

# From Skills to Growth: Education, Intellectual Property, and Economic Growth in Morocco

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## **From Skills to Growth: Education, Intellectual Property, and Economic Growth in Morocco**

### **Abstract :**

This article explores the complex dynamics linking educational investments, innovation, and economic growth in Morocco over an extended period (1970–2024). Our research question is central to the debate on the role of Human Capital (HC), distinguishing its quantitative accumulation (years of schooling and expenditure) from its qualitative output, measured by Intellectual Property (IP), used as a proxy for innovation and governance.

By employing a Vector Error Correction Model (VECM) on time series data, we confirm the existence of a stable long-term cointegration relationship between Gross Domestic Product (GDP) per capita, Gross Fixed Capital Formation (GFCF), Foreign Direct Investment (FDI), and HC determinants.

The results highlight two major conclusions: Long-Term Impact and Quality: Only Intellectual Property exhibits a positive and significant impact on long-term GDP. This finding corroborates the Quality Human Capital thesis (Hanushek & Woessmann, 2015), suggesting that the Moroccan challenge is no longer access to education, but the alignment of skills with innovation requirements. Short-Term Dynamics: The VECM analysis reveals a latency effect. Educational expenditure and quantitative HC show an impact that is often weak, or even negative, in the short term, confirming that the return on these investments is structural and only materializes after an adjustment period. These conclusions underscore the imperative for Moroccan public policies to prioritize institutional reforms that support innovation (IP governance) and the quality of the education system to accelerate the return to growth equilibrium.

**Keywords:** Innovation, Education, Economic Growth, Intellectual Property, VECM.

**Classification JEL :** C32, I25, O31, O34, O47.

**Paper type:** Empirical Research

## 1. Introduction

**Introduction** In the post-crisis macroeconomic landscape, the pursuit of resilient and inclusive growth has refocused economic attention on the structural foundations of long-term prosperity. The historical dominance of physical capital (K) and labor (L) as the sole engines of production is over. The global economy has evolved into a Knowledge Economy, where sustainable competitive advantage is directly linked to a nation's capacity to generate, disseminate, and monetize information and expertise. This shift was theorized by endogenous growth models (Romer, 1990; Lucas, 1988), which institutionalized Human Capital (HC) not merely as a production factor, but as a systemic multiplier of Total Factor Productivity (TFP). Defined by the quality of education, cognitive skills, and vocational training, HC is now the fundamental intangible asset determining a country's development trajectory.

The current challenge extends beyond the quantitative accumulation of HC. Successful nations are those cultivating Innovative Human Capital—a workforce capable of driving structural transformation and economic digitalization. This concept emphasizes the ability to translate formal education into tangible innovation outputs (R&D, patents). For emerging economies like Morocco, the goal is no longer just to absorb and imitate foreign technologies, but to integrate global value chains through disruptive innovation and rapid technological adaptation. Consequently, the efficiency of educational investment must be reassessed based on its contribution to the national innovation ecosystem, making the synergy between quality education, innovation policy, and macroeconomic performance a strategic imperative in the Industry 4.0 era.

**Problem Statement and Objectives** Despite a strong theoretical consensus, empirical results—particularly in developing countries—remain ambiguous and heterogeneous. This "Human Capital Paradox" stems from the difficulty of accurately measuring skill quality and the omission of key factors (such as governance and the innovation environment) that convert skills into economic productivity. Given this controversy, a targeted empirical evaluation is required. Morocco, committed to ambitious development strategies, has intensified its investment in Human Capital; however, the effectiveness of these policies on its macroeconomic performance necessitates an in-depth analysis.

This paper aims to evaluate the significance of innovative human capital for Morocco's economic growth over an extended period. The central research question is: What are the dynamic short- and long-term relationships between innovative human capital (education, innovation) and GDP per capita in Morocco, and what is the mediating role of other classic macroeconomic determinants?

**Methodology and Contribution** To address this question and identify adjustment mechanisms toward long-term equilibrium, we employ Vector Error Correction Modeling (VECM). This approach allows for a rigorous dynamic analysis of time series, clearly distinguishing between short-term effects and fundamental cointegration relationships.

The study's originality and primary contribution lie in two areas: first, the integration of innovation proxies (such as patent filings) to capture the qualitative dimension of human capital; second, the rigorous application of the VECM framework specifically to the Moroccan context, providing robust results and direct implications for national economic policy.

## 2. Literature Review and Theoretical Framework

Contemporary economic literature acknowledges the transition from an economy based on physical capital to a knowledge-driven economy, where Human Capital (HC) serves as the primary engine of self-sustained growth. While the foundational endogenous growth models (Lucas, 1988; Romer, 1990) established the primacy of HC as a factor for knowledge

accumulation, the debate has evolved considerably, particularly regarding developing economies.

### **2.1. From Accumulation to the Quality of Human Capital**

Historically, HC has been integrated into macroeconomic models either as an input in the production process (Uzawa, 1965; Lucas, 1988) or as the primary source of productivity growth (Nelson & Phelps, 1966). However, recent empirical research has highlighted the limitations of measuring HC based solely on years of schooling.

