Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 7939-7950
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.3731

Modeling the impact of exchange rate fluctuations on agricultural performance: Evidence from Morocco during the period 2000-2023

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Abstract: The agricultural sector is a cornerstone of Morocco's economic development, contributing significantly to food security, employment, raw materials for agro-industries, and national GDP. This study investigates the impact of Real Effective Exchange Rate (REER) fluctuations on agricultural performance in Morocco from 2000 to 2023. Using an econometric framework, three models were developed: the first examines the direct effects of REER on agriculture, the second explores the implications of REER misalignments (calculated via the Behavioral Equilibrium Exchange Rate (BEER) approach), and the third analyzes the distinct impacts of REER overvaluation and undervaluation. The ARDL method was employed to estimate these models, incorporating control variables such as GDP Growth Rate, inflation, and foreign direct investment. The findings reveal that REER fluctuations significantly influence agricultural performance, with undervaluation enhancing export competitiveness and overvaluation diminishing profitability and production. REER misalignments, particularly overvaluation, have adverse long-term effects on the sector's competitiveness. Conversely, undervaluation fosters growth through export stimulation and increased investments. The study underscores the need for a strategic exchange rate management policy aimed at stabilizing the REER and mitigating misalignments to support sustainable agricultural growth and competitiveness in Morocco. These insights provide a foundation for policymakers to devise macroeconomic strategies that enhance the agricultural sector's resilience and contribution to national economic development.

Keywords: *Agricultural, ARDL, Misalignment, Morocco, Real exchange rate, Sectoral performance.*

1. Introduction

The agricultural sector plays a crucial role in the economic and social development of many economies, particularly in developing countries, due to its significant contribution to employment, income generation, and food security(de Souza, 2024; Kotsadam & Tolonen, 2016; Mehra & Gammage, 1999, Arora, 2018; Bawa, 2019; van Rooyen & Sigwele, 1998). Additionally, agriculture significantly impacts the balance of payments through exports (Abbas, 2022; Blancus, 1978; Ervani, 2013; N et al., 2022). Given its importance, understanding the factors that influence agricultural performance remains a key area of interest for policymakers and researchers alike. Among these factors, macroeconomic variables, especially exchange rate fluctuations, are considered to have a profound effect on the agricultural sector.

Exchange rate fluctuations directly influence the competitiveness of agricultural exports, the cost of imported inputs, and the overall profitability of farming activities (Adekunle & Ndukwe, 2018b; Ali et al., 2020; Dang et al., 2020). For example, a depreciation of the exchange rate may boost export competitiveness by making agricultural products cheaper in international markets, while increasing the

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cost of imported fertilizers, machinery, and other essential inputs. Conversely, an appreciation of the local currency can reduce export competitiveness but lower input costs, creating a complex dynamic that impacts agricultural performance in diverse ways.

Despite the recognized role of exchange rate fluctuations in shaping agricultural output and trade, comprehensive studies exploring this relationship in small economies, such as Morocco, remain scarce. This gap in the literature is particularly surprising given the strategic role agriculture plays in Morocco's economic growth and rural development.

In Morocco, the agricultural sector plays a vital role in the country's political economy. According to the Ministry of Agriculture and Maritime Fisheries, it contributes 15% to GDP and employs 75% of the rural workforce, as well as 38% of the total workforce. These figures underscore the sector's critical importance to both the national economy and the livelihoods of a large portion of the population. However, the sector is highly vulnerable to external shocks, particularly exchange rate fluctuations, which can significantly impact the income and well-being of those dependent on agriculture (Abdou Oumara & El Youssfi, 2024; Bilali et al., 2012; Mathez & Loftus, 2023).

This study aims to examine the effects of exchange rate fluctuations on Morocco's agricultural performance, focusing on how these fluctuations influence agricultural output, exports, and input costs. The research is motivated by the need to provide policymakers with evidence-based insights to better manage the agricultural sector and enhance its resilience to external economic shocks.

Given the existing gap in the literature, and considering the strategic significance of agriculture to Morocco's economy, it is crucial to address the following question: How do exchange rate fluctuations influence the performance of the agricultural sector in Morocco? This question is essential for understanding how exchange rate fluctuations act as a key determinant of agricultural performance, particularly in Morocco. To explore this, the study will employ econometric modeling to analyze the impact of exchange rate volatility, misalignment, and overvaluation/undervaluation on agricultural performance in the Moroccan context.

