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Foreign Direct Investment as a Catalyst for Sustainable Knowledge-Economy Transitions: Skill Demand, Institutional Co-Creation, and Human Capital Formation in Morocco (1975–2020)

Fatine El Ghali Ghorafi

Facultad de Economía y Empresa, University of Almería, 04120 Almeria, Spain; fe904@ual.es

Abstract

Sustainable development depends on whether emerging economies can convert foreign direct investment (FDI) into durable, knowledge-based capabilities rather than transient, low-skill employment. This paper asks how FDI catalyzes sustainable human-capital formation and whether multinational enterprises (MNEs) can help build the institutions that underpin a knowledge-economy transition. Using a single-equation instrumental-variables (2SLS) model for human-capital formation, with secondary-school enrolment as the dependent variable over 46 annual observations for Morocco (1975–2020), we find a positive and statistically significant FDI effect ($\beta = 0.0029$ per million USD of FDI inflow, $p = 0.006$), robust in sign and significance across OLS, 2SLS, and Dynamic OLS specifications. The result is consistent with a skill-demand channel through which knowledge-intensive MNEs are associated with higher private and social returns to education and with increased targeted public and private training investment. Sectoral evidence from Morocco's aerospace and automotive clusters shows enrolment in vocationally oriented program growing 312% between 2005 and 2022, concentrated in curricula co-designed with foreign investors. Communications infrastructure carries a positive and significant coefficient across all four estimators but loses significance once urbanization is added as a control, so we do not treat it as a confirmed independent channel, while public education expenditure carries a negative and significant coefficient that is not stable in sign under Fully Modified OLS, indicating that its independent contribution is not well identified with the present instrument set. We interpret these findings through a sustainability lens, linking the mechanism to Sustainable Development Goals 4 (quality education), 8 (decent work and growth) and 9 (industry, innovation and infrastructure), and we specify three boundary conditions—skill specificity, investor commitment, and state coordination capacity—and argue that the mechanism should be expected to transfer to other developing economies, including in the MENA region and sub-Saharan Africa, only where these conditions co-occur, rather than as a general claim. The study advances the literature on MNE-led institutional co-creation and offers policy guidance for designing FDI strategies that support inclusive, sustainable knowledge-economy development across the MENA region and sub-Saharan Africa.

Keywords: foreign direct investment; sustainable development; knowledge economy; human capital; institutional co-creation; Morocco

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1. Introduction

Whether foreign direct investment (FDI) advances or merely bypasses sustainable development turns on a single question: Does it leave behind durable local capabilities, or only short-lived, low-skill jobs? For emerging economies pursuing the transition to a knowledge economy, the answer depends on human-capital formation—the accumulation of skills that allows host countries to capture, retain, and upgrade the knowledge that multinational enterprises (MNEs) bring. This concern sits at the heart of the 2030 Agenda: Sustainable Development Goal (SDG) 4 targets quality education and relevant technical skills, SDG 8, decent work and inclusive growth, and SDG 9, resilient industry and innovation. FDI can serve all three—or none—depending on whether it activates a self-reinforcing process of skill formation or simply consumes whatever skills already exist.

In knowledge-intensive economies, skill accumulation is not determined solely by autonomous public spending; it is co-shaped by the demand signals that productive actors emit. The arrival of skill-intensive MNEs is associated with a higher wage premium on education, with household schooling decisions, and with institutional supply responses in the form of vocationally oriented training. This paper focuses on that association—how FDI is linked to, and plausibly contributes to, sustainable human-capital formation—and on how MNEs act as institutional catalysts that reshape the educational infrastructure of host economies, a process we term "knowledge co-creation." Framing the question in sustainability terms matters because it shifts the policy objective from maximizing FDI volume to maximizing the durability and inclusiveness of the capabilities FDI leaves behind.

Morocco is an unusually instructive case. The sequential pattern—FDI arrival generating skill demand, which induces institutional supply responses—is documented with particular clarity in aerospace and automotive industry. The arrival of Safran in 2001, Boeing in 2003, and Bombardier in 2007 preceded the establishment of the Institut des Métiers de l'Aéronautique (IMA), which opened in 2011. Analogous dynamics applied to the IFMIA automotive training institutes, established ahead of the Renault and Stellantis plant openings. This demand-driven institutional reform is consistent with Rodrik's (2004) model and illustrates how MNEs reduce their liability of foreignness (Zaheer, 1995) not merely by adapting to local conditions, but by co-creating the knowledge infrastructure their operations require—infrastructure that, once built, becomes a public asset supporting broader sustainable development.

We estimate a single-equation instrumental-variables (2SLS) model of human-capital formation, using secondary enrolment rates as the dependent variable and FDI inflows, public education expenditure, and communications infrastructure as regressors, over 46 annual observations for Morocco (1975–2020). FDI is instrumented using domestic savings, domestic credit to the private sector, and the real interest rate—macro-financial variables theoretically and empirically linked to aggregate FDI (Section 3.3)—rather than derived from a fully specified multi-equation system, which we do not estimate or report here. Framing the analysis within the sustainable knowledge-economy literature enriches the traditional FDI–growth nexus by foregrounding knowledge externalities, skill complementarities, and institutional capacity as the determinants of whether FDI yields lasting development gains.

The study makes three contributions. First, it reframes the FDI–human-capital relationship as a sustainable-development mechanism, linking it explicitly to SDGs 4, 8, and 9 and integrating institutional, structural, and knowledge-economy perspectives within a single empirical framework. Second, it provides a longitudinal assessment spanning 46 years—covering Morocco's pre- and post-liberalization periods—of how FDI shapes the skill base on which a sustainable knowledge economy rests. Third, it documents MNE-led institutional co-creation as a transferable mechanism, specifying the three conditions

(Section 5.3) under which foreign investors generate durable knowledge externalities rather than transient employment; generalization to other MENA and sub-Saharan economies is offered conditionally on those conditions being present, not as a blanket claim.

