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Manufacturing Sector performance in Morocco: What Role Do Exchange Rate Fluctuations Play?

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Abstract

This study investigates the dynamic relationship between the real effective exchange rate (REER) and manufacturing value added (MAV) in Morocco, with a particular emphasis on the impact of exchange rate fluctuations on the competitiveness and growth of the manufacturing sector. The objective is to examine how variations in the REER, alongside internal and external economic determinants, influence the evolution of MAV. Additionally, the study explores the interdependencies among these variables to assess the long-term economic sustainability of Morocco's manufacturing sector. To achieve this, an Autoregressive Distributed Lag (ARDL) model and a Restricted Error Correction Model (RECM) are employed to analyze both short- and long-term relationships between key macroeconomic variables, including REER, Foreign Direct Investment (FDI), interest rates, human capital, and economic openness. The empirical analysis relies on data sourced from reputable institutions such as the World Bank (WDI) and Bank Al-Maghrib (BAM) over the period 1995–2023. The results reveal intricate interactions between the REER and MAV, underscoring the critical role of exchange rate stability in fostering competitiveness and sustainable growth in the manufacturing sector. Based on these findings, the study offers policy recommendations aimed at enhancing economic governance and strengthening the resilience of Morocco's manufacturing industry.

Keywords: *Real Effective Exchange Rate, Manufacturing Value Added, Competitiveness, Economic Growth, Morocco, ARDL, Error Correction Model.*

Introduction

The manufacturing sector is a key driver in the evolution of modern economies. It is not only the growth engine for many nations but also a major lever in economic transformation. Over the decades, economies have undergone a major transition, shifting from a heavy reliance on primary sectors, such as agriculture and the exploitation of raw materials, to economic models more focused on industry and manufacturing production. This transformation has enabled deeper economic diversification, modernization of infrastructures, and enhanced resilience of countries in the face of economic crises. The manufacturing sector thus plays a decisive role in absorbing economic shocks by providing a stable industrial base that helps economies better manage external disruptions and strengthen their resilience to crises(Coe & Yeung, 2015; Dalenogare et al., 2018; El Kadri et al., 2025; Lall, 1992; Sebayang et al., 2025).

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Furthermore, through its role in job creation, innovation, and technological development, the manufacturing sector helps countries reinvent themselves, modernize their infrastructures, and position themselves competitively in international markets. This dynamic has accelerated economic diversification by supporting not only the growth of related industries but also facilitating the emergence of new production sectors in high-value-added fields such as advanced technologies, renewable energy, and specialized services(Buccieri et al., 2020; Golovko & Valentini, 2011; Handoyo et al., 2023).

Morocco's case is no exception to this rule and fully illustrates this transformation dynamic. In recent years, the country has undertaken structural reforms to strengthen its manufacturing sector by revising its historically agriculture-based economic model. This economic diversification process has allowed Morocco to reduce its dependence on raw materials and shift towards key industrial sectors such as automotive, aeronautics, and electronics. Through these efforts, the country has gradually positioned itself as a major regional hub in industrial production, attracting foreign investments and contributing to the economic competitiveness of the region(Alba & Todorov, 2018; Arabi et al., 2024; Nait Abd et al., 2025; Oubrahim et al., 2023).

To achieve this, Morocco must maximize the use of all available levers to improve its competitiveness, taking into account not only political and social factors such as stability, innovation, human resources, and infrastructure, but also economic elements that influence the manufacturing sector. Among these levers, the management of macroeconomic indicators, and particularly the exchange rate, plays a central role in the dynamics of trade, the competitiveness of manufactured exports, and the management of financial risks(Mohamed, Elmoukhtar, et al., 2024; Mohamed, Hjouji, et al., 2024). It is therefore essential to understand the dynamics between this indicator and the evolution of the manufacturing sector in Morocco. From this perspective, we raise the following question: **what is the impact of the exchange rate on the evolution of the manufacturing sector in Morocco?**

This study aims to explore these processes in depth and provide relevant insights into the posed research question. To fully understand its implications, it is essential to carefully analyze the mechanisms underlying them. The specific objectives of this study are as follows:

- To analyze the effect of exchange rate fluctuations on the performance of the manufacturing sector in Morocco, focusing on its contribution to the country's GDP and competitiveness.
- To evaluate the impact of trade openness on the performance of the Moroccan manufacturing sector, exploring how international trade influences the development of the sector.
- To determine the role of foreign reserves in the evolution of the performance of the manufacturing sector in Morocco, considering how changes in foreign exchange reserves affect the growth and stability of the manufacturing sector.

To achieve these objectives, our work will be divided into four main sections. The first section will be a literature review, where we will frame the theoretical background of the topic and identify the scientific gap in existing research. The second section will present the methodology, detailing the variables used in the study as well as the methodological approach and model. The third section will present the results of the study, while the final section will be dedicated to the conclusion, where we will summarize the main results and provide recommendations.

Literature Review

Exchange rates serve as a fundamental determinant of manufacturing sector performance, a relationship widely explored in the economic literature. This connection has been examined from various angles, including its direct impact on overall sector performance, as well as its effects on manufacturing exports, employment, production, and the survival of SMEs. Studies emphasize the crucial role of exchange rate fluctuations in the competitiveness, productivity, and sustainability of the manufacturing sector.

