The Interactive Effect of Foreign Direct Investment and Human Capital on Export Diversification in Selected Member Countries of the Organization of Islamic Cooperation

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Abstract: The present study examines the interactive effect of foreign direct investment and human capital on export diversification in 19 member countries of the Organization of Islamic Cooperation over the period 2010–2022, using the Generalized Method of Moments (GMM) approach. The findings indicate that export diversification is a path-dependent and self-reinforcing process, meaning that previous successes in expanding the export basket enhance future achievements. Moreover, foreign direct investment alone is not a sufficient condition for export diversification; rather, its positive impact depends on the existence of an adequate level of human capital. Skilled labor, as a platform for absorbing and localizing transferred technologies, multiplies the effectiveness of foreign capital. Finally, financial development, efficient infrastructure, and strong institutions act as facilitating factors that provide the necessary conditions for the full realization of this synergy. Accordingly, integrated and coordinated policymaking in the areas of targeted attraction of foreign capital, investment in education and skill development, institutional strengthening, and infrastructure development constitutes a key strategy for moving away from single-product economies and achieving sustainable economic diversification in the countries under study.

Keywords: Foreign direct investment; human capital; export diversification; Generalized Method of Moments (GMM).

1. Introduction

Export diversification has emerged as a central objective of development strategies in both developing and emerging economies, particularly those that seek to reduce vulnerability to external shocks, stabilize export revenues, and achieve sustainable long-term growth. Heavy reliance on a narrow range of primary commodities or low-value-added products exposes economies to price volatility, demand fluctuations, and technological obsolescence, thereby constraining structural transformation and inclusive development [1, 2]. In this context, diversification of the export basket—both in terms of products and markets—has been widely recognized as a critical mechanism for enhancing economic resilience, improving productivity, and fostering learning-by-doing effects that support long-run growth trajectories [3, 4]. Theoretical and empirical studies increasingly emphasize that export diversification is not an automatic outcome of economic

growth, but rather the result of deliberate policy choices, institutional arrangements, and factor endowments that shape countries' productive capabilities [5, 6].

Among the key drivers highlighted in the literature, foreign direct investment (FDI) has attracted particular attention due to its potential role in transferring advanced technologies, managerial know-how, and access to international markets. FDI can facilitate export diversification by integrating host-country firms into global value chains, enhancing productivity, and enabling the production of more sophisticated and differentiated goods [7, 8]. Empirical evidence suggests that multinational enterprises often act as conduits for innovation diffusion and export upgrading, especially when linkages with domestic firms are strong and absorptive capacities are sufficiently developed [9, 10]. However, the impact of FDI on export diversification is far from uniform across countries, indicating that complementary domestic conditions play a decisive role in determining the magnitude and direction of this effect [1, 11].

Human capital represents one of the most critical complementary factors in this regard. The ability of an economy to absorb, adapt, and diffuse foreign technologies depends fundamentally on the skills, education, and cognitive capacities of its workforce. A growing body of literature argues that without an adequate stock of human capital, the benefits of FDI remain limited, confined to enclave-type activities with weak spillover effects [12, 13]. Skilled labor enhances firms' learning capabilities, supports innovation, and enables the production of higher-quality and more diversified export goods [14, 15]. Consequently, human capital not only exerts a direct influence on export performance but also conditions the effectiveness of FDI as a catalyst for export diversification [16, 17].

Recent empirical studies increasingly focus on the interaction between FDI and human capital, suggesting that their joint effect on export diversification may be significantly stronger than their individual impacts. In economies with higher levels of education and skill formation, foreign firms are more likely to engage in technologically advanced activities and establish deeper linkages with local suppliers, thereby generating stronger spillover effects [11, 12]. Conversely, in countries with weak human capital bases, FDI may remain concentrated in resource-based or low-skill sectors, contributing little to export upgrading and diversification [18, 19]. This interaction perspective highlights the importance of viewing export diversification as the outcome of a systemic process involving multiple interdependent factors rather than isolated policy instruments.