The argument matters beyond Morocco because it reframes a question that development agencies and national governments face whenever they design FDI-attraction strategies: should policy prioritize the volume of investment or its composition? A volume-first strategy treats FDI as fungible—any inflow is assumed to generate comparable developmental spillovers—and evaluates success primarily through aggregate inflow statistics. A composition-first strategy, by contrast, treats FDI as heterogeneous in its institutional consequences: some investment leaves behind durable capabilities, while other investment leaves behind little more than a wage bill. Distinguishing these two logics requires evidence on the mechanism connecting FDI to human-capital formation, not merely on the correlation between aggregate FDI and aggregate growth. This paper supplies that evidence for a single, well-documented case and specifies the conditions under which the underlying mechanism should be expected to generalize.

2. Theoretical Background and Literature Review

2.1. FDI, Human Capital, and Sustainable Knowledge-Economy Transitions

The knowledge-economy framework (Romer, 1990; Lucas, 1988) places human-capital accumulation at the center of sustained, and sustainable, development: durable growth depends on a renewable stock of skills rather than on the depletion of natural or low-cost-labor endowments. Within this framework, FDI acts as a conduit for knowledge transfer, technological upgrading, and skill formation in host economies (Borensztein et al., 1998; Alfaro et al., 2004). Two channels connect FDI to human capital. The direct channel operates through on-the-job training in MNE subsidiaries, which generates spillovers when trained workers move to domestic firms (Blomström & Kokko, 2003). The indirect channel operates through the labor market: knowledge-intensive MNEs raise the return to education and incentivize private and public investment in skills (Alfaro et al., 2004; Wong & Wong, 2008). Both channels bear directly on SDG 4 and SDG 8: they determine whether FDI produces relevant skills and decent, upgradeable work.

From an international-business perspective, this dynamic is central to how MNEs manage the liability of foreignness in emerging markets (Zaheer, 1995). Rather than simply absorbing the costs of unfamiliar institutions, leading MNEs co-invest in the institutions that reduce those costs over time. In Morocco's aerospace and automotive clusters, the IMA and IFMIA institutes represent institutional co-creation that aligns host-country capabilities with MNE requirements (Dunning, 2001; Buckley & Casson, 1976). This is fundamentally a sustainable knowledge-economy phenomenon: the MNE imports knowledge-intensive routines that the existing local system cannot supply, creating demand for a new institutional supply that persists beyond any single investment and supports SDG 9's emphasis on resilient, innovation-capable industry.

2.2. Empirical Evidence

Empirical evidence on the FDI–human-capital relationship is sparser than for FDI–growth or FDI–export links, partly because of data constraints on skill quality. Wong and Wong (2008) find positive FDI–human-capital effects across Asian economies; Blomström and Kokko (2003) document direct workforce-training effects across host countries. For Morocco specifically, prior work obtains a positive and significant FDI effect on secondary enrolment over 1975–2015 using a single-equation specification without a formal treatment of non-stationarity, cointegration, or instrument diagnostics. The present paper differs from that study in three concrete respects rather than merely extending its sample: it instruments

FDI with an explicit, theoretically motivated set of macro-financial variables rather than treating it as exogenous; it screens the underlying series for unit roots and cointegration and reports the full diagnostic battery (the Results section) rather than presenting a single point estimate; and it cross-validates the long-run coefficient across four estimators—OLS, 2SLS, DOLS, and FMOLS (the Results section)—rather than relying on one. The five additional years (2016–2020) are a secondary extension, not the paper's main claim to novelty. Recent work on FDI in emerging markets (Luo & Tung, 2007; Meyer & Sinani, 2009) underscores that the quality of local factor markets—human capital chief among them—decisively moderates spillover generation, and hence whether FDI contributes to sustainable upgrading or to enclave production with weak local linkages. More recent evidence outside Morocco reinforces this conditionality: Githaiga and Kilong'i (2023) find that FDI's effect on human-capital development across 34 sub-Saharan African countries is itself moderated by institutional quality, while Chizema (2025) shows that a human-capital index carries an insignificant or inconsistent coefficient in FDI–growth panel models for south and southeast Asia across several estimators, a pattern of estimator-sensitivity similar to the one we report for education expenditure and infrastructure below (Section 5.5).

2.3. Morocco: Sectoral Evidence and the Knowledge Co-Creation Mechanism

OFPPT (2022) data show enrolment in technical and vocational programs growing by 312% between 2005 and 2022, with the sharpest increases in programs developed in direct partnership with foreign investors. The IMA (aerospace) and IFMIA (automotive) institutes are the most visible institutional manifestations of FDI-induced skill demand. Their governance is instructive for sustainability: curricula are co-designed by MNE partners and the Moroccan state, funding is shared, and placement is jointly monitored—arrangements that embed private knowledge into durable public training capacity. Co-creation is most pronounced in aerospace and automotive because these industries require highly specific, non-transferable competencies that the general education system cannot supply—precisely the conditions under which the knowledge-economy argument predicts the strongest institutional response. By contrast, tourism and agro-industry, though significant FDI recipients, generate weaker vocational responses, indicating that the skill-specificity of investor demand moderates the magnitude—and the durability—of knowledge externalities.

This sectoral contrast is itself a sustainability finding. If FDI volume alone drove human-capital formation, tourism and agro-industry—both large, sustained recipients of foreign investment in Morocco—should exhibit institutional responses comparable to aerospace and automotive. They do not. The divergence indicates that the mechanism linking FDI to sustainable skill formation is not a generic externality of foreign presence but a structural feature of investor demand: knowledge-intensive investors need capabilities that cannot be purchased on the open labor market, and that necessity is what activates institutional co-creation. This has a direct implication for SDG-aligned investment promotion—attracting more FDI is not, by itself, a sufficient strategy for building a sustainable knowledge economy; attracting the right composition of FDI is.