From a first perspective, Otokini et al. (2018) explored the effects of exchange rate deregulation on manufacturing output in Nigeria from 1980 to 2016. Using the normalized cointegration technique, they found a non-significant positive long-run effect of exchange rate fluctuations on manufacturing output, while establishing a unidirectional causal relationship running from exchange rates to manufacturing output. Consequently, they emphasized the importance of exchange rate stabilization through appropriate policy tools and the promotion of export diversification to enhance foreign exchange inflows. Similarly, Falaye et al. (2018) analyzed Nigeria's manufacturing sector from 1990 to 2014, employing tests like Unit Root, Johansen co-integration, Granger causality, and the Error Correction Model. Their findings revealed that the devaluation of the Naira negatively affected manufacturing performance, while inflation rates and capacity utilization had positive effects. In contrast, exchange rates, imports, and foreign direct investment had a detrimental impact on the sector. These findings reinforced the significance of exchange rate management in the manufacturing sector’s performance. Furthermore, Sulaimon et al. (2020) expanded the scope by studying exchange rate fluctuations from 1990 to 2020. Their ARDL model analysis showed that exchange rate fluctuations and raw material imports had a negative effect on manufacturing output, whereas manufacturing capacity utilization had a positive impact. Based on these results, the authors recommended policies aimed at stabilizing exchange rates, restricting imports, and improving infrastructure to bolster Nigeria’s manufacturing sector competitiveness. Together, these studies highlight the crucial role of exchange rate stability in shaping the manufacturing sector's performance in Nigeria.

From a second perspective, the relationship between exchange rates and manufacturing exports has also been extensively studied, revealing varied effects across regions and export categories. In this context, Hunegnaw (2017), for example, examines how real exchange rates influence manufacturing exports in 10 East African countries. The study finds that long-term depreciation of the Real Effective Exchange Rate boosts manufacturing exports, particularly in labor-intensive and low-skill sectors, while negatively affecting high-skill, technology-intensive exports. However, the study concludes that economic growth plays a more significant role than currency devaluation in driving long-term export performance. Similarly, Sugiharti et al. (2020) investigates the impact of exchange rate volatility on Indonesia’s primary commodity exports to several countries, including the U.S., South Korea, Japan, India, and China. The study reveals that exchange rate volatility negatively affects exports, particularly commodities such as ores, chemicals, rubber, and pulp paper. Notably, both short-term and long-term impacts are observed, with exports to China mainly affected by plastics and India facing significant effects across multiple export categories. In contrast, Ekanayake et al., (2012) focuses on the effect of exchange rate volatility on South Africa's trade with the European Union over the period from 1980 to 2009. The study’s findings suggest that exchange rate volatility negatively impacts both exports and imports, although domestic economic activity and foreign exchange reserves positively influence imports. This provides a nuanced view of the mixed effects of exchange rate volatility on trade, as both imports and exports are also negatively impacted by relative prices and volatility. Furthermore, Ekanayake & Dissanayake (2022) extends this analysis by exploring the effects of real exchange rate volatility on U.S. exports to the BRICS countries (Brazil, Russia, India, China, and South Africa). The findings show that, in the long run, exchange rate volatility negatively impacts exports, although the short-term effects vary depending on the estimation technique used. Moreover, the study highlights the influence of foreign economic activity, which positively impacts exports, while emphasizing the persistent negative effects of exchange rate volatility in the long term across these countries. Finally, Grobar (1993) examines the impact of real exchange rate uncertainty on manufacturing exports from less-developed countries (LDCs). The study found that exchange rate uncertainty negatively impacted certain categories of manufactured goods exports from these countries.

Considering another angle, the connection between exchange rates and manufacturing performance is also influenced by elements like employment and production levels. Various studies have addressed this issue, such as Dekle (1998) emphasizes the significant effect of real exchange rate changes on Japanese manufacturing employment. His analysis of industry-level data from 1975 to 1994 shows that fluctuations in exchange rates, through changes in foreign prices, notably affect long-term employment in Japan's manufacturing sector. Interestingly, the study finds no difference in responsiveness between high and low export sectors to exchange rate changes, while introducing industry-specific real exchange rates to refine the measure of competitiveness. In a similar vein, Tkalec & Vizek (2009) examine the impact of macroeconomic policies, including exchange rate changes, on manufacturing production in Croatia across 22 industrial sectors. Their findings reveal that exchange rate depreciation positively impacts low-tech industries, while high-tech industries are adversely affected. The study underscores the influence of macroeconomic conditions, such as fiscal policies and consumption, particularly on low-tech sectors. Furthermore, Lotfalipour et al. (2013) focus on the effect of exchange rate fluctuations on manufacturing sector investment in Iran from 1995 to 2009. Using industry-level data and the Generalized Method of Moments (GMM) for estimation, the study finds a statistically significant negative relationship between exchange rate movements and investment in Iran's manufacturing sector. This suggests that exchange rate instability discourages industrial investment, emphasizing the importance of exchange rate stability for fostering investment in the manufacturing sector.

Lastly, regarding the ambiguous or insignificant effects of exchange rates, Zia & Mahmood (2013) analyzed the impact of exchange rate devaluation on Pakistan's manufacturing exports. While they found that devaluation initially boosted exports, the negative effects of exchange rate volatility gradually eroded this growth. Using a partner-country data comparison technique, the authors identified significant over invoicing patterns, indicating the need for policy adjustments to address these challenges. Similarly, Nyahokwe & Ncwadi (2013) examined the effect of exchange rate volatility on South Africa's aggregate export flows from 2000 to 2009. By employing GARCH and ARDL models, the study concluded that no statistically significant relationship existed between exchange rate volatility and South African exports.

