

## Analysis of Foreign Direct Investment (FDI) inflows to Algeria for the Period (1970-2022): Wavelet Transforms Analysis Application

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### **Abstract:**

This study analyzes foreign direct investment (FDI) inflows to Algeria for the period from 1970 to 2022, using wavelet Transforms analysis Application. Through this study, it became evident that foreign direct investment (FDI) did not experience a period of boom and prosperity in Algeria throughout the entire study period. On the contrary, the inflows were highly volatile and tended to decrease, reaching the point of being non-existent at times or even leading to the departure of investments from Algeria. At best, the inflows were very modest, not exceeding the threshold of three billion US dollars. The wavelet Transforms analysis provided a detailed examination of this in the study.

**Keywords:** foreign direct investment (FDI), wavelet Transforms analysis, Algeria, inflows

**Jel Classification Codes :** FS21 ; F31 ; F33.

### **Résumé:**

Cette étude analyse les flux d'investissement direct étranger (IDE) en Algérie pour la période de 1970 à 2022, en utilisant l'application de l'analyse par transformées en ondelettes. À travers cette étude, il est devenu évident que l'investissement direct étranger (IDE) n'a pas connu une période de boom et de prospérité en Algérie pendant toute la période étudiée. Au contraire, les entrées ont été très volatiles et ont eu tendance à diminuer, atteignant parfois le point d'être inexistantes ou même entraînant le départ des investissements d'Algérie. Au mieux, les entrées étaient très modestes, ne dépassant pas le seuil de trois milliards de dollars américains. L'analyse par transformées en ondelettes a fourni un examen détaillé de cela dans l'étude.

**Mots clés:** investissement direct étranger (IDE), analyse par transformées en ondelettes, Algérie, flux entrants

**Jel Classification Codes :** FS21 ; F31 ; F33.

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## **I. Introduction**

The contemporary world witnesses numerous significant economic developments across various fields, as countries strive to achieve international productive integration driven by the impact of scientific and technological revolution. These developments constitute tributaries flowing in favor of globalization, reflecting the general picture of the current global economy led by advanced capitalist economies. Some advanced countries have become pioneers in both importing and exporting investments simultaneously, largely due to the increasing role of multinational corporations.

Foreign direct investment (FDI) is considered a significant source for the inflow of capital and the increase of foreign currency reserves. Additionally, it plays a role in boosting capitalist accumulation and serves as a preferable alternative to borrowing from the external world, especially given the unfavorable conditions of external loans. Attracting and facilitating FDI has garnered considerable attention recently and has thus gained prominent status among the priorities of economic policymakers. This is due to its substantial role in driving economic growth and increasing growth rates within countries.

Inflows of foreign direct investment into a specific country can be understood through wavelet transforms analysis, which entails deciphering the patterns and trends followed by these investments over time. Such studies aim to analyze the factors influencing the attraction of foreign direct investment and identify any waves or shifts in this behavior.

Wavelet analysis relies on studying the time patterns in the inflows of foreign direct investment, assuming that there are periodic fluctuations or waves that appear over specific time periods. Wavelet analysis may involve identifying peaks and troughs, as well as long-term and short-term trends in investment inflows. Among the most recent studies that used wavelet analysis to examine foreign direct investment, we mention the following studies:

Effect of FDI on Pollution in China: New Insights Based on Wavelet Approach, By applying the wavelet tool, this study examines the effect of foreign direct investment (FDI) on pollution in China, for the period 1982 to 2016. Carbon dioxide and sulfur dioxide emissions are used as pollution variables. The results reveal that FDI positively affected pollution at high frequency (short term) during the 1980s and after 2000, and at low frequency (long term) but not at medium frequency (medium term) for the entire time period. It demonstrates that FDI increases pollution both in the short and long term, but not in the medium term. It indicates that FDI has created pollution havens in China. (Jun, Zakaria, Shahzad, & Mahmood, 2018)

The impact of major macroeconomic variables on foreign direct investment in Nigeria: evidence from a wavelet coherence technique, Utilizing Nigeria as a

case study, the investigators explored the linkages between FDI inflows and some selected macroeconomic indicators (exports, gross capital formation, trade openness, inflation, and economic growth) using yearly data spanning from 1981 to 2018. The study employed the ARDL technique to capture the linkages between FDI inflows and its determining indicators. Additionally, wavelet coherence techniques were used. The main novelty of wavelet coherence is its ability to obtain information on dynamic correlation and/or causality between economic variables at different frequencies and different time periods. (Adebayo, Onyibor, & Akinsola, 2021)

Exploring the dynamic link between FDI, remittances, and ecological footprint in Pakistan: Evidence from partial and multiple wavelet based-analysis, The current study examines the asymmetric nexus between foreign direct investment (FDI), foreign remittances inflow (RMIT), and ecological footprint (EF) for Pakistan from 1976Q1 to 2020Q4. To achieve this, the study employs Morlet's wavelet method, utilizing Wavelet Coherence Transform (WCT), Partial and Multiple Wavelet Coherence (PWC & MWC) to reveal the dynamic nexus among the series under study. Significant wavelet coherence and robust lead-lag association are observed with respect to frequency and time domains. (Chishti, 2023)

In order to analyze the inflows of foreign direct investment (FDI) to Algeria and track their behavior accurately, we will use wavelet transforms analysis in this study to examine the period from 1970 to 2022 (data from [unctad.org/fdistatistics](https://unctad.org/fdistatistics)). Thus, we can ask the following question: How did the FDI inflows to Algeria change over time during this period?