2.4. Institutional Co-Creation and the Limits of Spillover Theory

Classical spillover theory treats human-capital formation as an unintended by-product of FDI: workers trained inside MNE subsidiaries eventually move to domestic firms, diffusing tacit knowledge through labor mobility (Blomström & Kokko, 2003). This account is compatible with, but analytically distinct from, the co-creation mechanism advanced here. Spillover theory locates the transmission channel inside the firm and treats the host country's training infrastructure as exogenous; the co-creation account locates part of the transmission channel in the institutional response the MNE itself helps engineer and treats

training infrastructure as an outcome of the FDI relationship rather than a precondition for it. The two are not mutually exclusive—both operate in Morocco's aerospace and automotive clusters—but they carry different sustainability implications. Spillovers depend on worker mobility and are therefore vulnerable to labor-market frictions, non-compete practices, and skill hoarding by anchor firms; co-created institutions, once established, persist independently of any single worker's career trajectory and continue to train new cohorts even as the anchor investor's direct involvement evolves. This durability is precisely what makes institutional co-creation, rather than spillovers alone, the more consequential channel for sustainable, rather than merely transient, human-capital formation.

3. Data, Variables, and Estimation Strategy

3.1. Data Sources

Data on secondary-enrolment rates (KH) and public education expenditure (IEDUC) are drawn from UNESCO and the Haut-Commissariat au Plan (HCP) of Morocco. FDI net inflows (IED) are from UNCTAD. Communications infrastructure (IDIG) is proxied by fixed-telephone-line density, the only continuous annual series available for the full sample; a composite index incorporating internet penetration, broadband access, and mobile connectivity was not available for the earlier decades of the sample and is left for future work once a complete annual series can be assembled. The dataset covers 46 annual observations for Morocco over 1975–2020, spanning the pre- and post-liberalization eras. Several series (public education expenditure, and two of the three instruments used in the first stage) contain gaps in individual years, which were filled by linear interpolation; results should be read with this in mind. Variable definitions, sources, and treatment are summarized in Table 1, and full estimation and diagnostic results are reported in Table 2 (baseline 2SLS estimates), Table 3 (unit-root tests), Table 4 (cointegration test), Table 5 (structural-break tests), Table 6 (instrument diagnostics), Table 7 (comparative estimators), and Table 8 (additional robustness checks).

Table 1. Variable definitions, sources, and treatment.

Variable	Definition	Unit	Source	Coverage	Transformation/ Gaps	Expected Sign (KH eq.)
KH	Gross secondary-school enrolment rate	%	UNESCO/HCP Morocco	1975–2020, complete	None	Dependent variable
IED	FDI net inflows	Current USD, millions	UNCTAD	1975–2020, complete	None (alt.: % GDP, Table 8)	+
IEDUC	Public education expenditure	% of GDP	UNESCO/World Bank WDI	1975–2020; 12/46 years missing	Linear interpolation	+ (theoretical prior; not confirmed, Section 5.5)
IDIG	Communications-infrastructure proxy (fixed-telephone-line density)	Lines per 100 inhabitants	World Bank WDI/ITU	1975–2020, complete	None	+ (not robust to urbanization control, Section 4)
D2002	Structural-break dummy (Chow-confirmed break in IED)	0/1	Constructed	1975–2020	=1 for years $\geq$2002	n.s.

Table 1. *Cont.*

Variable	Definition	Unit	Source	Coverage	Transformation/ Gaps	Expected Sign (KH eq.)
AHORRO	Gross domestic savings (instrument)	% of GDP	World Bank WDI	1975–2020, complete	None	Instrument (excluded)
CREDITO	Domestic credit to private sector (instrument)	% of GDP	World Bank WDI	1975–2020; 9/46 years missing	Linear interpolation	Instrument (excluded)
INTERES	Real interest rate (instrument)	%	World Bank WDI	1975–2020; 3/46 years missing at start, 5/46 at end	Linear interpolation, edge values carried	Instrument (excluded)
GDPgrowth	Annual real GDP growth (robustness control, Table 8)	%	World Bank WDI	1975–2020, complete	None	Control
TradeOpen	Trade openness (exports + imports)	% of GDP	World Bank WDI	1975–2020, complete	None	Control
Urban	Urbanisation rate	% of population	World Bank WDI	1975–2020, complete	None	Control

Note. "Linear interpolation" fills individual-year gaps between two observed values; where a gap falls at the end of the series with no later observed point (CREDITO and INTERES, final years), the last observed value is carried forward, which is a stronger assumption and is flagged here for transparency. IDIG is a fixed-telephone-line proxy, not a composite internet/broadband/mobile index (Section 3.1).

3.2. The Human-Capital Equation

The equation is specified as $KH = \alpha_3 + \beta_{31} \cdot IED + \beta_{32} \cdot IEDUC + \beta_{33} \cdot IDIG + \varepsilon_3$, where KH is the gross secondary-enrolment rate (%), IED is FDI net inflows (current USD, millions), IEDUC is public education expenditure (% of GDP), and IDIG is the communications-infrastructure proxy. IED is treated as endogenous and instrumented using domestic savings (AHORRO), domestic credit to the private sector (CREDITO), and the real interest rate (INTERES). We estimate this as a single-equation instrumental-variables model; we do not estimate or report a full multi-equation system, and the instrument choice is justified directly on macro-financial grounds (Section 3.3) rather than by appeal to an unreported system.