The impact of exchange rates on the performance of Morocco's manufacturing sector remains insufficiently explored. To date, only one significant study, conducted by Labrar & Marhoum (2023) has addressed this issue, focusing on the period from 1988 to 2019 and analyzing the effects of real exchange rate misalignments on the Moroccan manufacturing industry. The lack of substantial literature on this subject represents a notable gap in the scientific community. In this context, the present research aims to thoroughly examine the influence of exchange rates on the performance of Morocco's manufacturing sector. This study seeks to deepen the understanding of exchange rate effects, considering both sector-specific characteristics and the implications of recent economic reforms in the country. Building on the identified gap in the literature, the current research aims to investigate the key determinants influencing the performance of Morocco's manufacturing sector, with a particular focus on the role of exchange rates. The following hypotheses are formulated to explore both internal and external factors that contribute to sectoral growth and performance:

Hypothesis 1: *External factors, such as the real effective exchange rate and trade openness, directly influence manufacturing value added in Morocco.*

Hypothesis 2: *Internal factors, such as investment in human capital, have a positive and significant impact on manufacturing value added in Morocco.*

Hypothesis 3: *The interaction between internal and external factors contributes to explaining the dynamics of the manufacturing sector in Morocco.*

Guided by these hypotheses, the empirical analysis will test their validity by examining relevant data and conducting econometric modeling, aiming to provide insights into the actual impact of internal and external factors on the performance of Morocco's manufacturing sector.

Methodology

The main objective of this study is to analyze the dynamic relationship between the real effective exchange rate (REER) and the manufacturing value added (MAV) in Morocco, with a particular focus on the impact of the REER on competitiveness and growth in the manufacturing sector. The study aims to understand how exchange rate fluctuations, along with other internal and external economic factors, influence the evolution of manufacturing value added. Moreover, it explores the links between these variables to evaluate the economic sustainability of the manufacturing sector in Morocco. The goal is to provide practical recommendations for policymakers to improve economic management.

Data description

The analysis period covers the years from 1995 to 2023, allowing for the capture of major economic developments, including global economic crises, fluctuations in international markets, as well as phases of growth and recession that have characterized the Moroccan economy. Morocco was chosen as the geographical area of study due to its central role in North Africa and its interactions with global markets.

The analysis is based on a study of the relationships between several economic variables, namely:

Variable	**Symbol**	**Source**
Manufacturing, added value	MAV	**WDI**
Exchange rate	REER	**WDI**
Labor	LB	**WDI**
Interest Rate	INT	**BAM**
Foreign Direct Investment	FDI	**WDI**
Openness	OP	**WDI**
Human Capital	MCU	**WDI**

Table 1: Variables description

The data used in this analysis comes from reliable sources such as the World Bank (via the World Development Indicators - WDI) and Bank Al-Maghrib (BAM). These databases provide accurate and up-to-date information on the key economic indicators required for this study. The analysis was conducted using R software, which enables precise estimation of ARDL and ECM models, as well as conducting cointegration tests and statistical diagnostics.

Model and methodological approach

Since the study variables exhibit mixed integration orders some variables are stationary at order 0, while others are non-stationary at order 1, an ARDL (AutoRegressive Distributed Lag) model is used to analyze both short- and long-term relationships between these variables. The ARDL model is particularly suitable for handling variables integrated at orders 0 and 1, without the need for preliminary cointegration tests.

For a more robust and detailed analysis, a Restricted Error Correction Model (RECM) is specified based on the ARDL model. This model captures short-term dynamics and explores the impact of REER adjustments on MAV, while considering other economic variables such as interest rates, FDI and human capital. The RECM model is restricted to better identify long-term relationships and limit the complexity of the results.

The RECM model used in this study can be expressed as follows:

$$MAV_t = \alpha_0 + \gamma ECT_{t-1} + \sum_{i=1}^{p_1} \beta_i \, MAV_{t-i} + \sum_{j=1}^{p_2} \beta_j \, REER_{t-j} + \sum_{k=1}^{p_3} \beta_k \, LB_{t-k} + \sum_{l=1}^{p_4} \beta_l \, INT_{t-l} + \sum_{m=1}^{p_5} \beta_m \, FDI_{t-m} + \sum_{n=1}^{p_6} \beta_n \, OP_{t-n} + \sum_{n=1}^{p_7} \beta_o \, MCU_{t-o} + \varepsilon_t$$

In addition, cointegration tests have been conducted to ensure that the selected variables exhibit long-term relationships, thus validating the use of the ARDL model. Statistical diagnostics have also been carried out to verify the robustness of the model, taking into account potential issues of multicollinearity, heteroscedasticity, and autocorrelation.

Results

Descriptive Analysis

The results of the descriptive analysis of the variables provide several key insights into the distribution and variability of the data used in this study.

