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The Impact of Human Capital on FDI with New Evidence from Bootstrap Panel Granger Causality Analysis

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Abstract

This study evaluates the causality relationship between human capital and foreign direct investment inflow in twenty-six OIC (the Organization of Islamic Cooperation) countries over the period 1970–2014. We employed the panel Granger non-causality testing approach of Kònya (2006) that is based on seemingly unrelated regression (SUR) systems, and Wald tests with country specific bootstrap critical values. The approach allows one to test for Granger non-causality on each member of panel, separately by taking into account the cross-sectional dependency and slope heterogeneity among countries investigated simultaneously. We found that the hypothesis of Granger non-causality from human capital to foreign direct investment (FDI) was rejected for more than half of the sample countries, mainly among African states. In addition, the effect magnitude of human capital on FDI varies among the states significantly.

Keywords: Foreign Direct Investment (FDI), Human Capital, Seemingly Unrelated Equation System, Bootstrapping, OIC Countries.
JEL Classification: C21, F2, F21.

1. Introduction[5]

The inflow of FDI into developing countries, including OIC members,

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has been significantly rising since 1990, and FDI attraction is token as a national development policy in OIC states. FDI has become an important source of external finance for developing countries. In addition to finance, FDI functions as a means of transferring technology and knowledge, and also accessing to regional and international markets. FDI has become an important source for economic development by importing technology, enhancing productivity and competitiveness.

According to several reports by UNCTAD, before 1980s the main cause of FDI inflow into developing countries was their rich natural resources; however, the concentration of international investments has shifted from natural resources to technology-centered services and industries over the past two decades. The experience of developing countries as Mauritius showed that countries with skilled and educated workforce have been more successful in attracting a new flow of international investments and internalizing its benefits.

OIC is a large international organization consisting of countries with different development levels from four continents. There are extensive inter-organizational investments between OIC countries by having affiliates in each other. The majority of these investments are made in small bilateral regional scales between neighboring countries. After a rise in FDI attraction by developing countries over the past two decades, OIC countries have become the new actors in this undertaking, and even can get more involved. The OIC countries account for 10% of global FDI, while the share of developing countries is approximately 50% (UNCTAD, 2015). In recent years, OIC countries in transition (e.g. Indonesia, Turkey, Malaysia, United Arab Emirates, Kazakhstan, and Saudi Arabia) could attract the highest FDI. In contrast, countries in Sub-Saharan Africa attracted the least amount of FDI. The main problems OIC countries face in attracting FDI are: inadequate knowledge and skill, poor infrastructures, and limited size of private sector (FDI Performance of the OIC Countries, 2014).

In this study, we empirically evaluated the direction of causality from human capital to FDI attraction in 26 OIC countries over the period 1970–2014. To do that, the panel Granger causality test procedure developed by Kónya (2006) was conducted which controls for heterogeneity coefficient and cross-sectional dependency concurrently. As noted by Bai and Kao (2006), the assumption of cross-sectional independence will be difficult to satisfy in panel data, neglecting that cross-sectional dependency could cause bias of inconsistency in empirical results. Moreover, many panel time series analysis e.g. GMM method assume slope homogeneity, while due to different degrees of economic development among members of panel, the assumption may be violated. The Kónya test (2006) is carried out under the structure of SUR (seemingly unrelated regression) via the Wald test to assess the causality along with critical values simulated by bootstrap method. Also the test can estimate the coefficients of each country individually under panel data causality, and dealing with the problem of cross-sectional dependence at the same time.

The remainder of this paper is organized as follows: In section 2, theoretical and empirical literature on the role of human capital in FDI attraction is discussed. Section 3 explains the bootstrap panel Granger causality test proposed by Kónya (2006), cross-sectional dependence tests, and the slope heterogeneity tests. Section 4 describes the data, and makes some preliminary econometric investigations. In section 5 empirical result are explicated. Section 6 presents the conclusion and recommendations.