3.3. Methodological Justification

Two-Stage Least Squares (2SLS) estimation of this single equation is motivated by the endogeneity of FDI: the FDI–human-capital relationship is bidirectional, so treating FDI as exogenous would bias the estimated effect on enrolment. The three instruments—domestic savings (AHORRO), domestic credit to the private sector (CREDITO), and the real interest rate (INTERES)—are macro-financial variables chosen on theoretical grounds set out below, rather than searched over post hoc, which limits the risk of instrument selection reflecting the result sought. Their relevance rests on a standard balance-of-payments and financial-account logic: aggregate domestic savings and credit conditions determine the pool of loanable funds and the cost of capital that shape the volume of FDI a country attracts and can absorb, and the real interest rate is a standard determinant of capital flows in open-economy macro models; the strength of this channel is confirmed empirically by the first-stage partial F-statistic (74.9; full instrument diagnostics reported below). Their exclusion restriction—that these financial variables affect secondary enrolment only

through their effect on FDI, and not through any direct channel—is plausible because household schooling decisions and public-education budgeting in Morocco are not, to our knowledge, directly indexed to domestic savings rates, private-sector credit growth, or the real interest rate; the channel from these macro-financial variables to enrolment, if any, runs through the investment they finance rather than directly. A Wooldridge regression test does not reject exogeneity of IED under this instrument set ($p = 0.41$); we nonetheless retain the 2SLS specification on theoretical grounds, consistent with the wider literature on FDI endogeneity, and report an OLS estimate alongside as a robustness check ($\beta = 0.0024$, $p = 0.007$, materially consistent with the 2SLS result). The heteroskedasticity-robust overidentification test does not reject instrument validity at the 5% level ($p = 0.064$); the classical Sargan statistic, which assumes homoskedasticity, does reject at conventional levels ($p = 0.005$), a discrepancy we attribute to heteroskedasticity in a 46-observation sample rather than to instrument invalidity per se (full statistics reported below). Given the 46-year span, we screen the series for non-stationarity using Augmented Dickey–Fuller and Phillips–Perron tests and assess long-run co-movement before interpreting the estimates (full diagnostics reported below).

3.4. Time-Series Properties and Robustness Strategy

Because the dataset spans 46 annual observations, non-stationarity is a first-order concern for a sustainability claim resting on a long-run relationship rather than a short-run correlation. Augmented Dickey–Fuller and Phillips–Perron tests (reported below) do not uniformly support treating all four series as I(1): first differences of FDI (IED) are clearly stationary under both tests, education expenditure (IEDUC) and the infrastructure proxy (IDIG) are stationary in differences under Phillips–Perron but not under ADF—a divergence attributable to the small sample—and the enrolment series (KH) does not stabilize under either test, consistent with a slow-moving, near-deterministic upward trajectory rather than a standard stochastic unit-root process. The Johansen trace statistic (reported below) falls just short of the 5% critical value for a single cointegrating vector (46.4 versus 47.9), and the maximum-eigenvalue statistic does not confirm cointegration even at the 10% level; we therefore treat the long-run relationship as suggestive rather than fully confirmed by the cointegration tests, and rely on the convergence of OLS, 2SLS, and DOLS estimates for the central inference. We identify one structural break in the IED series around 2002, coinciding with Morocco's accelerated investment liberalization and the arrival of the first aerospace anchor investors; a Chow test strongly confirms this break ($F = 74.5$, $p < 0.001$, Table 5), and a corresponding dummy variable is included in the baseline specification, although it does not itself reach significance ($p = 0.148$). A Zivot–Andrews test on the enrolment series does not identify a statistically significant break (reported below), so we do not report a separate KH break date.

As a further robustness check, we re-estimate the long-run relationship using Dynamic OLS (DOLS) with two leads and two lags and Fully Modified OLS (FMOLS). DOLS closely reproduces the 2SLS pattern: a positive and significant FDI coefficient ($\beta = 0.0043$, $p < 0.001$), a negative and significant IEDUC coefficient ($\beta = -5.32$, $p = 0.001$), and a positive and significant IDIG coefficient ($\beta = 0.102$, $p < 0.001$). FMOLS is less supportive on two of the three coefficients: the FDI coefficient shrinks and loses significance ($\beta = 0.0002$, $p = 0.81$), and the IEDUC coefficient reverses sign and becomes positive and significant ($\beta = 3.78$, $p = 0.010$), while IDIG remains positive and significant ($\beta = 0.158$, $p < 0.001$) across every specification. Taken together, the FDI–enrolment association is robust across OLS, 2SLS, and DOLS but attenuates under FMOLS, and the IEDUC coefficient is not stable in sign across estimators; we treat the FDI and infrastructure results as the paper's robust findings

and the IEDUC coefficient as inconclusive given the present data and instrument set, rather than reporting it as a confirmed positive or negative effect.

Small-sample consideration. The empirical analysis is based on 46 annual observations over 1975–2020, and every diagnostic reported in Tables 4–6 should be read with the power limits of that sample size in mind. Asymptotic critical values for unit-root, cointegration and overidentification tests are derived for large samples; in a 46-observation series their actual size and power properties are less well approximated, which is the most direct explanation for cases in this paper where two tests of the same null (ADF versus Phillips–Perron on IEDUC and IDIG in differences; classical Sargan versus the heteroskedasticity-robust overidentification test) disagree, and for the Johansen trace statistic falling just below its asymptotic critical value rather than clearly above or below it. Low power in a small sample cuts in a specific direction for inference: it makes it harder to reject false null hypotheses of no cointegration or instrument invalidity, so a test that fails to reject should not be over-read as confirmation, and a test that does reject a well-specified null (as the Chow test does for the 2002 IED break, with F = 74.5) is comparatively more informative because rejection is harder to obtain by chance in a small sample. For this reason, we do not rely on any single test threshold; instead, we anchor the paper's central inference on the convergence of OLS, 2SLS, and DOLS point estimates for the FDI coefficient (reported below), treating agreement across three independently motivated estimators as stronger evidence than any one asymptotic diagnostic in isolation.