In addition to FDI and human capital, the literature underscores the importance of financial development, infrastructure, and institutional quality as enabling conditions for export diversification. Well-functioning financial systems reduce credit constraints, facilitate risk-sharing, and support investment in new export activities, particularly for small and medium-sized enterprises seeking to enter foreign markets [20, 21]. Transport, communication, and logistics infrastructure lower trade costs, improve connectivity, and expand firms' access to global markets, thereby directly influencing the scope and composition of exports [3, 22]. Institutional quality—encompassing property rights protection, regulatory effectiveness, and governance standards—further shapes the incentives for investment, innovation, and market entry, playing a decisive role in sustaining diversification efforts [6, 23].

The relevance of these factors is particularly pronounced for member countries of the Organization of Islamic Cooperation (OIC), many of which exhibit structural characteristics that heighten the importance of export diversification. Several OIC economies remain heavily dependent on oil, gas, or a narrow range of primary commodities, rendering them vulnerable to external shocks and long-term demand transitions associated with global decarbonization and technological change [4, 24]. While some of these countries have attracted substantial FDI inflows, the extent to which such inflows have translated into diversified export structures varies widely,

suggesting differences in absorptive capacity, institutional environments, and development strategies [25, 26]. Understanding the mechanisms through which FDI and human capital jointly influence export diversification is therefore of particular policy relevance for this group of countries.

Empirical research on export diversification in developing and emerging economies has expanded considerably over the past decade, employing increasingly sophisticated econometric techniques to capture dynamic relationships and address endogeneity concerns. Dynamic panel data methods, particularly those based on the Generalized Method of Moments (GMM), have become standard tools for analyzing export diversification processes, given their ability to account for persistence effects and unobserved heterogeneity [27, 28]. Studies applying these methods consistently find that export diversification is path-dependent, with past diversification achievements exerting a strong influence on current outcomes [29, 30]. This persistence underscores the importance of sustained and coordinated policy interventions rather than short-term or isolated measures.

Despite the growing body of literature, several gaps remain. First, while numerous studies examine the effects of FDI or human capital on export diversification separately, fewer analyses explicitly model their interaction, particularly within the context of OIC member countries [8, 12]. Second, existing studies often focus on single-country cases or broad cross-country samples, potentially obscuring region-specific dynamics and institutional contexts [10, 17]. Third, the role of complementary factors such as financial development, infrastructure, and institutional quality in shaping the FDI–human capital–export diversification nexus warrants further empirical scrutiny using recent data and robust econometric frameworks [3, 16].

Addressing these gaps is essential for designing effective development strategies aimed at achieving sustainable export diversification. Policymakers require empirical evidence that clarifies not only whether FDI and human capital matter, but also how and under what conditions their interaction generates the greatest benefits. Such evidence is particularly valuable for OIC countries seeking to transition from resource-dependent growth models toward more diversified, knowledge-based economies capable of competing in increasingly complex global markets [24, 31].

Accordingly, this study aims to empirically examine the interactive effect of foreign direct investment and human capital on export diversification in selected member countries of the Organization of Islamic Cooperation over the period 2010–2022.

2. Methodology

Since, in many cases, the data used in panel models are inherently dynamic, incorporating this dynamic nature into panel models contributes to the validity and robustness of the results obtained from static panel methods. In panel data models, introducing the lagged dependent variable as an explanatory variable on the right-hand side of the model yields a dynamic specification (Baltagi, 2008). The presence of the lagged dependent variable on the right-hand side violates the classical assumption of no correlation between the explanatory (independent) variables and the disturbance term. As a result, the use of ordinary least squares (OLS) leads to biased and inconsistent estimates. The Generalized Method of Moments (GMM), by employing instrumental variables, addresses this problem—namely, the endogeneity of explanatory variables or the dynamic structure of the model—and, in order to eliminate bias arising from endogeneity, allows all regression variables, even their lagged values, to enter the model as instruments provided that they are uncorrelated with the disturbance components (Greene, 2008).

Matyas and Sevestre (1991) argue that the Anderson and Hsiao (1981) two-stage least squares method, proposed to resolve the problem of correlation between the disturbance term and explanatory variables, suffers from

difficulties in instrument selection, leading to large variances of the estimators and their statistical insignificance. To address this limitation, Arellano and Bond (1991) proposed the Generalized Method of Moments approach.

