

Navigating disruption and resilience: Modeling the Economic Impact of COVID-19 on Morocco's Textile Sector Using an Interrupted Time Series Approach

Naviguer entre perturbation et résilience : modélisation de l'impact économique de la COVID-19 sur le secteur textile marocain à l'aide d'une approche de séries chronologiques interrompues

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Abstract :

The COVID-19 pandemic generated an unprecedented shock to global trade, disproportionately affecting export-oriented industries. This study quantitatively assesses the impact of the March 2020 COVID-19 outbreak on Morocco's textile and apparel sector using an Interrupted Time Series (ITS) approach. Monthly data on textile imports and exports, in both quantities and values, covering January 2014 to December 2024 were analyzed. Segmented regression models estimate immediate level changes and post-intervention trend adjustments. The results indicate a statistically significant negative structural break in import quantities and values, as well as in export values following the onset of the pandemic. However, export quantities did not exhibit a significant structural decline, suggesting that the crisis primarily affected trade revenues rather than physical volumes. Post-2020 trends reveal a progressive recovery, with quantities rebounding more rapidly than monetary values, indicating margin compression and price volatility in international markets. Overall, the findings highlight both the short-term vulnerability and medium-term resilience of Morocco's textile industry. The study contributes empirical evidence on crisis-induced structural breaks and offers policy-relevant insights for strengthening industrial competitiveness within global value chains.

Key words: Interrupted Time Series, Textile Trade, COVID-19 Shock, Industrial Resilience

Résumé :

La pandémie de COVID-19 a provoqué un choc sans précédent sur le commerce mondial, affectant de manière disproportionnée les industries orientées vers l'exportation. Cette étude évalue quantitativement l'impact de l'apparition de la COVID-19 en mars 2020 sur le secteur textile et de l'habillement au Maroc en mobilisant une approche de **séries chronologiques interrompues** (*Interrupted Time Series – ITS*). Les analyses reposent sur des données mensuelles relatives aux importations et aux exportations de produits textiles, exprimées en quantités et en valeurs, couvrant la période de janvier 2014 à décembre 2024. Des modèles de régression segmentée sont utilisés afin d'estimer les changements immédiats de niveau ainsi que les ajustements de tendance intervenus après le début de la pandémie. Les résultats mettent en évidence une rupture structurelle négative statistiquement significative des quantités et des valeurs des importations, ainsi que de la valeur des exportations à la suite de l'apparition de la pandémie. En revanche, les quantités exportées ne présentent pas de diminution structurelle significative, ce qui suggère que la crise a principalement affecté les recettes commerciales plutôt que les volumes physiques échangés. Les tendances observées après 2020 révèlent une reprise progressive, les quantités retrouvant leur niveau plus rapidement que les valeurs monétaires, traduisant une compression des marges et une forte volatilité des prix sur les marchés internationaux. Dans l'ensemble, les résultats soulignent à la fois la vulnérabilité à court terme et la résilience à moyen terme de l'industrie textile marocaine. Cette étude apporte des preuves empiriques sur les ruptures structurelles induites par la crise et fournit des enseignements utiles aux décideurs publics pour renforcer la compétitivité industrielle du Maroc au sein des chaînes de valeur mondiales.

Mots-clés : séries chronologiques interrompues, commerce textile, choc de la COVID-19, résilience industrielle.

1. Introduction

The textile and apparel industry has historically been a cornerstone of Morocco's industrial and export economy. As a labor-intensive sector, it remains central to manufacturing employment, value-added creation, and export revenues. Morocco's proximity to Europe, combined with trade liberalization and agreements such as the EU-Morocco Association Agreement, has facilitated its integration into global textile value chains and fast-fashion circuits (Boumahdi & Hamliri, 2021a). The sector thus serves as a major subcontracting and outsourcing hub for European brands, reinforcing its strategic role in Morocco's export-oriented industrialization.

This global integration has yielded considerable benefits—access to markets, increased competitiveness, and expanded production networks. However, it has also exposed the Moroccan textile and apparel sector to external vulnerabilities. During the pandemic, lockdowns and border closures caused sharp declines in orders from European partners, severely impacting textile manufacturing and logistics hubs such as Tangier and Casablanca (Abous, Hamiche & Merouani, 2021). Similar disruptions were reflected in national trade and investment indicators, with global inflows stagnating and export values declining across manufacturing sectors (El Rhadbane & Moudden, 2022).

Despite the textile industry's strategic importance, empirical studies specifically addressing how external crisis affect Morocco's textile trade and investment flows are scarce. Most analyses examine macroeconomic indicators or aggregated industrial data, with little focus on sectoral trade dynamics or capital inflows. This has created a knowledge gap on how crisis reshape value chains, affect firm competitiveness, or alter Morocco's position within global apparel networks (Najab et al., 2022). Addressing this gap is essential for understanding the interplay between international shocks and Morocco's export-led industrial structure.

A longitudinal, data-driven assessment of the textile and apparel industry's resilience is therefore necessary—tracking its performance before, during, and after the 2020 crisis. Such research must integrate trade data to determine whether these shocks caused temporary slowdowns or permanent structural adjustments. The COVID-19 crisis, for instance, prompted a measurable contraction in export volumes and firm closures, disproportionately affecting small and medium-sized garment producers (Boumahdi & Hamliri, 2021). Yet, the absence of quantitative analysis at the sectoral level limits the capacity of policymakers to evaluate resilience or plan adaptive recovery strategies.

This study bridges this empirical gap by conducting a quantitative evaluation of the Moroccan textile and apparel sector's evolution across crisis periods—specifically analyzing trade values and volumes between 2014 and 2024. Using time-series modeling and structural break analysis, it identifies inflection points and recovery trajectories. The guiding question is: To what extent did the COVID-19 pandemic induce an immediate structural break and influence the long term resilience trajectory of Morocco's textile trade, as reflected in import and export dynamics ?

By addressing this, the study contributes to the literature on industrial resilience and global production restructuring, providing sector-specific insights for Morocco's policy design. It also aligns with recent evidence suggesting that Morocco's manufacturing sectors—particularly textiles—require enhanced diversification and innovation to withstand global (El Rhadbane & Moudden, 2022; Pouya et al., 2021)

Accordingly, the primary objective of this study is to evaluate the immediate and long-term effects of the COVID-19 pandemic on Morocco's textile trade by examining whether the health crisis generated a structural break in import and export dynamics and by assessing the sector's capacity for post-crisis recovery and resilience. To achieve this objective, the study quantifies

the pandemic-induced changes in textile import and export quantities and values, identifies the magnitude of the immediate disruption and subsequent trend adjustments, and analyses the extent to which Morocco's textile industry adapted to the new economic environment following the COVID-19 outbreak. Beyond its empirical objectives, this research makes several complementary contributions to the existing literature.

From a theoretical perspective, it advances the understanding of industrial resilience by providing empirical evidence on how a major external shock reshaped the trade dynamics of an export-oriented manufacturing sector in an emerging economy. From a methodological perspective, it demonstrates the relevance of the Interrupted Time Series (ITS) approach for distinguishing between immediate intervention effects and long-term structural changes in sectoral trade performance, thereby extending the application of this quasi-experimental method to the analysis of industrial trade dynamics.

Finally, from a managerial and policy perspective, the findings provide evidence-based insights that can support policymakers and industry stakeholders in designing strategies aimed at strengthening supply chain resilience, improving crisis preparedness, and enhancing the international competitiveness and long-term sustainability of Morocco's textile industry.

