

The Role of FDI, ICT, And Human Capital in Morocco's Growth Trajectory: An Empirical ARDL Analysis

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Abstract

In the context of Morocco's digital and economic transition, this study examines the combined impact of foreign direct investment (FDI), information and communication technologies (ICT), and human capital on economic growth between 1990 and 2023, using an ARDL (Autoregressive Distributed Lag) model with 34 annual observations. While previous research often assessed these factors separately, this study offers an integrated analysis tailored to the Moroccan context.

The findings reveal that FDI has a positive and significant effect on growth in both the short and long-term. ICT negatively affects growth in the short-term likely due to initial adaptation costs but turns positive in the long-term. Human capital boosts growth only in the short-term, indicating underexploited potential in the long-term. Inflation, meanwhile, consistently hampers growth. These results call for strategic reforms to enhance ICT integration and improve the match between education and labour market needs, thereby fostering inclusive and sustainable economic development.

Keywords: *FDI, ICT, human capital, economic growth, Morocco, ARDL.*

1. Introduction

In a world in perpetual change, digital transformation stands out as a significant lever for economic, social, and institutional change. For developing countries, and particularly for Morocco, this transition represents both a strategic opportunity and an unavoidable challenge. Recently, the Kingdom has started necessary development reforms based on the New Development Model, which calls for significant changes, including economic and digital transformation and more investment in people, to promote growth that is inclusive, sustainable, and strong (CSMD, 2021).

In this context, integrating ICT, primarily through the importation of technological goods, is considered a strategic component for modernising productive structures, enhancing national economic competitiveness, and tackling challenges related to climate urgency, increasing social inequalities, and heightened international competition (World Bank, 2023). However, this change won't be fully effective without also focusing on two other vital factors: FDI, which is crucial for sharing technology and funding innovation, and human capital, which affects how well digital technologies are used, adapted, and spread (UNCTAD, 2022; OECD, 2023).

Even though Morocco is working hard to attract FDI, improve digitalisation, and provide training, not many studies have looked at how these three factors work together in the same analysis, especially considering both short-term and long-term effects. Previous studies tend to separately address the role of FDI, ICT, or human capital in economic growth, without considering their simultaneous influence on macroeconomic performance (Asongu and Odhiambo, 2020; Ben Naceur et al., 2021). Moreover, the transmission mechanisms through which these factors influence growth remain underexplored within a contextualised framework in Morocco.

The objective of this study is to enrich the existing literature by analysing the individual effects of FDI, ICT, and human capital on Moroccan economic growth and integrating these variables into a single empirical model based on the ARDL method, which covers the period from 1990 to 2023. This approach allows for the distinction between short-term and long-term effects while providing functional empirical elements for the formulation of public policies. The work thus aims to meet the needs of decision-makers in understanding the most effective levers to leverage digital transformation in the national context.

In this regard, it is necessary to question the issue that this study aims to address, namely, to what extent do FDI, technological integration through ICT, and human capital simultaneously and differentially influence Morocco's economic growth in the short and long-term?

Addressing this issue can only be done after, in a second section, developing a critical review of the empirical literature on the impact of FDI, ICT, and human capital on economic growth.

The third section presents the chosen methodology, detailing the adopted econometric framework (ARDL model) as well as the data used. The fourth section presents the empirical results, distinguishing between short-term and long-term effects. Finally, a last section concludes the analysis by highlighting the main lessons learned from the study and formulating economic policy proposals in favour of sustainable and digitally inclusive growth.

2. Literature Review

The link between FDI, ICT integration, human capital, and economic growth remains a subject of ongoing debate due to varying national contexts, methodologies, and data limitations. Nevertheless, numerous studies provide valuable insights.

Widarni and Bawono (2021) find that human capital and ICT goods significantly drive growth in Indonesia, emphasising the roles of education and technology in enhancing productivity. Similarly, Maswana (2022) shows that ICT imports, particularly spare parts, boost growth in sub-Saharan Africa, especially in middle-income countries. An IMF study (2023) on the UAE reveals that ICT investments have a strong multiplier effect on non-oil GDP, underlining ICT's role in economic diversification.

