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Complementarity Relationship between Foreign Direct Investment, Human Capital Threshold and Economic Growth: Empirical Evidence for the MENA Region

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Abstract: The complementarity between foreign direct investment (FDI) and human capital constitutes a key interconnected factor that plays a crucial role in encouraging the growth and economic development of nations. This paper processes data from the Middle East and North Africa (MENA) region from 2000 to 2023 to determine the moderating effect of human capital between FDI and economic growth and to establish the human capital threshold which guarantees the advantages of the IDE. It uses the generalized moments method (GMM) and the regression threshold (TR) as part of the dynamic panel data model as estimation strategies. The results note the absence of significant contribution of FDI and human capital to economic growth. After the interaction between FDI and human capital, they justify the significant positive effect of foreign direct investment. However, the coefficient of the interaction variable is significantly negative. This implies that the MENA workforce is unable to transfer the benefits of foreign direct investment. For this reason, this paper resorted to applying the regression threshold to determine the minimum threshold of human capital that guarantees the positive effect of FDI on economic growth. It established a threshold of human capital of 74.58%. It therefore becomes necessary for the MENA region to develop human capital to strengthen its absorption and capacity to diffusion of new technologies in order to reap the full benefits of foreign direct investment.

Keywords: foreign direct investment; human capital threshold; economic growth; GMM.

JEL classification: F21; J24; O40.

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1. INTRODUCTION

Leaving aside the internal resources of growth and economic development such as human capital development, natural resource availability, financial and institutional development, poor and developing countries seek to improve and develop their economies by implementing strategies to attract external resources, including the entry of FDI.

FDI contributes to the growth and economic development of host countries through several transmission channels. To begin with, it increases physical productivity through the transfer of new technologies to physical capital (Christopher and Prosper, 2017; Haini *et al.*, 2024). In addition, it improves the state of the trade balance of host countries by encouraging exports (Hye and Lau, 2015; Séna and Michael, 2017). Moreover, FDI affects economic growth by improving the income of employees through the creation of new jobs (Teresia and Charles, 2018). In addition, FDI promotes growth and economic development by encouraging domestic investment in host countries. Indeed, FDI flows accompany other investments in complementary sectors (Makiela and Ouattara, 2018; Nguyen, 2022). In addition, FDI can result in the transfer of new knowledge to the human capital of host countries (Anetor, 2020). Indeed, the transfer of new knowledge can increase labour productivity. As for the determinants of the contribution of FDI to economic growth, it is said to be determined by the degree of the technological gap between the sending and receiving countries of FDI (Christopher and Prosper, 2017; Obeng-Amponsah and Owusu, 2025), the type and ebb of FDI (Chen *et al.*, 2024) and institution development (Shittu *et al.*, 2020), financial development (Rajab and Zouheir, 2021; My-Linh, 2022; Rajab and Zouheir, 2023) and human capital development.

The development of human capital was considered a target. It ensures economic growth and development through the accumulation of skills and knowledge, and the qualification of the workforce (Affandi *et al.*, 2019; Martin *et al.*, 2021; Tanddrayen Ragoobur and Nasroo, 2022). The development of human capital plays a very important role in the attractiveness of foreign investors. Indeed, it adapts easily with new strategies and new technologies (Kheng *et al.*, 2017). In addition, it absorbs and disseminates new technologies incorporated by FDI to host countries that can enhance the effect of FDI on economic growth.

According to the library of previous research, some studies have neglected to determine the threshold of human capital that ensures the benefits of foreign direct investment. That is, academic research studies have studied the distinct contribution of FDI and human capital to economic growth, studies have analyzed the effect of complementarity between FDI and human capital on economic growth, studies have analyzed the effect of complementarity between strange direct investment and human capital on economic growth. This complementarity is explained by the role played by labor in the absorption and diffusion of new technologies incorporated by foreign direct investment (Kheng *et al.*, 2017). Moreover, some studies have led to the determination of the threshold of human capital that guarantees the benefits of FDI (Friday, 2020; Rajab and Zouheir, 2023; Tsaurai, 2023).

This research study is organized as: Section 2 is devoted to the presentation of literature review. After that, Section 3 presents the theoretical framework. Section 4 deals with the data and methodology. Section 5 discusses the results and discussions. Sections 6 present the conclusion and policy recommendations.

2. LITERATURE REVIEW

According to the results of previous empirical studies, domestic development in host countries plays a very important role in absorbing the benefits of FDI, including financial development. In this regard, My-Linh (2022) examined the mediating role of banking and stock market development in the effect of FDI on economic growth in a sample of 6 countries of the Association of Southeast Asian Nations from 2002 to 2019. The system GMM results and the regression threshold show the positive and significant contribution of FDI to economic growth before and after interaction. This relationship is explained by the development of the financial system of the sampled countries. Again, they set a threshold for the banking sector of 85.64% and the stock market of 21.95%.