Accordingly, the following two hypotheses can be formulated:

Hypothesis 1:

FDI inflows to Algeria have gradually increased during this period as a result of economic and political reforms that enhanced the investment climate.

Hypothesis 2:

FDI inflows to Algeria have experienced significant fluctuations during this period due to global and local economic challenges, including oil price volatility and changes in economic policies.

In this study, we will employ the descriptive-analytical method, where the descriptive approach will provide an overview of FDI inflows during the study period. The analytical approach will be used to analyze the quantitative and qualitative data related to FDI changes and to identify the underlying causes and trends. We will follow the following plan: First, we will provide a historical overview of the trajectory of foreign direct investment (FDI) to Algeria. Then, we will discuss the Wavelet Transforms analysis technique and apply it to the FDI data series for Algeria from 1970 to 2022, detailing the empirical results.

## **II. Foreign direct investment in Algeria**

Algeria still has a significant journey ahead to bolster its appeal to foreign direct investments and investors, especially in sectors beyond hydrocarbons. While this lucrative industry has historically commanded attention, drawing numerous international companies amidst recent surges in global oil prices, efforts towards privatization in Algeria's pivotal public sectors remain modest. A notable concern pertains to Algeria's sole reliance on a state-owned banking system, devoid of private Algerian banks. To invigorate its banking landscape, Algeria must foster competition within the sector by promoting privatization and facilitating the establishment of private banks. Harmonizing the Algerian banking sector with global trends and shifts in business and investment, particularly foreign direct investments, is imperative.

Algeria persists in its endeavors to allure foreign direct investment, notably focusing on sectors dedicated to advancing and fortifying the nation's infrastructure. Among these endeavors are initiatives aimed at enhancing transportation networks across Algeria's expansive geographic expanse, intended to invigorate economic vibrancy and foster connectivity among diverse regions. Nevertheless, it's apparent that the hydrocarbon industry retains considerable allure for foreign investment in Algeria, overshadowing other sectors. This heavy reliance on hydrocarbons as the primary catalyst for GDP growth renders the Algerian economy susceptible to fluctuations in global oil prices. (World bank report n°36270.DZ, 2007)

According to statistical data on foreign direct investment (FDI) inflows into Algeria, it's apparent that these flows remained relatively subdued until the year 1996. This was despite Algeria's enactment of Laws 90-10 and 93-12 aimed at incentivizing foreign investment. Algeria's somewhat restrictive approach towards FDI played a role in this tepidity. Subsequent to Algeria's embrace of reforms and structural shifts post-1986, transitioning from a centrally planned economy to a more liberal one, and adopting measures advocated by the International Monetary Fund (IMF), efforts were undertaken to address the diverse imbalances stemming from the oil crisis of 1986. However, indicators related to institutions and governance suggest that Algeria's institutional framework remained somewhat fragile.

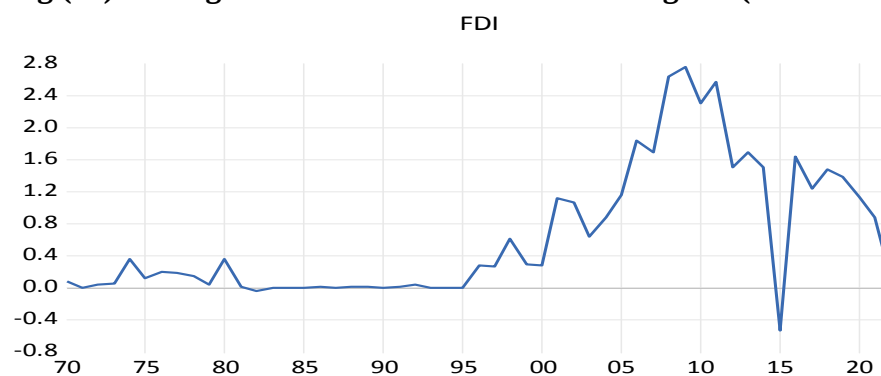
During this period marked by economic, political, and security instability, Algeria encountered difficulties in enticing foreign direct investment (FDI). However, in the late 1990s, there was a discernible upsurge in FDI inflows. This uptick was credited to the amelioration of internal conditions, notably the enhancement of the security landscape, subsequent to the era of terrorism, sabotage, and political upheaval commonly referred to as the "black decade." With the reinstatement of stability, Algeria exhibited a more receptive stance

towards the international community and embraced foreign investment, particularly in the hydrocarbon sector. The increase in FDI flows coincided with Algeria's implementation of an extensive development program, particularly focusing on infrastructure and essential national structures. This qualitative leap and significant rise in FDI inflows reflected Algeria's efforts to modernize and diversify its economy, paving the way for increased foreign investment and economic growth. (IMF, 2012)

Foreign direct investments (FDI) in Algeria witnessed a decline from 2.8 billion USD in 2012 (equivalent to 1.5% of GDP) to approximately 1.5 billion USD in 2016 (0.9% of GDP). Despite the implementation of various FDI restrictions in 2009, such as imposing a 49% foreign equity cap for new FDI projects, the downward trajectory in net FDI inflows persisted. Algeria's stringent foreign exchange regulations rank among the most rigorous in the Arab countries, a factor perceived by potential foreign investors as a significant hurdle to their operations in the country. (World Bank, 2017)