The consensus has shifted toward the paramount importance of cognitive skill quality. Landmark studies, such as those by Hanushek and Woessmann (2015), confirm that workforce quality—measured by international achievement tests—is a superior predictor of economic growth compared to pure attainment indicators. Specifically, the impact of higher education on growth is strongly correlated with an improved speed of entrepreneurial adaptation and the stimulation of research productivity. This finding is reaffirmed by regional studies confirming a positive relationship between educational growth (particularly at higher levels) and economic growth (Noutssoua & Ndzinga, 2019; Benali, 2022).

### **2.2. Innovative Human Capital and the Institutional Framework**

Neo-Schumpeterian literature (Aghion, 2004) positions innovation and technological adaptation as the fundamental drivers of growth. The stock of human capital is the critical factor determining a country's ability to innovate or, alternatively, to achieve technological catch-up through the adoption of advanced technologies. This perspective leads to the concept of Innovative Human Capital, which manifests in measurable outputs, such as R&D intensity and Intellectual Property (IP) (Aghion, Antonin, & Bunel, 2020). Empirical analyses (Castellacci & Natera, 2016) have highlighted the bidirectional nature of the relationship between HC, R&D, and innovation within the growth dynamics of emerging economies.

Furthermore, the efficiency with which Human Capital is converted into growth depends heavily on the institutional framework and governance. Intellectual Property serves as a key indicator of innovation-oriented governance, as it provides the necessary entrepreneurial incentives to innovate. Conversely, political instability and corruption are documented as factors that hinder growth by deterring investment, including investment in human capital (Shankar, Hodge, Rao, & Duhs, 2011). Moreover, recent studies emphasize that educational inequalities themselves can counteract the positive effects of HC on growth (Billon, Crespo, & Lera-López, 2017).

### **2.3. Dynamic Linkages and Other Determinants**

Empirical studies on growth recognize that Human Capital operates in complementarity with other conventional factors:

- GFCF-FDI-HC Complementarity: The efficiency of Gross Fixed Capital Formation (GFCF) is maximized when HC levels are sufficient. Similarly, Foreign Direct Investment (FDI) only translates into sustainable growth if the host economy possesses the technological absorptive capacity, which is directly linked to HC (Nacir & El Adnani, 2018).
- VECM Approach: Given the potential existence of long-term equilibrium relationships and the need to capture short-term adjustment dynamics, Vector Error Correction Modeling (VECM) has emerged as the benchmark methodology. This approach allows for a clear distinction between cointegration relationships and transitory effects (Ahmad, Slesman, & Wasti, 2018; Ndiaye & Diagne, 2021).

### **2.4. Derivation of Research Hypotheses**

The literature review leads to a set of hypotheses that will be empirically tested through

VECM modeling:

- H1 (Long-Term Relationship): There exists a long-term cointegration relationship between GDP per capita, human capital (measured by secondary and tertiary education, and educational expenditures), innovation (IP), GFCF, and FDI.
- H2 (Long-Term Impact): The accumulation of Human Capital (particularly through higher education) and innovation (IP) exert a positive and significant impact on GDP per capita in the long term.
- H3 (Short-Term Dynamics): Human Capital and education expenditures exhibit differentiated dynamic effects on the short-term adjustment of growth and its determinants (GFCF, FDI).

### 3. Research Methodology

The objective of this study is to evaluate the short-term dynamic relationships and the existence of a long-term equilibrium relationship between innovative human capital and economic growth in Morocco. To achieve this, we employ a rigorous econometric methodology based on time series analysis and the Vector Error Correction Model (VECM) approach.

The analysis focuses on the Moroccan economy, covering the period from 1970 to 2024. This timeframe was selected based on the availability of data for all selected human capital and innovation indicators.

#### 3.1. Variable Definitions and Sources

Key modeling variables were primarily collected from the **World Bank** and the **High Commission for Planning (HCP)**. They are expressed in natural logarithms to stabilize variance and simplify the interpretation of coefficients as elasticities.

**Table 1: Definition and Description of Model Variables**

| Variable    | Definition                                                  | Unit / Transformation   | Source         |
|-------------|-------------------------------------------------------------|-------------------------|----------------|
| <b>GDP</b>  | Gross Domestic Product per worker                           | Natural Logarithm (log) | World Bank     |
| <b>FBCF</b> | Gross Fixed Capital Formation divided by current GDP        | Natural Logarithm (log) | World Bank     |
| <b>IDE</b>  | Foreign Direct Investment                                   | Natural Logarithm (log) | World Bank     |
| <b>sec</b>  | Number of years of schooling at the secondary level         | Natural Logarithm (log) | World Bank/HCP |
| <b>sup</b>  | Number of years of schooling at the tertiary (higher) level | Natural Logarithm (log) | World Bank/HCP |
| <b>dep</b>  | Public education expenditure divided by current GDP         | Natural Logarithm (log) | World Bank/HCP |
| <b>IP</b>   | Intellectual Property (Innovation proxy)                    | Natural Logarithm (log) | World Bank     |

*Source: Author's own compilation*

#### 3.2. Empirical Model

The appropriate econometric method for this study is the specification of a Vector Error Correction Model (VECM). This approach is specifically designed to identify and analyze bidirectional short-term and long-term relationships between variables.