2. Role of Human Capital in FDI Attraction in Empirical Literature

FDI is a flow of resources (capital, knowledge, technology, and management techniques) for host countries which can generate increasing returns in production via externalities and productivity spillovers, and can support economic growth in the long term. The inflow of FDI is determined by several factors (e.g. market size and growth, natural resources abundant, human capital and skilled workforce, quality of infrastructure, government policies, political stability, and investment support laws). Among these factors, human capital accumulation plays a significant role in internalizing important achievements of FDI inflow into the host country, by import of capital, knowledge, technology and new management techniques. For example, Lucas (1990) assumes that deficiency of human capital in less developed countries discourages foreign capital inflow. In fact, an educated and trained workforce is able to not only adjust to frequent technological changes and development of capital goods, but also makes better use of machinery, equipment, and advanced technologies (Noorbakhsh et al., 2001).

Dunning (1988, 2009) realized that skill and education affect the volume and type of FDI inflow. Zhang and Markusen (1999) investigated the reason for low volume of FDI inflow into LDC countries, using a theoretical model and find that the multinational companies need skilled workforce, including managers, engineers, and technicians. The lack of well-trained workforce along with poor infrastructure, such as inadequate transportation and communication equipment, have been recognized as some of main barriers to capital inflow. Yeaple (2003) showed the American multinationals operating in low-skill industries tend to invest in countries with simple and low-income workforce. In contrast, high-skill industrial companies usually invest in countries with great skilled workforce. Heyuan and Teixeira (2010) evaluated the effect of human capital on FDI attraction among 77 firms in China. To do that, they study not only the direct impact of education and quality of human capital, but also their indirect impact through concluding contracts between firms and universities, and also through research and development activities. Their findings indicate that human capital education, knowledge and skill do not have a direct impact on FDI attraction; whereas R&D activities as well as knowledge centered infrastructures (universities) affect FDI attraction.

Morita and Sugawara (2015) constructed an overlapping generation model with human capital accumulation to analyze the effect of human capital level on FDI in a small open developing country. They realize that when the human capital level in the developing country is sufficiently small, manufactured goods firms do not conduct FDI and the economy in the developing country is trapped in poverty.

Kizilkaya et al. (2016) investigated the dynamic relationship between FDI, human capital, economic freedom and economic growth using various panel data models among 39 countries over the period 2000–2013. 1) According to panel fully modified ordinary least squares results, elements of FDI, human capital and economic freedom have a positive impact on economic growth; 2) according to panel dynamic ordinary least squares results, human capital and economic freedom have positive effect on economic growth, and finally 3) panel vector error correction model results supports the relationship between variables both for short and long term.

Alejandro and Osuna (2016) investigated the nonlinear relationship between human capital formations and FDI inflows in 32 Federal States of Mexico over the period 2007–2012 using panel data regression. They found that implications are important for Federal States, to configure an appropriate combination of tertiary and postgraduate critical mass of human capital to attract FDI inflows.

With regard to the empirical literature in this subject on the OIC countries, there is a limited number of empirical studies. Mina et al. (2007) estimated the effect of human capital on FDI attraction in six countries for the period 1980 to 2002. The results indicate that improvement of human capital (number of students enrolled for post-graduate studies) decreases FDI attraction in aforementioned countries. They attribute it to two reasons: 1) improvement of human capital quality encourage domestic employers to invest inside the country, resulting in raising the rate of domestic investment, and 2) selecting variables as proxy for human capital quality could be a wrong choice.

Najjarzadeh and Shaghaghi-Shahri (2004) ranked the OIC countries in terms of factors contributing to FDI attraction, using taxonomy ranking technique. To this end, they study the following indices: gross domestic product (GDP), regionalism, degree of openness, market size and economic stability. According to the results, Malaysia has the highest rank in terms of FDI attraction; whereas, Libya and Uzbekistan have the lowest ranks. Najjarzadeh et al. (2005) evaluated the FDI attraction function in OIC countries during the 1995–2000 period, using panel data method. According to their results, the expansion of market size and implementation of appropriate business policies (e.g. decreasing tariff rates, reduction of economic instability, and increasing budget) have a positive impact on FDI attraction. Ostadi et al. (2003) evaluated the FDI attraction function in D-8 over the period 1995–2010, using the fixed and random effects method. According to their findings, GDP, population, and degree of openness have positive effect on FDI attraction; whereas exchange rate, inflammation rate, and tax rate have negative effects.