In 2009, FDI reached its pinnacle value since independence, totaling 2.75 billion USD. However, there was a dip in FDI inflows in 2015, followed by a noteworthy recovery in 2016 that extended until 2020. Nonetheless, the Covid-19 pandemic exerted a discernible impact on FDI inflows, which remained constrained and did not surpass two billion dollars. Nonetheless, the Covid-19 pandemic is not the sole determinant influencing FDI. The advent of the new industrial revolution and a shift towards economic nationalism and sustainability trends are anticipated to profoundly shape the international production landscape in the forthcoming decade leading up to 2030. (UNCTAD, 2020)

**Fig.(01): Foreign direct investment inflows to Algeria (1970-2022)**



Source: <http://www.unctad.org/fdistatistics>

Multinational corporations wield substantial influence in providing employment opportunities and elevating the standard of employment through their governance structures, management methodologies, human resources strategies, compensation packages, labor relations, workplace environment,

employee engagement, and corporate social responsibility initiatives. Foreign direct investment (FDI) facilitated by multinational enterprises can play a pivotal role in tackling unemployment and ameliorating job quality in Algeria. As per statements by the Minister of Commerce in 2020, the distribution of foreign companies' nationalities operating in Algeria is as follows: 14% Turkish, 13% French, 11% Syrian, and 11% Chinese.

The American Institute, responsible for organizing the "Best Operators in Algeria 2018" program, acknowledged the endeavors of multinational corporations in enhancing job prospects and fostering favorable working conditions. Notably, DHL Service Point, a prominent player in logistics services on a global scale, clinched the top honor for the second consecutive year for fostering an exceptional work environment that adheres to the highest standards, thereby promoting employee retention. Additionally, Novartis Pharma and Novo Nordisk Algérie, operating within the pharmaceutical sector, were lauded for their contributions to job generation and the enhancement of employment quality in Algeria. (American institute, 2018)

Despite being rich in natural resources and maintaining economic stability, Algeria Historically, Algeria has been a magnet for substantial Foreign Direct Investment (FDI) flows. However, since the onset of the COVID-19 pandemic, these inflows have dwindled, with figures plummeting to just USD 89 million in 2022 as per UNCTAD's World Investment Report 2023. This signifies a significant downturn compared to the three-year average of USD 1.3 billion observed during the period from 2018 to 2020. Conversely, the stock of FDI has surged, reaching USD 34 billion in 2022, constituting approximately 17.4% of the country's GDP.

Algeria has witnessed a notable decline in the number of Foreign Direct Investment (FDI) projects following its peak of 28 projects in 2019. Despite endeavors to rebound, the country experienced a constrained number of projects, with merely five recorded in 2020 amidst the repercussions of the COVID-19 pandemic, and 12 in 2022. Remarkably, renewable and alternative energy projects comprised 25% of the total FDI projects in 2022, underscoring the influence of Algeria's abundant hydrocarbon resources. Additionally, sectors such as chemicals, coal, and oil and gas each contributed roughly one-sixth to the overall FDI projects in the country (as per data from Investment Monitor).

Official data from the Algerian Investment Promotion Agency highlights the leading investors in the country, originating from the United States (29%), Italy (10%), France (10%), Spain (7%), and the United Kingdom (6%). Investments primarily target the industrial sector, with a focus on hydrocarbons, alongside construction, transportation, and agriculture. (World investment report, 2023)

According to Decree No. 01/03 issued on 20 August 2001, any legal entity or individual, whether public or private, is empowered to invest in economic activities related to goods and services production, as well as in investments conducted under concessions and/or licenses. Both foreign and domestic private entities have the right to establish and possess business enterprises and engage in all forms of profitable ventures. In 2019, the government repealed the "51/49" regulation, which mandated majority Algerian ownership of all new businesses. This requirement now exclusively applies to specific strategic sectors such as hydrocarbons, mining, defense, and pharmaceuticals. (ANDI, 2023)

### ***III. Wavelet Transforms Analysis Application***

#### ***III.1. The essence of Application***

The wavelet transform is a mathematical tool used for analyzing signals or data that contain various frequency components that change over time. Unlike the Fourier transform, which decomposes a signal into a sum of sinusoidal functions, the wavelet transform uses wavelets, which are localized waves that can vary in both scale and position. This allows the wavelet transform to provide both time and frequency information simultaneously, making it particularly useful for analyzing non-stationary signals or data with localized features. Wavelet analysis can be defined as a mathematical analytical process applied to time-domain signals to convey their information to the frequency domain. Wavelet transform is considered one of the distinctive multiresolution transforms. Wavelet transformation finds applications in various fields such as image and video processing.

Wavelet transformation builds upon the Fourier transform, developed by the French mathematician and physicist Jean-Baptiste Joseph Fourier in 1822, to represent periodic signals as infinite series of trigonometric functions, sine and cosine, with frequencies related to the fundamental frequency of the periodic signal being analyzed, or to represent non-periodic and time-limited signals in the frequency domain (Percival & Walden, 2000).

The main challenge of the Fourier transform, a single-scale transform, lies in its inefficiency with non-stationary signals or signals that vary over time. It fails to provide information about frequency content over time and loses important signal properties such as direction and deviation. Hence, the Short Time Fourier Transform (STFT) was developed to address this issue, representing the signal using a time and frequency-specific window. However, STFT suffers from time and frequency resolution trade-offs, where a small window yields high resolution for fast-changing signals but low resolution for slow-changing signals, and vice versa with a large window.