1.1. Research Objectives

The primary goals of this research are as follows:

- Analyze the impact of exchange rate fluctuations on the performance of the agricultural sector in Morocco, particularly the effect of exchange rates on the agricultural sector's contribution to Morocco's GDP.
- Evaluate the effects of exchange rate volatility and misalignments (overvaluation and undervaluation) on the competitiveness of agricultural exports and the profitability of the sector.
- Formulate policy recommendations to improve the resilience of Morocco's agricultural sector against exchange rate fluctuations and enhance its competitiveness.

The structure of this paper is as follows: Section 1 introduces the research problem and its significance. Section 2 reviews the relevant literature, providing both the theoretical and empirical foundation for the study, and highlights the research gap in the Moroccan context. Section 3 outlines the methodology, including model specifications and data sources. Section 4 presents the empirical results, and Section 5 concludes with key findings and policy implications.

2. Literature Review

The relationship between exchange rates and the agricultural sector has been extensively studied across different countries, with findings showing varying effects depending on the country context, exchange rate movements, and specific agricultural products. This section reviews the literature on the impact of exchange rate fluctuations on agricultural performance, focusing on how these fluctuations influence agricultural output, exports, and productivity. Several studies have examined these dynamics in various regions, highlighting the diverse impacts that exchange rate changes can have on the performance of agricultural sectors globally.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
DOI: 10.55214/25768484.v8i6.3731

In Nigeria, Obayelu & Salau (2010) found that food prices, export crop prices, and exchange rates jointly explained a significant proportion of agricultural output, both in the short and long run. Specifically, they showed that exchange rate depreciation positively affected agricultural output, while food price increases had a negative impact. Similarly Okputu et al. (2012) focused on the effect of exchange rate devaluation on agricultural exports during the Pre-SAP (1972-1985) and SAP (1986-2010) periods. Their findings revealed that while exchange rate devaluation had a positive effect on agricultural exports, the overall impact was limited due to low agricultural output, with natural rubber being the only significant beneficiary.

Further exploring the Nigerian context, Oyinbo et al., (2014) examined the causal relationship between exchange rate deregulation and the agricultural share of GDP from 1986 to 2011. They concluded that deregulated exchange rates negatively impacted the agricultural share of GDP, suggesting that market-driven exchange rate policies had undesirable effects on the agricultural sector. In contrast, O & Abdullahi (2014) studied the effect of macroeconomic policies on agricultural output in Nigeria. Their findings indicated that increases in government spending and interest rates negatively impacted agricultural production, posing a risk to food security, and emphasized the need for a realistic exchange rate policy to ensure sustainable food security and growth.

Moreover, Gatawa and Mahmud (2017) used ARDL and GARCH models to analyze exchange rate fluctuations and their impact on agricultural exports in Nigeria from 1981 to 2014. They discovered that while exchange rate fluctuations had both short-term and long-term effects, the official exchange rate had a statistically significant negative long-term impact. They recommended stabilizing exchange rates and providing farm equipment and inputs on credit to boost exports. Supporting this, Oye et al. (2018) explored exchange rate devaluation's effects on agricultural output in Nigeria from 1986 to 2016. Their study found that exchange rate devaluation resulted in a decrease in agricultural output, with a unidirectional causality from exchange rate devaluation to export prices, further reinforcing the idea that exchange rate policies significantly influence agricultural performance.

In line with these findings, Adekunle & Ndukwe (2018) examined the relationship between real exchange rate dynamics and agricultural output in Nigeria from 1981 to 2016. Their study found no long-term relationship but emphasized that fiscal and monetary policy coordination was essential to enhance the agricultural sector's growth. Similarly, Brownson et al. (2012) analyzed macroeconomic fluctuations in Nigeria from 1970 to 2010. They found that factors such as real exports, external reserves, and inflation negatively affected agricultural productivity, while exchange rates and industrial capacity utilization had positive effects. They recommended policies to stabilize inflation and reduce external debt to boost agricultural productivity.

Emphasizing the importance of macroeconomic factors, Omojimite (2012) explored the role of institutional support and macroeconomic policies on agricultural sector growth in Nigeria. The study found that institutional reforms, credit to agriculture, and deficit financing positively impacted agricultural output growth, while the real exchange rate had a negative relationship with agricultural growth. This reinforces the need for liberalized interest rate policies and strengthened institutional support to boost the agricultural sector.

Turning to the international context, Yanikkaya et al. (2013) analyzed the impact of exchange rate volatility and the real exchange rate on agricultural exports in Turkey from 1971 to 2010. His study showed that while exchange rate volatility had no significant effect, the real exchange rate significantly impacted exports, particularly for products like raisins and tobacco. This highlights the crucial role of the real exchange rate in shaping agricultural export performance, particularly in emerging economies.