3. Methodology

3.1 Causality Methodology

The panel Granger non-causality approach by Kònya (2006) that examines the relationship between FDI and human capital (HUM) can be studied using the following bivariate and trivariate finite order vector autoregressive (VAR) model:

$$FDI_{it} = \alpha_i + \sum_{k=1}^{k=K} \rho_{ik} FDI_{it-k} + \sum_{p=1}^{p=P} \beta_{ik} HUM_{it-p} + u_{it} \text{ for } i = 1,2,\dots,N; \ t = 1,2,\dots,T \quad (1)$$

$$FDI_{it} = \alpha_i + \sum_{k=1}^{k=K} \rho_{ik} FDI_{it-k} + \sum_{p=1}^{p=P} \beta_{ik} HUM_{it-p} + \sum_{p=1}^{p=P} \theta_{ik} GY_{it-p} + u_{it} \text{ for } i = 1,2,\dots,N; \ t = 1,2,\dots,T \quad (2)$$

In models (1) and (2), FDI, HUM, and GY denote the foreign direct investment, human capital, and the growth rate of real GDP, respectively. i (i = 1, …, N) and t (t = 1, …, T) denote the country and the period, based on priority. k and p are the lag lengths for dependent variable (FDI) and for independent variables (HUM and GY). ρ, β, and θ are the coefficients, which may vary between different cross section units. The error terms, $u_{it}(u_{1t}, u_{2t}, \dots, u_{Nt})$, are supposed to be white noises, and may be correlated with each other.

We can consider the equations (1) and (2) as the following two sets of equations:

$$\begin{cases} FDI_{1t} = \alpha_1 + \sum_{k=1}^{k=K} \rho_{1k} FDI_{1t-k} + \sum_{p=1}^{p=P} \beta_{1k} HUM_{1t-p} + u_{1t} \\ FDI_{2t} = \alpha_2 + \sum_{k=1}^{k=K} \rho_{2k} FDI_{2t-k} + \sum_{p=1}^{p=P} \beta_{2k} HUM_{2t-p} + u_{2t} \quad (1-1) \\ \vdots \\ FDI_{Nt} = \alpha_N + \sum_{k=1}^{k=K} \rho_{Nk} FDI_{Nt-k} + \sum_{p=1}^{p=P} \beta_{Nk} HUM_{Nt-p} + u_{Nt} \end{cases}$$

and

$$\begin{cases} FDI_{1t} = \alpha_1 + \sum_{k=1}^{k=K} \rho_{1k} FDI_{1t-k} + \sum_{p=1}^{p=P} \beta_{1k} HUM_{1t-p} + \sum_{p=1}^{p=P} \theta_{1k} GY_{1t-p} + u_{1t} \\ FDI_{2t} = \alpha_2 + \sum_{k=1}^{k=K} \rho_{2k} FDI_{2t-k} + \sum_{p=1}^{p=P} \beta_{2k} HUM_{2t-p} + \sum_{p=1}^{p=P} \theta_{2k} GY_{2t-p} + u_{2t} \quad (2-1) \\ \vdots \\ FDI_{Nt} = \alpha_N + \sum_{k=1}^{k=K} \rho_{Nk} FDI_{Nt-k} + \sum_{p=1}^{p=P} \beta_{Nk} HUM_{Nt-p} + \sum_{p=1}^{p=P} \theta_{Nk} GY_{Nt-p} + u_{Nt} \end{cases}$$

As noted by Kònya (2006, P. 981), each equation in (1-1) and (2-1), has different predetermined variables. The only possible link among individual regressions is contemporaneous correlation within the systems. Hence, these sets of equations are not VAR but SUR systems. Secondly, since we shall use country specific bootstrap critical values, FDI, HUM, and GY are not supposed to be stationary, they denote the levels of FDI, HUM, and GY, irrespectively of the time-series properties of these variables.