Norehan et al. (2022) compare China and Malaysia, showing ICT positively influences growth in China but has a negative effect in Malaysia, where growth remains dependent on capital and labour. Sinha et al. (2020), covering 36 developing countries, and Hammed and Ademosu (2023), focusing on BRICS with ARDL methodology, both confirm the positive effects of FDI and ICT on GDP, with the latter highlighting the need for better ICT integration to mitigate potential downsides of FDI.

Campisi et al. (2013) find that ICT infrastructure and FDI enhance GDP across OECD and non-member countries, helping developing nations catch up through innovation. Belloumi and Touati (2022),

analysing 15 Arab countries, confirm the long-term positive impact of ICT and FDI on growth. Likewise, Sapuan and Roly (2021) and Morris and Oldroyd (2020) stress that combining human capital investment and technology boosts competitiveness and productivity.

Felipe et al. (2019) and Xu and Li (2020) underscore that education and health investments improve labour productivity and sustained growth. In South Africa, Habanabakize and Zerihun (2024) show mobile and internet usage as key ICT drivers of growth. Ramzan et al. (2019), studying 70 developing countries, highlight that FDI's benefits depend on the level of human capital, suggesting that strengthening human capital is crucial to maximising FDI gains.

In Morocco, empirical work is relatively limited. Arbia et al. (2023), using ARDL analysis from 1990–2021, find that while ICT negatively affects growth, FDI has a long-term positive impact, and education-driven human capital investment benefits both short- and long-term growth. Dabnichi and Ferroud (2024) also emphasise FDI's role in job creation, technology transfer, and output enhancement.

Elkhalfi et al. (2023) show that public investment in health and education improves Morocco's growth, particularly over the long-term. Kathir and Bulut (2024) highlight that despite corruption's negative effects; human capital remains a key growth driver. El Asli et al. (2024) further confirm the importance of human capital, productivity, and investment in fostering growth and call for structural reforms to enhance the business climate.

3. Data Methodology and Specification of the Empirical Model

3.1. Data

The variables selected in our study are essential for quantifying the role of FDI, ICT, and human capital in improving economic growth in Morocco.

The GDP growth rate is a central indicator of the economic performance of countries, according to the study by Alin Vasile (2022).

FDI, expressed as a percentage of GDP, corresponds to net FDI inflows taken from the World Bank's World Development Indicators and is considered an essential driver of economic growth. (Arbia et al., 2023).

In the context of digital transformation, which is based on the use of technology, ICT are assessed by examining imports of ICT goods, as explained by Widarni and Bawono (2021). This indicator is expressed as

a percentage of total goods imports. It includes telecommunications, audio, video and computer equipment, as well as electronic components and other ICT-related products, as classified by the World Bank.

According to technological diffusion and absorptive capacity theories (Cohen & Levinthal, 1990), ICT-related productivity gains are gradual and rely on complementary investments in human capital, infrastructure, and institutional reforms. In Morocco, the dominance of micro and small enterprises, skills mismatches, limited digital adoption, inadequate infrastructure, and bureaucratic rigidities hinder the short-term effectiveness of ICT and delay its growth benefits.

Human capital is measured in this study by the minimum primary school completion rate. This indicator allows for the assessment of girls and boys' access to this fundamental level of education. According to Ssozi and Asongu (2016), education and, more broadly, human capital play an essential role in stimulating economic productivity. This variable thus reflects the efficiency of the educational system and the quality of human capital training, considered crucial elements for reducing unemployment and promoting economic development (*Chitoui & Boushib, 2025*).

To ensure the relevance and robustness of our study, we also include a control variable: inflation, represented by the consumer price index (CPI). This allows us to account for the effects of inflation on economic dynamics, in line with previous economic literature. (Arbia and Sobhi, 2024; Wegari et al., 2023).

These variables were selected based on previous research, which highlights their importance, to assess the role of FDI, ICT, and human capital in strengthening economic growth within the framework of digital transformation in Morocco.

Table 1 summarises the descriptions of all variables and their sources.

Variables	Descriptions	Source
GDP	Economic growth rate	World Bank
FDI	Foreign Direct Investment	
ICT	Information and Communication Technology	
HC	Human Capital	
INFL	Inflation	High Commission for Planning - Morocco -

Source: the author's

3.2. Methodology

Our study aims to quantify the impact of FDI, ICT, and human capital on economic growth in Morocco through the use of the ARDL model. It is based on the works of Belloumi and Touati (2022), Widarni and Bawono (2021), and Arbia et al. (2023). The analysis covers the period 1990-2023, selected both for the availability of data and its representativeness of a phase marked by profound economic changes: the rise of FDI, technological advancements, and reforms in education and human capital. This period also reflects Morocco's efforts in terms of economic openness and global integration.