Transitioning to wavelet transform offers a solution to the resolution trade-off problem encountered in STFT by employing a variable-width window instead

of a fixed-width one. This allows for obtaining different information with variable frequency resolution, thus mitigating the resolution issues inherent in STFT. (Percival & Walden, 2000)

### III.2. The Expansion of Wavelet Series

The term "wavelets" refers to a collection of orthogonal basis functions derived from the dilation and translation of a scaling function (also known as the father wavelet), denoted by  $\phi$  and a mother wavelet, denoted by  $\psi$ , associated with an  $r$ -regular multiresolution analysis of  $L^2(\mathbb{R})$ . Various families of wavelets now exist, each with different degrees of smoothness and numbers of vanishing moments, combining compact support. These families, extensively documented by Daubechies, are among the most widely utilized in wavelet analysis. (Daubechies, 1992)

#### III.2.1. Practical Applications in Statistics

Wavelet series offer practical applications in statistics, as many functions commonly encountered in real-world scenarios can be represented sparsely and uniquely using wavelet series. This sparsity, or parsimonious representation, makes wavelet bases valuable not only due to their distinctive structure but also because they have been successfully applied in diverse contexts.

For the sake of simplicity in explanation, we will assume the use of periodized wavelet bases on the interval  $[0, 1]$ , as described in (Mallat, 2009). Letting the periodized wavelet be denoted as:

$$\phi_{jk}^p(t) = \sum_{l \in \mathbb{Z}} \phi_{jk}(t - l) \quad \text{and} \quad \psi_{jk}^p(t) = \sum_{l \in \mathbb{Z}} \psi_{jk}(t - l)$$

for  $t \in [0, 1]$

$$\phi_{jk}(t) = 2^{j/2} \phi(2^j t - k) \quad \text{and} \quad \psi_{jk}(t) = 2^{j/2} \psi(2^j t - k)$$

For any  $j_0 \geq 0$  the collection

$$\{\phi_{j_0 k}, \quad k = 0, 1, \dots, 2^{j_0} - 1; \psi_{j_0 k}, j \geq j_0 \geq 0, k = 0, 1, \dots, 2^j - 1\}$$

is then an orthonormal basis of  $L^2([0, 1])$ .

The idea underlying such an approach is to express any function  $g \in L^2([0, 1])$  in the form

$$g(t) = \sum_{k=0}^{2^{j_0}-1} \alpha_{j_0 k} \phi_{j_0 k}(t) + \sum_{j=j_0}^{\infty} \sum_{k=0}^{2^j-1} \beta_{jk} \psi_{jk}(t), j_0 \geq 0, t \in [0, 1]$$

Where

$$\alpha_{j_0 k} = \langle g, \phi_{j_0 k} \rangle = \int_0^1 g(t) \phi_{j_0 k}(t) dt, j_0 \geq 0, k = 0, 1, \dots, 2^{j_0} - 1$$

And

$$\beta_{jk} = \langle g, \psi_{jk} \rangle = \int_0^1 g(t) \psi_{jk}(t) dt, j_0 \geq 0, k = 0, 1, \dots, 2^{j_0} - 1$$

### III.2.2. The Discrete Wavelet Transform

In statistical contexts, our focus often shifts to discretely sampled functions rather than continuous ones. Consequently, the discrete wavelet transform (DWT) becomes the primary interest, serving as the wavelet counterpart to the discrete Fourier transform. The DWT operates on a vector of function values, allowing for efficient analysis and processing of discrete data.

$$g = (g(t_1), \dots, g(t_n))'$$

At equally spaced points  $t_i$  the discrete wavelet transform of  $g$  is given by:

$$d = Wg$$

Where  $d$  is an  $n \times 1$  vector consisting of both discrete scaling coefficients,  $c_{j_0 k}$ , and discrete wavelet coefficients,  $d_{jk}$ . and  $W$  represents an orthogonal  $n \times n$  matrix associated with the orthonormal wavelet basis chosen. The scaling coefficients  $c_{j_0 k}$  and wavelet coefficients  $d_{jk}$  are related to their continuous counterparts, denoted by  $\alpha_{j_0 k}$  and  $\beta_{jk}$ , respectively, with an approximation error of order  $n^{-1}$ , through the relationships:

$$c_{j_0 k} \approx \sqrt{n} \alpha_{j_0 k} \text{ and } d_{jk} \approx \sqrt{n} \beta_{jk}$$

The factor  $\sqrt{n}$  arises from the difference between continuous and discrete orthonormality conditions. While this root factor can be somewhat inconvenient, both the definition of the DWT and the wavelet coefficients adhere to convention. Consequently, distinct notation is employed to distinguish between the discrete wavelet coefficients and their continuous counterpart. Thanks to the orthogonality of the wavelet basis, the inverse discrete wavelet transform (IDWT) is straightforwardly expressed as:

$$g = W^t d$$

Where  $W^t$  denotes the transpose of  $W$ .

If  $n = 2^j$  for some positive integer  $j$ , the discrete wavelet transform (DWT) and its inverse (IDWT) can be efficiently computed using a fast algorithm developed by (Mallat, 2009), requiring only  $n$  operations. Under periodic boundary conditions and for a given signal  $j_0$ , the DWT of  $g$  yields an  $n$  dimensional vector  $d$ , comprising both discrete scaling coefficients  $c_{j_0 k}, k = 0, 1, \dots, 2^{j_0} - 1$  and discrete wavelet coefficients  $d_{jk}, j = j_0, \dots, j - 1; k = 0, 1, \dots, 2^{j_0} - 1$ .