In contrast, Fiaz et al. (2021)addressed the often-overlooked asymmetric effects of exchange rate fluctuations on Pakistan's agricultural sector. Using the NARDL model with data from 1970 to 2019, the study found that negative exchange rate movements had a greater impact on agricultural production than positive movements, both in the short and long run. This suggests that the direction of exchange rate changes significantly influences agricultural outcomes, underlining the importance of considering asymmetry when analyzing exchange rate effects.

Further evidence from Europe comes from Toktaş & Parlinska (2020), who analyzed the relationship between Poland's real effective exchange rate and its food and animal exports from 2012 to

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
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2020. The study found a long-term negative impact of the real effective exchange rate on food and animal exports, with a 1% increase in the exchange rate reducing exports by 3.091%. In contrast, industrial production had a positive effect, with a 1% increase in production boosting exports by 2.803%. This indicates that while exchange rate depreciation can harm exports, industrial growth can mitigate this negative effect.

Similarly, Kohler & Ferjani(2018) examined the impact of exchange rate fluctuations on Swiss agricultural and food exports after the 2008 global financial crisis. The study found that a 1% appreciation of the Swiss franc led to a decrease in agricultural exports by 0.8% to 0.9%. Despite this sensitivity, Swiss producers managed to mitigate these effects through product differentiation and targeting high-quality niche markets. This suggests that, although exchange rate fluctuations can affect agricultural exports, strategic responses from producers can help mitigate some of the negative impacts.

Finally, in the case of Egypt, Zaki (2023) focused on the effect of exchange rates on Egyptian agricultural exports and imports from 2000 to 2022. The study revealed a direct positive relationship between exchange rate fluctuations and agricultural exports, with a 10% increase in the exchange rate leading to a 13.4% rise in export value. However, no cointegration or causality was found for agricultural imports, suggesting that inelastic import behavior, driven by dependence on foreign inputs, might explain the results.

In conclusion, while numerous studies have explored the impact of exchange rate fluctuations on agricultural performance in various countries, there remains a significant gap in research specifically addressing this relationship in the Moroccan context. Despite the crucial role of agriculture in the country's economy, particularly in rural areas, limited studies have examined how exchange rate fluctuations directly affect agricultural output and exports in Morocco. This gap presents an opportunity to explore this issue further, offering valuable insights for shaping economic policies aimed at enhancing the competitiveness and resilience of the Moroccan agricultural sector.

3. Data & Methodology

To accomplish our predefined objectives, we will base our data processing on an AutoRegressive Distributed Lag (ARDL) model, as proposed by Pesaran et al. (2001). This model is particularly well-suited for evaluating both short-term and long-term relationships between variables, even when the data exhibit mixed orders of integration I(0) and I(1). In the first stage of our analysis, we calculated the misalignment of the Real Effective Exchange Rate (REER) using the Behavioral Equilibrium Exchange Rate (BEER) methodology proposed by Clark & Mac Donald (1999). This step enabled us to estimate the equilibrium REER and quantify deviations, laying the groundwork for analyzing the dynamic interactions between the direct effects of REER, REER misalignments, and REER overvaluation or undervaluation on the agricultural sector's performance, alongside other macroeconomic determinants.

The data used in this study consist of quarterly time series covering the period from 2000 to 2023, yielding a total of 96 observations. The data were collected from reliable sources, including the International Monetary Fund (IMF), Bank Al-Maghrib, High Commission for Planning, and the Moroccan Exchange Office. These variables represent key determinants of the agricultural sector's performance in Morocco and include the following: the Real Effective Exchange Rate (REER), Gross Domestic Product growth rate (GDP), Inflation rate (INF), Foreign Direct Investment (FDI), and agricultural sector's contribution to GDP (AGCGP).
The primary ARDL model can be expressed as:

$$AGCGP_t = \gamma + \delta_1 REER_t + \delta_2 GDP_t + \delta_3 INF_t + \delta_4 FDI_t + \varepsilon_t$$

To analyze the effects of REER misalignments, we extended the model to include the misalignment variable:

$$AGCGP_t = \phi + \theta_1 MISALIGNMENT_t + \theta_2 GDP_t + \theta_3 INF_t + \theta_4 FDI_t + \nu_t$$

Finally, to separately evaluate the effects of overvaluation and undervaluation, the model was further extended:

$$AGCGP_t = \eta + \lambda_1 OVEREV_t + \lambda_2 UNDEREV_t + \lambda_3 GDP_t + \lambda_4 INF_t + \lambda_5 FDI_t + \xi_t$$

In these equations:

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
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- γ, ϕ, η: Constant terms for each respective model.
- δ_i, θ_i, λ_i: Coefficients estimating the impact of REER, GDP, INF, FDI, and misalignment variables on agricultural performance.
- ε_t, ν_t, ξ_t: Error terms capturing unobserved influences.