Our objective is to evaluate the contribution of these three factors to the growth dynamics, taking into account the context of digital transition.

The researcher, et al. begin by testing the stationarity of the variables to determine whether they are integrated of order zero $I(0)$, order one $I(1)$, or a combination of both an essential prerequisite for applying the ARDL modeling framework. Following this step, the optimal model specification is identified by selecting the appropriate lag structure to capture the temporal dynamics among the variables accurately.

The search for a potential long-term relationship is then conducted using the bounds testing approach, which enables the identification of co-integration among the variables. If co-integration is established, the researcher proceeds with the estimation of both the short- and long-term relationships, based on the optimal lag structure previously determined. The robustness of the estimated model is assessed through various statistical indicators and diagnostic tests to ensure its reliability and validity.

The ARDL model is well-suited for analysing variables with mixed integration orders $I(0)$ and $I(1)$, enabling simultaneous estimation of short and long-term effects. Through the bounds test, it also identifies co-integration relationships while capturing adjustment dynamics toward equilibrium, making it a relevant tool for assessing both the immediate and lasting impacts of key growth factors on the Moroccan economy (Pesaran et al., 2001).

3.3. Model Specification

The main objective of this study is twofold. On one hand, we seek to quantify the impact of FDI, ICT, and human capital (HC) on Morocco's economic growth, both in the short and long-term. On the other hand,

this study aims to enrich the existing literature by providing an empirical analysis of the role of these variables in the country's economic growth.

For the estimation of our model, we rely on the specifications proposed by Belloumi and Touati (2022), Abadli et al. (2022), Azam and Ather Maqsood (2015), and Arbia and Sobhi (2024). Our analysis covers the period from 1990 to 2023 and is based on the following econometric model:

$$GDP = f(FD, ICT, HC, INFL) \tag{1}$$

The selection of explanatory variables is based on economic theory and the constraints of the data used in this study. Once the economic model is defined, it is essential to formalise it in an econometric form. Thus, we obtain the following equations:

$$GDP = \beta_0 + \beta_1 FDI + \beta_2 ICT + \beta_3 HC + \beta_4 INFL + \varepsilon_t \tag{2}$$

Our econometric analysis of time series will use the ARDL model, initially developed by (Pesaran & Shin, 1995). This model is particularly suited for studying the short-term dynamics of variables while taking into account the time dimension. It combines the characteristics of autoregressive models and distributed lag models.

The ARDL model combines the characteristics of autoregressive models and distributed lag models. In this framework, we include the lagged dependent variable (X_{t-p}) as well as the past values of the independent variable (X_{t-q}) among the explanatory variables (X_t).

If one wishes to take into account both the short-term and long-term effects of the mentioned explanatory variables, the ARDL representation of function (2) can be written as follows:

$$GDP_t = \alpha_0 + \sum_{i=1}^p \lambda_i GDP_{t-i} + \sum_{j=0}^{q_1} \beta_j FDI_{t-j} + \sum_{j=0}^{q_2} \gamma_j ICT_{t-j} + \sum_{j=0}^{q_3} \delta_j HC_{t-j} + \sum_{j=0}^{q_4} \phi_j INFL_{t-j} + \varepsilon_t \tag{3}$$

ARDL Model with Error Correction Representation

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^p \alpha_1^i \Delta GDP_{t-i} + \sum_{i=0}^{q_1} \alpha_2^i \Delta FDI_{t-i} + \sum_{i=0}^{q_2} \alpha_3^i \Delta ICT_{t-i} + \sum_{i=0}^{q_3} \alpha_4^i \Delta HC_{t-i} + \sum_{i=0}^{q_4} \alpha_5^i \Delta INFL_{t-i} + \phi_1 ECT_{t-1} + \varepsilon_t \tag{4}$$

4. RESULTS AND DISCUSSION

4.1. Preliminary analysis

Before analysing the results, we examine the descriptive statistics of the variables. Table 2 succinctly presents the descriptive statistics of the dependent variable and all independent variables, such as the mean,

median, standard deviation, Jarque-Bera test, and other key statistical parameters.