3.2 Testing Cross Section Dependence

To test for cross-sectional dependence among error terms of system equations (1-1) and also (2-1), the Lagrange multiplier test (LM test) which developed by Breusch and Pagan (1980) and Pesaran et al. (2008) has been extensively used in empirical studies.

In the LM test, the null hypothesis of no cross section dependence, $(H_0: cov(u_i, u_j) = 0)$ for all t and $i \neq j$, is tested against the alternative hypothesis of cross section dependence $(H_0: cov(u_i, u_j) \neq 0)$, for at least one pair of $i \neq j$. Breusch and Pagan develop the LM test to examine the null hypothesis.

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\omega}_{ij}^2 \quad (3)$$

Where, $\hat{\omega}_{ij}$ is the pairwise correlation of residuals from OLS estimation of model (1-1) or (1-2) for each i. Under the null hypothesis, LM test has asymptotic chi-square distribution with (N(N-1)/2) degree of freedom.

Pesaran et al. (2008) revised the LM test, called CD Test, to moderate its bias:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \widehat{\omega}_{ij} \ \frac{(T-K)\widehat{\omega}_{ij}^2 - \mu_{Tij}}{\sqrt{\vartheta_{Tij}^2}} \qquad (4)$$

Where, μ_{Tij} and ϑ_{Tij}^2 are the exact mean and variance of $(T-K)\widehat{\omega}_{ij}^2$, respectively. Under the null hypothesis scenario (independence of error terms in all years) and assuming that first $T \longrightarrow \infty$ and then $N \longrightarrow \infty$, the CD test is asymptotically distributed as standard normal.

3.3 Testing Slope Homogeneity

The second topic in the analysis of panel data is related to the slope homogeneity among panel cross-section units. According to Granger (2003), the causality from one variable to another variable by imposing the joint restriction for the whole panel is the strong null hypothesis. As noted by Breitung (2005), the homogeneity assumption for the parameters is not able to capture heterogeneity due to country specific characteristics.

The standard F-test is the most familiar way to test the null hypothesis of slope homogeneity for all cross-section units versus the hypothesis of heterogeneity of coefficients for minimum pairs-wise slopes. However, this test is compatible when 1) the number of cross-section dimension (N) is less than the time dimension (T), 2) descriptive variables are strongly exogenous, and 3) variance of error terms are similar. Swamy (1970) developed a test for equality of coefficients by introducing an estimator of integrated data. Although this test allow for dissimilarity of variance of error terms, the number of cross-section dimensions (N), which should be less than the time dimensions (T), is still a weakness of this method. Pesaran and Yamagata (2008) introduce a standardized version of the Swamy test '$\hat{\Delta}$,' which fits $(N,T) \longrightarrow \infty$. In this test, the first step is calculation of the modified Swamy test:

$$\tilde{S} = \sum_{i=1}^{n} (\widehat{\varphi}_i - \tilde{\varphi}_{WFE})' \frac{x'_i M_\tau x_i}{\tilde{\sigma}_i^2} (\widehat{\varphi}_i - \tilde{\varphi}_{WFE}) \qquad (5)$$

Where, $\hat{\varphi}_i$ is the estimator of the integrated ordinary least squares, and $\tilde{\varphi}_{WFE}$ is the estimator of the weight constant's effects of the model (1) coefficients vector; M_τ is the identity matrix and $\tilde{\sigma}_i^2$ is the estimator of σ_i^2. So, the standardized distribution or $\hat{\Delta}$ is calculated as follows:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-h}{\sqrt{2h}}\right) \tag{6}$$

where, h stands for the number of model variables. Under the normal distribution hypothesis for error terms, and $(N,T) \longrightarrow \infty$, $\tilde{\Delta}$ has asymptotical normal distribution. Small sample properties of $\tilde{\Delta}$ are improved, using its modified version:

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-E(\tilde{z}_{it})}{\sqrt{var(\tilde{z}_{it})}}\right) \tag{7}$$

$(\tilde{z}_{it}) = h$, $\text{var}(\tilde{z}_{it}) = 2h(t-h-1)/(T+1)$

Prior to the selecting an appropriate methodology for Granger causality test within panel data framework, we tested cross section dependence and slope homogeneity hypotheses for models (1-1) and (2-1), and prepared the results in Table 1. Panel A of Table 1 shows the results of cross section dependence tests. According to LM results and CD tests, the null hypothesis of no cross-sectional dependence is rejected for both models at the level of 1%. Panel B of Table 1 illustrates the results of slope homogeneity tests. Both $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$ tests reject the null hypothesis of slope homogeneity in system equations (1-1) and (2-1).

The results of cross-sectional dependence and slope homogeneity tests, confirm the error terms dependence and also slope heterogeneity, in the estimation of models (1-1) and (2-1). Hence, it is not recommended to adopt the conventional panel data methods e.g. the generalized method of moments for our models. Based on seemingly unrelated regression equations (SURE), Konya's (2009) approach was used to overcome both problems. This approach allows for not only the dependence of cross error terms, but also the heterogeneity of coefficients. Following to Konya's (2009), we use the Zellner's (1962) approach to estimate the equation systems (1-1) and (2-1) through SURE method.

Table 1: Results of Cross-Sectional Dependence and Slope Homogeneity Tests

Panel A. results of cross-sectional dependence tests				
Test	**Model (1)**		**Model (2)**	
	Test statics	**P-value**	**Test statics**	**P-value**
Breusch - Pagan (1980)	2338.606	0.000	2232.306	0.000
Pesaran (2008)	24.406	0.000	23.845	0.000
Panel B. results of slope homogeneity tests				
Test	**Model (1)**		**Model (2)**	
	Test statics	**P-value**	**Test statics**	**P-value**
Test $\tilde{\Delta}$	25.071	0.000	17.745	0.000
Test $\tilde{\Delta}$	25.931	0.000	18.571	0.000

Source: Authors' findings

To estimate the systems (1-1) and (2-1), first we should select the optimum lag length of k and p. As noted by Konya's (2009, pp. 982–983):

"Unfortunately, there is no simple rule to decide on the maximal lag, though there are formal model specification criteria to rely on. Ideally, the lag structure is allowed to vary across countries, variables and equation systems. However, for a relatively large panel like ours, this would increase the computational burden substantially. For this reason in each system, we allow different maximal lags for Y and X, but do not allow them to vary across countries. This means that altogether there are four maximal lag parameters."

We set maximal lags at 4, k=4 and p=4, and then we choose the combinations that minimize the Akaike Information Criterion (AIC):

$$AIC_{\mathrm{k}} = \ln|W| + \frac{2N^2q}{T} \quad (9)$$

The Wald test was employed to evaluate the Granger non-causality hypothesis from human capital to FDI i.e. all $\beta_{ik} = 0$ in (1-1) and (2-1). Also, the critical values of the test statistics were simulated by bootstrap method. Another important point to note is that since bootstrap method is applied to extract critical values of the Wald test, stationarity of the system's variables i.e. FDI and human capital is not necessary (Konya, 2006, p.979). The run of bootstrapping method in five steps is as follows:

Step 1: According to the Granger non-causality hypothesis, Equations (1-1) and (2-1) were estimated and error terms were obtained, regardless of HUM and GY, and then, we formed the residual matrix (T, N).

$$\hat{u}_{H_0 it} = FDI_{it} - \hat{\alpha}_i + \sum_{k=1}^{k=K} \hat{\rho}_{ik} FDI_{it-k} \quad (10)$$

Step 2: To establish simultaneous a correlation between error terms, we drew a bootstrap sample of matrix ϵ_{it} with (T+m, N) dimensions through randomized selections from elements of $\hat{u}_{H_0 it}$. To eliminate the effect of initial observations, we removed *m* initial observations.

