The Impact of Agricultural Sector on Economic Growth in MENA Countries: A Panel Econometric Approach

أثر القطاع الفلاحي على النمو الإقتصادي ببلدان الـ MENA: مقاربة قياسية بالـ PANEL

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Abstract: The agricultural sector is important to any economies in the world; it permits the development of economic growth, increase revenues and satisfaction of food demand. In this paper, we studied the relationship between agriculture value added (LNADA), food production index (LNFPI), and economic growth (LNGDP) in 8 MENA countries over the period of 1975-2014 with using a panel econometric approach and panel Granger causality. We found with pooled least squares with fixed-effects, FMOLS and DOLS models that there's a positive influence of agriculture value added on economic growth in pooled data and there's bidirectional causality between LNGDP and LNADA, and among LNADA and LNFPI, and we found also that there's unidirectional causality running from LNFPI to LNGDP.

Keys words: agricultural sector, economic growth, MENA countries, panel econometric approach, panel Granger causality.

Jel Classification: O13, C23

الملخص:

يلعب القطاع الفلاحي دورا هاما في الاقتصاديات العالمية, حيث يسمح بتطوير التنمية الاقتصادية, رفع المداخيل والأرباح, واشباع الطلب على الغذاء. في هذا البحث, سوف ندرس العلاقة ما بين القيمة المضافة للقطاع الفلاحي, المؤشر انتاج الغذاء, والناتج الوطني الخام كعامل للتنمية الاقتصادية لثمانية دول الشرق الأوسط وشمال افريقيا خلال الفترة 1975-2014 باستعمال النمذجة القياسية للبيانات البنال والسببية قرنجر. من خلال عملية التقدير للبانل مع التأثير الثابت, FMOLS و DOLS, وجدنا بأن هناك تأثير موجب بين القيمة المضافة للقطاع الفلاحي والناتج الوطني الخام وأيضا هناك علاقة سببية في اتجاهين على مستوى 10% بين القيمة المضافة للقطاع الفلاحي والناتج الوطني الخام وبين القيمة المضافة للقطاع الفلاحي والمؤشر انتاج الغذاء وأيضا هناك علاقة سببية في اتجاه واحد على مستوى 10% من والمؤشر انتاج الغذاء الى الناتج الوطني الخام.

الكلمات المفتاحية: القطاع الفلاحي, التنمية الاقتصادية, دول الشرق الأوسط وشمال افريقيا, النمذجة القياسية للبيانات البنال , السببية قرنجر.

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1. Introduction:

The agriculture sector has a major role to play for the increase of economic of most of MENA countries, but such countries are suffering from the most water-scarce and dry region in the world, many of them in the region, especially those around the Mediterranean Sea, are highly dependent on agriculture. Therefore, the impact of the unindustrialized sector to the overall economy varies significantly among countries in the region, ranging, for example, from about 3.2% in Saudi Arabia to 13.4% in Egypt. Large scale irrigation coupled with mechanization has enabled extensive production of high-value cash crops, including fruits, vegetables, cereals, and sugar.

In Tunisia, the main crops are cereals and olive oil, with almost half of all the cultivated land sown with cereals and another third planted. Tunisia is one of the world's biggest producers and exporters of olive oil, and it exports dates and citrus fruits that are grown mostly in the northern parts of the country. Also, Egypt, Tunisia, Saudi Arabia, Morocco and Jordan produced significant quantities of rice, maize, lentils, chickpeas, vegetables and fruits.

Date palm is one of the principal agricultural products in the arid and semi-arid region of the world, especially Middle East and North Africa (MENA) region. The Arab world has more than 84 million date palm trees with the majority in Egypt, Iraq, Saudi Arabia, Iran, Algeria, Morocco and Tunisia. Date palm trees produce huge amount of agricultural wastes in the form of dry leaves, stems, pits, seeds…etc. A typical date tree can generate as much as 20 kilograms of dry leaves per annum while date pits account for almost 10% of date fruits. Some studies have reported that Saudi Arabia alone generates more than 200,000 tons of date palm biomass each year.