The examination of the descriptive statistical data reveals that the average value of economic growth is 3,59. Among the explanatory variables, the FDI variable shows the smallest average value (2,013), followed by the control variable inflation (2,641), ICT (41,304), and finally, the most significant value is that of human capital (74,794).

Besides summarising these statistics, Table 2 shows the kurtosis index to check how flat the distribution of the variables is, and the Jarque-Bera test is used to see if the data series follows a normal distribution. Lastly, Table 2 presents the correlation matrix of the variables, highlighting the absence of strong multicollinearity between them, which confirms the validity of their simultaneous inclusion in the ARDL model. The notable negative correlations (HC_ICT, HC_INFL, FDI_INFL) reveal specific structural imbalances in the Moroccan economy, such as the poor match between skills and technologies, and the impact of macroeconomic instability on investment and human capital.

Table 2: Descriptive statistics and correlation coefficients for the studied variables

Variable	GDP	FDI	ICT	HC	INFL
Mean	3.590	2.013	41.304	74.794	2.641
Median	3.470	1.770	41.420	80.603	1.719
Maximum	12.372	6.444	47.231	104.691	7.986
Minimum	-7.178	0.547	30.909	45.089	0.303
Std. Dev.	3.976	1.180	3.805	20.355	2.205
Skewness	-0.504	1.602	-0.635	-0.210	0.991
Kurtosis	4.001	6.857	3.245	1.487	2.638
Jarque-Bera	2.861	35.633	2.377	3.491	5.758
Probability	0.239	0.000	0.304	0.174	0.056
Sum	122.066	68.450	1404.366	2543.010	89.809
Sum Sq. Dev.	521.767	46.025	477.961	13673.75	160.502
Observations	34	34	34	34	34
Correlation matrix					
GDP	1.000				
FDI	0.192	1.000			
ICT	0.059	-0.045	1.000		
HC	-0.053	0.207	-0.506	1.000	
INFL	-0.029	-0.449	-0.176	-0.407	1.000

Source: author's calculation

4.2. Stationarity Analysis

We used the Dickey-Fuller and Phillips-Perron tests to establish the order of integration for the various variables. Table 3 presents the results of this test, which indicate that the GDP and FDI variables are of order 0, while the ICT, HC, and INFL variables are of order 1. Since the orders of integration of the variables are varied, this study proves that our research meets the necessary prerequisites for the application of the ARDL model.

Table 3: Results of the Augmented Dickey-Fuller and Phillips-Perron Stationarity Tests

variable	Augmented Dickey-Fuller		Phillips-Perron		Specification	Order Integration
	In level	In first difference	In level	In first difference		
GDP	-10.773 (0.000) *	---	-10.247 (0.000) *	---	Intercept	I(0)
FDI	-6.049 (0.000) *	---	-6.041 (0.000) *	---	Intercept	I(0)
ICT	1.044 (0.996)	-7.562 (0.000) *	2.046 (0.999)	-6.525 (0.000) *	None	I(1)
HC	- 0.575015 (0.8618)	-3.617 (0.0109)**	-0.190 (0.9301)	-3.445 (0.0165)**	Intercept	I(1)
INFL	-1.014 (0.927)	-8.963 (0.000) *	-1.594 (0.773)	-10.036 (0.000) *	Trend and intercept	I(1)

Note: P values are indicated in parentheses, (*) and (**) signify significance at the 1% and 5% levels, respectively.

Source: author’s calculations.

4.3. Limit test

Given the mixed integration orders of the series, traditional co-integration tests like Engle-Granger and Johansen are unsuitable. Instead, the bounds test by *Pesaran et al. (2001)* offers a more appropriate approach. As shown in Table 4, the F-statistic (71.49) far exceeds the critical values for both lower (I(0)) and upper (I(1)) bounds at the 1%, 5%, and 10% significance levels, confirming a co-integration relationship. This indicates that GDP is linked in the long-term to the model’s explanatory variables.

Table 4: Results of the bound test

F- statistics	71,49	
Level	I(0)	I(1)
10%	2,46	3,46
5%	2,94	4,08
1%	4,09	5,53
Cointegrated		

Note: I (0) indicates the lower limit, while I (1) is the upper limit.