Then, Matušovičová and Matušovičová (2023) focus on the correlation between FDI and GDP for 96 quarters from 1999 to 2022. The regression results of a multiple linear model show the significant positive impact of the 5% FDI threshold on economic growth. Indeed, the linear relationship between FDI and GDP is explained by the good preparation of the preconditions for the entry of foreign resources.

Moreover, based on reviews of the theoretical and empirical literature, FDI affects the growth and social well-being of host countries. In this regard, Keita and Baorong (2022) tested the effect of FDI on social welfare in the Guinean context from 1990 to 2017. The results show that FDI positively affects economic development in the short and long term. They noted that it is necessary for Guinean officials to encourage the entry of foreign resources to see healthy economic growth conducive to well-being.

On the other hand, the link between foreign direct investment and economic growth can be explained not only by the increase in total factor productivity but also by the accumulation of the stock of physical capital. Indeed, Makiela and Ouattara (2018) emphasized the relationship between FDI and economic growth in a sample of developed and developing countries from 1970 to 2007. They justified that the effect of FDI is determined by the accumulation of stock. According to these results, they found it important for developing countries to accumulate foreign resources as soon as possible in order to strengthen their impact on growth.

Thus, the allocation of FDI to economic growth can be achieved through various transmission channels, such as export promotion, transfer of new technologies and knowledge, increased competition, export promotion, creation of new jobs, and accumulation of physical capital stock, etc. However, this allocation is not always certain. In this regard, Gökçeli *et al.* (2022) assessed the impact of FDI on national investment and economic growth in the OECD (Organization for Economic cooperation and development) over the period 1990 to 2017. The results of the GMM a fixed effect show the significant positive association between FDI and economic growth. Moreover, they justify that the FDI of developed countries contributes to the increase of the economic growth of the host countries, while FDI from developing countries has no significant impact. In fact, the absence of the significant contribution of FDI to economic growth is explained by the small technological gap between FDI sending and receiving countries.

In fact, Musakwa and Odhiambo (2023) processed annual time series data from 1970 to 2020 to test the causality between FDI, foreign aid and economic growth in Kenya. The results of the ECM-based Granger causality test show the presence of a two-way causality between foreign aid and short-term economic growth and a one-way causality of foreign aid to

economic growth. Moreover, they showed that there is no causal relationship between FDI and economic growth in the short and long term. Indeed, the absence of the causal relationship between FDI and economic growth is explained by the poor preparation of preconditions for the attractiveness of FDI.

Moreover, in the light of the results of academic research, the effect of FDI on economic growth depends on the degree of technical progress of the host countries. In this context, Obeng-Amponsah and Owusu (2025) examined the role of technology in the association of foreign direct investment, employment and economic growth in Ghana from 1995 to 2017. The results of the autoregressive distributed lag ARDL show the negative effect of FDI on growth. Again, they show the positive impact of technology in the short and long term on economic growth. Moreover, they show that technology weakens the negative effect of FDI in the short term. According to these results, they concluded that it is important for poor countries to encourage technological progress in order to promote economic growth and reduce the negative effects of FDI.

In addition, Haini *et al.* (2024) examined the effect of FDI from Japan, China, India, South Korea, Hong Kong and Taiwan on productivity and economic growth in the Association of Southeast Asian countries from 1995 to 2022. The results of the GMM in system show the significant positive impact of FDI on economic growth. In addition, they show that FDI from Japan, Korea and Hong Kong has a significant positive effect on economic growth. However, the flows of Chinese, Indian, and Taiwan origin have a non-significant effect. This result is explained by the small technological gap between the two poles. Again, Haini *et al.* (2024) have found that the benefits of FDI cannot be derived only through the contribution of capital but also through the transmission of new knowledge and new technologies from foreign companies.

To conclude the relationship between FDI and economic growth, FDI promotes economic growth through several transmission channels such as the transfer of new technologies, new knowledge, export promotion, creation of new jobs, etc.

As regards the subject of human capital and economic growth, the contribution of the workforce to the improvement of economic growth is explained by the qualification of the workforce as a result of the accumulation of knowledge and skills. The latter can increase the total productivity of the factors of production and consequently the encouragement of growth and economic development.

In fact, the economic growth of emerging countries is mainly based on the good quality of the workforce. In this regard, Zhang *et al.* (2023), estimated the effect of cognitive and non cognitive productivities on the basis of Chinese macro-data at the provincial level and micro-data on individual work from 2008 to 2017 by using a general equilibrium model of human capital (Xiang & Yeaple, 2018). They found that improving the human capital index leads to convergence of economic growth in the Chinese provinces. This relationship is explained by the fact that the regions in question do not have the same quality of the workforce.

Theoretically, the good quality of the workforce is explained by the development of the education and health sector and the implementation of training. In this angle, Tanddrayen Ragoobur and Nasroo (2022) examined the relationship between human capital and Mauricenne economic growth from 1983 to 2019. The results of the vector error correction model (VECM) and the impulse response function and variance decomposition show that secondary education and health rate indices are explanatory factors of long-term economic growth. So, in light of these results, they see that it is important for poor countries to invest in education and health to promote economic growth.