On the other hand, the industry sector supplies important agricultural inputs, new technology, electricity, more irrigation, and better infrastructure that links it to lucrative regional food markets (**World Economic Forum, 2016**).

In the light of this statement, we shall study the relationship between the agricultural sector and economic growth of eight MENA countries during the period 1975-2014 with a panel econometric approach. We will divide this research paper into 5 main titles, introduction, literature review, data and methodology, empirical result, and conclusion.

2. Literature Review:

Ligon and Sadoulet (2018) studied the relative benefits of agricultural growth on the distribution of expenditures for 62 countries over the period of 1978-2011. They divided into two panels, so the 1st panel was based on the expenditures, share of total expenditure (%) and average annual growth rate in expenditures per capita. The 2nd panel was based on income variable, per capita

GDP, average share of agriculture, average annual growth rates in value-added. They employed an unbalanced panel due to country-quantile and the interval between periods for the variables of expenditures and income. They concluded that the growth in GDP from agriculture has a larger effect on the expenditures of the poor than does growth in GDP from other sectors. They found also that income growth from agriculture was disproportionately beneficial for the poorest households in the poorer countries.

Bakari and Mabrouki (2018) examined the relationship between agricultural trade and economic growth in 4 countries of North Africa over the period 1982-2016. They used the fixed and random effect model for the variables of GDP, gross fixed capital formation, agricultural exports, and agricultural imports. They established that agricultural trade has a positive correlation with GDP, and they accepted the fixed-effect model with Hausman test, so this model indicates that all exogenous variables have a positive influence on economic growth, except the agricultural import which had an significant sign, so an increase by 1% in the agricultural exports may rise the level of GDP by 0.21%. They said also that there's a need to encourage the development and the investments in the agricultural sector to cover the value of imports (especially manufactural imports).

Getahun et al. (2018) employed panel cointegration and Granger causality to examine the link among investment in agriculture, food sectors, economic growth and food and nutrition insecurity. They based their investigation on 44 African countries over the period of 1961-2014 and they used the variables of total factor productivity, share of employment in agriculture, total gross output of crops and livestock, land, capital, machinery power, synthetic nitrogen/phosphorus/potassium fertilizers, policy variable, food production, undernourishment, global hunger index, institutional support and commitment index, budgetary commitment (share of government spending on agriculture), six governance indicators, GDP per capita growth, openness, the share of food and beverage imports, index of the share of the sum of imports and exports to GDP, R&D expenditures in the agriculture sector (number of wheel and crawler tractors), natural resources abundance as a share of GDP, the expenditure share of GDP in health, and education infrastructure development, the real agricultural output growth rate. They concluded that agricultural growth, government commitment to the sector, progress in food and nutrition security and improvement in governance quality have a positive influence on economic growth with FMOLS model and they found also that agricultural growth, government commitment, and quality of governance Granger causes overall economic growth.

Faycal and Ali (2016) investigated with ARDL model the relationship between the government support of the agricultural sector and economic growth

in Algeria over the period of 1970-2014. They used the variables of GDP growth rate, added-value in the agricultural sector growth rate, added-value in the industrial sector growth rate, added-value in the agricultural sector (% of GDP), added-value in the industrial sector (% of GDP), food and nutrition imports (% total of imports), final expenditure in the agricultural sector and irrigation, dummy variable of support of the agricultural production and producers and they found that the support of the agricultural production and producers has a positive influence on the agricultural growth, but it has a negative effect on economic growth in the long-term, so it leads to increase the investment, revenue and agricultural productions. However, the policy of supporting in the agricultural sector allows a surplus in the production factors and it permits to keep the agricultural sector in Algeria. They concluded also that the total agricultural support regardless of its relationship with production and producers has a positive effect on agricultural production growth and economic growth in the long term.

Matthew and Ben (2016) worked an empirical model about the agricultural sector and economic growth in Nigeria over the period of 1986-2014. They used the VAR model to study the relationship between the variables of per capita income, agricultural output and public agricultural expenditure. They found that most of the lag variables were not significant, but the regression coefficient was estimating at 0.968 in the income model, so it gave a good result and they said that the agricultural may play a major role in Nigeria's economic growth. They concluded also from impulse response and variance decomposition that the government should up its expenditure on the agricultural sector and to diversify the Nigeria's economy.