Source: author’s calculation

4.4. Determination of the optimal lag number for the ARDL model

Figure 1 illustrates the results of estimating 20 models, selected based on the Akaike Information Criterion (AIC), to determine the optimal lags. Among these models, the most appropriate for our study turns out to be the ARDL (1, 1, 1, 1, 1) model, indicating that a lag is retained for each of the variables included in the specification.

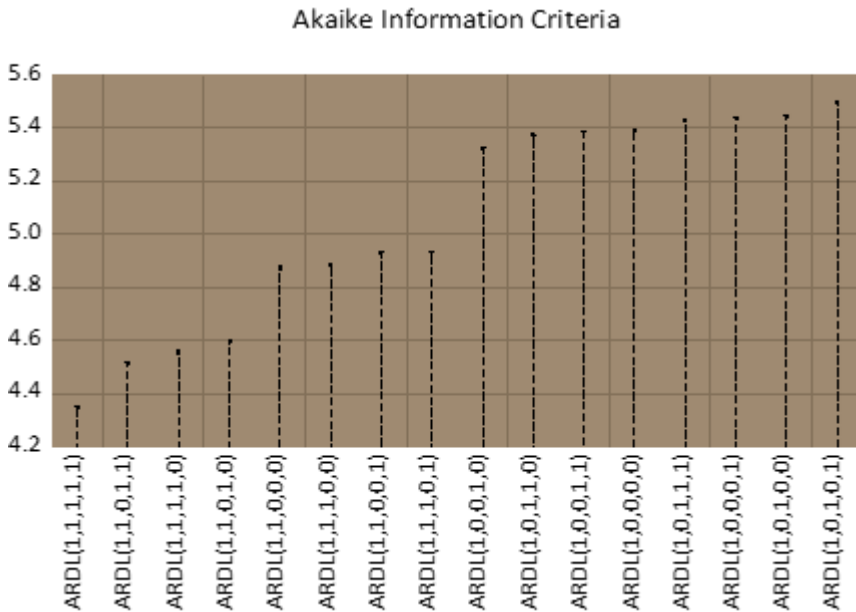


Figure 1: Akaike Information Criterion

Source: author’s calculation

4.5. Short-term and long-term estimation

Table 5 presents the final results of our analysis using the ARDL model.

Table 5: Short-term and long-term effect results

Long-term					short-term				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	1.676	0.286	5.856	0.000*	COINTEQ	-1.763	0.077	-22.851	0.000*
ICT	0.350	0.091	3.837	0.0006*	Δ(FDI)	1.355	0.201	6.730	0.000*
HC	0.026	0.016	1.574	0.126	Δ(ICT)	-0.288	0.090	-3.197	0.003*
INFL	-0.663	0.170	3.895	0.0006*	Δ(HC)	0.365	0.0925	3.944	0.0005*
C	-18.453	5.196	-3.551	0.0014*	Δ(INFL)	-0.427	0.193	2.202	0.036**
					R-squared	0.950		Mean dependent var	-0.0002
					Adjusted R-squared	0.943		S.D. dependent var	7.174
					F-statistic	134.960		Durbin-Watson stat	2.370
					Prob(F-statistic)	0.000000*			

Note: (*) and (**) indicate significance at the 1% and 5% levels, respectively.

Source: author’s calculations

Table 5 presents the estimated coefficients of the short-term and long-term variables.

In the short-term, the results show a positive and significant impact of FDI on economic growth, with a threshold of 1%. Indeed, a 1% increase in FDI flows leads to a 1,355% rise in economic growth. This result highlights the immediate role of FDI in financing digital transformation projects, particularly in infrastructure and high-tech sectors. The magnitude of the coefficient suggests that Morocco has sufficient absorption capacity to benefit from these investments, reflecting an effective mobilisation of foreign resources. The ability of FDI to fill the national investment gap, quickly generate jobs, and stimulate local demand can explain this relationship. Thus, FDI appears as a central lever for short-term economic growth, particularly in the context of the digital transition.