	MAV	REER	LB	INT	FDI	OP	MCU
nbr.val	2.900000e+01	29.000	29.000	29.000	29.000	29.000	29.000
nbr.na	0.000000e+00	0.000	0.000	0.000	0.000	0.000	0.000
min	7.269244e+09	95.382	47.700	1.500	0.664	45.672	8.653
max	2.163802e+10	114.853	53.223	7.000	6.444	101.132	12.123
range	1.436878e+10	19.470	5.523	5.500	5.780	55.460	3.469
median	1.504865e+10	103.349	52.463	3.250	1.948	68.844	9.995
mean	1.381312e+10	103.808	51.267	3.500	2.157	66.432	10.103
var	2.247519e+19	30.440	3.750	2.147	1.473	187.371	0.817

std.dev	4.740801e+09	5.517	1.936	1.465	1.214	13.688	0.904
normtest.p	2.200000e-02	0.120	0.000	0.001	0.003	0.097	0.262

Table 2: Descriptive data analysis

The descriptive statistics for the different variables show considerable variability between them, reflecting significant economic fluctuations over the period studied. For example, the range of variation for RRSP is 19.470, while that for OP is 55.460, indicating substantial differences in the evolution of these variables over the period. The range of MAV is particularly wide, reaching 1.44×10^{10}, reflecting a wide disparity in manufacturing value added over time. This suggests periods of strong growth and recession in the manufacturing sector.

The results of the normality tests reveal that only three variables - REER, OP and MCU follow a normal distribution, with p-values greater than 0.05. On the other hand, for other variables such as MAV, INT and FDI, the p-values are below 0.05, indicating a non-normality in the data.

This non-normality, often caused by extreme values or outliers, suggests that a logarithmic transformation would be necessary to make the distributions more symmetrical and stabilize the variance, thus enabling a more robust statistical analysis.

Correlation Analysis

The correlations between the Manufacturing Added Value dependent variable and the independent variables show diverse relationships. MAV is strongly negative with REER (-0.831), LB (-0.867), and INT (-0.805), indicating that currency appreciation, low labor and high interest rates are associated with a reduction in manufacturing value added. In contrast, MAV has a strong positive correlation with OP (0.889), suggesting that openness to foreign investment favors manufacturing growth. The correlation between MAV and FDI is weak (-0.097), indicating little or no significant impact of foreign direct investment on manufacturing value added in this context. Moreover, MAV is positively correlated with MCU (0.661), suggesting that better human capital promotes greater manufacturing value added.

The correlations between REER, LB and INT range from 0.666 to 0.718, indicating moderate to strong links, suggesting common macroeconomic influences. Furthermore, the correlation between LB and INT is 0.690, reflecting a significant but not excessive relationship. Finally, the correlation between OP and MCU is 0.579, which remains in a moderate range, safe for analysis. Overall, these correlations are sufficiently low to enable reliable analysis, without any major risk of collinearity.

	MAV	**REER**	**LB**	**INT**	**FDI**	**OP**	**MCU**
MAV	1.000	-0.831	-0.867	-0.805	-0.097	0.889	0.661
REER	-0.831	1.000	0.666	0.718	-0.112	-0.789	-0.543
LB	-0.867	0.666	1.000	0.690	0.183	-0.761	-0.658
INT	-0.805	0.718	0.690	1.000	-0.151	-0.684	-0.322
FDI	-0.097	-0.112	0.183	-0.151	1.000	-0.022	-0.299
OP	0.889	-0.789	-0.761	-0.684	-0.022	1.000	0.579
MCU	0.661	-0.543	-0.658	-0.322	-0.299	0.579	1.000

Table 3: Correlation analysis

Stationarity test

Applying the unit root test to the five series. Numerous unit root tests exist for this purpose. The pioneering work in this field includes those of Fuller (1976) and Dickey & Fuller (1979)., we find that the p-value of the ADF test is less than 5% for the LMAV, LREER, LINT, LLB and LMCU series, indicating that these series are stationary after first difference. This implies that their order of integration is (1). On the other hand, the LFDI and LOP series are stationary at the level, meaning that they do not require differentiation and are integrated of order (0).

This diversity in integration orders, with some series being stationary at level and others after first differencing, justifies the use of the ARDL model in our case.

Variables	**Observations**	**Order of integration**
LMAV	Non-stationary	I(1)
LREER	Non-stationary	I(1)
LLB	Non-stationary	I(1)
LINT	Non-stationary	I(1)
LFDI	Stationary	I(0)
LOP	Stationary	I(0)
LMCU	Non-stationary	I(1)

Table 4: Stationarity test

RECM Model

The estimation of the RECM, which is at the heart of this study, involves an initial step of estimating the ARDL model and testing for cointegration. This step enables us to determine the appropriate lag structure and identify the cointegrating relationships between the variables. Once these aspects have been validated, we proceed to estimate the RECM, which enables us to analyze both short-term adjustments and long-term relationships between the series studied.

Cointegration Test

The Bounds F-test is used to determine the presence of a cointegrating relationship in an ARDL model.

Test	**F-Statistic**	**P-Value**
	7.8273	1e-06

Table 5: Bounds test

The p-value obtained for the test is 1e-06, well below the 5% significance level, allowing us to reject the null hypothesis of no cointegration with a high degree of certainty. This indicates that the variables in the model are cointegrated, i.e. that they evolve jointly towards a long-term equilibrium. This stable long-term relationship justifies the use of the RECM, which enables us to analyze short-term adjustments while taking these long-term dynamics into account.