Edeme et al. (2016) employed panel regression model to study the link among agricultural sector and economic growth for ECOWAS countries (about 15 African countries) during the period of 1980-2013. They used the variables of labour force participation rate, capital stock, agricultural exports, non-agricultural exports, inflation, GDP and they concluded with fixed-effect model that almost all exogenous variables don't affect significantly the economic growth, but they had positive coefficients on the economic growth, except the non-agricultural exports which had a negative influence on economic growth. They found also for the pooled regression that the labour force participation rate, agricultural exports have a significant and positive impact on economic growth of such countries, demonstrating that the agriculture sector can have a key role in increasing the economic development especially in Liberia.

Verter and Bečvářová (2016) studied the effect of agricultural exports on economic growth in Nigeria during the period of 1980-2012. They employed the OLS regression, Granger causality, impulse response function and decomposition on the variables of real GDP growth, the agricultural export

quantity index, agricultural degree of openness, and the real effective exchange rate index. They established with OLS regression and Granger causality that there's bidirectional causality between the agricultural export quantity index and real GDP growth, so there's evidence of the hypothesis that agricultural exports led economic growth in this country. They found also that the agricultural export quantity index and the real effective exchange rate index have a significant and positive effect on GDP growth, but the agricultural degree of openness has a negative and significant impact on GDP growth.

Faridi (2012) used VECM model to estimate the long-run link among GDP, agricultural and non-agricultural exports for Pakistan over the period of 1972-2008. The variables were GDP, labour force participation, capital stock, agricultural exports, non-agricultural exports and inflation. He found that the capital stock, the labour force participation, and the non-agricultural exports have positive and significant influence on economic growth, indicating that a rise by 1 unit in these variables may raise the elasticity of GDP by 0.22, 1.70 and 0.58, respectively, but an increase in the agricultural exports by 1 unit may decrease the elasticity of GDP by 0.14. They concluded also that there's bidirectional causality between non-agricultural exports and real GDP, and there's no causality between agricultural exports and GDP.

Awokuse (2009) investigated the relationship between agricultural sector and economic growth for 15 developing and transition economies during the period of 1971-2006. They employed the procedure of ARDL for the variables of real GDP growth, gross capital formation per worker, population as proxy for labour, agricultural value added per worker, real exports, and inflation rate. They found that gross capital formation per worker, and the real exports have a positive and significant effect on economic growth. The concluded also that the agricultural sector impacts positively the economic growth for 10 of 15 countries examined.

Chebbi and Lachaal (2007) used the time-series co-integration technique and VAR model to examine the link between agriculture sector and economic growth in Tunisia during the period of 1961-2005. The variables were GDP index of agricultural sector in constant price, GDP index of manufacturing industry in constant price, GDP index of non-manufacturing industry in constant price, GDP index of transportation, tourism and telecommunication sector in constant price and GDP index of commerce and service sector in constant price. They found that there's a cointegration relationship among economic sectors and they rejected the weak exogeneity test, meaning that agricultural growth can cause the growth of the non-agricultural sector, and the non-agriculture sectors can cause the growth of the agricultural. They concluded also that a 1% rise in agricultural GDP may increase industry GDP by 0.285%. In the short-run analysis, the agricultural sector had a small and positive influence for the growth of the other non-agricultural sectors in Tunisia's economy.

3. Data and Methodology:

We shall study 8 MENA countries including Algeria, Egypt, Iran, Iraq, Jordan, Morocco, Saudi Arabia, and Tunisia during the period of 1975-2014; we took such dataset due to availability of the variables and we use them into natural logarithm. The following table describes the three variables used in this study.