In the long-term, the impact of FDI intensifies: a 1% increase in FDI flows leads to a 1,676% increase in economic growth. This progression highlights cumulative effects related to technology transfers, skill enhancement, and positive externalities on the local productive fabric. It also reflects a successful integration of FDI into the Moroccan economic

ecosystem. These investments contribute to the structural transformation of the national economy by promoting sustainable investments, integrating the country into global value chains, and improving the overall productivity of factors.

The difference observed between the short-term and long-term effects can be explained by the time required for the diffusion of imported technologies and their gradual appropriation by local companies. Thus, FDI is not limited to a conjunctural effect; they play a strategic role in consolidating long-term economic growth. These results are consistent with those in the existing literature, where several studies, such as those by Arbia et al. (2023) and Dabnichi and Ferroud (2024), find that FDI promotes long-term economic growth in Morocco and Abadli et al. (2022), which highlights their crucial role in this dynamic.

On the other hand, the coefficient for ICT is negative (-0.288) and significant at the 5% level in the short-term. This means that an increase of one unit in ICT reduces economic growth by 0.288%. The adaptation costs and organisational disruptions associated with their adoption explain this intriguing result. This phenomenon could reflect the transitional period necessary for companies to master these new technologies. However, in the long-term, the effect becomes positive and significant at the 1% level, with an increase of 0.350% in economic growth for each unit of ICT. This dynamic illustrates the value of persevering in technological investments despite temporary difficulties. Indeed, once the initial obstacles are overcome, ICT becomes an essential driver of innovation, efficiency, and modernisation in economic sectors.

Our short-term results align with those of Arbia et al. (2023), who observe a negative impact of ICT on economic growth in Morocco, and Norehan et al. (2022), who find a similar effect in Malaysia. However, our long-term results align with the conclusions of studies such as those by Morris and Oldroyd (2020), which assert that investment in ICT, primarily when associated with quality human capital, enhances productivity and competitiveness in the long-term.

Sapuan and Roly (2021) also highlight that ICT has a positive effect on economic growth, particularly in the ASEAN-8 countries.

Regarding human capital, its impact shows contrasting effects depending on the time horizon. In the short-term, its effect is positive and significant at the 1% threshold, contributing to an improvement in economic growth of 0,365% for each increase of one unit of human

capital. The result suggests that the improvement of education and skills quickly generates economic gains in Morocco and shows that the country already has a foundation of exploitable skills to support its digital transformation. However, in the long-term, although the effect remains positive with a coefficient of 0,026, it loses significance. This result suggests that current skills are reaching their limits in the face of the growing demands of the digital economy. This trend could be explained by a mismatch between available skills and labour market needs, as well as by a brain drain or inadequate training for productive sectors. This underlines the need to reform education and training systems to meet future labour market challenges.

Our short-term results align with the conclusions of Felipe et al. (2019) and Xu and Li (2020), who state that investment in human capital quickly contributes to improving productivity and competitiveness. In the long-term, however, these gains must be supported by structural reforms in education to meet the challenges of the digital economy, which confirms our long-term results. However, our long-term results diverge from those of Elkhalfi et al. (2023), who emphasize the importance of public spending on human capital particularly in education and health as a driver of long-term growth in Morocco. This divergence may stem from differences in the measurement of human capital: While Elkhalfi et al. use composite indicators reflecting both the quantity and quality of education and health investments, our study employs the primary school completion rate, which captures only the most basic level of education and may underestimate the broader contribution of human capital to sustained growth. Additionally, differences in model specification or the period, time analysed could also explain the contrasting findings.

Our findings resonate with broader African and non-OECD contexts. Habanabakize and Zerihun (2024) highlight ICT particularly mobile and internet use as key growth drivers in South Africa over both the short and long-term. While we similarly observe a positive long-term effect of ICT in Morocco, the short-term impact is negative, likely reflecting early-stage digital adoption and transitional disruptions. Campisi et al. (2013) show that ICT, FDI, and human capital promote structural transformation across 44 countries. Our Morocco-specific analysis supports their long-term growth link but reveals distinct challenges, particularly in aligning human capital with digital demands. Unlike Kathir and Bulut (2024), who find strong long-term returns from education and health, our results show only short-term gains from

human capital, suggesting structural reforms are needed for lasting impact. Overall, Morocco's digital transition is characterised by strong FDI absorption, delayed ICT returns, and a human capital base that requires modernisation to support sustained growth.