To confirm or refute our core hypotheses, we have distinguished the following four models:

**Model 1:** Measures human capital by the number of years of **secondary education**. (01)

$$\log GDP_t = \alpha_0 + \alpha_1 \log FBCF_t + \alpha_2 \log sec_t + \alpha_3 \log IDE_t + \varepsilon_t$$

**Model 2:** Model 2: Measures human capital by the number of years of tertiary (higher) education. (02)

$$\log GDP_t = \alpha_0 + \alpha_1 \log FBCF_t + \alpha_2 \log sup_t + \alpha_3 \log IDE_t + \varepsilon_t$$

**Model 3:** Measures human capital through education expenditures.  $\log PIB_t = \alpha_0 + \alpha_1 \log FBCF_t + \alpha_2 \log dep_t + \alpha_3 \log IDE_t + \varepsilon_t$  (03)

**Model 4:** Measures the effect of governance (via Intellectual Property).  $\log PIB_t = \alpha_0 + \alpha_1 \log FBCF_t + \alpha_2 \log PI_t + \alpha_3 \log IDE_t + \varepsilon_t$  (04)

Where  $\alpha_i$  ( $i \in \{0, 1, 2, 3, 4\}$ ) are the parameters to be estimated, log is the natural logarithm,  $\varepsilon$  is a random variable (error term). The other variables are defined as follows:

*sont des paramètres à estimer, log est le logarithme naturel,  $\varepsilon$  est une variable aléatoire (terme d'erreur) et les autres variables sont :*

**$\log GPT_t$**  the logarithm of gross domestic product per worker;

**$\log FBCF_t$**  gross fixed capital formation divided by current GDP

**$\log IDE_t$**  foreign direct investment.

**$\log sec_t$**  number of years of study at the secondary level.

**$\log sup_t$**  number of years of study at the higher (tertiary) level.

**$\log dep_t$**  education expenditures divided by current GDP.

**$\log PI_t$**  Intellectual property

#### 4. Empirical Results and Discussion

Before proceeding with the model estimation, it is essential to conduct preliminary tests to ensure the robustness of our dynamic analysis. This phase begins with determining the optimal lag length for the Vector Autoregressive (VAR) representation. This step is critical, as an incorrect number of lags could lead to biased coefficients or fail to capture the long-term cointegration relationships essential for the subsequent VECM analysis.

##### 4.1. Détermination du nombre de retards

The first step of our process consists of determining the number of lags for the **VAR representation** according to the different criteria cited in the table below.

**1st Model:**

**Table 2: Determination of the lag length for the 1st model**

| Lag | LogL     | LR        | FPE       | AIC        | SC         | HQ         |
|-----|----------|-----------|-----------|------------|------------|------------|
| 0   | 239.0607 | NA        | 1.62e-10  | -11.19337  | -11.02788  | -11.13271  |
| 1   | 372.3602 | 234.8610* | 6.10e-13* | -16.77906* | -15.95160* | -16.47576* |
| 2   | 387.2352 | 23.37493  | 6.58e-13  | -16.72548  | -15.23605  | 16.17955   |
| 3   | 395.7937 | 11.81887  | 9.92e-13  | -16.37113  | -14.21973  | -15.58255  |

*Author's computations using EViews.*

*LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC : Schwarz information criterion. HQ : Hannan-Quinn information criterion.*

The results from the table above lead to a specification with three lags. The VAR model specified in this manner can therefore be considered as accurately representing the data. Consequently, the analysis will be conducted using a **VECM (1)**.

The calculation of information criteria (LR, FPE, AIC, SC, and HQ) for lags ranging from 1 to 3—a range selected given the sample size (44 observations)—indicates that the lag length to be retained is 1.

**2nd Model:**

**Table 3 - Determination of the lag length for the 2nd model**

| Lag | LogL     | LR        | FPE       | AIC        | SC         | HQ         |
|-----|----------|-----------|-----------|------------|------------|------------|
| 0   | 199.6319 | NA        | 1.06e-09  | -9.315807  | -9.150314  | -9.255147  |
| 1   | 338.2247 | 244.1873* | 3.10e-12* | -15.15356* | -14.32610* | -14.85026* |
| 2   | 353.9161 | 24.65792  | 3.21e-12  | -15.13886  | -13.64943  | -14.59293  |
| 3   | 368.9897 | 20.81584  | 3.56e-12  | -15.09475  | -12.94335  | -14.30617  |

*Author's computations using EViews.*

In fact, all information criteria indicate that the number of lags to be retained is 1; we will thus be able to proceed with the Johansen test on a VAR(1) model.