The application of the GMM method offers advantages such as accounting for individual heterogeneity and utilizing more information, as well as eliminating biases present in cross-sectional regressions, resulting in more precise and efficient estimates with lower multicollinearity. Moreover, by reducing or eliminating multicollinearity, removing time-invariant variables, and increasing the time dimension of the variables, this model achieves greater estimation efficiency. On the one hand, this approach does not require precise information about the distribution of the disturbance term and is based on the assumption that the disturbance term is uncorrelated with the set of instrumental variables in the equations. On the other hand, given the potential correlation between the error term and explanatory variables in fixed-effects models, it enjoys higher validity. The mathematical and algebraic form of the generalized moment model is expressed as follows:

(1) $Y_{i,t} = a_1 + \beta_2 Y_{i,t-1} + \gamma X_{i,t} + \eta_i + \varepsilon_{i,t}$

In the above equation, Y denotes the dependent variable, X represents a set of explanatory variables, η_i captures individual or country-specific fixed effects, ε is the disturbance term, and t and i denote the time period and cross-sectional unit, respectively (Movahedmanesh, 2016).

Based on the approach of Arellano and Bond, a method was proposed for estimating the GMM model that involves eliminating time-invariant individual-specific effects η_i by taking first differences of Equation (1). After applying this transformation, the equation takes the following form:

(2) $Y_{i,t} - Y_{i,t-1} = \beta(Y_{i,t-1} - Y_{i,t-2}) + \gamma(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1})$

In this case, $(Y_{i,t-1} - Y_{i,t-2})$ is correlated with $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$, and therefore the OLS estimator does not yield a consistent and unbiased estimate of β. Consequently, valid instruments must be employed. Assuming that (a) the error terms are not serially correlated:

(3) $E[\varepsilon_{i,t} \varepsilon_{i,t-1}] = 0$, for $i = 1, \dots, N$ and $s \neq t$

and (b) the initial conditions are predetermined:

(4) $E[Y_{i,t} \varepsilon_{i,t-1}] = 0$, for $i = 1, \dots, N$ and $t \geq 2$

Arellano and Bond (1991) derived the following moment conditions:

(5) $E[Y_{i,t}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0$, for $i = 1, \dots, N$ and $s \geq 2$

Since values of $Y_{i,t}$ lagged by two periods or more are correlated with $(Y_{i,t-1} - Y_{i,t-2})$ but not with $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$, they can be considered valid instruments for estimation (Arianmehr et al., 2013; Rahimi et al., 2022).

The consistency of the GMM estimator depends on the validity of the assumptions regarding the absence of serial correlation in the error terms and the validity of the instruments. These assumptions can be tested using two tests proposed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).

The first is the Sargan test of overidentifying restrictions, which evaluates the validity of the instruments. The Sargan test statistic follows a chi-square distribution with degrees of freedom equal to the number of overidentifying restrictions. The hypotheses of this test are defined as follows:

H_0: The instruments are valid.

H_1: The instruments are invalid.

When the p-value of the Sargan test exceeds the chosen significance level, the null hypothesis is accepted. This test is based on examining the correlation between the instrumental variables and the error term and is conducted through the following steps.

First, the explanatory variables are divided into two groups: Group 1 consists of explanatory variables that are correlated with u_t, with their number denoted by q, and Group 2 consists of explanatory variables that are not correlated with u_t, with their number denoted by $m = k - q$.

Second, instrumental variables z_{1t} to z_{st} are selected, where $s \geq q$.

Third, the explanatory variables in Group 1 (x_{1t} to x_{qt}) are replaced with the instrumental variables z_{1t} to z_{qt}, the regression equation is estimated, and the residuals e_t are obtained.

Fourth, the residuals are regressed on the Group 2 explanatory variables (which are independent of the error term) and on the instrumental variables, and the coefficient of determination R^2 is calculated.

(6) $S = (n - k)R^2 \sim \chi^2_{(s-q)}$

If the test statistic falls within the critical region, H_0 is rejected, indicating that the employed instruments are invalid because the error terms are correlated with the variables in Group 2 (Manjazeb & Nosrati, 2018).