Finally, inflation, which is used as a control variable in our study, negatively affects economic growth, both in the short-term and in the long-term, with the impact worsening over time. This gradual worsening reveals the cumulative deleterious effects of price instability on the economic environment. In the short-term, inflation primarily reduces purchasing power and consumption, while in the long-term, it discourages investment and distorts economic decisions, sustainably hindering growth potential. These results demonstrate the value of macroeconomic stability for successfully achieving digital transformation.

Moreover, the short-term results obtained through the estimation of the ARDL model reveal intriguing dynamics between the various explanatory variables and economic growth in Morocco. The coefficient of the adjustment variable (COINTEQ) is negative and highly significant (-1,763; $p < 0,001$), which confirms the existence of a long-term equilibrium relationship between the variables. Its absolute value greater than 1 also indicates a rapid adjustment of the Moroccan economy towards this equilibrium after a cyclical shock. Moreover, our model shows an excellent fit, with an R^2 of 0,950, meaning it explains 95% of the variability in economic growth. The F-statistic (134,96 ; Prob. = 0,000) confirms the overall significance of the model, while the Durbin-Watson test (2,37) indicates the absence of autocorrelation in the residuals.

4.6. Model robustness tests.

The examination of the empirical results presented in Table 6 indicates that the ARDL model is correctly specified and statistically valid within the framework of our study. The Ramsey RESET test does not detect any specification errors, particularly regarding the functional form of the model (Prob = 0.304 > 0.05), which confirms the adequacy of the chosen model.

Furthermore, the results of the Breusch-Godfrey test reveal the absence of autocorrelation in the residuals (Prob = 0.507 > 0.05). Similarly, the Breusch-Pagan-Godfrey (Prob = 0.409 > 0.05) and White (Prob = 0.643 > 0.05) heteroscedasticity tests show no signs of non-constant error variability. Additionally, the Jarque-Bera test indicates that

the residuals are normally distributed (Prob = 0.674 > 0.05), which is crucial for making valid statistical conclusions.

Ultimately, the set of diagnostic tests validates the robustness of the estimated ARDL model. Thus, the obtained results can be considered reliable and interpreted for both the analysis of short-term dynamics and the long-term relationships between the studied variables.

Table 6: Results of the diagnostic tests

Tests	Values (probability)
Autocorrelation of errors: Breusch-Godfrey LM	0.701 (0.507)
Heteroskedasticity: Breusch-Pagan-Godfrey	1.086 (0.409)
Heteroskedasticity: Arch-test	0.218 (0.643)
Normality of residues: Jarque-Bera	0.786 (0.674)
Ramsey Reset	1.106 (0.304)

Note: () indicates the probability associated with each test.

Source: author’s calculation

Additionally, Figures 2 and 3 show that the estimated ARDL models are stable at the 5% significance level because the lines from the CUSUM and CUSUMSQ tests stay within the critical limits. These results indicate the absence of structural instability in the model parameters throughout the studied period.