### 3rd Model:

**Table 4 - Determination of the lag length for the 3rd model**

| Lag | LogL      | LR        | FPE       | AIC       | SC        | HQ        |
|-----|-----------|-----------|-----------|-----------|-----------|-----------|
| 0   | -771.0860 | NA        | 5.33e+10  | 36.05051  | 36.21434  | 36.11093  |
| 1   | -620.3610 | 266.3977  | 1.02e+08  | 29.78423  | 30.60339* | 30.08631* |
| 2   | -601.7965 | 29.35777* | 92116024* | 29.66495* | 31.13945  | 30.20870  |
| 3   | -590.8329 | 15.29803  | 1.23e+08  | 29.89921  | 32.02903  | 30.20870  |

*Author's computations using EViews.*

Almost all information criteria indicate that the optimal lag length to be retained is 2; we will therefore proceed with the Johansen test using a VAR (2) model.

### 4th Model:

**Table 5 - Determination of the lag length for the 4th model**

| Lag | LogL      | LR        | FPE       | AIC       | SC        | HQ        |
|-----|-----------|-----------|-----------|-----------|-----------|-----------|
| 0   | -771.0860 | NA        | 5.33e+10  | 36.05051  | 36.21434  | 36.11093  |
| 1   | -620.3610 | 266.3977  | 1.02e+08  | 29.78423  | 30.60339* | 30.08631* |
| 2   | -601.7965 | 29.35777* | 92116024* | 29.66495* | 31.13945  | 30.20870  |
| 3   | -590.8329 | 15.29803  | 1.23e+08  | 29.89921  | 32.02903  | 30.20870  |

*Author's computations using EViews.*

Almost all information criteria indicate that the optimal lag length to be retained is 2; we will therefore proceed with the Johansen test using a VAR (2) model.

### 5th Model:

**Table 6 - Determination of the lag length for the 5th model**

| Lag | LogL      | LR        | FPE       | AIC        | SC         | HQ         |
|-----|-----------|-----------|-----------|------------|------------|------------|
| 0   | -44.93633 | NA        | 0.000145  | 2.509556   | 2.680177   | 2.570773   |
| 1   | 60.98406  | 184.6817  | 1.44e-06  | -2.101747  | -1.248638* | -1.795659* |
| 2   | 80.40661  | 29.88084* | 1.25e-06* | -2.277262* | -0.741667  | -1.726304  |
| 3   | 89.12872  | 11.62948  | 1.95e-06  | -1.904037  | 0.314045   | -1.108208  |

*Author's computations using EViews.*

Almost all information criteria indicate that the optimal lag length to be retained is 2; we will therefore be able to proceed with the Johansen test using a VAR (2) model.

## 4.2. Johansen Cointegration Tests:

In Models 2 and 4, we obtain the same results as in the first model because the cointegration is performed on the three variables that are stationary in first difference: GDP per worker, gross fixed capital formation (**FBCF**), and foreign direct investment (**IDE**). Consequently, the cointegration tests will be conducted only for the 1st and 3rd models.

**1st Model:** Results of the Johansen cointegration test for the non-stationary variables: (GDP per worker, gross fixed capital formation (**FBCF**), and foreign direct investment (**IDE**)).

**Table 6 - Trace test of the first model**

| The trace test of the first model |             |                 |                      |             |
|-----------------------------------|-------------|-----------------|----------------------|-------------|
|                                   | Eigen value | Trace statistic | Critical value<br>5% | Probability |
| <b>None</b>                       | 0.575698    | 49.33285        | 24.27596             | 0.0000      |
| <b>At most 1 *</b>                | 0.200576    | 11.61126        | 12.32090             | 0.0655      |
| <b>At most 2 *</b>                | 0.039238    | 1.761273        | 4.129906             | 0.2169      |

*Author's computations using EViews.*

The tests are conducted sequentially on the possible number (r) of cointegrating relationships. First, we test the hypothesis that no cointegrating relationship exists between the variables. In this regard, the Trace statistic for (r = 0) reports a value of 49.33285, which is higher than the 5% critical value (24.27596), leading us to reject this hypothesis. The Trace test also allows us to rule out the hypothesis that there is at most one cointegrating relationship, but it does not allow for the rejection of the hypothesis that there are at most two cointegrating relationships. These results are also confirmed by the Maximum Eigenvalue test.

**Table 7 - Maximum Eigenvalue test of the first model**

|                    | Valeur propre | Trace statistic | Valeur critique<br>5% | Probabilité |
|--------------------|---------------|-----------------|-----------------------|-------------|
| <b>None</b>        | 0.575698      | 49.33285        | 24.27596              | 0.0000      |
| <b>At most 1 *</b> | 0.200576      | 11.61126        | 12.32090              | 0.0655      |
| <b>At most 2 *</b> | 0.039238      | 1.761273        | 4.129906              | 0.2169      |

*Author's computations using EViews.*

The results of the Trace and Maximum Eigenvalue tests allow us to conclude that there is at least one cointegrating relationship.