2. Literature review

2.1 Textile Industry in the context of COVID-19

The global health crisis triggered by the spread of COVID-19 in 2020 marked an unprecedented disruption in modern economic history. Its singularity lies in the speed of transmission across an interconnected global economy, where unrestricted international movement facilitated rapid contagion. Within three months, nearly half of the world's population was confined, halting large segments of economic activity. Unlike previous crisis—most notably the 2008–2009 financial crisis—COVID-19 combined a simultaneous global demand collapse with severe supply-side constraints, creating unparalleled economic turmoil. (World Bank Group., 2020)

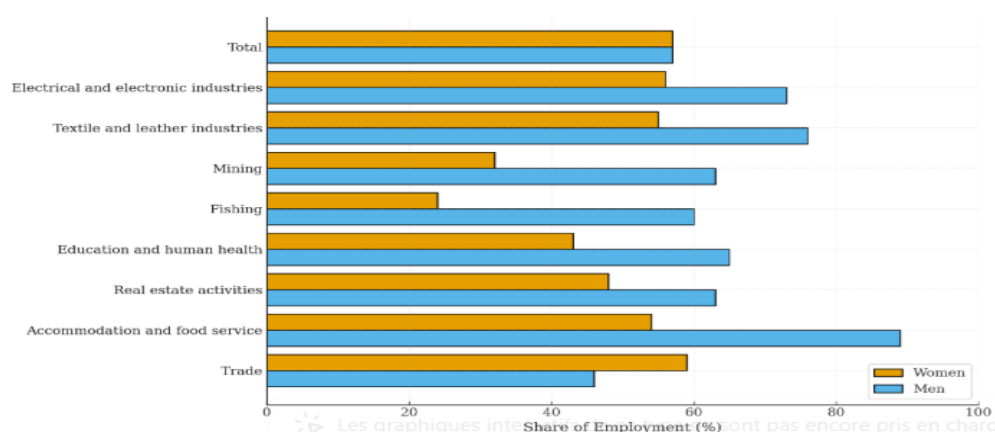
According to the World Trade Organization (2020), international trade contracted by approximately 13%, while the World Bank (2020) reported a –3% global GDP decline, affecting over 170 countries. The crisis led to financial losses exceeding 900 billion USD, along with steep declines in commodity prices and extreme volatility in global markets. Capital outflows from developing economies surpassed those recorded during the 2008 crisis, exposing deep structural dependencies within the global economic system. (World Bank Group., 2020)

2.2 Moroccan textile industry in the context of Covid-19

In Morocco, the pandemic precipitated an unprecedented economic contraction. The declaration of a national health emergency in March 2020 led to border closures, supply chain disruptions, and a near halt in domestic production. The Ministry of Economy and Finance (2021) estimated a 6% contraction in GDP, equating to daily losses of approximately one billion dirhams. Major sectors were severely impacted: tourism revenues fell by 60%, remittances by 30%, exports by 61.5%, and the transport sector by 81%. Industrial activity suffered steep declines, with exports dropping 93% in electronics, 96% in automobiles, and 86.5% in textiles and apparel (Ministry of Economy & Finance, 2021). These declines translated directly into employment losses. According to the High Commission for Planning (HCP), 27% of companies

reduced or suspended their workforce, corresponding to 20% of total organized employment. The services sector lost approximately 245,000 jobs (17.5%), while the textile, accommodation, construction, and catering industries experienced staff reductions of 34%, 31%, 27%, and 26%, respectively. More than half of all firms ceased or curtailed operations, with 49% of them being SMEs, indicating the disproportionate vulnerability of smaller enterprises. (Haut Commissariat au Plan, 2022)

Figure N°1. Proportion of businesses temporarily or permanently on hold by sector of activity

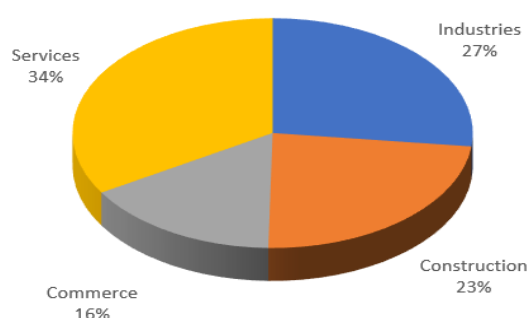


Source: Main findings of the business climate survey on the effects of Covid-19 on business activity, The High Commission for Planning, June 2022

2.3 Employment and industrial impact

The employment repercussions were severe. The HCP estimated that approximately 726,000 jobs—or 20% of organized sector employment—were lost during the crisis. This included 21% of jobs in very small enterprises (VSEs), 22% in SMEs, and 19% in large firms. Notably, 57% of all job losses occurred within VSEs and SMEs, which demonstrate their structural fragility. The industrial sector alone shed 195,000 jobs (22%), followed by construction with 170,000 (24%) and services with 245,000 (17.5%). Within manufacturing, the clothing industry registered the steepest decline, reducing employment by 34%, followed by accommodation (31%), construction (27%), and food services (26%). (Haut Commissariat au Plan, 2022)

Figure N° 2. Breakdown of the reduction in employment by sector of activity

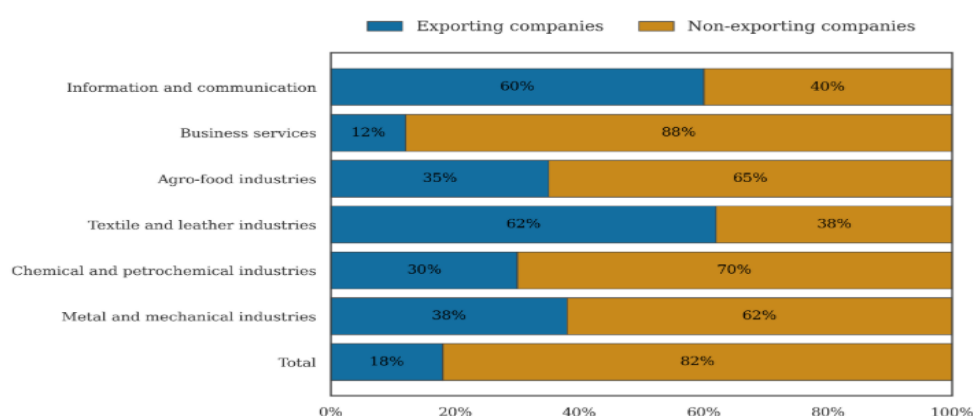


Source: Main results of the business activity effects survey related to Covid-19, The High Commission for Planning, June 2022

2.4 Export Sector Impact

The export-oriented segment of Morocco's economy also suffered significantly. The HCP reported that 133,000 jobs were lost within exporting firms, representing 18% of total employment reductions across all sectors. The textile and leather industry accounted for over 50,000 job losses, equivalent to 62% of employment reductions in export-oriented manufacturing. In contrast, information and communication industries reported a 60% employment decline, while the metal, agri-food, and chemical sectors saw workforce reductions of 38%, 35%, and 30%, respectively. These figures illustrate both the scale and asymmetry of the pandemic's industrial impact. Export-dependent industries—particularly textiles—were exposed to cascading disruptions from international market closures, supply bottlenecks, and shifting global demand patterns. (Haut Commissariat au Plan, 2022)

Figure N°3. Proportion of jobs that would have been reduced at export companies



Source: Main findings of the business activity survey on the effects of Covid-19 on companies, The High Commission for Planning, June 2022.