We refrain from delving into the technical intricacies of the algorithm for the  $n$  DWT mentioned earlier. Essentially, this algorithm employs a rapid

hierarchical scheme to compute the required inner products. At each step, it applies low-pass and high-pass filters, followed by decimation (selecting every even member of a sequence). Similarly, the IDWT can be obtained through related filtering operations. (Donoho & Johnstone, 1994)

#### ***IV. The applied study (Wavelet Transforms Analysis)***

##### ***IV.1. Decomposition: Maximum overlap discrete wavelet transform - MODWT.***

The initial graph in the output displays the original series alongside any padded values introduced if a dyadic adjustment was implemented. The final two graphs depict the wavelet and scaling coefficients, respectively. It's worth recalling that during the first scale, the wavelet decomposition divides the frequency spectrum into two equal segments: the low-frequency and high-frequency segments. As a reminder, the low-frequency segment corresponds to the scaling coefficients **V**, while the high-frequency segment corresponds to the wavelet coefficients **W**. (Greenblatt, 1996)

##### ***IV.1.1. Analyzing the scaling coefficients V1***

- At the beginning of the period: Low values ranging between 0 and 0.2 indicate weak or insignificant investments during this period.
- Gradual increase: Subsequently, gradual increasing values appear, indicating continuous improvement in foreign direct investment flows over time.
- Peaks and troughs: Peaks can be observed throughout the period, where investment flows rise to higher levels. These peaks alternate with periods of lows where investment flows decrease.
- Relative acceleration: Investment flow values accelerate over time, with values increasing faster in later periods compared to earlier periods.
- Moderate stability: Periods of moderate stability in investment flow can be observed, where values remain relatively constant over a certain period of time.

##### ***IV.1.2. Analyzing the wavelet coefficients W1***

Based on wavelet coefficient values on a scale of 1, we can observe some patterns and changes in the flow of foreign direct investment into Algeria:

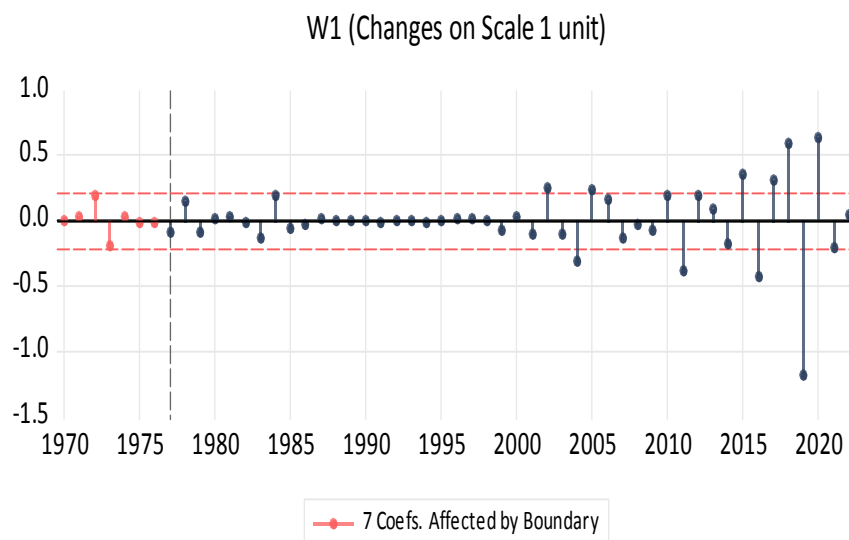
- Negative changes: Many values show both positive and negative fluctuations, indicating volatility in investment flow over time.
- Zero values: Several zero values indicate periods of no change in investment flow.
- Intermittent changes: Some values show intermittent changes, suggesting slowdowns or accelerations in investment flows at certain periods.
- Significant changes: There are a few values indicating significant changes in investment flows, which could have a significant impact on the economy.

By applying a threshold to the wavelet coefficients, wavelet transforms with

a threshold are typically used as a tool to reduce noise or focus on the main components of the signal and reduce insignificant details. Zero values after application indicate that transactions below the threshold have become zero. Non-zero values indicate transactions that exceeded the threshold and were retained. This means that different values after application may carry important information for ongoing analysis.

The only positive value **(0.1353)** indicates a significant change in investment flows after applying the threshold. The negative value **(-0.0850)** also indicates a negative change. The other retained values indicate changes or important components in the continuous signal after application. (Look at figure number 2)

**Fig.(02): W1(changes on scale 1 unit)**



**Source:** Results from applying *Eviews 13*

#### IV.1.3. Analyzing the scaling coefficients V2

- Beginning of the period: There seem to be low values at the beginning of the period, which may indicate a period of stability or weakness in the flow of foreign direct investment .
- Sudden acceleration: This is followed by a sudden acceleration in investment flow values, with values sharply increasing over a short period.
- High peak: A high peak in investment flows can be observed, with values reaching relatively high levels.
- Moderate decline: After the peak, values decrease significantly, indicating a decline in investment flows after a period of rapid growth.
- Stability of values: The data specifically shows periods of stability in the values, where there are no significant changes in investment flow.