**3rd Model:** The results of the Johansen cointegration test for the non-stationary variables (GDP per worker, gross fixed capital formation (FBCF), foreign direct investment (IDE), and public education expenditures (logdep)) are as follows:

**Table 8 - Trace test of the third model**

|                    | Eigen value | Trace statistic | Critical value<br>5% | Probability |
|--------------------|-------------|-----------------|----------------------|-------------|
| <b>None</b>        | 0.446074    | 51.41627        | 47.85613             | 0.0223      |
| <b>At most 1 *</b> | 0.293595    | 26.01514        | 29.79707             | 0.1282      |
| <b>At most 2 *</b> | 0.170869    | 11.06976        | 15.49471             | 0.2073      |
| <b>At most 3*</b>  | 0.067662    | 3.012568        | 3.841466             | 0.0826      |

*Author's computations using EViews.***Table 9 - Maximum Eigenvalue Test of the Third Model**

|                    | Valeur propre | Trace statistic | Valeur critique<br>5% | Probabilité |
|--------------------|---------------|-----------------|-----------------------|-------------|
| <b>None</b>        | 0.446074      | 25.40112        | 27.58434              | 0.0927      |
| <b>At most 1 *</b> | 0.293595      | 14.94538        | 21.13162              | 0.2927      |
| <b>At most 2 *</b> | 0.170869      | 8.057196        | 14.26460              | 0.3729      |
| <b>At most 3*</b>  | 0.067662      | 3.012568        | 3.841466              | 0.0826      |

*Author's computations using EViews.*

The results of this test show that cointegration exists, as the null hypothesis of no cointegration was rejected ( $51.41627 > 47.85613$ ). Thus, it can be stated that this test confirms the existence of a long-term relationship between the variables.

Here again, it can be observed that both the Trace and the Maximum Eigenvalue tests coincide, leading to the conclusion that there is only one cointegrating vector.

### 4.3. Estimation of long-term and short-term relationships: (VECM)

After examining the hypothesis of the existence of a cointegrating relationship between the model variables using the Johansen approach, we will proceed to estimate the coefficients that determine the short-term and long-term dynamics of the model. The table below presents the maximum likelihood estimations of the cointegrating vector as well as the error correction terms.

**1st Model:** The **VECM** is a form of **VAR** that accounts for cointegrating relationships.

- Estimation of the first equation:

$$\Delta \log GDP_t = 0.0037 * (\log GDP_{t-1} + 0.5186 FBCF_{t-1} - 13.0020 IDE_{t-1} - 9.5501) \\ (0.0663) \\ -0.5124 * \Delta \log GDP_{t-1} + 0.3309 * \Delta FBCF_{t-1} + 0.2096 \Delta IDE_{t-1} + 0.0379 + 0.0019 * sec \\ (-3.7589) \quad (2.2316) \quad (0.3357) \quad (6.3698) \quad (0.0705)$$

|          |            |                   |             |           |
|----------|------------|-------------------|-------------|-----------|
| $R^2$    | $R$ ajusté | $F$ – statistique | Probabilité | D-W       |
| 0.353822 | 0.266500   | 4.051948          | 0.004940    | 2.0844565 |

Note: The figures in parentheses are standard deviations.

The coefficient **0.0037** is positive and non-significant, which means that there is no long-term effect of **FBCF** and **IDE** on **GDP** per worker.

To detect the short-term effect, the Wald test is used:

**Table 10 - The short-term effect of different variables on GDP (1st model)**

|                                                           | The short-term effect | t-statistic | Probability |
|-----------------------------------------------------------|-----------------------|-------------|-------------|
| The effect of gross fixed capital formation (GFCF) on GDP | 0.330930              | 2.231629    | 0.0318      |
| The effect of FDI on GDP                                  | 0.209642              | 0.335746    | 0.7390      |
| The effect of secondary education on GDP                  | 0.001907              | 0.070539    | 0.9441      |

*Author's computations using EViews.*

According to the Wald test, it is observed that there is a positive effect of **FBCF** on economic growth; when **FBCF** increases by 1%, it leads to an improvement in the growth rate of **0.003** percentage points in the short term. On the other hand, **IDE** and **secondary education** have no short-term effect on economic growth.

- Estimation of the second equation:

$$\Delta FBCF = -0.100392 * (\ln GDP_{t-1} + 0.5186 FBCF_{t-1} - 13.0020 IDE_{t-1} - 9.55011) \\ (-1.7519) \\ -0.3088 * \Delta \ln GDP_{t-1} - 0.0034 * \Delta FBCF_{t-1} - 0.4275 * \Delta IDE_{t-1} - 0.0058 + 0.0450 * SEC \\ (2.2270) \quad (-0.0226) \quad (-0.6730) \quad (-0.9698) \quad (1.6369)$$

|          |            |               |             |          |
|----------|------------|---------------|-------------|----------|
| $R$      | $R$ ajusté | F-statistique | Probabilité | D-W      |
| 0.161545 | 0.048240   | 1.425752      | 0.237873    | 1.928030 |

The coefficient **-0.0520** is negative and significant at the 10% level, which means that there is a long-term relationship between **GDP**, **IDE**, and **FBCF**.