4. Results and Discussions

4.1. Estimation of the Misalignments in the Real Exchange Rate of the Moroccan Dirham

This section addresses the point where it becomes necessary to estimate the equilibrium real exchange rate of the Moroccan Dirham, with the ultimate goal of calculating the magnitude of the misalignment of the real exchange rate of the Dirham compared to its equilibrium level. This will be based on the macroeconometric (BEER) approach developed by Clark & Mac Donald (1999). To achieve this, we will follow the steps below:

Table 1.
Selected variables with the REER.

Variable	Definition	Data sources
REER	Real effective exchange rate	International monetary fund
INF	Inflation rate	BANK AL-MAGHRIB
DEBT	External debt	Moroccan exchange office
REM	Transfers from Moroccans residing abroad	Moroccan exchange office
FDI	Foreign direct investment	Moroccan exchange office
TB	Trade balance	BANK AL-MAGHRIB
TOT	Terms of trade	Office des changes-Maroc
GDP	GDP growth rate	High commission for planning

4.1.1. Presentation of the Variables for Estimating the REER

We therefore choose to retain the following explanatory variables: terms of trade, trade openness, trade balance, and total public debt.

4.1.2. Study of the Stationarity of the Time Series Selected for the Estimation

In this step, we will test the stationarity of the series. Numerous unit root tests exist for this purpose. The pioneering work in this field includes those of Fuller (1976) and Dickey & Fuller (1979). In our case, we apply the Augmented Dickey-Fuller (ADF) test to the selected variables. The results are summarized in the following table:

Table 2.
Unit root test using augmented dickey fuller (ADF).

Variable	Intercept and trend	Intercept and trend	Order of integration
	At level	1st difference	
REER	-1.8033 (0.70)	-6.9754 (0.00)***	I(1)
INF	-3.9600 (0.01)*	Not applicable	I(0)
DEBT	-2.9547 (0.15)	-4.6430 (0.00)***	I(1)
REM	-2.6804 (0.25)	-3.8699 (0.02)*	I(1)
FDI	-2.4113 (0.02)*	Not applicable	I(0)
TB	-1.1325 (0.92)	-3.5828 (0.04)*	I(1)
TOT	-2.2923 (0.18)	-4.7766 (0.00)***	I(1)
GDP	-7.4570 (0.00)***	Not applicable	I(0)

Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

The stationarity test results highlight key insights into the behavior of macroeconomic variables. Some variables, such as INF, FDI, and GDP, are stationary at the level I(0), indicating stability over time without requiring differencing. Others, like REER, DEBT, REM, TB, and TOT, are stationary

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
DOI: 10.55214/25768484.v8i6.3731

only after the first difference I(1), reflecting the presence of unit roots and the influence of long-term stochastic trends.

Given the presence of mixed stationarity of unit roots, ARDL estimation is the most suitable analytical approach for capturing both short- and long-run elasticities. Furthermore, to assess the existence of long-run cointegration, we scrutinize the F-statistics in relation to the critical value outlined in Table 3. Employing the ARDL (3,2,1,4,4,0,4,4) lag model, we find that the F-statistics registers at 7.218, surpassing the upper bound value of 4,35 at the 1% significance level. This outcome confirms the presence of a long-term cointegrating relationship.

Table 3.
Bounds test results.

Test Statistic	**Value**	
F-statistic	7.2181	
k	7	
Signification	I(0)	I(1)
10%	2.017	3,052
5%	2.336	3.458
1%	3.021	4.35

4.1.3. Estimation of Short-Term and Long-Term Relationships

The results of the estimation of short-term and long-term relationships using the ARDL (3,2,1,4,4,0,4,4) model with optimal lag lengths are as follows

Table 4.
Estimation of the long-term relationship.

Variable	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
TB(-1)	0.23718	0.20796	1.14053	0.25731
DEBT(-1)	-1.75293	6.73311	-0.26034	0.79524
FDI(-1)	1.54934	0.95323	1.62535	0.10783
INF(-1)	2.04061***	0.58893	3.46493	0.00084
REM	-0.00017**	0.00006	-2.82871	0.00584
TOT(-1)	-0.22351**	0.10972	-2.03708	0.04479
GDP (-1)	-1.65359***	0.46698	-3.54106	0.00065
C	133.89807***	9.32901	14.35287	0.00000

Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

Table 5.
Estimation of the short-term relationship.