#### IV.1.4. Analyzing the wavelet coefficients W2

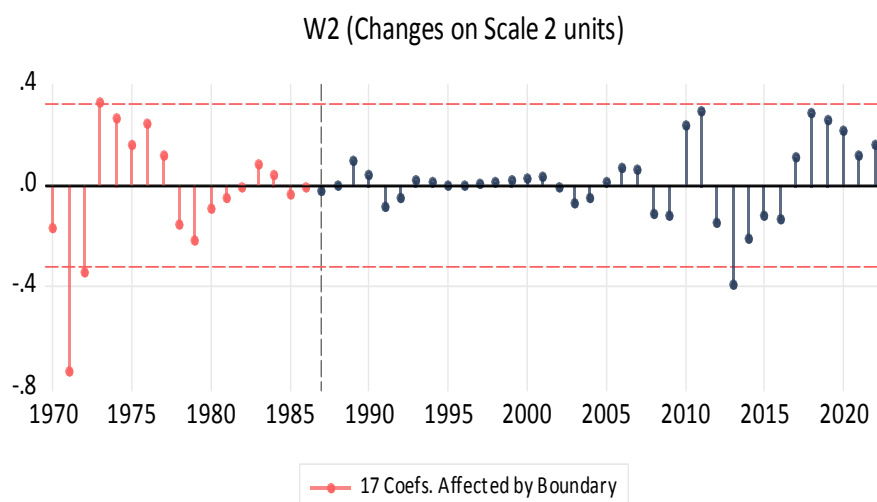
Based on wavelet coefficient values on a scale of 2, we can observe some patterns and changes in the flow of foreign direct investment into Algeria:

- Intermittent changes: There are intermittent changes in the values, indicating fluctuations in foreign direct investment flow over time.
- Moderate changes: Overall, the values appear moderate, with some natural oscillations.
- Zero values: Zero values indicate that there are no significant changes at certain points in the specified time.
- Moderate changes in investment flows: Some values indicate moderate changes in investment flows, which could be associated with slight improvements or declines in the economy.

By applying a threshold to the wavelet coefficients, zero values indicate transactions that were below the threshold and were zeroed out, while non-zero values indicate transactions that exceeded the threshold and were retained.

From the non-zero values, we can see that there are significant changes in transactions after applying the threshold. For example, the value **-0.2895** indicates a negative change after applying the threshold, while the positive value **0.4553** indicates a positive change. (Look at figure number 3).

**Fig.(03): W2(changes on scale 2 unit)**



**Source:** Results from applying *Eviews 13*

#### IV.1.5. Analyzing the scaling coefficients V3

- Beginning of the period: The values at the beginning of the period appear relatively low, indicating a continuation of a period of weakness in foreign direct investment flow.
- Gradual improvement: A gradual improvement in values is evident over the period, with a continuous increase in investment flows over time.

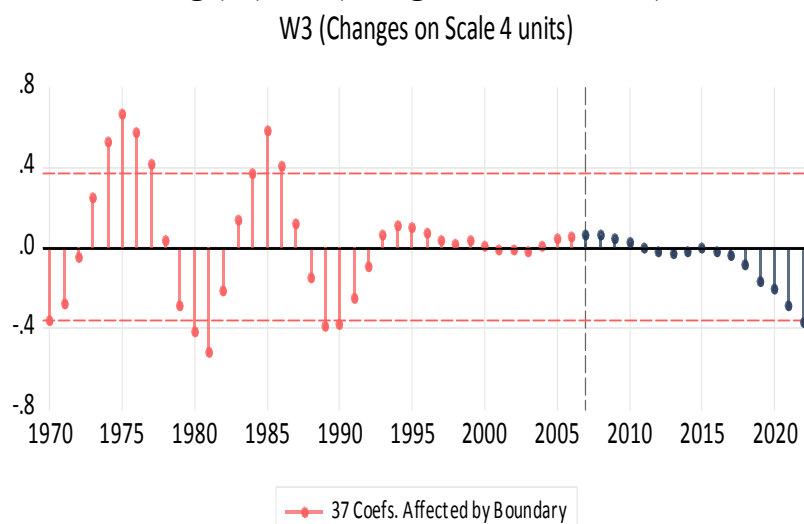
- Moderate peak: The values appear moderately high, suggesting continued growth in investment flows but at a moderate rate.
- Moderate stability: There seem to be periods of stability in the values, with no significant changes in investment flow.
- End of the period: There is a decrease in values towards the end of the period, indicating a decline in investment flows at this stage.

#### IV.1.6. Analyzing the wavelet coefficients W3

Analysis of wavelet coefficients at scale 3 provides a deeper insight into foreign direct investment flow and its changes. Here's a potential analysis based on the provided values:

- Significant increases: Some values show significant increases such as **1.8314** and **0.6222**, indicating large investment inflows during specific periods.
- Negative change: Some values show negative changes like **-1.4955** and **-1.0101**, indicating a decrease in investment flow during those periods.
- Continuity and volatility: Positive values indicate continuity in investment flow while negative values suggest volatility in investments.
- Variable changes: The difference between positive and negative values indicates variable changes in investment flows, which could result from economic or political condition. (Look at figure number 4)

**Fig.(04): W3(changes on scale 4 unit)**



Source: Results from applying *Eviews 13*

#### IV.1.7. Analyzing the scaling coefficients V4

- Beginning of the period: The values at the beginning of the period appear relatively low, indicating a continuation of a period of weakness in foreign direct investment flows.
- Gradual improvement: There is a gradual improvement in values over the period, with a continuous increase in investment flows over time.

▪ Moderate peak: The values appear moderately high, suggesting a continuation of growth in investment flows but at a moderate rate.

▪ Moderate stability: There seem to be periods of stability in the values, where there are no significant changes in investment flow.

▪ End of the period: There is a decline in values towards the end of the period, indicating a decrease in investment flows at this stage.