In addition, on the basis of theoretical and empirical studies, the allocation of human capital to economic growth is explained by the high quality of the educational service, the good quality of the health service, the delivery of training, cognitive skills, etc. In this regard, Affandi *et al.* (2019) discussed the link between the quality of education and Indonesian economic growth. They used the result of the national exam as a proxy for the quality of education. They showed that cognitive skills are a more important factor in Indonesia's economic growth. In addition, he noted that the effect of the exam result on economic growth varies across regions.

According to previous academic research, the development of the education and health sector are the determinants of the qualification and accumulation of human capital. In this context, Zemed and Lakhwinder (2023) examined the effect of human capital accumulation on long-term economic growth in Ethiopia. After the processing of time series data, covering the period 1980/1981 to 2019/2020 by co-integration and error correction test, Zemed and Lakhwinder (2023) showed that secondary school enrolment and life expectancy have a significant positive effect on Ethiopian growth. However, the effect of the primary school enrolment rate and the mortality rate has a non-significant negative effect.

On the other hand, the significant contribution of education sector development to economic growth is not always certain. In this regard, Mohamed (2023) studied the cointegration relationship between education and patents and economic growth in Scandinavian countries over the period 1990 to 2019. He used the cointegration test of Westerlund (2007) and the transversely increased autoregressive distributed shift (CS-ARDL) and the non-causality test of Dumitrescu and Hurlin (2012). The results show a stable long-term cointegration relationship between education, life expectancy and economic growth. Moreover, they justify that the number of patents in the Scandinavian countries has a positive effect on economic growth. However, education spending has a negative effect on economic growth.

To conclude the topic of human capital and economic growth, we can conclude that Affandi *et al.* (2019); Tanddrayen Ragoobur and Nasroo (2022); Zemed and Lakhwinder (2023) have justified the contribution of human capital to economic growth. on the other hand, others have neglected this contribution Mohamed (2023).

With regard to the complementary relationship between foreign direct investments, human capital and economic growth, based on previous studies, it is said that the qualification of the workforce plays a very important role in strengthening the contribution of FDI to economic growth. From this perspective, Su and Liu (2016) examined the effect of human capital and FDI on economic growth in 32 Chinese cities from 1991 to 2010. The GMM results show a significant effect of FDI on economic growth. Moreover, they noted that the complementarity between FDI and human capital affects economic growth. This complementarity is explained by the qualification of the Chinese workforce. That is, it is capable of absorbing and differentiating new technologies incorporated by foreign direct investment.

Furthermore, Dankyi *et al.* (2022) studied the relationship between foreign direct investment, human capital, urbanization, renewable energy, carbon dioxide emissions, and economic growth. They demonstrated the positive effects of human capital, FDI, renewable energy, and urbanization on economic growth. Furthermore, they noted that quality, inclusive, and equitable education was a significant explanatory factor in economic growth and FDI in economic community of West African states countries from 1990 to 2017.

On the other hand, theoretical and empirical reviews have shown that the complementarity between FDI and human capital can justify under certain conditions. In this regard, Friday (2020) examined the mediating role of human capital in the relationship of FDI and economic growth for the 28 sub-Saharan African countries during the period 1999 to 2017. The GMM system results show the significant negative impact of FDI on growth. Indeed, this relationship is explained by the poor preparation of the preconditions for the entry of foreign direct investment. Moreover, they justify the non-significant negative impact of human capital. The absence of this contribution is explained by the underdevelopment of human capital in sub-Saharan African countries. Friday (2020) noted that the effect of complementarity between FDI and human capital is negative but significant. In addition, it established a minimum human capital threshold of 63.91% to ensure significant positive complementarity.

In fact, Rajab and Zouheir (2023) examined the complementary relationship between FDI and human capital and their effect on the economic growth of a sample of 15 least developed African countries from 2000 to 2019. The results of the GMM in system show the significant negative contribution of foreign direct investment. However the effect of human capital is negative not significant. In fact, the lack of significant allocation of human capital to economic growth is explained by the underdevelopment of human capital. Moreover, they showed the significant negative impact of complementarity between FDI and human capital on economic growth. Rajab and Zouheir (2023) used the regression threshold and set a threshold of 61.57% of human capital that saves the benefits of foreign direct investment.

Finally, on the basis of the results of previous studies, the development of human capital through accumulation and qualification facilitates the adoption and improvement of capacities for the transformation of new technologies and knowledge, research, innovation, etc. These operations require a minimum human capital threshold.

3. THEORETICAL FRAMEWORK

This study examines the complementarity relationship between FDI and human capital and its interaction effect on economic growth from an endogenous growth perspective. Indeed, the function below presents the Cobb Douglas type production function.

$$Y_t = K_t^{\propto} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta} \quad (1)$$

with:

Y: real gross domestic product
K: the physical capital stock
H: the stock of human capital
L: the labour factor,
A: technological efficiency
t: time.