Model Results

The results of the RECM estimation are presented in Table 6, providing a detailed analysis of short- and long-term dynamics.

	Estimate	Std. Error	t value	Pr(>|t|)
Δ(L(MAV, 1))	0.76876	0.09428	8.154	1.81e-06 ***
Δ(REER)	-2.31379	0.40720	-5.682	7.51e-05 ***
Δ(L(REER, 1))	3.56086	0.54897	6.486	2.05e-05 ***
Δ(LB)	3.35391	0.62653	5.353	0.000131 ***
Δ(L(LB, 1))	-0.50367	0.62459	-0.806	0.434517
Δ(FDI)	-0.12905	0.01496	-8.627	9.70e-07 ***
Δ(L(FDI, 1))	-0.05848	0.01284	-4.556	0.000540 ***
Δ(MCU)	0.29486	0.11862	2.486	0.027317 *
Δ(L(MCU, 1))	-0.00690	0.11365	-0.061	0.952509
Δ(INT)	-0.30632	0.05335	-5.742	6.80e-05 ***
Δ(L(INT, 1))	0.69182	0.09096	7.605	3.87e-06 ***
Δ(OP)	-0.09150	0.01860	-4.920	0.000280 ***
Δ(L(OP, 1))	-0.07970	0.01891	-4.215	0.001011 **
ect	-2.06389	0.17719	-11.648	2.98e-08 ***

Table 6: Coefficient estimates
Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

The results of the analysis show several factors influencing MAV, and each variable has a specific impact on the evolution of this sector. Specifically, Among the most significant variables, past manufacturing value added (Δ(L(MAV, 1))) plays a key role, with a coefficient of 0.7688 and a p-value of less than 0.001. This indicates that the evolution of manufacturing output in the previous period has a significant positive effect on current output. This result underlines the importance of past dynamics in the growth of the manufacturing sector.

On the other hand, the REER has a negative impact on MAV. An appreciation of the currency increase in the REER leads to a reduction in manufacturing output, with a coefficient of -2.3138 and a p-value of 9.550e-05. This suggests that the competitiveness of manufacturing exports is reduced by currency appreciation, negatively affecting the sector. However, this effect is mitigated by lagged adjustment, as shown by the variable Δ(L(REER, 1)), with a coefficient of 3.5609, indicating a positive effect on MAV when exchange rate adjustments occur after a certain period.

Additionally, Labor also has a significant and positive effect on manufacturing output. A 1% increase in the percentage of workers in the economy leads to a 3.3539% increase in manufacturing value added, showing that labor is an essential factor in boosting production in this sector. Similarly, FDI shows a negative effect, with a coefficient of -0.1290, indicating that foreign investment could have competitive effects on the local manufacturing sector, or even move to other sectors.

Moreover, the INT also affects manufacturing output. A rise in interest rates results in an immediate 0.3063% reduction in manufacturing value added, reflecting the negative impact on investment and credit costs for the sector. However, a delayed effect is observed with Δ(L(INT, 1)), where an increase in interest rates in the previous period generates a positive effect on manufacturing output, with a coefficient of 0.6918.

In terms of economic openness, OP shows a negative effect on manufacturing output, with a coefficient of -0.0915, suggesting that increased international competitiveness may reduce local production. This effect is also visible with a lag, with a coefficient of -0.0797 for Δ(L(OP, 1)), indicating that the impact of economic openness is felt with some delay.

Finally, analysis of MCU, measured by spending on health and education, shows a positive effect, albeit weaker than for other variables. A 1% increase in spending on health and education leads to a 0.2949% increase in manufacturing value added. This indicates that although improving human capital has a beneficial effect on manufacturing output, its impact remains limited compared to variables such as labor and interest rates.

The results suggest that manufacturing output is strongly influenced by structural factors, such as exchange rate adjustments, employment and interest rates. However, variables such as economic openness and foreign direct investment exert a negative impact, probably due to increased competition or the relocation of activities to other sectors. Investment in human capital, while having a positive effect, remains less powerful than other economic factors. A balance between these different variables is necessary to promote sustainable growth in the manufacturing sector.

Model diagnosis

The results of the RECM diagnostic tests are generally favorable to the model specification.

Test	**P-value**	**Conclusion**
Breusch-Godfrey test	0.0201	Serial autocorrelation
Breusch-Pagan test	0.3709	No heteroscedasticity
Jarque-Bera test	0.4781	Normally distributed residuals.

Table 7: Diagnostic tests

The p-value of 0.02017 observed in the Breusch-Godfrey test, below the 5% threshold, indicates autocorrelation in the model residuals. This means that the errors are not independent, which could compromise the precision of parameter estimates and the validity of statistical tests. To correct this autocorrelation, it would be useful to consider adjustments such as adding additional lags or adopting robust standard errors.

On the other hand, the Breusch-Pagan test, with a p-value of 0.3709, indicates the absence of heteroscedasticity, since the p-value is above the 5% threshold. This means that the error variance remains constant across observations, which is a good indicator of compliance with the model's assumption of homoscedasticity. This absence of heteroscedasticity reinforces the reliability of parameter estimates in this respect.

In the case of the Jarque-Bera test, with a p-value of 0.4781, the null hypothesis that the residuals follow a normal distribution is not rejected. This suggests that the model errors are normally distributed, which is essential for the validity of statistical tests based on the assumption of normality of the residuals, such as the t- or F-tests.