4. Results

FDI is positively and significantly associated with secondary enrolment (Table 2; β_{31} = 0.0029 per million USD, t = 2.767, p = 0.006), a result that is materially consistent across OLS (β = 0.0024, p = 0.007) and DOLS (β = 0.0043, $p < 0.001$), and that weakens under FMOLS. The finding is consistent with the knowledge-economy skill-demand channel: investors with intensive skill requirements are associated with a higher private and social return to education, which in turn is linked to household schooling decisions and public spending priorities. From a sustainability standpoint, this is the mechanism most consistent with how FDI is linked to SDG 4 and SDG 8—converting investment into a renewable skill base rather than a one-off employment pulse.

Table 2. 2SLS estimation results: Human-capital equation, dependent variable secondary-enrolment rate KH (Morocco, 1975–2020).

Variable	Coefficient	Std. Error	z-Statistic	*p*-Value
IED (FDI inflows, millions USD)	0.0029	0.0011	2.767	0.006 ***
IEDUC (education expenditure)	−5.280	1.423	−3.709	<0.001 ***
IDIG (communications infrastructure)	0.126	0.015	8.227	<0.001 ***
Break dummy (2002)	−1.968	1.359	−1.448	0.148
Constant	20.527	10.888	1.885	0.059 *
Adjusted R^2	0.974	—	—	—

Note. Estimation by 2SLS. IED instrumented by domestic savings (AHORRO), domestic credit to the private sector (CREDITO), and the real interest rate (INTERES). Cragg–Donald/partial F = 74.9; heteroskedasticity-robust overidentification test p = 0.064. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 3. Unit-root tests (ADF and Phillips–Perron), levels and first differences.

Variable	ADF Stat.	ADF *p*	PP Stat.	PP *p*	Lags (ADF)	5% Crit. (ADF)
KH, level	−1.452	0.845	−0.523	0.982	2	−3.518
KH, Δ	−1.624	0.471	−2.807	0.057	1	−2.932
IED, level	−0.832	0.963	−1.249	0.900	1	−3.515
IED, Δ	−8.970	0.000 ***	−8.965	0.000 ***	0	−2.930
IEDUC, level	−3.121	0.101	−2.879	0.169	9	−3.540
IEDUC, Δ	−1.710	0.426	−8.887	0.000 ***	10	−2.951
IDIG, level	−0.535	0.982	−0.076	0.993	2	−3.518
IDIG, Δ	−2.475	0.122	−6.538	0.000 ***	2	−2.933

Note. ADF regression includes constant and trend in levels, constant only in differences; lag order selected by AIC. PP uses the Newey–West/Bartlett correction. *** $p < 0.01$. N = 46 (45 for first differences).

Table 4. Johansen cointegration test (KH, IED, IEDUC, IDIG).

H0 (Rank)	Trace Stat.	Trace 90% CV	Trace 95% CV	Max-Eig Stat.	Max-Eig 95% CV
r = 0	46.443	44.493	47.855	23.009	27.586
r ≤ 1	23.434	27.067	29.796	12.791	21.131
r ≤ 2	10.642	13.429	15.494	6.841	14.264
r ≤ 3	3.802	2.706	3.842	3.802	3.842

Note. VAR lag-difference order k = 1 (selected by AIC on the underlying VAR in levels); no deterministic trend in the cointegrating relation. N = 46.

Table 5. Structural-break tests.

Test	Series	Candidate/Detected Break	Statistic	*p*-Value
Chow (break fixed at 2002)	IED	2002	F = 74.541	<0.001
Zivot–Andrews	KH	1977 (sample edge; not interpretable)	t = −3.951	0.537
Zivot–Andrews	IED	1976 (sample edge; not interpretable)	t = −4.035	0.480

Note. Zivot–Andrews allows a single break in intercept and trend, trim = 0.15, max lag = 2.

Table 6. Instrument diagnostics (first-stage and overidentification).

Statistic	Value	Distribution/df	*p*-Value	Interpretation
Cragg–Donald/partial F (first stage)	74.9	—	<0.001	Instruments strong (Stock–Yogo 10% threshold ≈ 10)
Sargan (classical overidentification)	10.762	$\chi^2(2)$	0.005	Rejects at 5% (assumes homoskedasticity)
Hansen J-type/Wooldridge robust score (overidentification)	5.499	$\chi^2(2)$	0.064	Does not reject at 5%
Wooldridge regression test (exogeneity of IED)	0.674	$\chi^2(1)$	0.412	Does not reject exogeneity

Note. Instruments: domestic savings (AHORRO), domestic credit to the private sector (CREDITO), real interest rate (INTERES). Robust covariance estimator throughout.

OFPPT (2022) data confirm the sectoral manifestation: enrolment in technical and vocational programs grew 312% between 2005 and 2022, concentrated in aerospace, automotive, and electronics programs co-developed with foreign investors. The IMA aerospace curriculum was developed jointly with Safran and Boeing; IFMIA automotive programs were co-designed with Renault and Stellantis. This co-creation pattern is consistent with Rodrik's (2004) model of demand-driven institutional reform and with the international-business literature on MNE-driven capability upgrading (Dunning, 2001), and it is the institutional channel through which SDG 9's resilient-industry objective is realized in practice. This

sectoral evidence is descriptive rather than econometrically identified: it is drawn from OFPPT enrolment statistics and the documented governance arrangements of IMA and IFMIA, not from a formal, reproducible coding of delegation depth, and it illustrates the mechanism behind the macro-level 2SLS result rather than independently testing it. We were not able to independently verify the initial and final enrolment values, the exact programs included, or the specific OFPPT source table underlying the 312% figure; it is retained from the source the author identified as OFPPT (2022), but readers should treat the precise magnitude as unverified pending the underlying table. Section 6 (Limitations) discusses the scope this choice implies in more detail.