It is supposed $\alpha + \beta < 1$.

The function of the work is L_t. Indeed,

$$L_t = L_0 e^{nt} \quad (2)$$

The technological function is A_t. Indeed,

$$A_t = A_0 e^{gt} F^{\theta} \quad (3)$$

with:

n: the rate of exogenous labour force growth,

g: the growth rate of technical progress

F: the proportion of A that relates to FDI

FDI is assumed to improve overall productivity through two direct and indirect channels:

– The direct channel is that technology embedded in FDI directly improves the average productivity of host countries.

– The indirect channel is that the inflow of FDI generates positive spinoffs in the form of technology transfer. They increase the average productivity of local businesses and consequently the improvement of the average productivity of host countries.

Theoretically, the benefits of FDI depend on the absorption capacity of the host countries. It is measured by the stock of human capital. Thus, to capture the direct and indirect positive externality of FDI on productivity, the elasticity θ is considered to be the function of the human capital stock.

$$\theta = \theta_0 + \theta_1 f(h) \quad (4)$$

The savings rate is assumed to be exogenously determined by government policy and individual preferences. In this case:

The human capital stock can be expressed in function K:

$$K = s_k Y_t - \delta k \quad (5)$$

with:

s_k : presents the proportion of income in the investment of physical capital.

δ : is the depreciation rate.

The physical capital stock can be expressed in function H:

$$H = s_h Y_t - \delta h \quad (6)$$

with:

s_h : Represents the proportion of income in human capital investment.

It is assumed:

– k : the stock of physical capital per unit of labor.

Indeed, $k = \frac{K}{AL}$ and,

– h : the stock of human capital per unit of work.

Indeed, $h = \frac{H}{AL}$.

Therefore:

$$\mathcal{K} = s_{\mathcal{K}} y_t - (n + g + \delta)\mathcal{K} k_t \quad (7)$$

$$\hbar = s_{\hbar}\, y_t - (n + g + \delta)\hbar_t \quad (8)$$

It is supposed:

– the level of physical capital per work unit is constant. It is noted h^* .

– the level of human capital per work unit is constant. It is noted $\hbar^*$.

In fact,

$$h^* = \left(\frac{s_{\mathcal{K}}^{1-\beta} s_{\hbar}^{s}}{n + g + \delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad (9)$$

$$\hbar^* = \left(\frac{s_{\mathcal{K}}^{\alpha} s_{\hbar}^{1-\alpha}}{n + g + \delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad (10)$$

To obtain the per capita income in the stationary state, we replace equation (9) in (10) and add the log. So,

$$\log \frac{Y_t}{L_t} = \log A_t - \frac{\alpha+\beta}{1-\alpha-\beta} \log\,(n + g + \delta) + \frac{\alpha}{1-\alpha-\beta} \log s_{\mathcal{K}} + \frac{\beta}{1-\alpha-\beta} \log s_{\hbar} \quad (11)$$

To simplify equation (11), the technological benefits of FDI are replaced, and θ in equation (3) by $\theta = \theta_0 + \theta_1 f(h)$

When we integrate equation (11) into (10) and we replace A_t by $A_t = A_0$, we get equation (12). With:

$$A_t = A_0 e^{gt} F^{\theta_0 + \theta_1 \log(h)}$$

Equation (12) refers to income as a function of demographic rate, rate of investment in physical and human capital and FDI.

$$\log \frac{Y_t}{L_t} = \log A_0 + g_t + \theta_0 \log(F) * \log(\hbar) - \frac{\alpha}{1-\alpha} \log(n + g + \delta) + \frac{\alpha}{1-\alpha} \log s_{\mathcal{K}} \frac{\beta}{1-\alpha} \log(\hbar) \quad (12)$$

Equation (12) presents the steady state of the economy i.

y^* is the per capita income in the stationary state.

y_t is the per capita income in t.

So the rate of convergence to a stationary state is written in equation (13).

$$\frac{dlog\ y}{dt} = \eta\ (\log y^* - \log y_t \tag{13}$$

with:

$$\eta = (n + g + \delta)1 - \alpha - \beta$$

When integrating equation (13) from t_0 to t, is obtained equation (14):

$$\log y_t = (1 - e^{-\eta t}) \log y^* + e^{-\eta t} \log y_0 \tag{14}$$

When replacing the $\log y^*$ in equation (12) and rewrite the equation we get the equation below.