The presence of higher-order serial correlation in the first-differenced errors, following an AR(2) process, indicates that the moment conditions required for the serial correlation test are not valid. This is because the first-difference transformation is an appropriate method for eliminating fixed effects only when the order of serial correlation in the disturbance terms is not higher than one. Accordingly, the first-order autoregressive coefficient AR(1) should be statistically significant, while the second-order autoregressive coefficient AR(2) should not be significant. To examine the order of serial correlation in the error terms, Arellano and Bond proposed a test statistic that asymptotically follows a standard normal distribution, defined as follows:

(7) $M_2 = (\hat{\varepsilon}'_{-2}\hat{\varepsilon}_*)/\hat{\sigma}^{1/2} \sim N(0,1)$

In this expression, $\hat{\varepsilon}_{-2}$ denotes the vector of residuals lagged by two periods, and $\hat{\varepsilon}_*$ represents the vector $\sum_{i=1}^{N}(T_i - 4) \cdot 1$. In this test, rejection of the null hypothesis implies that the disturbance terms exhibit second-order serial correlation, whereas failure to reject the null hypothesis indicates the presence of only first-order serial correlation. Under these conditions, the use of first-differencing to eliminate fixed effects is preferable and more appropriate than the orthogonal deviations transformation.

The present study examines the interactive effect of foreign direct investment and human capital on export diversification in 19 selected member countries of the Organization of Islamic Cooperation (Iran, Iraq, Saudi Arabia, Oman, Qatar, Kuwait, Bahrain, the United Arab Emirates, Jordan, Malaysia, Türkiye, Tajikistan, Indonesia, Pakistan, Azerbaijan, Bangladesh, Kazakhstan, Kyrgyzstan, and Albania) over the period 2010–2022. Accordingly, the research model is specified as Equation (8):

(8) $ED_{it} = \beta_0 ED_{it-1} + \beta_1 FINDEV_{it} + \beta_2 INFR_{it} + \beta_3 IQA_{it} + \beta_4 HUK_{it} + \beta_5 FDI_{it} + \beta_6 (FDI \times HUK)_{it} + \varepsilon_{it}$

where ED denotes export diversification, $FINDEV$ represents financial development, $INFR$ indicates infrastructure, IQA refers to institutional quality, FDI denotes foreign direct investment, HUK represents human capital, and $FDI \times HUK$ captures the interactive effect of foreign direct investment and human capital.

It should be noted that financial development is proxied by domestic credit to the private sector by banks (percentage of GDP), infrastructure is measured by fixed telephone subscriptions (per 100 people), institutional quality is captured by the property rights protection index, human capital is measured by gross secondary school enrollment (%), and foreign direct investment is measured by FDI inflows (percentage of GDP). The data used in this study are obtained from internationally recognized sources: financial development, foreign direct investment, human capital, and infrastructure data are extracted from the World Bank database; the institutional quality index is obtained from the Fraser Institute database; and the export diversification index is sourced from the United Nations Conference on Trade and Development (UNCTAD).

3. Findings and Results

The first step in panel data econometrics, prior to conducting any estimation, is to determine whether cross-sectional dependence or independence exists among the panel units. Various tests have been proposed in the literature for this purpose, among which the Pesaran cross-sectional dependence test is commonly used. In this test, the null hypothesis indicates the absence of cross-sectional dependence (cross-sectional independence), while the alternative hypothesis indicates the presence of cross-sectional dependence. If the calculated probability value is greater than the 5 percent significance level, the null hypothesis is not rejected and the cross-sections are considered independent. The results of the Pesaran cross-sectional dependence test are reported in Table 1. As shown in Table 1, since the probability value (0.00) is less than 5 percent, the alternative hypothesis of cross-sectional dependence is accepted.

Table 1. Results of the Pesaran Cross-Sectional Dependence Test

Test	Test Statistic	Probability	Result
Pesaran CD Test	3.45	0.00	Confirmation of cross-sectional dependence

In the next stage, and prior to estimating the research model, it is necessary to test the stationarity of all variables used in the estimations, since non-stationary variables may lead to spurious regression results. Therefore, to ensure the absence of spurious regression, the stationarity of the variables is examined using the Pesaran unit root test. In this test, the null hypothesis indicates the presence of a unit root (non-stationarity), while the alternative hypothesis indicates the absence of a unit root (stationarity).

The results of this test are presented in Table 2. As shown in Table 2, the absolute value of the Pesaran test statistic for export diversification is smaller than the absolute critical value at the 5 percent significance level; therefore, the null hypothesis of a unit root is accepted for export diversification, indicating that this variable is non-stationary. However, for the remaining variables, the absolute values of the test statistics exceed the 5 percent critical value, indicating that these variables are stationary at levels.