Table 1. Variable Definition

Variables	Measures	Source
AVA: Agriculture value added	Constant 2010 US $	World Bank
FPI: Food production index	(2004-2006=100)	World Bank
GDP: Gross domestic product	Constant 2010 US $	World Bank

Source: Made by the researchers

- **The model:**

$$LNGDP_{it} = a_0 + a_1 LNADA_{it} + a_2 LNFPI_{it} + e_{it}$$

$LNGDP_{it}$: designs the natural logarithm of gross domestic product or the economic growth factor in the specific country i at time t.

a_0: is the intercept variable and it represents all factors that are not defined in this study, especially the technology advancement. It defines also if the panel model regression has a fixed or random effect.

$LNADA_{it}$: designs the natural logarithm of agriculture value added or the contribution of agriculture sector to the production supplies in the specific country i at time t. It includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production (net output).

$LNFPI_{it}$; represents the natural logarithm of food production index in the specific country i at time t. It covers crops that are considered edible and that contain nutrients.

e_{it}: is the error term in the specific country i at time t. It's used to test if the statistical model is well specified or not and it's also employed to display the cointegration and causality between variables.

This research is one of the rare studies that modelling those variables within a panel framework and to examine the impact on indicators of economic growth.

We shall start by making panel model regression and make the Hausman test to display the perfect model the fixed-effect model or the random-effect model. After, we will apply a heterogeneous panel cointegration to study the dynamic relationship between these variables and which it could demonstrate the role of agricultural sector on economic growth. Also, the test for causal relationship between these variables in a panel background is typically led in three steps. First, we should check the order of integration in time series variables. Then, after having recognized the order of integration in the series, the panel cointegration tests are used to investigate the long-run link. Therefore, if the order of integration is found to be one for all variables (1^{st} difference), the next step is to use the cointegration analysis to examine the existence of long-run relationship. And, the last phase is represented by employing dynamic panel causality tests in order to evaluate the long-run direction of causality.

3.1. Panel unit root tests:

The panel-based methods proposed by **Levin, Lin and Chu (2002)**, **Im, Pesaran and Shin (2003)**, Augmented Dickey-Fuller-Fisher and Phillips-Perron-Fisher of **Maddala and Wu (1999)**, **Breitung (2000)**, **Hadri (2000)** and **Heteroscedastic consistent test** are used in this paper. For each estimation technique, we test for unit roots in the panel by using three types of models (one with constant and trend, one with only constant and one with no constant and no trend).

3.2. Panel cointegration test:

We shall develop **Pedroni (1999, 2004)** panel cointegration test that use eleven tests to examine the cointegration relationship and which allow for heterogeneity among individual members of the panel.

3.3. FMOLS and DOLS models:

FMOLS (Fully-Modified Ordinary Least Square) represents a non-parametric approach and which it takes into explanation the possible correlation between the error term and the first difference of the regressors as well as the presence of a constant term, to dealing with correction for a serial correlation. This model was developed by **(Phillips, 1995)**

DOLS (Dynamic OLS) is parametric method where the lagged first-difference terms are explicitly estimated. In this case, the errors of the model are augmented with leads, lags and contemporaneous values of the regressors. This model was developed by **(Saikkonen, 1992)** and **(Stock and Watson, 1993)**

We shall perform these two methods with Eviews 9 and we will use pooled (weighted) estimation that account for heterogeneity by using cross-section specific estimates of the long-run covariance and the asymptotic covariance

estimated using a moment estimator, because we need to reweight the data prior to computing pooled FMOLS and DOLS.

3.4. Panel Granger causality test:

If variables of this study are cointegrated this implies that causality exists between the two series, but this does not indicate the direction of causality. The Granger causality in the long-run relationship employed two step processes.

4. Empirical results

4.1. Pooled regression estimation:

The Hausman test indicated that the probability of the test is inferior to 10%, 5% and 1%, so we can't accept the null hypothesis, rather we accept the alternative hypothesis and we can say that the model is well specified with fixed-effects.

The pooled least squares fixed-effects model is statistically accepted due to high value of regression coefficient and Fisher-statistic, so we have 92.1% of exogenous variables that explain the economic growth factor and the model is statistically fit.

The intercept term was negative and significant, indicating that the technology advancement in pooled data won't increase the elasticity of GDP, so we can say that such countries aren't using impeccably machinery and innovation to improve the agriculture sector and diversify the MENA's economy.