Public education expenditure (IEDUC) does not carry a stable sign across estimators (see Section 5.5 for the full diagnostic comparison), so we do not draw a directional conclusion about its independent effect on enrolment in this specification. Communications infrastructure (IDIG) is positive and significant across the OLS, 2SLS, DOLS, and FMOLS specifications reported in Table 7, but this result is not robust to the inclusion of urbanization as a control (see the robustness checks immediately below), so we do not treat it as a confirmed independent channel either. The adjusted R^2 of 0.974 indicates that the specification explains the great majority of variation in enrolment over the sample.

Table 7. Comparative estimates: OLS, 2SLS, DOLS, and FMOLS.

Variable	OLS: β (SE) [t] {*p*}	2SLS: β (SE) [z] {*p*}	DOLS: β (SE) [t] {*p*}	FMOLS: β (SE) [z] {*p*}
IED	0.0024 *** (0.0009) [2.68] {0.007}	0.0029 *** (0.0011) [2.77] {0.006}	0.0043 *** (0.0012) [3.69] {<0.001}	0.0002 n.s. (0.0010) [0.24] {0.808}
IEDUC	−5.051 *** (1.657) [−3.05] {0.002}	−5.280 *** (1.423) [−3.71] {<0.001}	−5.316 *** (1.534) [−3.47] {0.001}	3.781 ** (1.471) [2.57] {0.010}
IDIG	0.132 *** (0.016) [8.18] {<0.001}	0.126 *** (0.015) [8.23] {<0.001}	0.102 *** (0.018) [5.57] {<0.001}	0.158 *** (0.014) [11.43] {<0.001}
Break dummy (2002)	−1.912 n.s. (1.719) [−1.11] {0.266}	−1.968 n.s. (1.359) [−1.45] {0.148}	−1.767 n.s. (1.598) [−1.11] {0.269}	−3.881 n.s. (2.414) [−1.61] {0.108}
Constant	17.498 n.s. (11.574) [1.51] {0.131}	20.527 * (10.888) [1.89] {0.059}	28.384 ** (11.312) [2.51] {0.012}	−38.042 *** (9.944) [−3.83] {<0.001}
N	46	46	41	46
Adj. R^2	0.974	0.974	0.975	—

Note. DOLS includes two leads and two lags of ΔIED; HAC (Newey–West, 2 lags) standard errors. FMOLS uses a Bartlett-kernel long-run covariance correction (Phillips & Hansen, 1990). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. n.s. = not significant.

Additional Robustness Checks: Omitted Variables and FDI Measurement

Two further checks address concerns about the parsimony of the baseline specification and the use of nominal FDI. First, because 46 years of Moroccan development plausibly involve common trends in GDP growth, trade openness, and urbanization that could confound the FDI–enrolment association, we re-estimate the 2SLS equation adding annual GDP growth, trade openness (exports plus imports as a share of GDP), and the urbanization rate as controls (Table 8). Second, because current-USD FDI inflows are affected by inflation, exchange-rate movements, and the growing size of the Moroccan economy over the sample, we re-estimate the equation with FDI expressed as a share of GDP rather than in nominal millions of USD (Table 8).

Table 8. Robustness checks: sensitivity of the FDI coefficient to additional controls and to an FDI/GDP specification.

Variable	Baseline 2SLS β (SE) {*p*}	+ GDP Growth, Trade Openness, Urbanization β (SE) {*p*}	IED as % GDP β (SE) {*p*}
IED	0.0029 *** (0.0011) {0.006}	0.0064 *** (0.0019) {0.001}	8.804 *** (3.168) {0.006} [1]
IEDUC	−5.280 *** (1.423) {<0.001}	−2.057 n.s. (1.789) {0.250}	−2.521 n.s. (1.655) {0.128}
IDIG	0.126 *** (0.015) {<0.001}	0.021 n.s. (0.042) {0.621}	0.129 *** (0.022) {<0.001}
Urbanization	—	1.229 *** (0.469) {0.009}	—
GDP growth	—	−0.014 n.s. (0.120) {0.908}	—
Trade openness	—	0.057 n.s. (0.110) {0.602}	—

[1] Coefficient units differ (IED as % GDP rather than USD millions), so this coefficient is not directly comparable in magnitude to the baseline. *** $p < 0.01$. Robust covariance throughout; instruments AHORRO, CREDITO, INTERES in all three columns. n.s. = not significant.

The FDI coefficient is robust—and in fact larger and more precisely estimated—both when GDP growth, trade openness, and urbanization are added as controls, and when FDI is rescaled as a share of GDP, addressing the measurement and omitted-variable concerns directly. The result for communications infrastructure (IDIG) is not robust to this check however: once urbanization is included, IDIG loses statistical significance, while urbanization itself is strongly significant. This is consistent with IDIG (proxied by fixed-telephone-line density) and urbanization sharing a common secular trend over 1975–2020, so that the earlier IDIG coefficient may partly reflect urbanization rather than a distinct communications-infrastructure channel. We therefore withdraw the earlier claim that IDIG is the most stable regressor after FDI, and instead report it as sensitive to the inclusion of urbanization as a control. Education expenditure (IEDUC) becomes statistically insignificant, rather than negative and significant, once these controls are added; combined with its sign instability across estimators (Section 5.5), we treat its independent contribution as genuinely unresolved by the present data rather than reporting any directional finding for it under any specification.

5. Discussion: Sustainability Implications and Transferability

5.1. Policy Implications for Sustainable Development

The finding that FDI is a robust demand-side driver of human-capital formation reframes a core sustainable-development choice; the communications-infrastructure result is less robust (it does not survive controlling for urbanization, Section 4) and is therefore not treated here as an independently confirmed complementary factor. Because the independent contribution of public education expenditure is not stably identified in this specification, the paper does not take a position on whether expenditure and FDI-linked demand are substitutes or complements; it instead documents that FDI-linked demand and infrastructure are the two channels for which the evidence is consistent across estimators. Morocco's dual-track approach—general secondary education alongside FDI-linked vocational institutes—embodies a coordination logic that this evidence supports for the FDI and infrastructure channels specifically. The key policy lever for an SDG-aligned FDI strategy is therefore not the volume of FDI but its sectoral composition: knowledge-intensive investors generate stronger and more durable human-capital externalities than resource-extractive or low-complexity investors and so contribute more to a sustainable knowledge-economy transition.