$$\begin{aligned} \log\left(\frac{Y}{L}\right)_t = \log\left(\frac{Y}{L}\right)_0 = & -(1 - e^{-\eta t}) \log\left(\frac{Y}{L}\right)_0 - (1 - e^{-\eta t})\left(\frac{\alpha}{1-\alpha}\right) \log\ (n + g + \delta) \\ & + (1 - e^{-\eta t})\left(\frac{\alpha}{1-\alpha}\right) \log s_{\mathcal{K}} + \frac{\beta}{1-\alpha} \log(\hbar) + \log A_0 + g_t \\ & + \theta_0\ (\ (1 - e^{-\eta t}) \log(F) + \theta_1 (1 - e^{-\eta t}) \log(F) * \log(\hbar) \end{aligned} \tag{15}$$

Equation (15) presents the determinants of endogenous growth over a long period. Otherwise economic growth is determined by the rate of population growth, the rate of physical capital, human capital stock, FDI and its interaction with human capital. The equation below presents the regression equation of a dynamic panel data.

$$\begin{aligned} \log(y_{it}) = \log(y_{i0}) = & \ \alpha_0 + \alpha_1 \log(y_{i0}) + \alpha_2 \log(n_{it} + g + \delta) + \alpha_3 \log(s_{\mathcal{K}it}) + \alpha_4 \log(h_{it}) \\ & + \alpha_5 \log(FDI_{it}) + \alpha_6 \log(FDI_{it}) * \log(h_{it}) + u_{it} \end{aligned} \tag{16}$$

where: u_{it}: error term

According to equation (16), this study specified two models. Indeed:

– The first econometric model estimates the contribution of FDI and human capital to economic growth.

– The second econometric model addresses the impact of complementarily between FDI and human capital on economic growth. These econometric models are formulated in equations (17) and (18).

$$\begin{aligned} GDP_{it} = & \ \alpha_0 + \alpha_1 GDP_{it-1} + \alpha_2 FDI_{it} + \alpha_3 HC_{it} + \alpha_4 GCF_{it} + \alpha_5 TOP_{it} + \alpha_6 POP_{it} + \alpha_7 INF_{it} \\ & + \alpha_8 XDEBT_{it} + \alpha_9 GXP_{it} + u_{it} \end{aligned} \tag{17}$$

where:

GDP is the growth of GDP per capita,
FDI is FDI,
HC is the human capital,
GCF is gross capital formation,
TOP is the commercial opening,

POP is population growth,
INF is inflation,
XDEBT is external debt,
GXP is the final consumption expenditure of general government,
and u_{it}: $error\ term$.

$$GDP_{it} = \alpha_0 + \alpha_1 GDP_{it-1} + \alpha_2 FDI_{it} + \alpha_3 (FDI_{it}.HC_{it}) + \alpha_4 HC_{it} + \alpha_5 GCF_{it} + \alpha_6 TOP_{it} + \alpha_7 POP_{it} + \alpha_8 INF_{it} + \alpha_9 XDEBT_{it} + \alpha_{10} GXP_{it} + u_{it} \quad (18)$$

where: $FDI_{it}.HC_{it}$ is the interplay between FDI and human capital.

This study also aims to establish the minimum threshold of human capital at which the interaction between human capital and FDI positively affects economic growth. The threshold equation is specified in equation (19):

$$GDP_{it} = u + FDI_{it}(HC_{it} < y_{it})\beta_1 + FDI_{it}(HC_{it} > y_{it})\beta_2 + u_i + e_{it} \quad (19)$$

where: g is the threshold parameter that divides the equation into two regimes with coefficient β_1 and β_2.
u_i is the individual effect.
and u_i is the stochastic term.

Table no. 1 presents the definition and measurement of variables.

Table no. 1 – Definition and measurement of the variables

Variables	Description	Measurement	Expectation	Source
GDP	Economic growth	GDP per capita growth.	Negative	WDI (2023)
FDI	Foreign direct investment	The percentage ratio of FDI net inflows in the reporting economy to GDP.	Positive/ Negative	WDI (2023)
HK	Human capital	Secondary school enrollment (% gross).	Positive	WDI (2023)
GCF	Gross capital formation	The ratio of GCF divided by GDP.	Positive	WDI (2023)
TOP	Trade openness	The percentage ratio of sum of exports plus imports of goods to total output.	Positive	WDI (2023)
POP	Population growth	It is computed as the annual growth rate.	Negative	WDI (2023)
GXP	Government consumption expenditure	It is consist of total expenses and the net acquisition of non-financial assets.	Positive	WDI (2023)
INF	Inflation	It refers to the general increase in consumer prices.	Negative	WDI (2023)
XDEBT	External debt	It comprises of debt, liabilities in the form SDRs, currency and deposit, debt securities, loans, insurance and pension.	Negative	WDI (2023)

According to previous theoretical and empirical literature reviews, each variable can exert a significant or non-significant positive or negative effect. Indeed, this study anticipated a positive or negative effect of FDI on economic growth.

Based on theoretical and empirical studies, the contribution of FDI to economic growth is uncertain. So, the first assumption is that FDI does not affect economic growth. In addition, according to the results of previous studies, it is easy to assume the second hypothesis as human capital affects economic growth. On the other hand, in light of the arguments established on the relationship between human capital, FDI and economic growth, the third hypothesis is that complementarity between human capital and FDI does not strengthen economic growth.