The COVID-19 crisis profoundly disrupted Morocco's textile and apparel industry, producing sharp declines in trade, employment, and production. However, the crisis also revealed critical structural weaknesses—such as dependency on external markets and limited domestic value creation—while catalysing strategic shifts toward diversification, regional integration, and industrial resilience. These dynamics underline the importance of quantitative time-based analyses, such as Interrupted Time Series models, to capture the evolution of these disruptions and subsequent recoveries over time.

2.5 Interrupted Time Series as a Framework for Economic and Trade Analysis

Recent developments in empirical economics have positioned Interrupted Time Series (ITS) analysis as one of the most reliable quasi-experimental methods for assessing the economic and industrial consequences of exogenous shocks such as the COVID-19 pandemic. Unlike cross-sectional or descriptive analyses, ITS provides a longitudinal lens that isolates the temporal effect of interventions or crisis on key performance indicators, making it particularly valuable for examining trade and industrial responses. The method's adaptability has prompted its increasing use in studies that analyze disruptions to production, trade, and market behavior

across sectors and regions.(Kontopantelis et al., 2015)

In industrial and macroeconomic contexts, several studies have demonstrated ITS's robustness in identifying both the immediate and lasting effects of shocks. Masena et al. (2024) applied ITS to measure pandemic-induced losses in South Africa's wholesale and retail industries, revealing pronounced short-term contractions followed by partial recoveries aligned with the easing of restrictions (Masena et al., 2024). Similarly, Hyndman and Rostami-Tabar (2024) advanced the use of ITS for economic forecasting, showing its value in predicting post-shock adjustments in industrial output and consumer demand(Hyndman & Rostami-Tabar, 2025). Earlier research by Mohammed et al. (2016) used ITS to analyze inflation dynamics in Ghana, while Kontopantelis et al. (2015) and McDowall et al. (2019) provided the theoretical and statistical foundations for regression-based ITS approaches in non-randomized economic settings(Kontopantelis et al., 2015). These works collectively demonstrate that ITS can effectively detect discontinuities, assess policy impacts, and model recovery trajectories in complex economic systems.

The integration of ITS with autoregressive models has further refined its analytical precision. Studies such as Zhou and Hu (2023) and Li and Liu (2023) have shown that ITS models effectively capture step changes and trend modifications while accounting for serial correlation and seasonality(Li et al., 2023; Zhou et al., 2023). Meanwhile, Travis-Lumer et al. (2022) expanded ITS applications to pandemic-related policy evaluations, highlighting its flexibility in assessing both macroeconomic indicators and sector-specific performance (Travis-Lumer et al., 2022). The methodological advancements proposed by Bottomley et al. (2019) further enhance model validity by introducing power analyses, control series, and simulation testing to strengthen causal inference in observational data (Bottomley et al., 2019).

Recent industrial and digitalization research also recognizes ITS as an essential instrument for understanding adaptive industrial transformations under conditions of uncertainty. For instance, Kashpruk et al. (2023) explored ITS-based forecasting in Industry 4.0 environments, demonstrating how the approach can model the temporal impact of technological and market disruptions (Kashpruk et al., 2023). In parallel, Bunn et al. (2023) applied ITS to evaluate pandemic-related employment shocks across service and industrial sectors, capturing heterogeneity in recovery patterns among different industries. Together, these studies confirm ITS's ability to model both abrupt structural breaks and gradual adaptive processes in time-series data, making it a methodological bridge between econometric rigor and policy relevance(Bunn et al., 2023).

Building on these advances, the present research applies an ITS framework to Morocco's textile trade between 2014 and 2023 to quantify the immediate and long-term impacts of COVID-19 on imports and exports. This methodological choice reflects a response to a key gap in existing scholarship, where studies on Morocco's textile industry remain largely descriptive (Abous et al., 2021) and rarely capture the temporal dynamics of crisis and recovery. The ITS model's capacity to differentiate between short-term disruptions and persistent trend changes enables a deeper understanding of the sector's adaptive behavior within global value chains. By empirically modeling the level and slope changes in Morocco's textile trade flows, this study contributes to three key areas: first, it enhances understanding of industrial resilience by tracing the speed and magnitude of post-shock recovery; second, it strengthens trade policy evaluation by identifying structural breaks and the effects of containment measures; and third, it extends methodological innovation by adapting ITS to the analysis of industrial trade dynamics in

emerging economies.

Through this empirically grounded framework, the study not only advances theoretical debates on industrial adaptability and structural transformation, but also delivers practical insights for evidence-based policymaking. Specifically, it elucidates how Morocco's textile industry—a cornerstone of its export economy—has navigated systemic shocks and reconfigured its trade trajectories in response to global disruptions, offering lessons for resilient industrial development in the post-pandemic era.

2.6 Literature synthesis and research gap

Overall, the existing literature consistently demonstrates that the COVID-19 pandemic generated profound disruptions across global textile industries through supply chain interruptions, declining international demand, and increased market uncertainty. Previous studies have extensively documented the economic consequences of the crisis at the macroeconomic level and have highlighted the adaptive strategies adopted by firms, including digital transformation, production reconfiguration, and supply chain restructuring. Likewise, recent methodological contributions emphasize the suitability of Interrupted Time Series (ITS) analysis for evaluating the effects of major external shocks on economic and industrial performance.

Despite these valuable contributions, several important gaps remain. First, most empirical studies focusing on Morocco examine the economic consequences of the pandemic from a macroeconomic or descriptive perspective, without providing a rigorous quantitative assessment of structural changes in textile trade over time. Second, although Morocco's textile industry represents one of the country's most strategic export-oriented sectors, limited research has investigated whether the COVID-19 crisis produced immediate structural breaks or permanent changes in import and export dynamics. Third, the application of Interrupted Time Series analysis to evaluate industrial resilience within the Moroccan textile sector remains largely unexplored, despite its recognized capacity to distinguish short-term intervention effects from long-term trend modifications.

To address these gaps, the present study employs an Interrupted Time Series framework to quantify the immediate impact of the COVID-19 pandemic on Morocco's textile imports and exports and to evaluate the sector's post-crisis recovery trajectory. By examining both level and trend changes over the 2014–2024 period, this research contributes to a deeper understanding of industrial resilience and structural adaptation in export-oriented manufacturing industries. Consequently, the study extends the existing literature by providing robust empirical evidence from an emerging economy while offering methodological and managerial insights that may support future industrial and trade policy decisions.

2.7 Research hypotheses

Building upon the theoretical and empirical literature reviewed above, this study formulates three research hypotheses concerning the impact of the COVID-19 pandemic on Morocco's textile trade. These hypotheses are derived from previous evidence highlighting the disruptive effects of major external shocks on international trade, supply chains, and industrial resilience, and are empirically tested using the Interrupted Time Series framework.

⇒ *H1. The COVID-19 pandemic generated a significant immediate structural break in Morocco's textile import dynamics.*

This hypothesis assumes that the introduction of containment measures and the disruption of global supply chains caused a statistically significant decline in textile imports immediately following the COVID-19 outbreak.

⇒ *H2. The COVID-19 pandemic generated a significant immediate structural break in Morocco's textile export dynamics.*

This hypothesis proposes that the pandemic produced an immediate disruption in Morocco's textile exports due to declining international demand, border restrictions, and interruptions in global value chains.

⇒ *H3. Morocco's textile industry exhibited a progressive post-pandemic recovery, reflecting the sector's resilience over time.*

This hypothesis assumes that, despite the initial disruption caused by the pandemic, textile trade gradually recovered through structural adaptation, market diversification, and the restoration of international trade flows.