The coefficient of LNADA was positive and statistically accepted at level of 1%, so a rise by 1 unit in this variable will increase the elasticity of GDP by 0.925, indicating that the value-added from agricultural sector was benefit for such MENA countries (pooled data) and it will support the economic growth if they will give more importance as they give to the manufacture sector, especially the countries that depend a lot on fossil exports.

Considering the country-specific effect, the result indicate that agriculture sector had different relationship with economic growth with respect to the base category, so we found that there's a negative link between those variables in Algeria, Egypt, Iran, Morocco and Saudi Arabia, indicating that these countries individually are ignoring the agricultural sector because they depend a lot on other sector than agriculture. However, we found that there's a positive relationship between agriculture sector and GDP in Iraq, Jordan and Tunisia, demonstrating that these countries independently are giving an importance to this sector to develop and expanse their economic growth.

4.2. Panel unit root results:

The variables were reported to be integrated on first difference I (1), so we rejected the null hypothesis at level significance of 1% and 5% for all tests except the **Hadri** and **Heteroscedastic consistent** test, these two tests accepted only the alternative hypothesis for LNGDP and LNFPI series. Consequently, we can perform the Pedroni cointegration test and the estimation of FMOLS and DOLS models.

4.3. Panel cointegration results:

We showed from the panel cointegration of Pedroni test that there's a rejection of the null hypothesis of no cointegration at level of 1% for almost all tests, except for the model with no trend and no intercept, and we confirmed with the Kao test that there's a long-run relationship. Therefore, we can say that the variables move together in the long-run. The implication is that there is a long-run relationship between LNGDP, LNADA and LNFPI.

4.4. The FMOLS and DOLS estimations:

We found almost the same result as it's in the fixed-effects model, so the coefficient of LNADA was positive and statistically accepted at level of 1%, so a rise by 1 unit in this variable will increase the elasticity of GDP by 0.932, representing that the agricultural sector had a major role to play for the expansion of economic growth in the MENA country. However, the insignificant and negative sign of LNFPI proves that such country aren't producing perfectly crops, food, nutrition and the agricultural sector need improved machinery, technology and competent labour force to increase and to enhance the level of non-industrialized sector.

4.5. Granger panel causality test:

We displayed that there's bidirectional causality at level of 10% between LNGDP and LNADA, and among LNADA and LNFPI, and we found also that there's unidirectional causality at level of 10% running from LNFPI to LNGDP, proving the results that we had with fixed-effects model, FMOLS and DOLS models. However, the relationship between agricultural value-added and food production index was not estimated, so we can say that an improvement in agricultural sector can affect positively the production of food and vice versa.

5. Conclusion:

In this paper, we studied the role of agricultural sector on economic growth of 8 MENA countries over the period 1975-2014. We made pooled least squares with fixed-effects, FMOLS and DOLS models to estimate the relationship between agriculture value added, food production index, and GDP.

We found that there's a positive impact of agriculture value added on economic growth for both models but the food production index was not significant, indicating that the improvement in the agricultural sector may increase the level of economic growth and it permits to diversify the MENA's economy.

Therefore, there's a need to better encourage and develop investment and exports in the agricultural sector to cover the value of imports, especially in manufacturing sector. They ought to look for new plans that can develop the agricultural trade and eliminating the unnecessary agricultural imports which it decreases the level of the economic growth and the trade balance. They should also enhance the investment in research and development by including new machineries, tractors and introduce renewable energy in the agricultural sector which will permit new and unlimited source of energy.

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Appendices:

Table 2. The Hausman test

Test	Chi-Sq. Statistic	Prob
Cross-section random	305.026***	0

Source: Done on Eviews 9

*, **, ***, indicates that we can't reject the alternative hypothesis at 10%, 5% and 1%.

Table 3. Pooled least squares with fixed effect model

Variables	Coefficient	T-stat	Prob
Intercept	-17.083	-41.159***	0
LNADA	0.925	31.410***	0
LNFPI	0.023	0.816	0.415
Fixed-effects (Cross)			
Algeria	-0.245	**Jordan**	2.407
Egypt	-1.247	**Morocco**	-0.190
Iran	-1.364	**Saudi Arabia**	-0.531
Iraq	0.298	**Tunisia**	0.873
R^2	0.921		
F-stat	403.558***		
Prob (F-stat)	0		

Source: Made on Eviews 9.