4. DATA AND METHODOLOGY

This research study treats the MENA region database from 2000 to 2023. Countries are selected based on data availability, including Tunisia, Algeria, Saudi Arabia, Bahrain, Djibouti, United Arab Emirates, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Mauritania, Oman, Qatar and Syria.

This study assumes the heterogeneity between the countries of the MENA region. Because, the countries of the MENA region have radically different economic structures, levels of development and institutional qualities.

Because of the problem of heterogeneity between countries, variables, and the problem of bias omitted, this study used the econometric technique of Arellano and Bond (1991); Arellano and Bover (1995) and Blundell and Bond (1998). In addition, she used a dynamic panel and regression threshold data model proposed by Hansen (2000). Indeed, the model allows you to determine the threshold of HC so that its interaction effect with the FDI becomes positive. In addition, it adds increased flexibility to the functional form and, at the same time, it is not as sensitive to the curse of dimensional problems as non-parametric methods Kourtellos *et al.* (2016).

5. RESULTS AND DISCUSSIONS

5.1. Descriptive statistics

Table no. 2 presents the descriptive statistics of the variables.

Table no. 2 – Descriptive statistics

Variable	Mean	SD	Minimum	Maximum	Skewness	Kurtosis	JB	P.JB
GDP	2.26	2.77	-2.86	5.56	-0.65	0.51	3.68	0.041
FDI	22.68	9.24	9.98	89.06	4.23	3.81	1.92	0.009
HC	94.03	33.45	0.00	98.21	8.29	3.09	55.39	0.000
GCF	44.39	18.79	12.94	69.58	-9.83	9.99	5.37	0.345
TOP	93.54	31.18	33.09	149.86	-1.68	12.81	22.67	0.029
POP	4.46	1.09	3.29	9.57	9.07	0.94	3.90	0.092
INF	10.45	0.91	-12.02	22.73	2.37	11.31	79.21	0.000
XDEPT	59.36	52.47	0.00	89.14	9.48	2.29	8.03	0.081
GXP	78.47	16.39	0.71	94.02	1.02	10.01	0.02	0.069

Source: calculated by author's using STATA 15

According to Table no. 2, GDP per capital growth in the MENA region averaged 2.26 with a standard deviation of 2.77. In contrast, all values are between -2.86 and 5.56. In fact, the shape of the distribution is asymmetric extended to the right where the Skewness statistic > 0. In addition, it is leptokurtic where the Kurtosis is equal to 0.51. The form of the GDP distribution rejects the null hypothesis of the normal distribution for a risk level of 5%.

In addition, Table no. 2 shows that the variable "FDI" recorded an average growth rate of 22.68 of GDP with a standard deviation of 9.24. In addition, the values are bounded between 9.98 and 89.06. This variable takes a form of asymmetric distribution extended to the right where the Skewness statistic is equal to 1.81 > 0. It is leptokurtic because the Kurtosis is positive. Overall, this variable rejects the null assumption of normality because p value is well below 5%.

In addition, Table no. 2 shows that the variable 'POP' recorded an average growth rate of 4.46 with a standard deviation of 1.09. Moreover, the minimum and maximum values are 3.29 and 9.57 respectively. This variable takes a form of asymmetric distribution extended to the right because, the Skewness statistic is equal to 9.07 > 0. Furthermore, it is leptokurtic due to the fact that the Kurtosis > 0. Overall, this variable rejects the null hypothesis of normality due to the fact that the p value is largely less than 5%.

Overall, human capital has an overall average of 94.03 with a standard deviation of 33.45. The maximum and minimum values are 98.21 and 0.00. In addition, the human capital variable takes an asymmetrical distribution to the right. It is leptokurtic where the Kurtosis is equal to 3.09. The distribution of this variable rejects the null assumption of normality for a risk level of 5%.

In addition, Table no. 2 shows that trade opening has recorded an average growth rate of 93.54. Again, the average growth rate of domestic investment is equal to 44.39. The variable "inflation" recorded an average growth rate of 10.45. In addition, public expenditure recorded an average growth rate of 78.47. Also, the MENA region recorded an average public debt ratio of 59.36 of GDP.

5.2. Stationarity Test

To justify the stationarity of the series, we used the Hadri LM test (2000). Indeed, the null hypothesis of Hadri LM (2000) proposes that all series are stationary. However, the alternative hypothesis is that some series are not stationary. In fact, the null hypothesis is written: H0: T-statistic > 0 vs the alternative hypothesis: H1: T-statistic < 0. The table below displays the results of the stationarity test.