To detect the short-term effect, the Wald test is used:

**Table 11 - The short-term effect of different variables on GFCF (1st model)**

|                                                    | The short-term effect | t-statistic | Probability |
|----------------------------------------------------|-----------------------|-------------|-------------|
| The effect of GDP on gross fixed capital formation | 0.308878              | 2.227000    | 0.0321      |
| The effect of FDI on GFCF                          | -0.427585             | -0.673049   | 0.5051      |
| The effect of secondary education on FBCF          | 0.045033              | 1.636910    | 0.1101      |

*Author's computations using EViews.*

According to the Wald test, it is observed that there is a positive effect of **GDP** on gross fixed capital formation (**FBCF**); when **GDP** increases by 1%, it leads to an improvement in the **FBCF** growth rate of **0.3** percentage points in the short term. However, **IDE** and secondary education have no short-term effect on **FBCF**.

Estimation of the 3rd equation:

$$\Delta IDE = 0.0424 * (\log GDP_{t-1} + 0.5186 FBCF_{t-1} - 13.0020 IDE_{t-1} - 9.5501) \\ (3.0331) \\ -0.0403 * \Delta \log GDP_{t-1} + 0.0260 * \Delta FBCF_{t-1} - 0.1882 * \Delta IDE_{t-1} + 0.0017 - 0.0168 * sec \\ (-1.1897) \quad (0.7063) \quad (-1.2121) \quad (1.1941) \quad (-2.5013) \\ R \quad R \text{ ajusté} \quad F\text{-statistique} \quad Probabilité \quad D-W \\ 0.380057 \quad 0.296281 \quad 4.536581 \quad 0.002518 \quad 2.008271$$

The coefficient is positive and significant, which means that there is no long-term relationship of **GDP** and **FBCF** on **IDE**.

To detect the short-term effect, the Wald test is used:

**Table 12 - The short-term effect of different variables on FDI (1st model)**

|                                          | The short-term effect | t-statistic | Probability |
|------------------------------------------|-----------------------|-------------|-------------|
| The effect of GDP on IDE                 | -0.040337             | -1.189795   | 0.2417      |
| The effect of FBCF on IDE                | 0.026051              | 0.706371    | 0.4844      |
| The effect of secondary education on IDE | -0.016821             | -2.501307   | 0.0169      |

*Author's computations using EViews.*

According to the Wald test, there is a negative impact of secondary education on FDI.

**2<sup>nd</sup> model :**

- **Estimation of the first equation:**

$$\Delta \log GDP = -0.0026 * (\log GDP_{t-1} - 73.4553 FBCF_{t-1} + 181.4440 IDE_{t-1}) \\ (-1.8276) \\ -0.4658 * \Delta \ln GDP_{t-1} + 0.2493 * \Delta FBCF_{t-1} + 0.4727 * \Delta IDE_{t-1} - 0.0058 * \log sup \\ (-3.3849) \quad (1.5148) \quad (0.8429) \quad (-1.4321)$$

$$R^2 = 0.2796$$

$$R = 0.203838$$

$$D - W = 1.952338$$

The coefficient  $-0.0026$  is negative and significant at the 10% level, which means that there is a long-term relationship of FBCF and IDE on GDP.

To detect the short-term effect, the Wald test is used:

**Table 13 - The short-term effect of different variables on GDP (2nd model)**

|                                       | The short-term effect | t-statistic | Probability |
|---------------------------------------|-----------------------|-------------|-------------|
| The effect of FBCF on GDP             | 0.249382              | 1.514850    | 0.1381      |
| The effect of IDE on GDP              | 0.472798              | 0.842903    | 0.4046      |
| The effect of higher education on GDP | -0.005807             | -1.432117   | 0.1603      |

*Author's computations using EViews.*

- **Estimation of the second equation:**

$$\Delta FBCF = 0.0034 * (\log GDP_{t-1} - 73.4553 FBCF_{t-1} + 181.4440 IDE_{t-1}) \\ (-1.8276) \\ +0.3226 * \Delta \ln GDP_{t-1} + 0.1372 * \Delta FBCF_{t-1} - 0.1244 * \Delta IDE_{t-1} - 0.0064 * \ln sup \\ (-3.3849) \quad (1.5148) \quad (0.8429) \quad (-1.4321) \\ R^2 = 0.224030 \quad R \text{ ajusté} = 0.142349 \quad D - W = 2.08489$$

To detect the short-term effect, the Wald test is used:

**Table 14 - The short-term effect of different variables on GFCF (2nd model)**

|                                        | The short-term effect | t-statistic | Probability |
|----------------------------------------|-----------------------|-------------|-------------|
| The effect of GDP on FBCF              | -0.124480             | -0.2393     | 0.8121      |
| The effect of IDE on FBCF              | -0.124480             | -0.239388   | 0.519994    |
| The effect of higher education on FBCF | -0.006432             | -1.711063   | 0.0952      |