3 Methods

3.1. Study Design

In this quasi-experimental study, an interrupted time series (ITS) analysis was employed to examine the impact of the COVID-19 pandemic on textile trade indicators in Morocco. To capture the macroeconomic shock induced by the pandemic, we focused on monthly national statistics related to textile importation and exportation volumes and values. The intervention point for the ITS model corresponds to March 2020, which coincide with the confirmation of the first COVID-19 case and the immediate implementation of strict containment measures in Morocco.

3.2. Data source

The access to foreign trade dataset required for the present research, an official request was submitted to the Moroccan Exchange Office (Office des Changes). The dataset was provided in Excel format and covered a period of 132 months, consisting of 74 months prior to the COVID-19 pandemic outbreak (January 2014–February 2020) and 58 months thereafter (March 2020–December 2024). All variables were restructured into the appropriate Interrupted Time Series (ITS) format, including the specification of the intervention point corresponding to March 2020: First confirmed COVID-19 case in Morocco and implementation of restrictive measures. Data processing and preparation for ITS modeling were conducted during 2023.

3.3. Statistical analysis

Descriptive statistics were computed to characterize monthly trends in textile imports and exports (quantities and values) from January 2014 to December 2024. Measures of central

tendency and dispersion summarized data variability. March 2020 was defined as the intervention point corresponding to the onset of the COVID-19 shock. Normality was assessed using the Shapiro–Wilk test. As most variables deviated from normal distribution, non-parametric tests were applied to compare pre- and post-intervention periods. The Mann–Whitney U test evaluated median differences between periods, while the Wilcoxon signed-rank test was used for paired monthly comparisons. Effect sizes were calculated to quantify the magnitude of observed changes.

3.4. interrupted time series

We initially performed descriptive comparisons and a paired t-test to assess changes in the annual mean values of textile importation and exportation indicators before and after the onset of the COVID-19 pandemic. Interrupted Time Series Analysis (ITSA) was applied to evaluate both the immediate and long-term effects of the pandemic on Morocco's textile trade flows. ITSA is widely recognized as a relevant methodology for assessing population-level interventions or unexpected shocks when randomized controlled trials are not feasible, and has been extensively used to analyze the effects of major public health and economic disruptions, including the COVID-19 pandemic.

In our ITS model, March 2020 — the month of the first confirmed COVID-19 case in Morocco and the introduction of national containment measures — was defined as the intervention point. The model estimates two key effects on each trade indicator: (1) a level change, representing the immediate deviation from the expected pre-pandemic trajectory, and (2) a slope change, capturing potential long-term modifications in trade trends following the shock. Time was operationalized as the number of months from January 2014 to December 2024. The ITS analysis was conducted using the following segmented regression model:

$$Y_t = \beta_0 + \beta_1 \cdot Time_t + \beta_2 \cdot COVID19_t + \beta_3 \cdot TimeAfterCOVID19_t + \varepsilon_t$$

where:

- Y_t denotes the textile trade indicator (import volume, import value, export volume, export value) at month t
- $Time_t$ is the number of months from January 2014 onward
- $COVID19_t$ is a binary variable coded 0 for pre-pandemic months and 1 from March 2020 onward
- Time After COVID-19
- equals 0 before March 2020 and counts months after the pandemic onset
- β_0 estimates the baseline level of the indicator
- β_1 estimates the pre-pandemic trend
- β_2 reflects the immediate level change after the COVID-19 outbreak
- β_3 represents the change in long-term trend following the pandemic
- ε_t is the error term

All analyses were conducted in Python (v3.11) using the Anaconda 2024.02 environment. Data preprocessing was performed with pandas and numpy, while statistical tests and modeling employed statsmodels and scipy. stats. Descriptive statistics and paired t-tests compared pre-

and post-pandemic textile trade indicators. An Interrupted Time Series Analysis (ITSA) using segmented regression estimated the immediate (level) and long-term (slope) impacts of COVID-19 on Morocco's textile trade. Newey–West HAC standard errors were applied to correct for autocorrelation, and model diagnostics, including Durbin–Watson and Ljung–Box Q tests, verified robustness. Visualizations were created with matplotlib and seaborn, and all procedures were documented in Jupyter Notebook to ensure reproducibility.

4. Results

4.1 Descriptive analysis

The descriptive statistics presented in Table 1 sum up the distributional characteristics of textile importation and exportation data, both in terms of quantities and values. The results show also the magnitude, variability, and central tendency of trade flows within the Moroccan textile sector during the study period. The mean importation quantity was approximately 4.69×10^7 units, with a standard deviation of 1.05×10^7 , indicating moderate dispersion around the mean. The minimum and maximum values (2.37×10^7 to 7.47×10^7) reflect significant month-to-month variation, likely attributable to supply-chain disruptions and subsequent recovery phases during the pandemic period.

In monetary terms, the mean importation value reached 3.01×10^9 MAD (SD = 6.93×10^8 MAD), with a range from 1.12×10^9 MAD to 4.83×10^9 MAD. The interquartile range (25 % = 2.47×10^9 ; 75 % = 3.54×10^9) shows that the majority of observations cluster within a relatively stable import bracket, supporting the idea that Morocco's textile industry maintained its input supply chain despite external shocks.

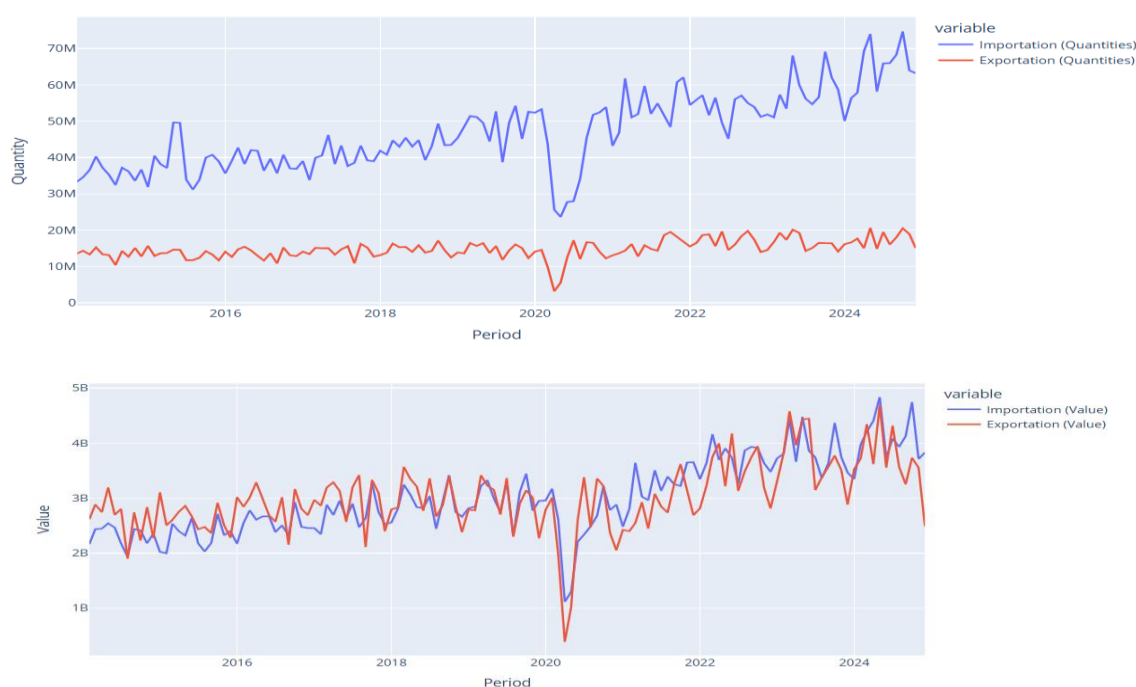
Regarding exportation quantities, the mean stands at 1.48×10^7 units (SD = 2.57×10^6), with the 25th and 75th percentiles spanning 1.34×10^7 to 1.63×10^7 units which suggests more constrained variation in exports compared with imports. For exportation values, the mean is 3.01×10^9 MAD (SD = 6.25×10^8 MAD), ranging from 3.88×10^8 MAD to 4.68×10^9 MAD. The median (2.99×10^9 MAD) closely aligns with the mean, indicating a near-symmetric distribution without extreme outliers, consistent with stable export revenues after the initial COVID-19 shock.