Step 3: we simulated FDI data, using the estimated coefficient in the first step, and employing bootstrap sampling of residuals in the second step.

Step 4: we estimated Equations (1-1) and (2-1) using simulated FDI data. In addition, we employed the Wald test to evaluate Granger non-causality from HUM to FDI.

$$FDI^*_{it} = \hat{\alpha}_i + \sum_{k=1}^{k=K} \hat{\rho}_{ik} FDI^*_{it-k} + \epsilon_{\text{it}} \quad (11)$$

Step 5: we repeated these four steps 5000 times, computed Wald test, and recorded all results from the test statistics. Then, based on the obtained 5000 Wald test results, the critical value for each country was computed at the levels of 90%, 95%, and 99%.

4. Data

The purpose of this study was to examine the causal relationship between human capital and attraction of FDI in 26 OIC countries over the period 1970–2014. The countries considered include Algeria, Benin, Brunei

Darussalam, Burkina Faso, Cameroon, Ivory Coast, Egypt, Gabon, Gambia, Indonesia, Islamic Republic of Iran, Kuwait, Malaysia, Mauritania, Morocco, Niger, Nigeria, Pakistan, Qatar, Saudi Arabia, Senegal, Sierra Leone, Togo, Tunisia, Turkey and the United Arab Emirates. The main information sources on FDI inflow are UNCTAD website and data for the average years of education. Also, real GDP came from the Data Center of the Pennsylvania State University.

Following to Hall and Jones (1999), Klenow and Rodriguez-Clare (1997), and Cohen and Leker (2014), we employed the following function to calculate human capital index:

$$H = e^{\varphi(E)} \tag{12}$$

Where, E stands for the average years of education. The function assigned a greater weight to education. So, $\varphi(E)$ is a function with the slope of 0.134 for E≤4, 0.101 for E≤8>4, and 0.068 for E>8. In other words, this function can be formulated as follows:

$$\Phi(E) = \begin{cases} 0.134 * E & if\ s \leq 4 \\ (0.134 * 4) + (0.101 * (E - 4)) & if\ 4 < s \leq 8 \\ (0.134 * 4) + (0.101 * 4) + (0.068 * (E - 8)) & if\ s > 8 \end{cases} \tag{13}$$

Function (13) assumes that a worker's earnings are proportional to his or her human capital. This is because education years and earning have a log-linear relationship, and consequently do the human capital and years of education (H=e^E). According to Psacharopoulos (1994), the return for an additional year of education in Sub-Saharan Africa is 13.4%. The rate of return for global average years of education and OECD countries is 10.1% and 6.8%, respectively. Since the OIC is composed of countries from different regions and with different income levels, this function seems to fit the study[1].

5. Results

To test Granger non-causality from HUM to FDI, equations system

1. A second solution is to assume that the average social return for education is 7%, i.e. H=(1.07)E.

(1-1) was estimated using the SUR method. According to the Akaike test, we find the optimum lag to be 1 for FDI (K*=1) and 1 for HUM (P*=1). The results of the Wald test, its critical values, and the coefficient of the first lag of HUM (i.e. β_{i1}) are presented in Table 2. According to the results, the Granger non-causality from HUM to FDI was rejected at 1% for Burkina Faso, Mauritania, Morocco and Senegal, 5% for Benin, Gambia, Sierra Leone, Togo and Tunisia, and 10% for Algeria, Brunei Darussalam, Cameroon and Turkey. This hypothesis was proven true for the remaining 13 member states. The critical values vary at different levels from one country to another. For example, the critical value of the Wald test for Turkey at the level of 10% is 13.347; whereas it is 5.193 for Tunisia.