5.2. Managerial Implications

For MNE managers, proactive engagement in host-country training-institution design is not corporate philanthropy but a mechanism for reducing the liability of foreignness

and securing long-term operational viability. The IMA and IFMIA cases show that firms negotiating co-governance arrangements for vocational training can more reliably secure the skilled workforce that complex, knowledge-intensive manufacturing requires, while contributing to host-country sustainable-development objectives—an alignment of private advantage and public benefit that strengthens the social license to operate.

5.3. Boundary Conditions and Transferability

Because this journal's readership is international, the transferability of the mechanism matters as much as the Moroccan result. The co-creation mechanism is not automatic; it is contingent on three enabling conditions. First, skill specificity: requirements must be precise and non-substitutable through general education, as in aerospace and automotive but not in tourism or agro-industry. Second, credible investor commitment: the volume and durability of demand must justify the fixed costs of joint institutional design. Third, minimum state coordination capacity: the host state must be able to negotiate, enforce, and update co-governance arrangements. Where any condition is absent—resource-extractive FDI, short-horizon investment, or fragmented bureaucratic authority—the mechanism is unlikely to activate. Morocco may possess unusually strong coordination capacity relative to other emerging economies, which makes that capacity a precondition to build rather than to assume. Specifying these conditions makes the policy guidance precise and the mechanism testable elsewhere: the framework applies wherever the three conditions co-occur, which delimits realistic SDG-aligned FDI strategies for MENA and sub-Saharan economies.

The high adjusted R^2 (0.974) indicates the specification explains the great majority of variation in enrolment over the sample, consistent with FDI tracking Morocco's long-run enrolment trajectory; the communications-infrastructure coefficient, while positive in the baseline, does not survive the urbanization-controlled robustness check reported in Section 4 and is not relied upon here. This does not mean the relationship is contemporaneous: institutional responses to knowledge demand are incremental, which is why durable, coordinated policy outperforms one-off spending, and why the long-run estimators (2SLS, DOLS) rather than short-run correlations are the appropriate basis for the sustainability claim advanced here.

5.4. Linking the Mechanism to SDG Monitoring

A further implication concerns how the mechanism documented here should inform SDG monitoring practice. National SDG 4 and SDG 8 indicators typically track aggregate enrolment, completion, and employment rates without disaggregating by the institutional channel through which skills were acquired. The Moroccan evidence suggests that a meaningful share of the recent growth in technical and vocational enrolment is attributable to a specific, traceable institutional channel—FDI-linked, co-governed training institutes—rather than to generic expansion of the public education system. Monitoring frameworks that track enrolment growth by governance type, and not only by level and field of study, would allow policymakers to distinguish durable, demand-anchored capability formation from enrolment growth that may prove more transient. This is a modest but practicable extension of existing SDG indicator frameworks, and one that the Moroccan dual-track system—general secondary education alongside FDI-linked vocational institutes—is already structurally positioned to support, since the relevant governance distinction is legible in existing administrative records rather than requiring new data collection instruments.

5.5. Robustness and Diagnostic Limitations

The estimates reported above are subject to four diagnostic qualifications that we consolidate here rather than distribute across the results narrative. First, given the limited power of asymptotic cointegration tests in a moderate sample (N = 46), the Johansen trace

statistic is best read as indicative of long-run co-movement rather than as a definitive confirmation: it falls just short of the 5% critical value for a single cointegrating vector (46.4 versus 47.9) and does not confirm cointegration even at the 10% level under the maximum-eigenvalue test (Section 3.4). Rather than relying on a single asymptotic test, we validate the long-run relationship through the structural convergence of the 2SLS and DOLS estimators, which agree closely in sign, magnitude, and significance on the FDI coefficient. Second, the coefficient on public education expenditure (IEDUC) is not stable in sign across estimators, moving from negative and significant under 2SLS and DOLS ($\beta = -5.28$ and -5.32, respectively) to positive and significant under FMOLS ($\beta = 3.78$); we treat this coefficient as inconclusive rather than reporting a directional finding, and do not draw on it in support of the paper's central argument. Third, the FDI coefficient itself, while positive and significant under OLS, 2SLS, and DOLS, attenuates and loses significance under FMOLS ($\beta = 0.0002$, $p = 0.81$). This pattern is consistent with FMOLS's reliance on strict exogeneity and near-exact cointegration, assumptions that are demanding for a variable such as FDI that the literature commonly treats as potentially endogenous; the close agreement between 2SLS and DOLS, which explicitly accommodate that possibility, is the more direct evidence for the paper's central finding. We note, however, that the Wooldridge exogeneity test reported in Section 3.3 does not itself reject exogeneity of IED under the present instrument set ($p = 0.41$), so this pattern should be read as consistent with, rather than as independent confirmation of, the case for an instrumental-variables approach. Fourth, instrument validity shows a related pattern: the classical Sargan test rejects the overidentifying restrictions ($p = 0.005$), while the heteroskedasticity-robust Hansen J-type test does not reject at the 5% level ($p = 0.064$). Because the classical Sargan statistic assumes homoskedasticity—an assumption unlikely to hold in a 46-year macroeconomic time series—we treat its rejection as symptomatic of heteroskedasticity rather than of instrument invalidity, and take the robust test, which does not reject exclusion at the 5% level, as the more informative diagnostic for this sample; we nonetheless report both statistics for transparency. None of these qualifications overturns the paper's central finding—a positive, economically and statistically significant association between FDI and secondary enrolment—but together they indicate that the long-run relationship, and in particular the role of public education expenditure, should be treated as an area for further data collection and refinement rather than as fully settled by the present evidence.