Autocorrelation correction

The autocorrelation correction makes the results more reliable by eliminating the bias that can occur when residuals are correlated over time.

	Estimate	Std. Error	t value	Pr(>|t|)
Δ(L(MAV, 1))	0.7687573	0.0822366	9.3481	3.911e-07 ***
Δ(REER)	-2.3137934	0.4176764	-5.5397	9.550e-05 ***
Δ(L(REER, 1))	3.5608571	0.6047345	5.8883	5.338e-05 ***
Δ(LB)	3.3539111	0.5442111	6.1629	3.416e-05 ***
Δ(L(LB, 1))	-0.5036681	0.4462118	-1.1288	0.2793972
Δ(FDI)	-0.1290494	0.0152788	-8.4463	1.228e-06 ***
Δ(L(FDI, 1))	-0.0584801	0.0155822	-3.7530	0.0024136 **
Δ(MCU)	0.2948590	0.1072320	2.7497	0.0165464 *
Δ(L(MCU, 1))	-0.0069005	0.0832089	-0.0829	0.9351707
Δ(INT)	-0.3063171	0.0312689	-9.7962	2.284e-07 ***
Δ(L(INT, 1))	0.6918177	0.0812450	8.5152	1.122e-06 ***
Δ(OP)	-0.0914965	0.0164048	-5.5774	8.960e-05 ***
Δ(L(OP, 1))	-0.0796981	0.0169789	-4.6940	0.0004198 ***
ect	-2.0638907	0.2050416	-10.0657	1.667e-07 ***

Table 8: Coefficient estimates after autocorrelation correction
Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

After correction, the p-values become more precise, and the coefficients of significant variables are better estimated, improving the robustness of the model’s conclusions. In the corrected results, variables such as Δ(L(LB, 1)) and Δ(L(MCU, 1)) remain insignificant, but others—like Δ(FDI), Δ(INT), and Δ(L(OP, 1))—are more significant, with very low p-values, suggesting stronger relationships with manufacturing value added (MAV).

Looking at exchange rate fluctuations, the results confirm a widely recognized economic theory: exchange rates are crucial for a country's competitiveness. As the heartbeat of the economy, they affect how attractive exports remain, how affordable imports are, and how competitive the manufacturing sector can be on the global stage. Our findings indicate that when the Moroccan dirham appreciates, the manufacturing sector suffers. Specifically, an increase in the REER reduces manufacturing value added, indicating that currency appreciation diminishes the competitiveness of Moroccan exports, slows down production, and hampers overall economic growth.

This pattern is not unique to Morocco. Similar findings have been observed in other economies facing currency fluctuations. For instance, Sulaimon et al. (2020) found that exchange rate fluctuations also hindered manufacturing output in Nigeria, while Falaye et al. (2018) highlighted the damaging effects of currency devaluation on the manufacturing sector. In line with these studies, our results suggest that there is a delicate balance between exchange rate policies and industrial growth. Lotfalipour et al. (2013) found that exchange rate instability discouraged industrial investment in Iran, as businesses were hesitant to expand in an unpredictable currency environment.

However, our analysis presents an interesting twist: while a strong dirham negatively impacts manufacturing in the short term, exchange rate adjustments over time can help stabilize the sector. As businesses adapt, they may adjust their strategies, diversify markets, or optimize production costs. This resilience is seen in studies like Hunegnaw (2018), who found that long-term depreciation of the REER boosted manufacturing exports in East Africa, especially in labor-intensive industries. Thus, while currency fluctuations create immediate challenges, manufacturers may eventually find ways to maintain their competitiveness through strategic adaptations.

Moreover, the link between exchange rates and manufacturing performance is also influenced by other factors, such as employment, FDI, and trade openness. Labor, unsurprisingly, plays a critical role. Our findings confirm that when employment rises, manufacturing value added increases as well. This aligns with Dekle (1998), who found a similar pattern in Japan's manufacturing sector, where exchange rate fluctuations significantly influenced employment levels. More workers equates to more production, a dynamic that policymakers must consider when addressing economic reforms.

Interestingly, the role of FDI in boosting Morocco's manufacturing sector is not as clear-cut. Instead of fostering industrial growth, foreign direct investment appears to be flowing into other sectors, leaving manufacturing behind. This observation echoes Ekanayake's (2012) study in South Africa, where exchange rate volatility negatively affected both imports and exports, despite foreign reserves. If FDI is bypassing the manufacturing sector, it may be time to adopt a more targeted approach, ensuring that foreign capital strengthens local production rather than fueling growth in other industries.

Finally, trade openness presents both opportunities and challenges. On one hand, greater international trade is expected to boost the manufacturing sector, yet our results suggest the reality is more complex. Increased competition from global markets may squeeze local industries, making it more difficult for them to grow. This is consistent with Sugiharti (2020), who found that exchange rate volatility hurt Indonesian exports, particularly in commodity-based industries. Similarly, Ekanayake (2022) observed that exchange rate instability negatively affected U.S. exports to BRICS countries. Thus, while trade openness can provide growth opportunities, it must be paired with policies that protect and strengthen domestic manufacturing, or local businesses may struggle to stay competitive.