Except Turkey, the remaining countries with rejected Granger non-causality hypothesis are African. In addition, the human capital in the majority of these countries is lower than the average. The impact factor of human capital on FDI inflow into countries with rejected Granger non-causality hypothesis varies between 0.002 and 0.11. The greatest impact of human capital on FDI inflow is for Mauritania, Sierra Leone and Burkina Faso, and the lowest is for Algeria, Turkey and Cameroon.

To conduct further investigation and sensitivity analysis, the real GDP growth can be considered as an important determinant of FDI attraction and a proxy for the effect of market size included as the third variable in model (2-1). Although, we investigated the causal relationship only between FDI and human capital. According to the AIC, we find the optimum lag to be 3 for FDI (K*=3) and 1 for HUM and GY (P*=1). The results of the Wald test, its critical values and β_{i1} are shown in Table 3. According to the results, the null hypothesis (i.e. no causal relationship from human capital to FDI inflow) was rejected for Benin and Burkina Faso (at 1%), Gambia, Mauritania, Morocco, Pakistan and Senegal (at 5%) and Sierra Leone and Togo (at 10%). The main hypothesis maintaining that there is no causal relationship from human capital to FDI inflow, is proven true at the conventional statistical levels for the remaining 17 countries. The comparison of results from model (1-1) and model (2-1) indicated that out of 13 countries with rejected Granger non-causality hypothesis (based on model (1-1), which did not consider the variable GY), the hypothesis

Table 2: Results of Granger Non-Causality Test from HUM to FDI Based on Model (1-1)

Country	Wald Test	Critical Values			Value of β_{i1}	The average level of human capital	The average of FDI inflow rate
		90%	95%	99%			
Algeria	11.583*	9.365	14.127	26.277	0.002	1.615	0.167
Benin	17.238**	7.316	10.69	18.724	0.014	2.133	0.516
Burkina Faso	47.955***	8.536	12.282	24.364	0.062	2.346	1.625
Cameron	5.607*	5.193	7.701	13.644	0.006	1.302	0.462
Ivory Coast	4.93	6.798	9.818	16.817	0.005	1.064	0.243
Egypt	0	6.413	9.583	18.565	0	1.466	0.162
Gabon	2.5	6.127	8.814	16.896	0.007	1.804	0.356
Gambia	10.512**	6.735	10.098	18.666	0.025	1.494	0.68
Indonesia	3.5	7.579	11.039	21.448	0.002	1.672	0.787
IR Iran	5.2	5.464	7.91	14.366	0.001	1.551	0.109
Kuwait	8.79	15.046	21.729	41.335	0.002	1.299	0.464
Malaysia	1.01	8.3	12.064	24.594	0.002	1.236	0.4
Mauritania	18.658***	6.211	9.151	16.349	0.111	1.282	0.923
Morocco	140.172***	6.312	9.034	16.716	0.029	2.033	0.616
Niger	8.8	13.802	19.89	38.213	0.059	2.069	0.835
Nigeria	0.14	8.576	12.042	24.948	-0.002	1.554	0.346
Pakistan	12.61	15.772	23.584	46.55	0.002	1.925	0.127
Diameter	1.76	8.511	12.236	21.26	0.004	1.829	0.699
Saudi Arabia	1.45	6.791	9.976	18.979	0.004	1.238	0.917
Senegal	33.265***	6.484	9.717	16.981	0.021	2.262	1.199
Sierra Leone	17.818**	7.911	11.013	19.601	0.064	1.404	0.533
Togo	15.762**	6.634	9.264	15.771	0.027	1.742	0.663
Tunisia	12.566**	5.814	8.504	15.569	0.008	1.416	1.424
Turkey	14.927*	13.347	19.375	38.059	0.004	1.081	1.085
UAE	8.94	9.328	13.738	26.398	0.005	1.378	1.068

Source: Authors' findings

was rejected only for eight countries (based on model (2-1), which considered the variable GY). In addition to eight African countries, the results from model (2-1) indicated that the Granger non-causality hypothesis between human capital and FDI inflow was rejected also for Pakistan.