Table 2. Results of the Pesaran Stationarity Test for the Model Variables

Variable	Symbol	Test Statistic	Critical Value	Result
Export diversification	ED	−1.69	−2.22	Non-stationary
Foreign direct investment	FDI	−2.55	−2.22	Stationary
Human capital	HUK	−2.86	−2.22	Stationary
Foreign direct investment × human capital	FDI×HUK	−2.35	−2.22	Stationary
Financial development	FINDEV	−2.27	−2.22	Stationary
Infrastructure	INFR	−2.30	−2.22	Stationary
Institutions	IQA	−2.35	−2.22	Stationary

Estimating a model in the presence of non-stationary variables may result in a spurious regression. To address this issue, cointegration tests can be employed. The concept of cointegration implies the existence of a long-run equilibrium relationship toward which the economic system converges over time. If the model variables are non-stationary but cointegrated, the estimated results can be considered reliable. In this study, given the presence of cross-sectional dependence, the Westerlund cointegration test is used to examine cointegration. The null hypothesis of this test indicates the absence of cointegration, while the alternative hypothesis indicates the existence of cointegration among the variables. If the probability value is less than 5 percent, the null hypothesis is rejected and

the alternative hypothesis of cointegration is accepted. The results of the Westerlund cointegration test are reported in Table 3.

According to Table 3, the results of the Westerlund cointegration test confirm the existence of cointegration among the variables under study for all countries in the sample.

Table 3. Results of the Westerlund Cointegration Test for All Sample Countries

Test Statistic	Probability	Result
1.98	0.02	Confirmation of cointegration

Table 4 reports the results obtained from estimating the research model using the Generalized Method of Moments (GMM). The results presented in Table 4 indicate the following.

Export diversification with one lag has a positive and statistically significant effect on export diversification. Therefore, countries that have succeeded in developing a diversified export basket in the past are able to maintain this advantage in subsequent periods. This outcome may be attributed to the existence of commercial infrastructure, well-established international networks, accumulated technical know-how, and stable supportive regulations. This strong effect indicates that the process of export diversification is gradual and path-dependent.

Foreign direct investment has a positive and statistically significant effect on export diversification. Accordingly, foreign direct investment, through the transfer of advanced technologies, specialized knowledge from global markets, and international distribution networks, provides a powerful foundation for expanding and diversifying the export structure of the host economy. This transfer of knowledge and capabilities, particularly through linkages with local supply chains, enhances the ability of domestic firms to produce more diversified and competitive goods and facilitates entry into new export markets. Consequently, foreign direct investment inflows act not only directly but also indirectly—by strengthening the productive and commercial capacities of local firms—as a key driving force in the export diversification process.

The interaction effect of foreign direct investment and human capital has a positive and statistically significant impact on export diversification. This significant interaction effect indicates that the positive influence of foreign direct investment on export diversification is reinforced in the presence of a skilled and educated labor force. In fact, high-quality human capital acts as an essential facilitator that enables the absorption, localization, and diffusion of new knowledge and technologies transferred through foreign firms, thereby maximizing the spillover effects of these investments.

Financial development has a positive and statistically significant effect on export diversification. Thus, financial development, by reducing financing costs, covering commercial risks, and facilitating innovation, provides the necessary institutional infrastructure for structural transformation of the economy. This transformation enables a shift away from dependence on traditional exports toward a more diversified export basket with higher value added and greater resilience to external shocks.

Infrastructure has a positive and statistically significant effect on export diversification. Therefore, efficient infrastructure expands a country's range of strategic choices for export diversification. Infrastructure development enables effective access to dispersed resources and production capacities across different regions and allows countries to exploit diverse comparative advantages in building a diversified and resilient export basket.

Institutions have a positive and statistically significant effect on export diversification. Accordingly, strong institutions reduce investment risks in new and non-traditional sectors, protect intellectual property rights for new

products, and facilitate customs and trade procedures. Such an environment is essential for attracting productive foreign direct investment and for firms' efforts to enter new markets.