6. Conclusions

This paper has provided 2SLS evidence that FDI is positively and significantly associated with secondary-education enrolment in Morocco over 1975–2020 ($\beta = 0.0029$, $p = 0.006$), a result corroborated by OLS and DOLS and attenuated, though not reversed in sign, under FMOLS. The association is consistent with a knowledge-economy skill-demand channel, through which FDI is linked to higher returns to education and to both household schooling decisions and public investment in training capacity; given the single-country design, the moderate sample size (n = 46), and the residual identification concerns discussed in Section 5.5, we present this as the mechanism most consistent with the evidence rather than as a fully identified causal effect. Morocco's aerospace and automotive clusters—where FDI arrival preceded the establishment of dedicated training institutes—provide sectoral, descriptive corroboration (Section 4), and the mechanism maps onto SDGs 4, 8, and 9. Extension of this mechanism to other MENA and sub-Saharan African economies is not claimed generally; it is expected only where the three boundary conditions specified in Section 5.3—skill specificity, credible investor commitment, and state coordination capacity—co-occur.

Three contributions stand out. First, by situating the FDI–human-capital relationship within a sustainable-development framework and integrating institutional, structural, and knowledge-economy perspectives, the study offers a more complete account than prior single-equation analyses. Second, the 46-year horizon captures the full arc of Morocco's liberalization and institutional reform. Third, the evidence on MNE-led institutional co-creation—most visibly in IMA and IFMIA—advances understanding of how MNEs shape, rather than merely respond to, the institutions on which a sustainable knowledge economy depends, and the boundary conditions in Section 5.3 make that mechanism transferable.

Limitations should be acknowledged. The single-country design limits external generalizability; gross secondary enrolment captures educational participation rather than the quality, relevance, or eventual labor-market utilization of acquired skills, and is a broader indicator than the specialized vocational training (aerospace, automotive) emphasized in the sectoral discussion—we were not able to test robustness against completion rates, tertiary enrolment, or vocational-specific enrolment for lack of a complete comparable series, and flag this as a priority for future work rather than a resolved point. The small sample (n = 46) constrains the power of formal tests: the Johansen cointegration evidence is suggestive rather than conclusive, the FDI–enrolment coefficient attenuates under FMOLS, and instrument validity is not confirmed uniformly across the classical and robust overidentification tests (Section 5.5); we cannot rule out weak or partially invalid instruments, and the possibility that IED and KH share a common stochastic trend not fully captured by the cointegration tests reported here. The baseline equation omits several variables—income per capita, demographic structure, labor-market conditions, and specific education-policy reforms—that could jointly affect FDI and enrolment; Section 4's robustness check adds GDP growth, trade openness, and urbanization and shows the FDI coefficient is robust to their inclusion, but the equation remains parsimonious relative to the 46 years of structural change it spans, and residual omitted-variable bias cannot be excluded. The communications-infrastructure variable is proxied by fixed-telephone-line density rather than a composite index of internet, broadband, and mobile connectivity, its apparent effect does not survive the urbanization-controlled check in Section 4, and several series required linear interpolation to fill individual-year gaps; all of these should be revisited once a complete annual digital-connectivity series is assembled. The coefficient on public education expenditure is not stable in sign across estimators and becomes insignificant once urbanization is controlled for; we treat it as inconclusive rather than as evidence of either a positive or a negative independent effect, noting that expenditure may also operate with lags or interact with FDI in ways the present linear, contemporaneous specification does not capture. Structural-break dates (2002 for IED) are supported by a Chow test at a theory-motivated date rather than by an endogenous break-search procedure; we did not conduct a full endogenous multiple-break search, which is a further limitation. Future research should extend the framework to panel settings across comparable emerging economies, incorporate firm-level data on MNE training expenditure, test lagged and interacted specifications for education expenditure, and develop sector-level measures of skill specificity. The central policy message is offered as consistent with, rather than definitively established by, this evidence: for an SDG-aligned development strategy, what matters is not the volume of FDI but its sectoral composition and the co-governance arrangements through which investor skill demand may be channeled into durable public training supply.

A further limitation, introduced in Section 4, concerns measurement of the co-creation mechanism itself: the sectoral evidence is descriptive rather than derived from a formal, reproducible coding of delegation depth of the kind that a comparative institutional design could provide. This is a deliberate scope choice: the present paper's contribution is to

establish the macro-level, longitudinal FDI–enrolment relationship and to ground it in illustrative sectoral evidence, not to fully operationalize the institutional mechanism at the level of governance detail. Readers interested in a more granular, cross-country test of the coordination-capacity conditions under which such co-creation arises are referred to the companion comparative literature on delegated governance in Morocco and neighboring economies. Notwithstanding this scope limitation, the combination of a robust macro-econometric result and a well-documented, temporally sequenced sectoral mechanism offers stronger grounds for the sustainability claim advanced here than either source of evidence would support in isolation.

Taken as a whole, the paper's sustainability contribution is to shift the evaluative question that FDI-promotion strategies are typically asked to answer. Volume-based metrics—inflows as a share of GDP, number of projects, jobs announced at investment signing—capture the visible, short-run face of FDI but say little about whether that investment leaves behind a renewable skill base once the initial project cycle ends. The evidence assembled here suggests that a composition- and institution-focused metric—whether FDI is concentrated in skill-specific sectors, and whether it is accompanied by credible, co-governed training arrangements—is a more informative predictor of durable, SDG-aligned development outcomes. Embedding that distinction into how governments and development agencies evaluate FDI strategies is, in the end, the paper's principal policy contribution.

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