Table N°1: Descriptive statistics of quantities related to textile imports and exports

	Importation (Quantity)	Importation (Value)	Exportation (Quantity)	Exportation (Value)
Min	2.367283 ^e +07	1.115399 ^e +09	3.219501 ^e +06	3.876702 ^e +08
Mean	4.687370 ^e +07	3.005891 ^e +09	1.483130 ^e +07	3.007738 ^e +09
Std	1.054168 ^e +07	6.934870 ^e +08	2.573663 ^e +06	6.251509 ^e +08
25%	3.888726 ^e +07	2.474723 ^e +09	1.337361 ^e +07	2.666841 ^e +09
50%	4.527350 ^e +07	2.879118 ^e +09	1.462884 ^e +07	2.985049 ^e +09
75%	5.395651 ^e +07	3.536137 ^e +09	1.625646 ^e +07	3.356595 ^e +09
Max	7.467264 ^e +07	4.833584 ^e +09	2.063346 ^e +07	4.684600 ^e +09

Source: Compiled and elaborated by the authors

Figure N°4. Evolution of Importation and Exportation in terms of quantity and Value from 2014 to 2024



Source: Compiled and elaborated by the authors

4.2 Variation of importation and exportation before and after the pandemic covid19

Table 2 presents the comparison of Morocco's textile trade indicators before and after March 2020. Using the Mann–Whitney U test.

The Wilcoxon Sum Rank Test results presented in Table 2 provide robust nonparametric evidence of significant differences in both importation and exportation indicators before and after the onset of the COVID-19 pandemic (March 2020). All test statistics yielded p-values < 0.001, confirming statistically significant shifts in trade dynamics across all dimensions analyzed.

The median importation quantity increased from 4.03×10^7 units before the pandemic to 5.50×10^7 units afterward, while the median importation value rose from 2.64×10^9 MAD to 3.64×10^9 MAD. These increases are statistically significant ($p < 0.001$) and suggest a recovery and possibly a structural reconfiguration of import activities following initial disruptions.

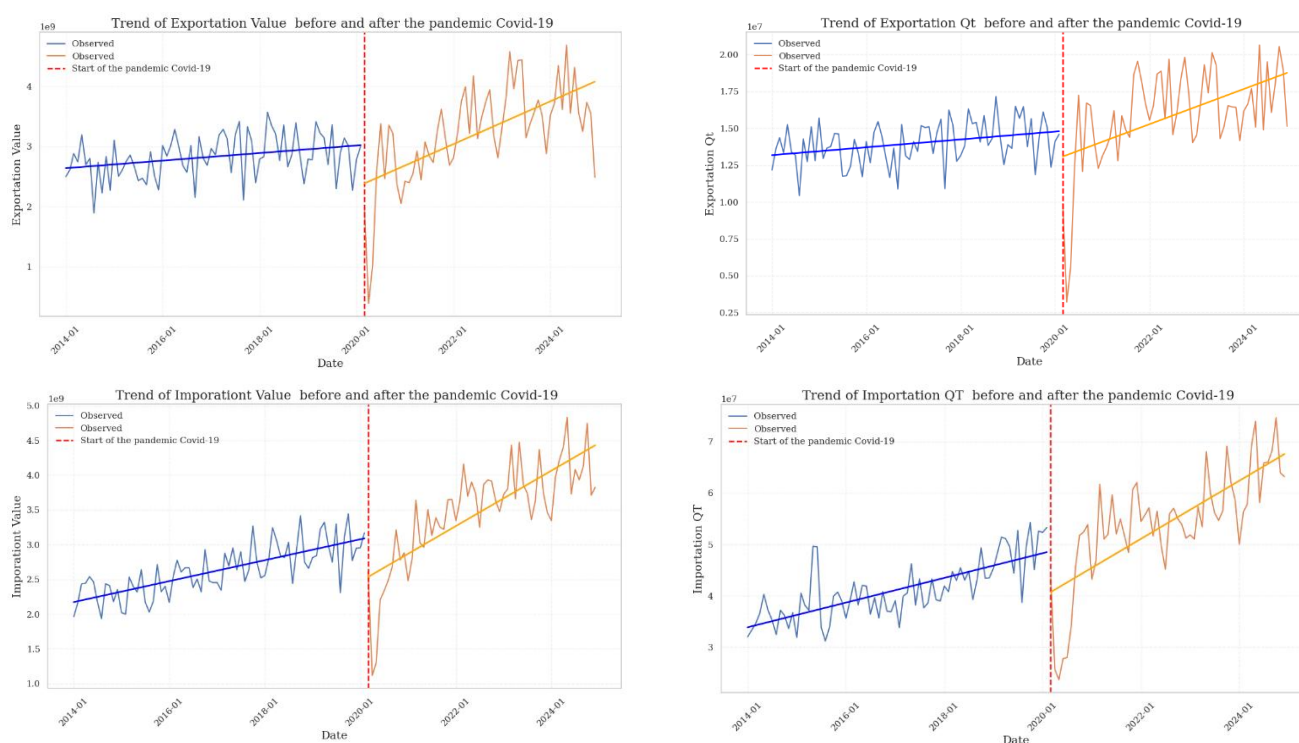
For exportation, both quantities and values also display higher post-pandemic medians ($1.41 \times 10^7 \rightarrow 1.63 \times 10^7$ units; $2.83 \times 10^9 \rightarrow 3.28 \times 10^9$ MAD), again with $p < 0.001$. This statistically significant improvement signals a gradual recovery and resilience of Morocco's textile exports despite the severe contraction observed in early 2020.

Table N° 2: Median comparison of textile imports and exports indicators before and after the COVID-19 outbreak (Mann–Whitney U test)

	Median Before March 2020	Median After March 2020	Sig Sum rank test
Importation (Quantities)	4.027560 ^e +07	5.495205 ^e +07	0.000
Importation (Value)	2.637457 ^e +09	3.643286 ^e +09	0.000
Exportation (Quantities)	1.409013 ^e +07	1.629679 ^e +07	0.000
Exportation (Value)	2.834824 ^e +09	3.281535 ^e +09	0.000

Source: Compiled and elaborated by the authors

Figure N° 5. Trends in textile import and export Indicators before and after the COVID-19 pandemic (Interrupted Time Series analysis)



Source: Compiled and elaborated by the authors

4.3 Results and findings: The effects of the COVID-19 international economic crisis on the Moroccan textile industry

The Interrupted Time Series (ITS) regression models presented in Figure 5 provide evidence of the distinct effects of the COVID-19 pandemic on Morocco's textile trade performance between 2014 and 2024. Using heteroskedasticity-robust standard errors (HC1), the models capture both pre-pandemic trends (Time) and the immediate level change associated with the onset of the pandemic (Pandemic COVID-19 β_2).