Conclusion

Exchange rate fluctuations are more than just numbers on a financial report; they have real consequences for businesses, workers, and the overall health of our manufacturing sector. In our study, we sought to analyze the dynamic relationship between the REER and MAV in Morocco from 1995 to 2023, using a Restricted Error Correction Model. The results of our analysis shed light on how the REER impacts the competitiveness of Moroccan manufacturing exports, and consequently, the overall performance of the sector.

Our findings reveal that the relationship between the REER and manufacturing value added is significant but complex. The appreciation of the exchange rate, in particular, has a negative effect on the competitiveness of exports in the manufacturing sector, reducing the sector's contribution to the national economy. This effect, however, is not immediate but rather appears over a longer time horizon, suggesting that the impacts of exchange rate fluctuations need to be carefully managed to avoid long-term negative consequences.

In addition to exchange rate movements, other factors such as labor productivity, interest rates, and FDI were found to play crucial roles in shaping the growth of the manufacturing sector. While FDI has the potential to foster technological advancement and infrastructure development, its impact on manufacturing value added can be multifaceted, sometimes even exerting a negative influence due to the intensification of international competition.

Despite the crucial role of human capital, which supports the growth of the sector, our study suggests that labor quality and productivity are secondary factors in this dynamic, highlighting the need for broader structural reforms to unlock the full potential of the manufacturing industry. The results underscore the importance of a comprehensive economic policy that addresses not only exchange rate management but also labor market development, access to financing, and the fostering of innovation within the sector.

Based on the findings of our study, we offer the following recommendations for policymakers in Morocco to strengthen the manufacturing sector’s competitiveness:

Proactive Management of Exchange Rates: Policymakers must adopt a more flexible exchange rate management policy to mitigate the negative impacts of exchange rate appreciation on manufacturing exports. This approach would help maintain export competitiveness without undermining overall economic stability.

Investment in Human Capital and Skills Development: The Moroccan government should invest in vocational training and educational programs to enhance labor productivity. These investments would ensure that the manufacturing sector is supported by a highly skilled workforce, capable of driving innovation and improving productivity in line with global standards.

Facilitating Access to Competitive Financing: The government should facilitate access to low-cost financing for manufacturing firms, particularly for small and medium-sized enterprises. Targeted fiscal incentives and subsidies for research and development (R&D) could further enhance the sector’s ability to innovate and stay competitive.

Revised Foreign Direct Investment (FDI) Strategies: While FDI can contribute to technological advancement, the Moroccan government must reconsider its approach to attracting foreign investments. The focus should be on attracting FDI that supports local manufacturing capabilities and creates high-value jobs, rather than merely increasing competition from international firms.

Strengthening Infrastructure and Fostering Innovation: A focus on improving industrial infrastructure, alongside the promotion of new technologies such as automation and advanced manufacturing processes, would help Morocco's manufacturing sector increase its efficiency and global competitiveness.

In conclusion, the findings of this study highlight the complex interplay between exchange rate fluctuations and manufacturing performance in Morocco. The key to sustaining long-term growth in the manufacturing sector lies in careful management of exchange rate policies, targeted investments in human capital, and fostering an environment conducive to innovation. By aligning these strategies with broader economic reforms, Morocco can ensure that its manufacturing sector continues to play a vital role in driving economic diversification, job creation, and technological advancement, ultimately supporting its integration into the global economy.

References

Alba, J. M. D., & Todorov, V. (2018). How green is manufacturing? Status and prospects of national green industrialisation. The case of Morocco. *International Journal of Innovation and Sustainable Development*, *12*(3), 308. https://doi.org/10.1504/IJISD.2018.091519

Arabi, S., Bajjou, M. S., Chafi, A., & Hammoumi, M. E. (2024). The Implementation of Lean

Manufacturing Tools in Morocco: A Study on Small and Medium-Sized Enterprises. *2024 4th International Conference on Innovative Research in Applied Science, Engineering and Technology (IRASET)*, 1–6. https://doi.org/10.1109/IRASET60544.2024.10548803

Buccieri, D., Javalgi, R. G., & Cavusgil, E. (2020). International new venture performance: Role of international entrepreneurial culture, ambidextrous innovation, and dynamic marketing capabilities. *International Business Review*, *29*(2). Scopus. https://doi.org/10.1016/j.ibusrev.2019.101639

Coe, N. M., & Yeung, H. W.-C. (2015). *Global production networks: Theorizing economic development in an interconnected world* (p. 288). Scopus. https://doi.org/10.1093/acprof:oso/9780198703907.001.0001

Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. *International Journal of Production Economics*, *204*, 383–394. Scopus. https://doi.org/10.1016/j.ijpe.2018.08.019

Dekle, R. (1998). The yen and Japanese manufacturing employment. *Journal of International Money and Finance*, *17*(5), 785–801. https://doi.org/10.1016/S0261-5606(98)00026-6

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*, *74*(366), 427–431. https://doi.org/10.2307/2286348

Ekanayake, E. M., & Dissanayake, A. (2022). Effects of Real Exchange Rate Volatility on Trade: Empirical Analysis of the United States Exports to BRICS. *Journal of Risk and Financial Management*, *15*(2), Article 2. https://doi.org/10.3390/jrfm15020073

Ekanayake, E. M., Thaver, R. L., & Plante, D. (2012). *The Effects of Exchange Rate Volatility on South Africa's Trade with the European Union* (SSRN Scholarly Paper 2094540). Social Science Research Network. https://papers.ssrn.com/abstract=2094540

El Kadri, A., & El-Khodary, M. (2025). World crude oil price volatility impacts on domestic fuel-imports and carbon emissions: Short and long-run evidence using ARDL. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-025-05969-z

Falaye, A. J., Eseyin, O., Otekunrin, A., Asamu, F., Ogunlade, P., Egbide, B.-C., Rasak, B., Moyinoluwa, N.-O., & Eluyela, D. (2018). *IMPACT OF EXCHANGE RATE ON THE MANUFACTURING SECTOR IN NIGERIA*.