#### IV.1.8. Analyzing the wavelet coefficients W4

Analysis of wavelet coefficients at scale 4 provides us with a deeper insight into changes in foreign direct investment flow. Here are some possible analyses:

○ Negative change: The first value **(-0.1349)** indicates a negative change in investment flow, suggesting a decrease in investments during the specified period.

○ Positive change: The second value **(0.6874)** indicates a positive change in investment flow, suggesting an increase in investments.

○ Significant change: The difference between the negative and positive values indicates a significant change in foreign direct investment flow over time.

○ Volatility: The following values **(-0.1924** and **-0.4323)** show other fluctuations in investment flows, which could result from changing economic or political conditions.

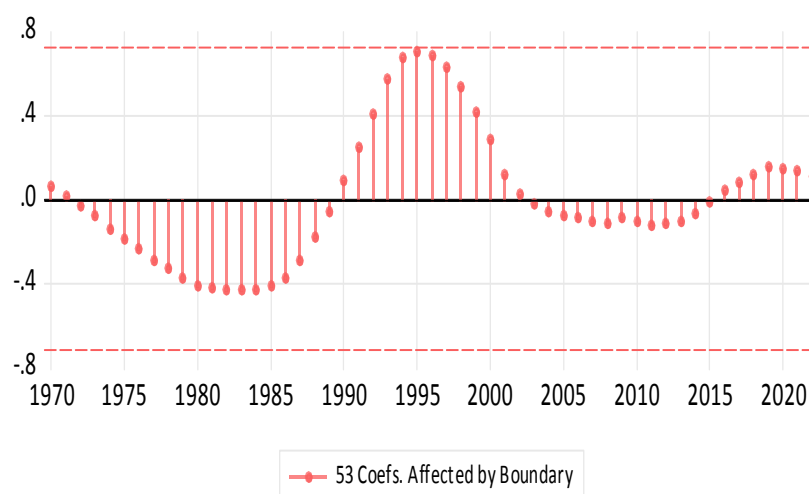
After applying a threshold to the wavelet coefficients, we find:

○ **(-0.6491)** This value indicates a negative change in investment flow, suggesting a decrease in investments during the specified period.

○ **(1.5725)** This value indicates a positive change in investment flow, and therefore, it is indicative of an increase in investments. (Look at figure number 5)

**Fig.(05): W4(changes on scale 8unit)**

W4 (Changes on Scale 8 units)



Source: Results from applying *Eviews 13*

#### IV.1.9. Analyzing the scaling coefficients V5

▪ Sudden Increase: There appears to be a sudden increase in values at the beginning of the period, indicating a significant rise in foreign direct investment flow.

▪ High Peak: The values exhibit a high peak, suggesting that investment flow levels were unusually high during this period.

▪ Continued Growth: Continued growth in investment flows can be observed over the period, with values remaining relatively high.

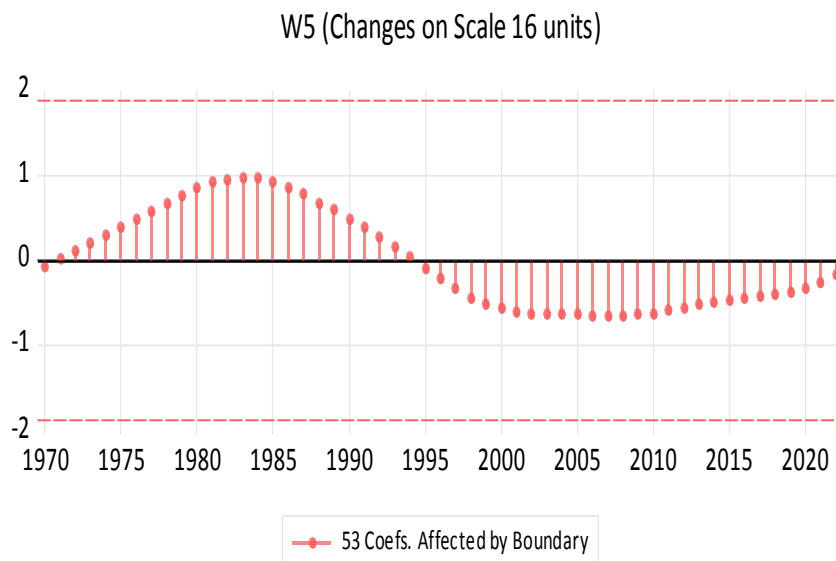
▪ Moderate Decline: After the peak, there seems to be a moderate decline in values, indicating a decrease in investment flows after a period of significant increase.

#### IV.1.10. Analyzing the wavelet coefficients W5

Based on wavelet coefficients at scale 5, the analysis can be as follows:

- (0.2457) This positive value indicates a significant change or increase in foreign direct investment flow during the specified period.
- (-2.2269) This value indicates a significantly negative change in foreign direct investment flow, suggesting a significant decrease in investments during the specified period. (Look at figure number 6)

