	0.000	0.000	0.115
	C		D		c		D		d	
Nigeria	-0.011	-2.492	-3.099	0.087	-2.409	-0.045	-3.021	-0.005	-3.244	0.020
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.000	0.001
	D		C		D		D		C	
Oman	0.024	-2.776	-1.462	0.002	-1.167	-0.009				
	0.000	0.000	0.000	0.648	0.000	0.000				
	C		C		D					
Pakistan	-0.001	-2.812	-2.737	0.006	-2.776	0.011				
	0.082	0.000	0.000	0.000	0.000	0.000				
	D		C		C					
Senegal	-0.001	-2.050	-2.163	-0.028	-3.063	0.000				

Country	$\hat{\theta}_1$	$\hat{\rho}_1$	$\hat{\theta}_2$	$\hat{\rho}_2$	$\hat{\theta}_3$	$\hat{\rho}_3$	$\hat{\theta}_4$	$\hat{\rho}_4$	$\hat{\theta}_5$	$\hat{\rho}_5$
	0.667	0.000	0.000	0.000	0.000	0.924				
	d		D		c					
	0.001	-2.657	-2.591	-0.024	-2.713	-0.047	-3.760	-0.108	-4.070	0.034
Sierra Leone	0.514	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	c		D		D		D		C	
	0.005	-1.303	-1.546	0.033	-1.272	-0.003				
Syria	0.234	0.000	0.000	0.000	0.000	0.212				
	C		C		d					
	0.012	-2.904	-2.566	-0.026	-3.106	-0.035				
Togo	0.000	0.000	0.000	0.000	0.000	0.000				
	C		D		D					
	0.003	-2.177	-1.997	0.012	-2.003	0.014				
Tunisia	0.074	0.000	0.000	0.000	0.000	0.000				
	C		C		C					
	0.006	-1.691	-1.580	0.023						
Turkey	0.000	0.000	0.000	0.000						
	C		C							

Notes: C, c, D, and d denote catching up, weak catching up, divergence, and weak divergence, respectively.

4. Conclusion

One of the oldest controversies in the economic growth literature is Convergence hypothesis. According to the hypothesis, income per capita inequality will disappear in the long run. This paper examined the GDP per capita catching up process of selected OIC (36 countries) toward USA GDP per capita by time series model of convergence hypothesis and univariate stationarity test over period 1950-2008. Toward this end, we used the Carrion-i-Silvestre *et al.* (2005) stationarity test that allows for break in intercept and slope of linear trend. Whereas most OIC member countries specialized in one or two primary commodities such as oil and coffee, our results supports the presence of clustering patterns of the break dates based on external shocks like booms and collapses of primary commodity prices. Also, our results show that the military conflicts, internal and external wars have affected the catching up process in some countries same as Afghanistan, Algeria, Lebanon, Iran, and Iraq. The evidences show these shocks have permanent effect on catching up process some countries and only some OIC member countries experienced catching up process in some period because of positive term of trade shocks. Because they did not have the necessary infrastructure, they could not escape the poverty trap and most OIC member countries stay poor. Therefore, if OIC countries move toward diversification in export goods basket and political stability and reinforce the economic and social infrastructures, there is possible that they escape from vicious cycles.


YEAR
AFGHANISTAN AFGHANISTAN_TR
ALBANIA ALBANIA_TR
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BAHRAIN BAHRAIN_TR
BANGLADESH BANGLADESH_TR
BENIN BENIN_TR
BURKINAFASO BURKINAFASO_TR
CAMEROON CAMEROON_TR
COMORO COMORO_TR
COTEDIVOIRE COTEDIVOIRE_TR
DJIBOUTI DJIBOUTI_TR
EGYPT EGYPT_TR
GABON GABON_TR
GAMBIA GAMBIA_TR
GUINEA GUINEA_TR
GUINEABISSAU GUINEABISSAU_TR
INDONESIA INDONESIA_TR
IRAN IRAN_TR
IRAQ IRAQ_TR
JORDAN JORDAN_TR
KUWAIT KUWAIT_TR
LEBANON LEBANON_TR
LIBYA LIBYA_TR
MALAYSIA MALAYSIA_TR

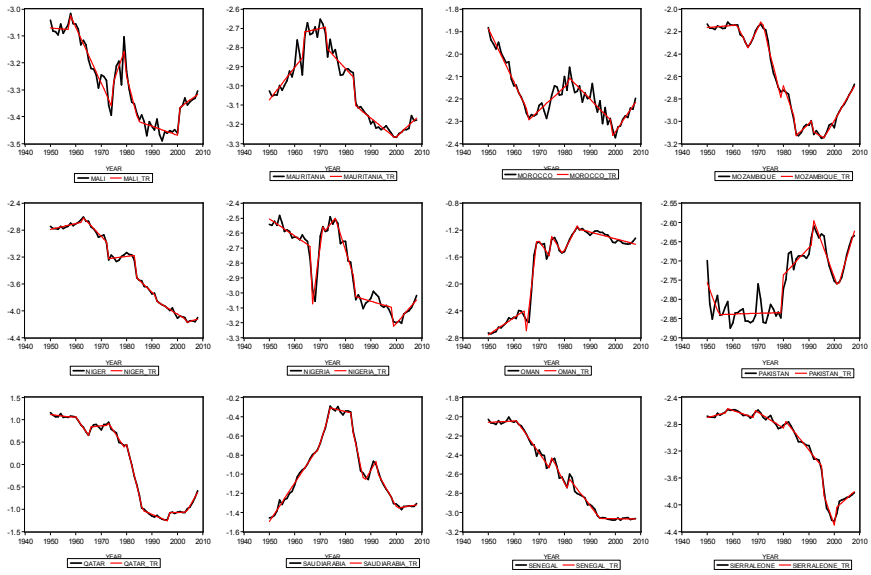

Figure1: Dynamics of the differences of the logarithm per capita GDP series and estimated flexible linear trend

1) Black lines are actual series and red lines are estimated trend with multiple breaks.
2) 2) Source: Authors findings.

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