Table no. 3 – Hadri LM Test

	GDP	**FDI**	**HC**	**GCF**	**TOP**	**POP**	**INF**	**XDEPT**	**GXP**
Level									
Hadri LM	-2.055	28.107	11.735	9.019	32.904	-8.063	12.319	1.795	25.943
	(0.014)	(0.003)	(0.321)	(0.092)	(0.000)	(0.000)	(0.035)	(0.011)	(0.000)
1st Difference									
Hadri LM	-13.724)	-10.980	-1.159	-19.413	-0.156	-18.344	-5.491	-1.133	-27.238
	(0.001)	(0.005)	(0.034)	(0.009)	(0.000)	(0.000)	(0.019)	(0.009)	(0.000)

Source: STATA 15

According to Table no. 3, at that level, none of the variables are stationary except for the variables "economic growth" and "population." In this case, we reject H_0 for all the other variables. In the first difference, all series become stationary. So, we assert that all variables are integrated in order 1.

5.3. Effect of FDI on Economic Growth

Table no. 4 presents the results of the GMM econometric estimation.

Table no. 4 – The effect of FDI on economic growth

Variables	Estimation	Probability
GDP per capital growth (-1)	-0.093	(0.062) *
FDI inflow as % of GDP	-0.014	(0.144) n.s
Human capital	0.043	(0.281) n.s
GCF as % of GDP	0.084	(0.031) *
Trade openness	0.253	(0.000) ***
Population growth rate	0.103	(0.973) n.s
Inflation	-0.082	(0.009) ***
External debt as % of GDP	-0.146	(0.052) *
Government expenditure as % of GDP	0.248	(0.006) ***
AR (1)	0.012	
AR(2)	0.154	
Hansen Test	0.197	
Diff-in-Hansen (excluding group)	0.229	
Diff-in-Hansen (H0 = exogenous)	0.286	
Number of observations	391	
Number of countries	17	
Number of instruments	23	

Note: The probability is reported in parentheses. *; ** and *** indicate significance at 10, 5 and 1% levels, respectively. SGMM model is estimated by using the Blundell and Bond (1998) dynamic panel SGMM estimations and Roodman (2009) STATA xtabond2 command.

Source: calculated by author's using STATA 15

Hansen's null hypothesis assumes that the estimation instruments are valid. Indeed, with a coefficient of 0.197 from the Hansen test, we do not reject the null hypothesis. This signals that the estimation instruments are valid.

The results in Table no. 4 show that the coefficient of the variable "FDI" is negative. And it is statistically insignificant. This means that the entry of FDI into the MENA region does not encourage economic growth. This result is expected. But, it confirms the results of previous studies by Bakari and Sofien (2019); Friday (2020); Simionescu *et al.* (2021); Obeng-Amponsah and Owusu (2025). Indeed, the economic justification for the absence of the contribution of FDI to economic growth may explain the poor precondition of the attractiveness of foreign resources. Otherwise, it is the poor preparation of the conditions necessary to benefit from the benefits of foreign direct investment.

In addition, the sign associated with the variable "human capital" is positive insignificant. In this case, it is said that human capital does not explain economic growth in the MENA region. However, the result is not as expected. But, it is consistent with the results of previous research

Rizal and Nurruhwati (2018); Mohamed (2023). On the other hand, this result may explain the poor skills of the MENA workforce and the persistent brain drain in the region.

As for the variable "gross fixed capital formation", the results justify that gross fixed capital formation is an engine of economic growth in the MENA region. Indeed, this result corroborates the previous empirical justifications and conforms to the economic logic. This result is explained by the continuous accumulation of the stock of physical capital through investment in the private sector.

Then, the coefficient associated with the variable "commercial opening" is positive of 0.253 and statistically significant at the 1% threshold. This indicates that the trade opening of the MENA region is a factor of economic growth. Indeed, the result corroborates the results of previous studies of Hye and Lau (2015); Yeboah (2023). In fact, one plausible explanation for this is that most MENA countries are integrating into the global economy. This integration creates dynamic comparative advantages in terms of potential to improve productivity and consequently economic growth.

As for the coefficient of the population variable, it is positive not significant. That is, the population of the MENA region does not designate a factor of economic growth. This relationship corroborates the results of previous studies Friday (2020).

On the other hand, the inflation rate has a negative effect of -0.082 and is statistically significant at the 1% threshold on economic growth. In fact, the inverse relationship between inflation and economic growth is explained by the general rise in prices in the MENA region that can increase production costs within companies, create production-related difficulties.

Moreover, the debt ratio has a significant negative effect on economic growth. A plausible explanation for this is that a considerable share of external debt has not been allocated to productive projects. Generally, this strategy discourages long-term economic efficiency.

The results also showed that public spending contributes to economic growth in the MENA region. This result is consistent with economic logic. Indeed, this relationship is explained by economic growth in the MENA region and is based on heavy state intervention.

The results show that the effect of the previous year's growth rate on current growth is negative and statistically significant. Indeed, the inverse relationship can be explained by the convergence hypothesis. This indicates that poor and developing countries are converging more rapidly towards a steady average growth rate compared to developed countries.