4.3.1. Importation and exportation dynamics

Both importation models exhibit strong explanatory power ($R^2 = 0.661$ for quantities; $R^2 = 0.669$ for values). The positive and highly significant time coefficients ($\beta_1 = 2.883 \times 10^5$; $p < 0.001$ and $\beta_1 = 1.927 \times 10^7$; $p < 0.001$) confirm a long-term upward trajectory in import flows prior to the pandemic.

However, the intervention coefficient (β_2) is negative and statistically significant for both importation quantities ($\beta_2 = -6.054 \times 10^6$; $p = 0.024$) and values ($\beta_2 = -4.203 \times 10^8$; $p = 0.022$). This indicates that the onset of COVID-19 produced an immediate contraction in textile imports, consistent with temporary disruptions in supply chains, port restrictions, and reduced industrial demand during early 2020. Despite this short-term shock, the positive time trend implies a gradual recovery, suggesting that Morocco's textile sector adapted rapidly by re-establishing input sourcing and import logistics once restrictions eased.

For exportation, both models show lower explanatory power ($R^2 \approx 0.27$), highlighting greater volatility and external sensitivity to global market conditions. The time variable remains positive and significant ($p < 0.001$), indicating a general upward export trend over time. Nonetheless, the pandemic effect (β_2) diverges: while the coefficient for export quantities ($\beta_2 = -1.188 \times 10^6$; $p = 0.242$) is not significant, the coefficient for export values ($\beta_2 = -4.684 \times 10^8$; $p = 0.044$) is negative and significant. This implies that COVID-19 had a stronger impact on export revenue than on physical quantities, reflecting a decline in average unit prices or high-value orders as international buyers cut costs and postponed contracts. The industry thus faced a temporary price-driven downturn, even as production capacity and export volumes began to stabilize.

The ITS models reveal that the COVID-19 pandemic caused a statistically significant negative structural break in both importation and exportation, particularly in monetary terms. The results confirm that Morocco's textile trade experienced a sharp but transitory downturn, followed by signs of recovery driven by sectoral adaptability, diversification of markets, and policy support. These findings align with global evidence that textile and apparel industries underwent rapid restructuring during the pandemic to meet emerging domestic and international demands for medical and protective textiles (OECD, 2021; UNCTAD, 2022; WTO, 2021).

The results of the Interrupted Time Series (ITS) regression clearly demonstrate that the COVID-19 pandemic exerted a significant short-term impact on Morocco's textile trade, both in terms of quantities and monetary values of importation and exportation.

For importation, the coefficients associated with the pandemic period ($\beta_2 = -6.05 \times 10^6$; $p = 0.024$ for quantities and $\beta_2 = -4.20 \times 10^8$; $p = 0.022$ for values) indicate a pronounced decline following the onset of the pandemic in March 2020. This suggests that border closures, global supply-chain disruptions, and reduced industrial activity sharply constrained textile imports. Nevertheless, the positive and highly significant time trend ($p < 0.001$) in both models reveals that import levels began to recover progressively afterward, reflecting the sector's resilience and the rapid reorganization of procurement channels once trade restrictions eased.

For exportation, the effect of the pandemic differed between physical quantities and export values. The coefficient for exported quantities ($\beta_2 = -1.19 \times 10^6$; $p = 0.242$) is not statistically significant, indicating that the overall export volume did not experience a marked structural

break. By contrast, export values fell significantly ($\beta_2 = -4.68 \times 10^8$; $p = 0.044$), showing that the crisis reduced the financial worth of exports rather than their volume. This reduction likely stems from falling international prices, canceled or delayed high-value contracts, and intensified competition in global markets during 2020–2021.

In sum, COVID-19 led to a temporary but substantial contraction in the financial dimension of Morocco's textile trade, while physical flows proved more stable. The results point to a price-driven rather than quantity-driven downturn. The gradual recovery of coefficients over time emphasizes the industry's adaptive capacity, particularly its diversification toward health-related textile products and its reintegration into global value chains once restrictions were lifted. These findings align with broader international evidence that the pandemic caused abrupt trade shocks followed by sectoral restructuring and resilience (OECD, 2021; UNCTAD, 2022; WTO, 2021)

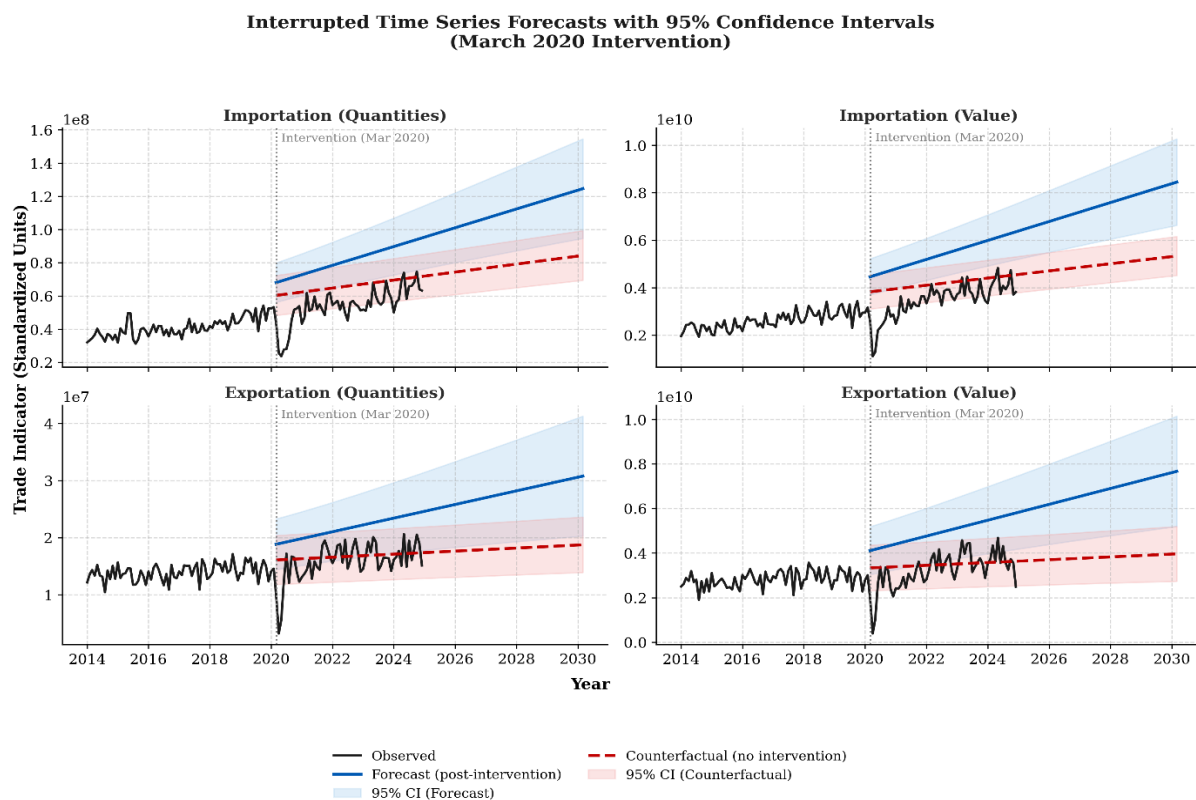
Table N°3: Estimated impact of the March 2020 COVID-19 Shock on textile Imports and Exports (ITS Model Results)