**Fig.(06): W5(changes on scale 16 unit)**



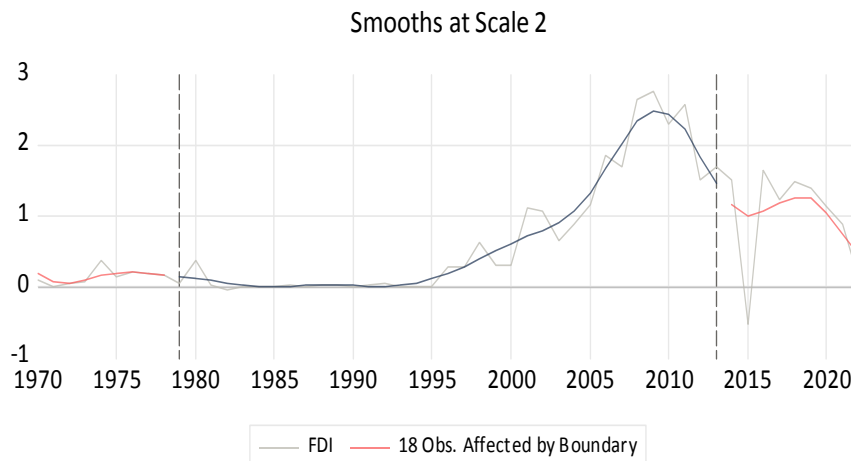
**Source:** Results from applying *Eviews 13*

#### IV.2. Decomposition: Maximum overlap discrete wavelet transform multi

The resulting output comprises smooth and detail series. The initial plot depicts the smooth series at the highest decomposition level superimposed over the original series to provide context. Any observations influenced by boundary coefficients will be highlighted in red, with their corresponding numbers listed in the legend. Moreover, given that observations impacted by the boundary will be

divided between the beginning and end of the original series, two dashed vertical lines are included at each decomposition scale. These lines delineate the sections that separate the total set of observations into those affected by the boundary and those unaffected.

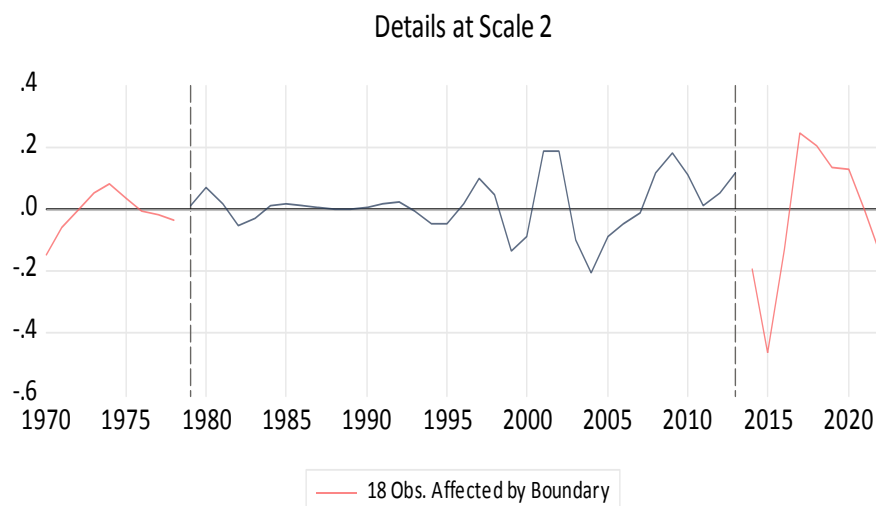
**Fig.(07): Smooths at scale 2**



**Source:** Results from applying *Eviews 13*

Through the wavelet series, there are 18 years of direct foreign investment flow to Algeria that have been affected and exhibited abnormal behavior. These years are: 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, representing the initial phase. Additionally, the years: 2014, 2015, 2016, 2018, 2019, 2020, 2021, and 2022, representing the final phase. (Look at figure number 7)

**Fig.(08): Details at scale 2**



**Source:** Results from applying *Eviews 13*

Further details on a finer scale reveal that the most impactful years are six, namely 1970, 1971, 1972, 1973 in the initial phase, and the years 2021 and 2022 in the final phase. (Look at figure number 8)

## **V. Conclusion**

Algeria, as an integral part of the global economic system, has recognized the crucial role played by foreign direct investment (FDI) in achieving sustainable development. FDI contributes to increasing GDP growth rates, creating job opportunities, transferring modern technology, inheriting advanced management systems, enhancing human resource performance, stimulating export activities, and supporting competitive capacities in various fields. This impact is evident in numerous sectors such as the food and pharmaceutical industries, mechanical industries, as well as service sectors like telecommunications, transportation, and tourism. Naturally, Algeria's leading industry, the oil industry, also benefits in its extraction, conversion, and transportation operations. Several agreements have been signed with foreign partners aimed at developing production in many existing factories.

Through our study, it became evident that foreign direct investment (FDI) did not experience a period of boom and prosperity in Algeria throughout the entire study period. On the contrary, the inflows were highly volatile and tended to decrease, reaching the point of being non-existent at times or even leading to the departure of investments from Algeria. At best, the inflows were very modest, not exceeding the threshold of three billion US dollars. The wavelet analysis provided a detailed examination of this in the study, these results confirms the second hypothesis and refutes the first hypothesis.

Despite the significant importance of foreign direct investment (FDI) and its crucial role in diversifying the economy's sources of financing and transferring technology, Algeria remains one of the countries that have not greatly benefited from it and is among the weakly-attractive nations. It would be beneficial for Algeria to work on improving its attractiveness to FDI by adopting clear policies and strategies in this regard and working more on providing an attractive investment climate for foreign direct investments by reducing the conditions imposed on the inflow of foreign capital; and improving the country's infrastructure and institutional framework. Nevertheless, in recent years, Algeria has benefited from the support of the World Bank to improve its business climate. However, more is needed, and Algeria has a long way to go in terms of reforms, particularly in governance and institutional structure, to improve the business climate and make Algeria more attractive, thus benefiting from increased foreign investment inflows.

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