Table 4. Results of the Estimation of the Research Model

Variables	Coefficient	Standard Error	Statistic	Probability
Export diversification (lagged)	0.45	0.099	4.54	0.00
Foreign direct investment	0.55	0.17	3.23	0.00
Human capital	0.15	0.108	1.39	0.16
Foreign direct investment × Human capital	0.32	0.079	4.05	0.00
Financial development	0.02	0.009	2.22	0.02
Infrastructure	0.21	0.098	2.14	0.03
Institutions	0.15	0.06	2.50	0.01
Constant (c)	0.46	0.092	5.00	0.00

The Sargan test is used to examine the validity of overidentifying restrictions, that is, the appropriateness of the instrumental variables employed. The null hypothesis of this test states that the instruments used are valid. If the significance level of the Sargan statistic exceeds 0.05, the validity of the instruments used in the estimation cannot be rejected at the 95 percent confidence level. The results of the Sargan test are presented in Table 5.

As shown in Table 5, since the probability value is greater than 5 percent, the null hypothesis of no correlation between the instruments and the disturbance term cannot be rejected. Therefore, it can be concluded that the instruments used for estimation are valid.

Table 5. Results of the Sargan Test

Test	Statistic (χ^2)	Probability
Sargan	12.82	1.000

Another important test in the GMM framework is the examination of autocorrelation in the residuals of the estimated model. Arellano and Bond (1999) state that, in GMM estimation, the disturbance terms should exhibit first-order serial correlation AR(1) but should not exhibit second-order serial correlation AR(2). The results of this test are reported in Table 6. According to Table 6, at the 95 percent confidence level, first-order autocorrelation is statistically significant, whereas second-order autocorrelation is not statistically significant.

Table 6. Results of the Autocorrelation Test in the GMM Framework

Test	Statistic (Z)	Probability
AR(1)	−2.82	0.004
AR(2)	−1.05	0.29

4.   Discussion and Conclusion

The findings of the present study provide robust empirical evidence on the determinants of export diversification in selected member countries of the Organization of Islamic Cooperation, with particular emphasis on the interactive role of foreign direct investment and human capital. The dynamic estimation results confirm that export diversification is a path-dependent process, as the lagged value of export diversification exerts a positive and statistically significant effect on current diversification outcomes. This result is consistent with the theoretical notion of cumulative causation, according to which past successes in expanding the export basket generate learning effects, institutional experience, and market familiarity that facilitate further diversification. Similar evidence of persistence in export structures has been reported in earlier empirical studies, which argue that diversification evolves gradually through accumulated capabilities rather than abrupt structural shifts [1, 2, 29]. The significance of the

lagged dependent variable in the present study underscores the importance of long-term policy continuity and sustained investment in productive capacities to maintain and deepen diversification trajectories [27, 30].

The positive and statistically significant effect of foreign direct investment on export diversification confirms the role of FDI as a key external driver of structural transformation in developing and emerging economies. This finding aligns with a substantial body of literature emphasizing that FDI contributes to export diversification by facilitating technology transfer, improving managerial practices, and linking domestic firms to international production and distribution networks [7, 8, 10]. In the context of OIC member countries, where domestic technological capabilities are often limited, foreign firms can play a critical role in introducing new product lines and upgrading existing export structures. Empirical studies focusing on Asia, Africa, and resource-rich economies similarly document that FDI inflows enhance the range and sophistication of exports, particularly when they are oriented toward manufacturing and tradable services rather than extractive sectors [9, 11, 25]. The present findings therefore reinforce the view that attracting productive and export-oriented FDI remains a crucial strategy for economies seeking to diversify away from narrow commodity dependence.

However, the results also indicate that the direct effect of human capital on export diversification, although positive, is not statistically significant in isolation. This outcome suggests that human capital alone may not be sufficient to generate diversification unless it is effectively integrated into productive and trade-related activities. Similar mixed evidence has been reported in prior studies, where the impact of education and skill accumulation on export diversification appears contingent on complementary factors such as technology access, institutional quality, and market opportunities [17, 29]. In many OIC countries, structural mismatches between education systems and labor market needs may limit the direct contribution of human capital to export diversification. This finding highlights the importance of aligning human capital development with industrial and trade strategies rather than relying solely on quantitative expansions in education enrollment [13, 15].