Variable	Importation (Quantities)	p-value	Importation (Value)	p-value	Exportation (Quantities)	p-value	Exportation (Value)	p-value
Constant (β_0)	3.066×10^7	< 0.001	1.929×10^9	< 0.001	1.226×10^7	< 0.001	2.351×10^9	< 0.001
Time (β_1)	2.883×10^5	< 0.001	1.927×10^7	< 0.001	4.727×10^4	< 0.001	1.318×10^7	< 0.001
Pandemic Covid-19 (β_2)	-6.054×10^6	0.024	-4.203×10^8	0.022	-1.188×10^6	0.242	-4.684×10^8	0.044
R ²	0.661		0.669		0.269		0.272	
Adj. R ²	0.656		0.664		0.257		0.261	
F-Statistic	153.3		172.3		35.84		29.20	
Prob (F)	< 0.001		< 0.001		< 0.001		< 0.001	
Observations	132		132		132		132	

Source: Compiled and elaborated by the authors

4.3.2. Interpretation of Interrupted Time Series Forecasts (March 2020 Intervention)

The figure presents four Interrupted Time Series (ITS) forecast models that evaluate the impact of the March 2020 COVID-19 intervention on Morocco's textile trade performance. The analysis distinguishes between importation and exportation activities, both in terms of quantities and values. Using data from 2014 to 2020 as the pre-intervention period, the models estimate counterfactual trends—representing expected outcomes in the absence of the pandemic—and forecast post-intervention trajectories up to 2030. Confidence intervals at the 95 percent level are provided for both projections.

Figure N° 6: Interrupted Time Series analysis forecasts

Source: Compiled and elaborated by the authors

Importation Trends

In the importation series, the pre-2020 data indicate a steady increase in both the quantity and value of textile imports, reflecting Morocco's growing integration into global supply chains. The immediate downturn observed in early 2020 coincides with the onset of the pandemic and represents a clear negative step change resulting from global supply chain disruptions, trade restrictions, and temporary factory closures. Following this decline, the post-intervention forecasts demonstrate a gradual but robust recovery. The projected path of import quantities rises faster than the counterfactual baseline, suggesting that import activity not only rebounded but also entered an accelerated growth phase after 2021. This pattern implies that Moroccan textile firms adapted by expanding input sourcing to meet the resurgent export demand, consistent with a broader shift toward resilience-building and production reorganization. The confidence intervals widen over time, reflecting growing forecast uncertainty typical of long-term projections.

Import values follow a similar trajectory. The decline observed in 2020 is followed by a significant recovery, with the post-intervention forecast surpassing the no-pandemic counterfactual path. This divergence indicates that the unit value of imported textile goods increased, likely due to higher international prices, logistics costs, and a possible reorientation toward higher-quality intermediate goods. The results support the interpretation that Morocco's textile industry has pursued qualitative upgrading of its input base since the pandemic, aligning with its industrial modernization policies.

Exportation Trends

The exportation series shows a comparable pattern, albeit with more volatility. Export quantities experienced a sharp contraction in early 2020, reflecting the collapse of external demand from key European markets during lockdowns. The subsequent rebound is gradual but steady, with forecasted quantities exceeding the counterfactual trajectory from 2022 onward. This suggests that the Moroccan textile sector quickly restructured production and diversified markets, including the shift toward the manufacture of personal protective equipment and medical textiles during the pandemic period. The increasing slope of the forecast line indicates acceleration in export activity, consistent with the reopening of global markets and the reestablishment of supply links.

In contrast, export values display a slower recovery relative to quantities. While exports resumed after 2021, the observed data and forecasted trends suggest that the value of exports remained below the pre-pandemic counterfactual path. This pattern may indicate margin compression or a shift toward lower-priced product categories in the recovery phase. It also reflects global price volatility and intensified competition in post-COVID apparel markets. The relatively narrow confidence intervals show that the model predicts stable growth in export value over the medium term, though at a more moderate pace than expected prior to 2020.

Across all four series, the ITS results confirm that the COVID-19 pandemic caused a clear and statistically significant disruption in trade performance, followed by an adaptive recovery phase. The direction and magnitude of slope changes after the intervention point reveal structural adjustments within the textile sector. The rebound in trade quantities is stronger and faster than that in trade values, suggesting that Moroccan producers prioritized maintaining production volumes and market presence even at the cost of reduced unit margins. This dynamic aligns with resilience-oriented behavior commonly observed in export-dependent industries after systemic shocks. The divergence between import and export recoveries also indicates the persistence of input dependence, as firms continued to rely on imported materials for production revival.

From an econometric perspective, the ITS models capture both the short-term impact and the longer-term trend shifts induced by the pandemic. The negative step effects in 2020 confirm the immediate contraction, while the positive slope changes in the post-intervention period highlight sustained recovery momentum. The presence of upward-trending post-2021 forecasts in both import and export quantities implies a reversion not merely to pre-crisis levels but to an enhanced growth trajectory, demonstrating sectoral adaptability. The value series, by contrast, illustrate that the recovery in trade prices or margins lagged behind volume adjustments, revealing that profitability remains vulnerable to global cost pressures.

Economically, these results suggest that Morocco's textile industry responded to the COVID-19 crisis with significant adaptive capacity. The sector demonstrated resilience through diversification, technological adoption, and realignment of supply networks. However, the modest performance in export values emphasizes the need for continued investment in value chain upgrading and product innovation to ensure sustainable competitiveness. The post-crisis divergence between quantity and value growth further demonstrates the importance of transitioning from volume-based to knowledge- and design-based competitiveness.

The Interrupted Time Series analysis indicates that the COVID-19 crisis initially produced a

sharp contraction in Morocco's textile trade but was followed by a sustained recovery. The upward post-intervention trajectories for both imports and exports demonstrate that the sector not only recovered but entered a phase of accelerated structural adjustment. Nonetheless, the gap between quantitative recovery and value stagnation highlights underlying challenges related to product upgrading and margin optimization. The evidence suggests that Morocco's textile industry has emerged from the pandemic more resilient, yet still dependent on continued innovation and policy support to consolidate its position within global value chains.

Overall, the empirical findings provide substantial support for the proposed research hypotheses. Hypothesis H1 is confirmed, as the Interrupted Time Series analysis reveals a statistically significant immediate structural break in Morocco's textile imports following the onset of the COVID-19 pandemic. Hypothesis H2 is partially confirmed, since the pandemic produced a significant negative effect on textile export values, whereas the structural break observed in export quantities was not statistically significant. Finally, Hypothesis H3 is confirmed, as the positive post-intervention trajectories indicate a progressive recovery of the sector, reflecting the adaptive capacity and resilience of Morocco's textile industry despite the severe disruption generated by the COVID-19 crisis.

5. Discussion

This study examined monthly time series data on Morocco's textile imports and exports (quantities and values) for the period 2014–2024. Using an Interrupted Time Series (ITS) framework. The analysis assessed the impact of the COVID-19 outbreak in March 2020 on both imports and exports in textile industry.

Overall, the evolution of Morocco's textile trade indicators shows a noticeable inflection associated with the COVID-19 crisis. Before March 2020, both imports and exports followed a stable upward trend driven by supported by demand from European partners and the progressive modernization of local production capacity. The pandemic initially caused a sharp contraction due to border closures decision undertaken by Moroccan authority, supply-chain disruptions, and the reallocation of production toward sanitary textiles. However, the post-2020 period marked a rapid recovery and consolidation phase, supported by government incentives and measures, renewed European demand, and also the strategic repositioning of Moroccan firms within nearshoring networks. This rebound reveals the resilience and adaptive capacity of the Moroccan textile industry, which leveraged its geographic proximity, integrated logistics infrastructure, and flexible production model to regain competitiveness in global value chains. The upward post-intervention trend observed in the ITS analysis thus reflects not only cyclical recovery but also structural transformations linked to digitalization, sustainability initiatives, and the rise of regional industrial integration.