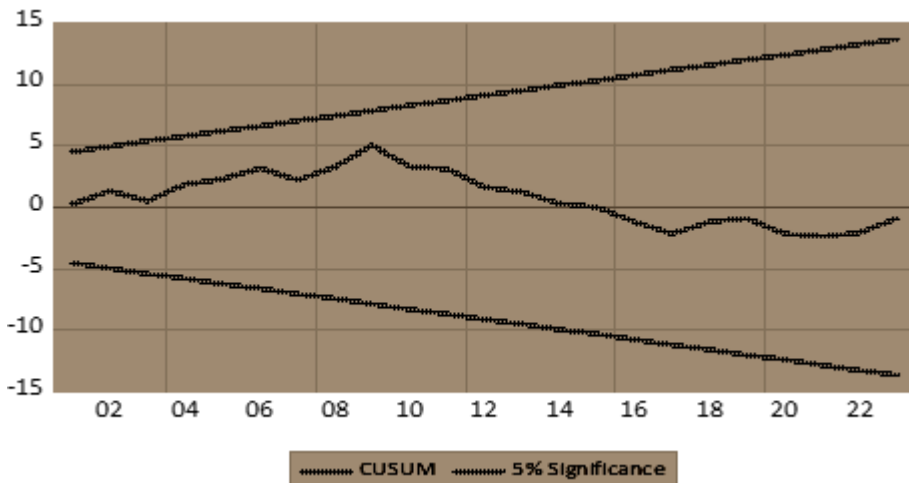


Figure 2: CUSUM long-term analysis stability test

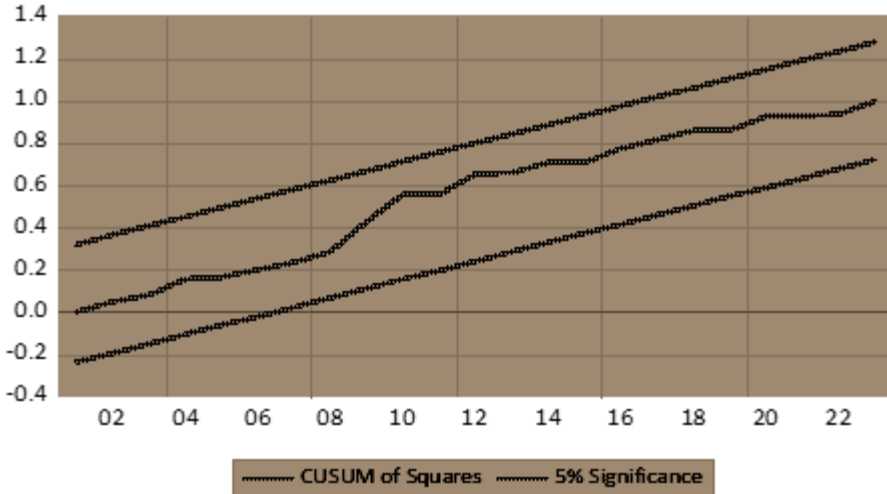


Figure 3: CUSUMSQ long-term analysis stability test
 Source: author's calculation

5. Conclusion

In a context where Morocco is resolutely embarking on the path of digital transformation, this study highlights the differentiated role, in the short and long-term, of FDI, ICT, and human capital in the dynamics of national economic growth between 1990 and 2023. The analysis, conducted using an ARDL model, shows that FDI acts as a strategic lever for growth both in the short and long-term. ICTs, on the other hand, only exert significant positive effects in the long-term, after a phase of institutional and organisational adaptation. Human capital shows a positive effect in the short-term. Still, its impact diminishes in the long-term, suggesting that this level of education remains insufficient to support the structural transformation of the economy sustainably.

These results call for more clearly articulated action around the complementarity between the three levers studied. First, strengthening human capital requires a deep reform of the educational system to move beyond the primary level, promoting scientific and technical disciplines, modernizing vocational training, and ensuring a better match between the skills acquired and the needs of the labour market. Next, to accelerate the adoption of ICT and mitigate the negative effects observed in the short-term, the authorities must strengthen digital infrastructure, improve connectivity in disadvantaged areas, and develop large-scale digital literacy programs. Finally, FDI attraction policies would benefit from

being more targeted, prioritising investments in high-value-added sectors, promoting technology transfers, and integrating local companies into global value chains.

This study, however, has certain limitations. The choice of variables, particularly the use of the primary completion rate as a proxy for human capital, may not fully reflect the qualitative dimensions of the latter, such as the quality of education, advanced levels of training, or the health of the population. This measurement bias could partly explain the weakness of the long-term effect observed for this variable. Moreover, the analysis does not take into account the cross-interaction effects between the explanatory variables, whereas synergies (for example, between FDI and ICT, or between human capital and FDI) may exist and amplify their impact on growth. Moreover, institutional, regulatory, or environmental factors, which play a crucial role in the success of development strategies, have been excluded from the model.

These limitations open interesting perspectives for future work. It would be relevant to extend the analysis by incorporating institutional variables (quality of governance, business climate), technological readiness indices, or even indicators related to sustainable development and the informal economy. The use of more advanced econometric methodologies, particularly threshold or non-linear models, would also allow for a better capture of differentiated effects according to levels of development. Finally, comparative studies at the regional or continental level would enable Morocco to position itself about other developing countries and identify best practices in digital and industrial policies.

Ultimately, this research provides a solid empirical basis to inform Morocco's strategic choices in economic development in the digital age. However, it calls for further analysis to better understand the complexity of the ongoing structural transformations and maximise their operational impact.

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