The most salient result of the study is the positive and statistically significant interaction effect between foreign direct investment and human capital on export diversification. This finding provides strong support for the complementarity hypothesis, according to which the benefits of FDI for export diversification are substantially amplified in the presence of a skilled and educated workforce. In line with absorptive capacity theory, human capital enhances the ability of domestic firms and workers to learn from foreign enterprises, adapt imported technologies, and diffuse knowledge throughout the economy [12, 18]. Empirical evidence from Africa and other developing regions similarly demonstrates that FDI-induced export diversification is strongest in countries with higher levels of education and technical skills [8, 11]. The present results extend this literature by confirming that such complementarities are also highly relevant for OIC member countries, many of which are striving to move toward knowledge-based and diversified economic structures.

Financial development is found to exert a positive and statistically significant effect on export diversification, indicating that well-functioning financial systems play a critical enabling role in the diversification process. By reducing credit constraints, facilitating risk management, and supporting investment in new and innovative activities, financial development lowers entry barriers for firms seeking to diversify their export portfolios [20, 21]. This finding is consistent with earlier studies emphasizing that access to finance is particularly important for small and medium-sized enterprises, which often face higher risks and financing costs when entering new export markets [3, 4]. In the context of OIC economies, strengthening financial intermediation can therefore enhance the capacity of domestic firms to exploit opportunities created by FDI and human capital accumulation.

The positive and significant impact of infrastructure on export diversification further underscores the importance of physical and logistical foundations for trade expansion. Efficient transport and communication infrastructure reduce trade costs, improve connectivity, and expand firms' access to both domestic and international markets [16, 22]. This result is consistent with empirical findings showing that infrastructure development is a key determinant of export diversification and sophistication, particularly in economies characterized by geographical dispersion and uneven regional development [3, 11]. For OIC countries, investments in infrastructure can facilitate the exploitation of diverse regional comparative advantages and support the integration of domestic supply chains into global value networks.

Institutional quality also emerges as a significant determinant of export diversification, confirming that governance structures, regulatory quality, and property rights protection shape the incentives for firms to invest in new export activities. Strong institutions reduce uncertainty, protect intellectual property, and facilitate contract enforcement, thereby encouraging innovation and entry into non-traditional export sectors [6, 23]. This finding aligns with institutional economics perspectives that emphasize the primacy of institutions in shaping long-run development outcomes [5]. In the OIC context, institutional reforms aimed at improving transparency, reducing bureaucratic barriers, and strengthening trade-related governance can therefore play a pivotal role in sustaining export diversification efforts [24, 26].

Taken together, the results of this study highlight that export diversification is a multifaceted and systemic process driven by the interaction of external resources, domestic capabilities, and enabling environments. Foreign direct investment acts as a catalyst, but its effectiveness critically depends on the presence of adequate human capital, supportive financial systems, efficient infrastructure, and strong institutions. These findings reinforce the argument that isolated policy interventions are unlikely to yield durable diversification outcomes; instead, coordinated and complementary strategies are required to unlock the full potential of export diversification [1, 4]. For OIC member countries facing the dual challenges of commodity dependence and global economic uncertainty, such integrated approaches are particularly essential for achieving resilient and sustainable growth paths.

Despite its contributions, this study is subject to several limitations. First, the analysis relies on aggregate country-level data, which may mask sectoral heterogeneity and firm-level dynamics underlying export diversification processes. Second, the measurement of human capital and institutional quality is constrained by the availability of internationally comparable indicators, which may not fully capture qualitative dimensions such as skill relevance or governance effectiveness. Third, although the dynamic GMM approach addresses endogeneity concerns, the results remain sensitive to instrument selection and data limitations inherent in panel studies of this nature.

Future research could extend the present analysis by employing sectoral or firm-level data to explore how the interaction between foreign direct investment and human capital varies across industries with different technological intensities. Further studies may also incorporate alternative measures of human capital quality, such as vocational training or innovation-related skills, to capture more nuanced effects. In addition, comparative analyses across different regional groupings could shed light on whether the observed relationships are specific to OIC member countries or reflect broader development patterns.

From a practical perspective, policymakers should adopt integrated strategies that simultaneously promote targeted foreign direct investment, invest in education and skill development, strengthen financial systems, expand infrastructure, and improve institutional quality. Emphasis should be placed on aligning human capital development with the needs of export-oriented sectors and encouraging linkages between foreign and domestic

firms. Such coordinated efforts can enhance the absorptive capacity of local economies, maximize spillover effects from foreign investment, and support the transition toward diversified and resilient export structures.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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