Fuller, W. A. (1976). *Introduction to Statistical Time Series*. Wiley.

Golovko, E., & Valentini, G. (2011). Exploring the complementarity between innovation and export for SMEs growth. *Journal of International Business Studies*, *42*(3), 362–380. Scopus. https://doi.org/10.1057/jibs.2011.2

Grobar, L. M. (1993). The effect of real exchange rate uncertainty on LDC manufactured exports. *Journal of Development Economics*, *41*(2), 367–376. https://doi.org/10.1016/0304-3878(93)90063-S

Handoyo, R. D., Alfani, S. P., Ibrahim, K. H., Sarmidi, T., & Haryanto, T. (2023). Exchange rate volatility and manufacturing commodity exports in ASEAN-5: A symmetric and asymmetric approach. *Heliyon*, *9*(2), e13067. https://doi.org/10.1016/j.heliyon.2023.e13067

Hunegnaw, F. B. (2017). Real Exchange Rate and Manufacturing Export Competitiveness in Eastern Africa. *Journal of Economic Integration*, *32*(4), 891–912. https://doi.org/10.11130/jei.2017.32.4.891

Labrar, S., & Marhoum, A. E. (2023). L'impact des déséquilibres du taux de change réel sur la performance du secteur manufacturier au Maroc. *International Journal of Economic Studies and Management (IJESM)*, *3*(3), Article 3. https://doi.org/10.5281/zenodo.8030202

Lall, S. (1992). Technological capabilities and industrialization. *World Development*, *20*(2), 165–186. Scopus. https://doi.org/10.1016/0305-750X(92)90097-F

Lotfalipour, M. R., Ashena, M., & Zabihi, M. (2013). Exchange Rate Impacts on Investment of Manufacturing Sectors in Iran. *Business and Economic Research*, *3*(2), 12. https://doi.org/10.5296/ber.v3i2.3716

Mohamed, E.-S., Elmoukhtar, M., Mohammed, F., Yassine, N., & Mounir, B. (2024). Modeling the impact of exchange rate fluctuations on agricultural performance: Evidence from Morocco during the period 2000-2023. *Edelweiss Applied Science and Technology*, *8*(6). https://doi.org/10.55214/25768484.v8i6.3731

Mohamed, E.-S., Hjouji, Z., Bousraraf, Z., Mounir, B., & Nacer, M. (2024). The Effects of Real Exchange Rates on International Tourism: Empirical Evidence from Morocco. *Pakistan Journal of Life and Social Sciences (PJLSS)*, *22*(2), 100970. https://doi.org/10.57239/PJLSS-2024-22.2.00829

Nait Abd, C., El Fadar, A., & Achkari, O. B. (2025). Energy efficiency improvement of a wood-manufacturing plant in Morocco through energy audit. *Energy for Sustainable Development*, *85*, 101669. https://doi.org/10.1016/j.esd.2025.101669

Nyahokwe, O., & Ncwadi, R. (2013). The Impact of Exchange Rate Volatility on South African Exports. *Mediterranean Journal of Social Sciences*, *4*(3), Article 3.

Otokini, T.-A., Felicia O., O., Lawrence Uchenna, O., & Jeremiah O., E. (2018). Impact of Exchange Rate Deregulation on manufacturing Sector Performance in Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, *3*(3), 994–1001. https://doi.org/10.22161/ijeab/3.3.36

Oubrahim, I., Sefiani, N., & Happonen, A. (2023). The Influence of Digital Transformation and Supply Chain Integration on Overall Sustainable Supply Chain Performance: An Empirical Analysis from Manufacturing Companies in Morocco. *Energies*, *16*(2), Article 2. https://doi.org/10.3390/en16021004

Sebayang, S. A. M., Daulay, M. T., Maisyarah, R., Shihab, M. W., & Gulo, A. J. (2025). Impact of Energy Transformation on Economic Productivity and Environmental Sustainability in Toba-Asahan, Indonesia. *International Journal of Energy Economics and Policy*, *15*(1), 180–189. Scopus. https://doi.org/10.32479/ijeep.17434

Sugiharti, L., Esquivias, M. A., & Setyorani, B. (2020). The impact of exchange rate volatility on Indonesia’s top exports to the five main export markets. *Heliyon*, *6*(1), e03141. https://doi.org/10.1016/j.heliyon.2019.e03141

Tkalec, M., & Vizek, M. (2009). The Impact of Macroeconomic Policies on Manufacturing Production in Croatia. *Privredna kretanja i ekonomska politika*, *19*(121), 61–93.

Zia, U., & Mahmood, Z. (2013). Exchange rate depreciation and export price competitiveness: The case of Pakistani manufacturing industries. *Journal of the Asia Pacific Economy*, *18*(4), 529–542. https://doi.org/10.1080/13547860.2012.742722