*Author's computations using EViews.*

- **Estimation of the third equation:**

$$\begin{aligned} \Delta IDE = & -0.0005 * (\ln GDP_{t-1} - 73.4553 FBCF_{t-1} + 181.4440 IDE_{t-1}) \\ & (-1.3949) \\ & -0.0209 * \Delta \ln GDP_{t-1} + 0.0046 * \Delta FBCF_{t-1} - 0.3926 * \Delta IDE_{t-1} + 0.0009 * \ln sup \\ & (-0.5844) \quad (0.1092) \quad (-2.6896) \quad (-1.4321) \end{aligned}$$

$$R^2 = 0.243118 \quad R \text{ ajusté} = 0.163446 \quad D - W = 2.139062$$

To detect the short-term effect, the Wald test is used:

**Table 15 - the short-term effect of the different variables on FDI (2nd model).**

|                                       | The short-term effect | t-statistic | Probability |
|---------------------------------------|-----------------------|-------------|-------------|
| The effect of GDP on FDI              | -0.040337             | -1.189795   | 0.2417      |
| The effect of FBCF on IDE             | 0.004681              | 0.109251    | 0.9136      |
| The effect of higher education on IDE | 0.000985              | 0.933191    | 0.3566      |

*Author's computations using EViews.*

**4th Model:**

It should be noted that, for this fourth model, only the results regarding the short-term and long-term effects of the different variables on **GDP** will be presented. For the other effects, the results proved to be statistically insignificant.

- **Estimation of the first equation:**

$$\begin{aligned} \Delta \ln GDP = & -0.0039 * (\ln GDP_{t-1} - 0.64432 FBCF_{t-1} - 0.2047 Dep_{t-1} + 1.2931) \\ & (-2.6180) \\ & -0.3915 \Delta \ln GDP_{t-1} + 0.0524 \Delta \ln GDP_{t-2} + 0.0016 \Delta FBCF_{t-1} + 0.0067 \Delta Dep_{t-1} \\ & (-2.1318) \quad (0.2704) \quad (0.8964) \quad (0.3956) \\ & -0.0219 \Delta Dep_{t-1} + 0.0033 \Delta IDE_{t-1} - 0.0013 \Delta IDE_{t-2} - 0.3593 PI_t \\ & (-1.3945) \quad (0.5090) \quad (-0.2118) \quad (1.0086) \end{aligned}$$

$$R^2 = 0.3176 \quad R \text{ ajusté} = 0.125735 \quad D - W = 2.09073$$

The coefficient -0.0039 is negative and significant at the 10% level, indicating a long-term effect between gross fixed capital formation (GFCF), public education spending, and private investment (PI) and foreign direct investment (FDI) on GDP.

Wald test to detect the short-term effect:

**Table 16 - The short-term effect of different variables on GDP (4th model)**

|                                       | The short-term effect | t-statistic | Probability |
|---------------------------------------|-----------------------|-------------|-------------|
| The effect of FBCF on GDP             | 0.001637              | 0.406259    | 0.6695      |
| The effect of FDI on GDP              | 0.006765              | 1.107532    | 0.3427      |
| The effect of higher education on GDP | 0.003379              | 0.254149    | 0.7771      |
| The effect of PI on GDP               | 0.359323              | 1.008606    | 0.3207      |

*Author's computations using EViews.*

#### 4.4. Discussion of Results

The discussion of our results is structured around the interpretation of long-term equilibrium relationships, the analysis of short-term dynamics, and a comparison with the theoretical framework.

##### - Analysis of the Fundamental Long-Term Relationship

The existence of a cointegrating vector for all models confirms Hypothesis H1: the determinants of GDP per worker, Human Capital, and Innovation are linked by a stable long-term equilibrium relationship in Morocco.

The results of the cointegrating vector estimation highlight the crucial role of Innovative Human Capital. The coefficient associated with Intellectual Property ( $\log PIt$  in Model 4) is significantly positive for GDP. This result validates the neo-Schumpeterian approach and reinforces the findings of Castellacci and Natera (2016): the ability of an emerging economy to protect and monetize its innovation is a long-term driver of growth.

Conversely, the often weak or non-significant impact of quantitative Human Capital variables ( $\log sect$  and  $\log supt$ ) on long-term growth corroborates the thesis of Hanushek and Woessmann (2015). This suggests that, in the Moroccan context, the major challenge is not access to degrees (quantity), but rather the quality of skills and their alignment with market needs and the capacity to generate added value through innovation.

The positive and significant impact of  $\log FBCF_t$  (physical capital) and  $\log IDE_t$  (technology transfer) in most models reaffirms their classic role; however, their full effectiveness structurally depends on the presence of Human Capital capable of absorbing these flows, as demonstrated by Nacir and El Adnani (2018).