*, **, ***, indicates that we can't reject the alternative hypothesis at 10%, 5% and 1%.

Table 4. Panel unit root test for individual intercept and trend

Null hypothesis : Unit Root								Null hypothesis: No Unit Root
Variables		Methods						
		LLC (t-stat)	Breit (t-stat)	IPS (w-stat)	MW-ADF. F (χ^2)	MW-PP. F (χ^2)	Hadri (z-stat)	Heteroscedastic consistent (z-stat)
Level	LNADA	-6.202*** (0)	-1.505* (0.066)	-4.952*** (0)	56.*** (0)	54.620*** (0)	6.268 (0)	6.229 (0)
	LNFPI	-0.708 (0.239)	0.051 (0.520)	-2.039** (0.020)	26.35** (0.049)	38.45*** (0.001)	4.612 (0)	3.462 (0)
	LNGDP	-0.215** (0.015)	-0.023 (0.490)	-3.036*** (0.001)	53.79*** (0)	61.979*** (0)	7.166 (0.000)	6.007 (0.002)
1st dif	ΔLNADA	-20.328*** (0)	-14.22*** (0)	-19.81*** (0)	396.7*** (0)	1228.1*** (0)	5.849 (0)	15.084 (0)
	ΔLNFPI	-12.795*** (0)	-6.458*** (0)	-13.96*** (0)	229.6*** (0)	226.5*** (0)	1.759* (0.039)	2.927 (0.001)
	ΔLNGDP	-18.20*** (0)	-6.67*** (0)	-19.67*** (0)	504.2*** (0)	1222.7*** (0)	2.986 (0.001)	10.305 (0)

Source: Done on Eviews 9

Table 5. Panel unit root test for individual intercept

Null hypothesis : Unit Root								Null hypothesis: No Unit Root
Variables		Methods						
		LLC (t-stat)	Breit (t-stat)	IPS (w-stat)	MW-ADF. F (χ^2)	MW-PP. F (χ^2)	Hadri (z-stat)	Heteroscedastic consistent (z-stat)
Level	LNADA	0.908 (0.818)	…	2.23 (0.987)	10.45 (0.841)	17.162 (0.375)	10.92 (0)	11.016 (0)
	LNFPI	-2.486*** (0.006)	…	1.822 (0.965)	6.235 (0.985)	14.929 (0.529)	11.178 (0)	10.827 (0)
	LNGDP	-2.723** (0.003)	…	0.48 (0.684)	14.989 (0.525)	19.78 (0.230)	10.902 (0)	10.804 (0)
1st dif	ΔLNADA	-21.16*** (0)	…	-20.16*** (0)	234.8*** (0)	249.7*** (0)	2.336 (0.009)	3.689 (0.001)
	ΔLNFPI	-14.06*** (0)	…	-15.37*** (0)	178.97*** (0)	181.45*** (0)	-0.4*** (0.655)	0.64*** (0.260)
	ΔLNGDP	-17.62*** (0)	…	-18.47*** (0)	205.88*** (0)	233*** (0)	1.452** (0.073)	1.788* (0.036)

Source: Done on Eviews 9

Table 6. Panel unit root test with no individual intercept and trend

Null hypothesis : Unit Root							Null hypothesis: No Unit Root	
Variables		Methods						
		LLC (t-stat)	Breit (t-stat)	IPS (w-stat)	MW-ADF. F (χ^2)	MW-PP. F (χ^2)	Hadri (z-stat)	Heteroscedastic consistent (z-stat)
Level	LNADA	16.19 (1)	…	…	0.191 (1)	0.022 (1)	…	…
	LNFPI	12.75 (1)	…	…	0.213 (1)	0.254 (1)	…	…
	LNGDP	8.180 (1)	…	…	0.469 (1)	0.169 (1)	…	…
1st dif	ΔLNADA	-7.526*** (0)	…	…	516.4*** (0)	523.4*** (0)	…	…
	ΔLNFPI	-7.45*** (0)	…	…	132.5*** (0)	172.64*** (0)	…	…
	ΔLNGDP	-13.88*** (0)	…	…	410.37*** (0)	586.87*** (0)	…	…