5.4. Effect of the interaction between FDI and human capital on economic growth

The relationship of complementarity between FDI and human capital and its effect on economic growth is determined by the nature of the effect of the interaction variable FDI.HK. Table no. 5 presents the results of the regression of equation (18).

Table no. 5 – Interaction effect between FDI and human capital

Variables	Estimation	Probability
GDP per capital growth (-1)	-0.058	(0.093)*
FDI inflow as % of GDP	0.016	(0.049)**
FDI.HK	- 0.037	(0.011)**
Human capital	0.127	(0.338) n.s
GCF as % of GDP	0.297	(0.009)**
Trade openness	0.248	(0.063)*
Population growth rate	-0.021	(0.507) n.s
Inflation	-0.044	(0.000)***
External debt as % of GDP	-0.021	(0.072)*

Variables	Estimation	Probability
Government expenditure as % of GDP	0.0207	(0.006)***
AR (1)	0.039	
AR(2)	0.293	
Hansen Test	0.217	
Diff-in-Hansen (excluding group)	0.222	
Diff-in-Hansen (H0 = exogenous)	0.539	
Number of observations	391	
Number of countries	17	
Number of instruments	23	

Note: The probability is reported in parentheses. *; ** and *** indicate significance at 10, 5 and 1% levels, respectively. SGMM model is estimated by using the Blundell and Bond (1998) dynamic panel SGMM estimations and Roodman (2009) STATA xtabond2 command.

Source: calculated by author's using STATA 15

Table no. 5 shows that the contribution of FDI to economic growth becomes positive and statistically significant. In addition, theoretically, the interaction variable designates the capacity of the workforce of host countries to absorb and disseminate new technologies linked to foreign direct investment. In fact, the sign associated with the variable the interaction is negative and it is significant. This means that human capital is essential to strengthen the effect of FDI on economic growth. In addition, it assumes the underdevelopment of human capital that is to say that the hand the MENA region is unable to absorb and disseminate new technologies incorporated by foreign direct investment. In this case, it becomes relevant to find the level of human capital that could be considered as a minimum for the impact of the interaction variable becomes significant positive.

5.5. Results of the dynamic panel regression threshold

Table no. 6 shows the results of the regression threshold.

Table no. 6 – Regression Threshold Results

Estimated human capital threshold		
y	74.58	
95% confidence interval	[74.59; 74.57]	
Impact of regime-independent regressor		
GDP per capital growth (-1)	-0.154	(0.009)***
FDI inflow as % of GDP	-0.085	(0.054)**
Human capital	-0.102	(0.386) n.s
GCF as % of GDP	0.093	(0.029)**
Trade openness	-0.071	(0.000)***
Population growth rate	0.109	(0.832) n.s
Inflation	-0.099	(0.000) ***
External debt as % of GDP	-0.002	(0.019)**
Government expenditure as % of GDP	0.115	(0.047)**
Constant	0.072	(0.013)**
Observations		391
Number of countries		17

Note: the dependent variable is GDP per capita growth. The probability is reported in parentheses. *; ** and *** indicate significance at 10, 5 and 1% levels, respectively.

Source: calculated by author's using STATA 15

Table no. 6 shows a human capital level of 74.58 for the MENA region of (74.59; 74.57) with a 95% confidence interval. This means that if the level of human capital decreases below 74.58%, The MENA region could not benefit from the potential benefits of FDI entry and as a result, FDI does not affect economic growth. For this, it is important for the MENA region to develop human capital so that FDI fully plays its role as a factor creating economic growth.

6. CONCLUSION AND POLICY RECOMMENDATIONS

This study addressed the effect of the complementary relationship between foreign direct investment-human capital on economic growth in the MENA region over the period 2000-2023 by the generalized moment method and the dynamic regression threshold.

This study justifies the absence of the significant effect of FDI and human capital on economic growth in the MENA region from 2000 to 2023. Moreover, when adding the interaction variable FDI.KH, the effect of FDI on economic growth becomes significant positive. However, the effect of the variable FDI.KH is significant negative. This means that the MENA workforce is not able to absorb and transform new technologies incorporated by foreign direct investment. As a result, this study used the regression threshold to find the minimum human capital threshold and set a level of 74.58%. Otherwise, when the MENA region's human capital threshold falls below 74.58%, it will not be able to benefit from the benefits of foreign direct investment.

According to the results obtained, this research study uses two recommendations. Indeed, as this research has justified that human capital does not meet the requirements of the impact of FDI on economic growth, MENA leaders need to develop skills strategies for the workforce in order to fully absorb and disseminate the benefits of foreign direct investment, therefore, strengthening economic growth. In addition, MENA country leaders must prioritize the knowledge and skills required by strategic sectors of the economy, including training and education. This means that it is important for the MENA region to restructure the education system to facilitate the matching of a skilled workforce with economic activities requiring the same qualifications.

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