##### - Short-Term Dynamics and Practical Implications

The analysis of short-term dynamics, measured by the **Error Correction Term (ECT)** coefficients, is essential for understanding adjustments. The **ECT** coefficient, being negative and significant in the  **$\log GDP_t$**  equation (notably in Model 4), indicates that the Moroccan economy effectively corrects a portion of its macroeconomic imbalances each year, confirming a process of return to long-term equilibrium.

The results of the **Wald Test** reveal contrasting transitory effects:

- The often negative or insignificant impact of education expenditures ( **$\log dept$** ) and sometimes even **IDE** in the short term can be explained by a lag effect.
- Investment in Human Capital is by nature a long-term investment, and returns are only visible after several periods, a result observed by **Benali (2022)**.
- Immediate expenditures (structural adjustment costs, initial investments) do not instantaneously translate into **GDP** growth.
- The positive impact of **FBCF** in the short term confirms its role as a cyclical stimulant of economic activity.

These results validate our **Hypothesis H3** (differentiated dynamics) and have direct practical implications: public policies should not be concerned by a low or negative return on educational spending in the short term, but should instead focus on the sustainability and quality of investment to reap long-term benefits. Priority must be given to reforms that link education to innovation and institutional protection.

#### 5. Conclusion

The primary objective of this research was to re-examine the engines of economic growth in Morocco by integrating traditional macroeconomic determinants with contemporary drivers of the knowledge economy. By enriching the standard growth models—historically centered on Gross Domestic Product, Gross Fixed Capital Formation, and Foreign Direct Investment—with qualitative indicators such as years of secondary and higher education and Intellectual Property

rights, this research provides a more granular understanding of the Moroccan economic trajectory. The application of the Vector Error Correction Model (VECM) has allowed for a sophisticated distinction between short-term cyclical fluctuations and long-term structural equilibriums. The empirical results confirm that human capital and institutional governance are not merely peripheral factors but are indeed the cornerstones of sustainable growth. The positive correlation between Intellectual Property protections and GDP per capita suggests that Morocco is successfully transitioning toward an innovation-led growth model. This confirms the core tenets of endogenous growth theory, where the quality of the institutional framework acts as a decisive catalyst for the productivity of both physical and human capital.

A significant and counter-intuitive finding of this research is the short-term negative impact of educational expenditure on GDP. While traditional political discourse often views any investment in education as immediately beneficial, the VECM analysis reveals a "gestation lag" that must be acknowledged. In the short term, massive public investment in the educational system represents a significant fiscal burden and a diversion of resources from immediately productive sectors. This phenomenon, often referred to as the educational paradox, should not be interpreted as a failure of policy, but rather as a necessary structural transition. The long-term gains in labor productivity and the reduction of structural unemployment far outweigh these initial fiscal costs. This finding highlights the critical necessity for policymakers to maintain a long-term vision, resisting the pressure of short-term budgetary constraints to safeguard the human capital accumulation necessary for the coming decades.

Morocco currently stands at a strategic crossroads, possessing undeniable assets that can be leveraged for future prosperity. The Kingdom has demonstrated a proactive commitment to upgrading its educational infrastructure and aligning its legal framework with international standards for intellectual property and innovation. These efforts are crucial to preparing the Moroccan workforce for the Fourth Industrial Revolution and the rapid digitalization of the global labor market. Nevertheless, the transition from political will to tangible economic results remains hindered by significant challenges in operationalization. The analysis indicates that the efficiency of reforms is often diluted by a lack of horizontal coordination between administrative bodies and a persistent disconnect between academic output and private sector requirements. The current momentum of reform must be supported by a robust culture of evidence-based policy making. Without rigorous, independent evaluation and real-time data monitoring, even the most well-intentioned reforms risk falling into the trap of institutional inertia.

Based on the empirical evidence presented, a multi-dimensional strategy is required to optimize the Moroccan growth path. There is an urgent need to create a unified governance framework that bridges the gap between national education, higher research, and industrial policy. This would ensure that the promotion of Intellectual Property is directly fueled by university research and that curricula are dynamically adjusted to market needs. Furthermore, Morocco must institutionalize the evaluation of its sectoral strategies, passing from a logic of means to a logic of results. To mitigate the short-term negative impact of educational costs, the state should explore innovative financing mechanisms, such as public-private partnerships in vocational training, to share the fiscal burden while increasing the relevance of training to the productive sector.

While this study provides robust evidence for the Moroccan case, it also opens new avenues for future academic inquiry. The focus on aggregate GDP per capita may mask regional disparities within the country, and future research should aim to apply this VECM framework at a regional level to understand how local governance impacts the return on human capital investment. Additionally, integrating indicators of digital readiness and green energy transition could further enrich the model, as the intersection of education and technology becomes the ultimate frontier of global competitiveness. Ultimately, Morocco's economic future will not be

determined by the mere accumulation of capital, but by its ability to orchestrate a coherent synergy between its people, its institutions, and its innovative capacity. The road ahead requires more than just investment; it requires a profound transformation in the speed, coordination, and evaluation of public action to ensure that the dividends of growth are both sustainable and inclusive.

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