Source: Done on Eviews 9

*, **, *** represents 10%, 5% and 1% levels of significance for all unit root tests. The null hypothesis is that the variable follows a unit root process. Contrary for the Hadri and Heteroscedastic consistent tests (z-stat), the levels of significance were 10%, 5% and 1%. Δ is the 1st difference operator.

Table 7. Pedroni residual cointegration

	Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
		Test	Statistics	Prob	Test	Statistics	Prob
Panel model with individual intercept and individual trend	Pedroni (1999)	Panel v-stat	1.267	0.102	Group p-stat	-2.423***	0.007
		Panel rho-stat	-5.148***	0	Group pp- stat	-5.256***	0
		Panel PP-stat	-8.229***	0	Group ADF- stat	-4.535***	0
		Panel v-stat	-7.983***	0			
	Pedroni (2004)	Panel v-stat	0.611	0.270			
		Panel rho-stat	-3.358***	0.004			
		Panel PP-stat	-5.378***	0			
		Panel v-stat	-5.015***	0			
Panel model with individual intercept only	Pedroni (1999)	Panel v-stat	2.116**	0.017	Group p-stat	-3.55***	0.002
		Panel rho-stat	-5.378***	0	Group pp- stat	-6.462***	0
		Panel PP-stat	-7.175***	0	Group ADF- stat	-5.200***	0
		Panel v-stat	-6.674***	0			
	Pedroni (2004)	Panel v-stat	1.844**	0.032			
		Panel rho-stat	-3.994***	0			
		Panel PP-stat	-5.205**	0			
		Panel v-stat	-4.583***	0			
Panel model with no intercept or trend	Pedroni (1999)	Panel v-stat	-1.516	0.935	Group p-stat	0.013	0.505
		Panel rho-stat	0.041	0.516	Group pp- stat	-1.386*	0.082
		Panel PP-stat	-0.605	0.272	Group ADF- stat	-0.362	0.358
		Panel v-stat	0.062	0.524			
	Pedroni (2004)	Panel v-stat	-1.644	0.950			
		Panel rho-stat	-0.136	0.445			
		Panel PP-stat	-0.840	0.200			
		Panel v-stat	0.318	0.624			

Source: Done on Eviews 9

Table 8. Kao residual cointegration test

ADF	T-stat	Prob
	-2.904***	0.001

Source: Done on Eviews 9

*, **, *** represents 10%, 5% and 1% levels of significance, so we can't reject the alternative hypothesis of existence of cointegration relationship between variables.

Table 9. Estimation of FMOLS and DOLS with weighted panel method

Dependent variable: LNGDP	FMOLS			DOLS		
Variables	**Coefficient**	**t-stat**	**Prob**	**Coefficient**	**t-stat**	**Prob**
LNADA	0.861***	4.400	0.000	0.932***	4.210	0
LNFPI	-0.001	-0.005	0.995	-0.077	-0.354	0.723
R^2	0.953			0.962		

Source: Done on Eviews 9.

*, **, ***, indicates that we can't reject the alternative hypothesis at 10%, 5% and 1%.

Table 10. Granger panel causality test with eight lags, p = 2:

Null Hypothesis	F-stat	Prob
LNADA does not Granger cause LNGDP	**4.187****	**0.016**
LNGDP does not Granger cause LNADA	**2.527***	**0.081**
LNFPI does not Granger cause LNGDP	**2.512***	**0.082**
LNGDP does not Granger cause LNFPI	**0.819**	**0.441**
LNFPI does not Granger cause LNADA	**2.621***	**0.074**
LNADA does not Granger cause LNFPI	**5.227*****	**0.005**

Source: Done on Eviews 9.

*, **, ***, indicates that we can't reject the alternative hypothesis at 10%, 5% and 1%.