Table 3: Results of Granger non-causality from HUM to FDI based on model (2-1)

Country	Wald Test	Critical Values			Value of β_{i1}
		90%	95%	99%	
Algeria	3.133	17.385	24.693	46.097	0.001
Benin	25.453***	9.082	14.298	24.626	0.019
Brunei Darussalam	3.957	8.431	12.868	24.213	0.024
Burkina Faso	67.639***	8.18	12.602	22.141	0.088
Cameron	3.248	8.146	11.088	22.921	0.005
Ivory Coast	6.495	10.071	13.822	32.774	0.007
Egypt	0.003	8.556	13.848	24.196	-0.0001
Gabon	1.905	9.616	16.067	29.678	0.006
Gambia	16.081**	8.412	12.113	23.788	0.038
Indonesia	8.045	9.684	14.712	25.728	0.002
IR Iran	1.912	8.109	12.163	22.225	0.001
Kuwait	2.988	15.048	20.64	39.801	0.002
Malaysia	1.506	10.119	14.06	25.067	0.002
Mauritania	17.183**	8.213	11.079	26.248	0.113
Morocco	25.35**	15.405	21.028	44.61	0.019
Niger	6.741	17.547	24.987	45.454	0.058
Nigeria	0.173	11.697	17.104	25.66	-0.002
Pakistan	33.262**	11.406	17.645	35.143	0.004
Diameter	1.95	10.095	14.388	24.308	0.005
Saudi Arabia	3.589	7.504	12.401	20.885	0.005
Senegal	19.934**	9.808	14.761	30.274	0.019
Sierra Leone	11.361*	10.718	15.08	24.09	0.063
Togo	9.552*	8.119	12.431	19.9	0.024
Tunisia	6.976	8.147	11.522	23.524	0.007
Turkey	10.417	14.63	21.931	44.722	0.004
UAE	7.922	13.746	19.406	33.381	0.005

Source: Authors' findings

6. Conclusions

In this study, we tested the Granger non-causality hypothesis about human capital and FDI inflow among 26 member states of OIC during the 1970–2014 period. To do that, we applied the seemingly unrelated equation system which was able to capture 1) simultaneous correlations among error terms of panel cross-section units, and 2) slope heterogeneity. Also, to capture the stochastic properties of regressors in the system, we use the bootstrap method to drive the distribution of Wald test.

According to the results, the hypothesis of Granger non-causality from human capital to FDI is rejected for more than half of the samples, mainly among African countries. This is because of the abundance of low-income, poorly educated workforce who can no longer absorb new technologies. In addition, there is a significant difference between the countries in terms of the effect magnitude (between 0.002 and 0.11) of human capital on FDI. The greatest impact of human capital on FDI inflow is for Mauritania, Sierra Leone and Burkina Faso, and the lowest is for Algeria, Turkey and Cameroon.

According to the findings (effect of human capital on FDI attraction), given the FDI trend over the past two decades and the concentration of these investments on technology-centered services and industries, the OIC countries, specifically low-income ones in Sub-Saharan Africa, are recommended to focus on improvement of skills and training their workforce, as important determinants of FDI attraction. These factors enable them to absorb added values through FDI attraction. This can be achieved by reducing the costs of human capital formation and improving the skills and productivity of workforce through public training programs and/or financial supports for private entities. It should be mentioned that the rejection of the causal relation between human capital and foreign direct investment in a country like Iran, where training is provided for free by the government, can be caused by factors such as international sanctions on the country's political and economic conditions, and creating uncertainty in investment. Accordingly, rejection of causal relation in other countries can be affected by factors such as the above-mentioned conditions, too. It is therefore recommended to macro-economic policymakers that, in order to create certainty in attracting investments, they primarily focus on providing economic stability, and then try to increase human capital stock (in terms of number of years of providing and quality) in order to attract foreign direct investment, and direct it to high-value added activities. Furthermore it is recommended to future researchers to study the simultaneous effects of economic and political stability in analyzing the role of human capital in foreign direct investment.

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