Further, the COVID-19 pandemic represented one of the most disruptive global shocks to the textile and apparel industry in modern history. Across both advanced and developing economies, the crisis revealed deep structural vulnerabilities in terms of production networks, labor systems, and trade dependencies to developed countries (Chakraborty & Biswas, 2020). Yet, it also accelerated a wave of digital transformation and industrial adaptation that has reshaped the organization of textile value chains—particularly in emerging manufacturing hubs such as Morocco, where firms rapidly adopted digital solutions and Industry 4.0 technologies to maintain competitiveness and resilience (El Maalmi et al., 2022).

Initial pandemic waves in early 2020 experienced a rapid contraction in textile manufacturing as lockdowns decision, mobility restrictions across countries, and border closures interrupted global trade flows. Several studies conducted in this regard show that supply chains linking Asia to Europe and North Africa were abruptly fragmented, causing order cancellations, delivery delays, and inventory surpluses (Chakraborty & Biswas, 2020)). In Morocco, the pandemic's immediate effect was the suspension of export operations to European partners, severely affecting small and medium-sized enterprises (SMEs) dependent on subcontracting relationships. The disruption of logistics and transport infrastructure intensified the shock, particularly in ports and inland supply routes, exposing the fragility of Morocco's export model (Jelti et al., 2023).

Despite this severe downturn, Moroccan firms demonstrated high adaptive capacity and resilience towards pandemic crisis. Many quickly reallocated productions toward sanitary textiles—especially masks and personal protective equipment—to meet urgent domestic and international demand. This strategic shift not only stabilized short-term revenues but also showcased the flexibility and responsiveness of Morocco's vertically integrated textile clusters. Comparable adaptive behavior was documented in other emerging economies, where the reconfiguration of production toward health-related goods temporarily mitigated the economic collapse in apparel exports (DEHBI, 2021).

A major consequence of the pandemic was the acceleration of digital transformation within manufacturing. In Morocco, empirical studies revealed that the crisis served as a catalyst for the adoption of Industry 4.0 technologies such as RFID tracking, smart logistics, and data-driven production planning. These innovations were not only instrumental in maintaining operations under mobility restrictions but also enhanced traceability and sustainability performance (El Maalmi et al., 2022); (DEHBI, 2021). Similarly, global research indicates that digitalization—ranging from automation and IoT to blockchain—has become the central pillar of resilience strategies in the post-COVID textile sector).

The crisis triggered a fundamental rethinking of global sourcing strategies. The vulnerability of long, Asia-centered supply chains prompted European fashion brands to accelerate nearshoring—relocating production closer to consumer markets to minimize transport risk and lead times. Morocco has emerged as one of the key beneficiaries of this strategic realignment. With its geographic proximity to Europe, competitive labor costs, and modern logistics infrastructure, Morocco is consolidating its position as a regional textile hub integrated into European value chains (Abous et al., 2021)). This shift represents not merely a cyclical rebound but a structural repositioning of Morocco within the global apparel map.

The pandemic has also heightened the urgency of sustainable production models. Moroccan studies indicate that firms are increasingly embedding circular economy principles—such as textile recycling, eco-design, and energy efficiency—into their recovery strategies (El Maalmi et al., 2022). Globally, research confirms that sustainability is now a key competitive factor, with COVID-19 acting as a moral and strategic inflection point toward greener supply chains. For Morocco, this transition aligns with national policy objectives promoting low-carbon manufacturing and renewable energy integration.

The pandemic's socioeconomic toll on Morocco's textile workforce was substantial, particularly among informal and low-wage employees. Factory closures, order cancellations, and reduced working hours caused temporary unemployment spikes and income losses. However, government-supported wage subsidies and SME recovery programs mitigated part of this shock (Sakib & Rahman, 2024)). In the long run, automation and digitalization are likely to transform the nature of employment in the sector, necessitating new skills and continuous

learning frameworks (Rhouiri et al., 2023).

Ultimately, the COVID-19 crisis served as a catalyst for structural transformation. Rather than reverting to pre-pandemic configurations, Morocco's textile industry has emerged with enhanced digital maturity, improved supply-chain integration, and a stronger commitment to sustainability. These transformations have strengthened the sector's resilience and positioned Morocco as a key actor in a more regionalized and environmentally conscious global textile network (Slimani, 2021).

6. Limitations

This study draws on aggregated trade data to capture the performance of Morocco's textile sector. However, these indicators often blur important distinctions. Fluctuations in export value, for example, may reflect price inflation in raw materials and logistics rather than genuine recovery in production or employment. Likewise, combining fast-fashion manufacturing, technical textiles, and PPE within a single category conceals the very different trajectories of these subsectors during the pandemic.

Although the interrupted time series design effectively detects structural changes around the COVID-19 shock, it cannot isolate its causes. The observed break coincided with several overlapping phenomena—factory repurposing for PPE, temporary fiscal and wage measures, and shifts in European demand. In the absence of detailed covariates such as order cancellations, freight costs, or retail indices, the model captures temporal association rather than pure causation. The post-2020 recovery observed in textile trade flows should be interpreted with caution. The industry is currently undergoing deeper transformations driven by nearshoring, sustainability standards, and technological upgrading. Linear forecasts over a ten-year horizon inevitably overlook these discontinuities. The ITS model, therefore, provides a description of short-term adaptation and resilience, but not a definitive projection of Morocco's long-term textile competitiveness.

7. Conclusion

The interrupted time series (ITS) analysis conducted in this study provides evidence that the COVID-19 containment measures, and their gradual relaxation, fundamentally reshaped the trajectory of Morocco's textile trade between 2020 and 2022. During the most acute phase of the crisis, the Moroccan industry experienced a sharp and statistically significant contraction in both imports and exports. This decline was driven by the unavoidable consequences of border closures, global supply chain disruptions, and the temporary collapse in international demand—particularly from our key European partners. These conditions exposed the sector's structural vulnerabilities but also revealed the critical importance of agility, innovation, and regional integration in ensuring long-term competitiveness.

As restrictions were progressively eased and global mobility resumed, the ITS findings revealed a pronounced and sustained rebound across trade indicators. This recovery went far beyond a cyclical return to pre-pandemic levels; it reflected a profound structural realignment within Morocco's textile and apparel ecosystem. Firms across the value chain demonstrated remarkable resilience—rapidly reorienting production capacities, embracing digital technologies, and optimizing logistics systems to meet shifting international demand. This period marked the emergence of a new competitive model, one rooted in operational flexibility, sustainability, and technological modernization (Hmamed et al., 2023); (El Maalmi et al.,

2023); (Tam & Lung, 2022).

The post-pandemic expansion of the sector has confirmed Morocco's growing role as a strategic hub for Euro-Mediterranean nearshoring. By capitalizing on its geographic proximity, modern infrastructure, and skilled workforce, Morocco has positioned itself as a reliable and agile partner for global brands seeking resilient, sustainable, and regionally integrated supply chains (Smouh et al., 2022); (El Maalmi et al., 2023); (Martín, 2004). The transformation observed through the ITS analysis reflects not only the strength of the textile industry itself but also the effectiveness of national industrial policies that prioritized modernization, digital transition, and sustainable development.

Today, Morocco's textile industry stands at the forefront of industrial renewal—more resilient, technologically advanced, and environmentally conscious than ever before. The lessons of the COVID-19 crisis have been translated into tangible reforms, strategic investments, and a renewed commitment to value creation. This trajectory reaffirms our collective vision of a Moroccan textile sector that is not only globally competitive but also a key driver of inclusive growth, innovation, and sustainable prosperity for the decades to come.

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