Variable	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
COINTEQ	-0.2866***	0.0335	-8.5642	0.0000
D(REER(-1))	0.1255	0.0759	1.6535	0.1027
D(REER(-2))	-0.1305	0.0749	-1.7413	0.0860
D(TB)	0.1208	0.1557	0.7759	0.4404
D(TB(-1))	-0.4430***	0.1619	-2.7366	0.0079
D(DEBT)	-9.1239**	3.9509	-2.3093	0.0239
D(FDI)	-0.2779	0.1518	-1.8314	0.0713
D(FDI(-1))	-0.2597	0.1633	-1.5907	0.1162
D(FDI(-2))	0.0523	0.1586	0.3300	0.7424
D(FDI(-3))	-0.5053***	0.1325	-3.8128	0.0003
D(INF)	-0.0812	0.1944	-0.4177	0.6774
D(INF(-1))	0.0259	0.2093	0.1236	0.9019
D(INF(-2))	-0.2435	0.2060	-1.1819	0.2413

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ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
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D(INF(-3))	-0.3944**	0.1834	-2.1512	0.0349
D(TOT)	-0.1057	0.0558	-1.8944	0.0623
D(TOT(-1))	-0.0001	0.0589	-0.0011	0.9992
D(TOT(-2))	-0.1315**	0.0572	-2.2988	0.0245
D(TOT(-3))	0.2046***	0.0512	3.9938	0.0002
D(GDP)	-0.3294***	0.0663	-4.9670	0.0000
D(GDP(-1))	0.3921***	0.0567	6.9165	0.0000
D(GDP(-2))	0.1770**	0.0617	2.8668	0.0055
D(GDP(-3))	0.4066***	0.0602	6.7506	0.0000

Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

These results provide insights into the dynamics of the short-term and long-term relationships among the variables in the ARDL model, including their adjustments toward equilibrium.

4.1.4. Diagnostic Test

This phase of the ARDL model involves verifying the robustness of the estimated model. It includes assessing the normality of the errors, checking for autocorrelation, and confirming their white noise properties.

Table 6.
Diagnostic test results.

Hypotheses	Tests	Test statistic	P-value
1. Normality test	Jarque-Bera test	0.81	0.40
2. No autocorrelation test	Breusch-Godfrey serial correlation LM test	0.31	0.7356
3. Homoscedasticity test	ARCH test	0.68	0.409

The diagnostic tests performed on the ARDL model confirm its robustness and validity. The residuals satisfy the essential assumptions: they are normally distributed, as indicated by the Jarque-Bera test (p-value: 0.40), exhibit no autocorrelation according to the Breusch-Godfrey test (p-value: 0.7356), and are homoscedastic, as demonstrated by the ARCH test (p-value: 0.409). These results validate the ARDL model, confirming its reliability for analyzing both short-term and long-term relationships among the variables.

4.1.5. Calculation of the Misalignment of the Real Effective Exchange Rate of the Dirham

The equilibrium real exchange rate represents its long-term level. It is estimated by applying the Hodrick-Prescott (HP) filter to decompose the real exchange rate fundamentals into trend and cyclical components. The trend component, often referred to as the "sustainable fundamental," reflects the permanent, long-lasting aspects of the fundamentals, as opposed to the cyclical components, which are more transient. Misalignment is calculated as the difference between the observed REER and the estimated equilibrium RER. The latter is derived by substituting the observed values of economic fundamentals into the previously estimated long-term equation. This misalignment is expressed as a percentage, as indicated by the following formula:

$$\text{Mis} = \text{Misalignment (\%)} = \frac{\text{Observed REER} - \text{Equilibrium REER}}{\text{Equilibrium REER}} * 100$$

According to this formula, three scenarios can arise. The first is a negative misalignment, where the exchange rate is depreciated relative to its equilibrium level, which improves price competitiveness. The second scenario is a zero-misalignment index, indicating no misalignment because the real exchange rate is aligned with its equilibrium level. The third scenario is a positive misalignment index, signifying a real appreciation of the national currency's exchange rate, which could negatively affect price competitiveness. The graph below shows the evolution of the degree of misalignment in the real effective exchange:

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
DOI: 10.55214/25768484.v8i6.3731

This graph highlights seven periods of misalignment where the real exchange rate of the Moroccan Dirham deviated from its equilibrium value. With an overall average of 0.16%, these misalignments range within an interval of [-0.508%, +0.352%].

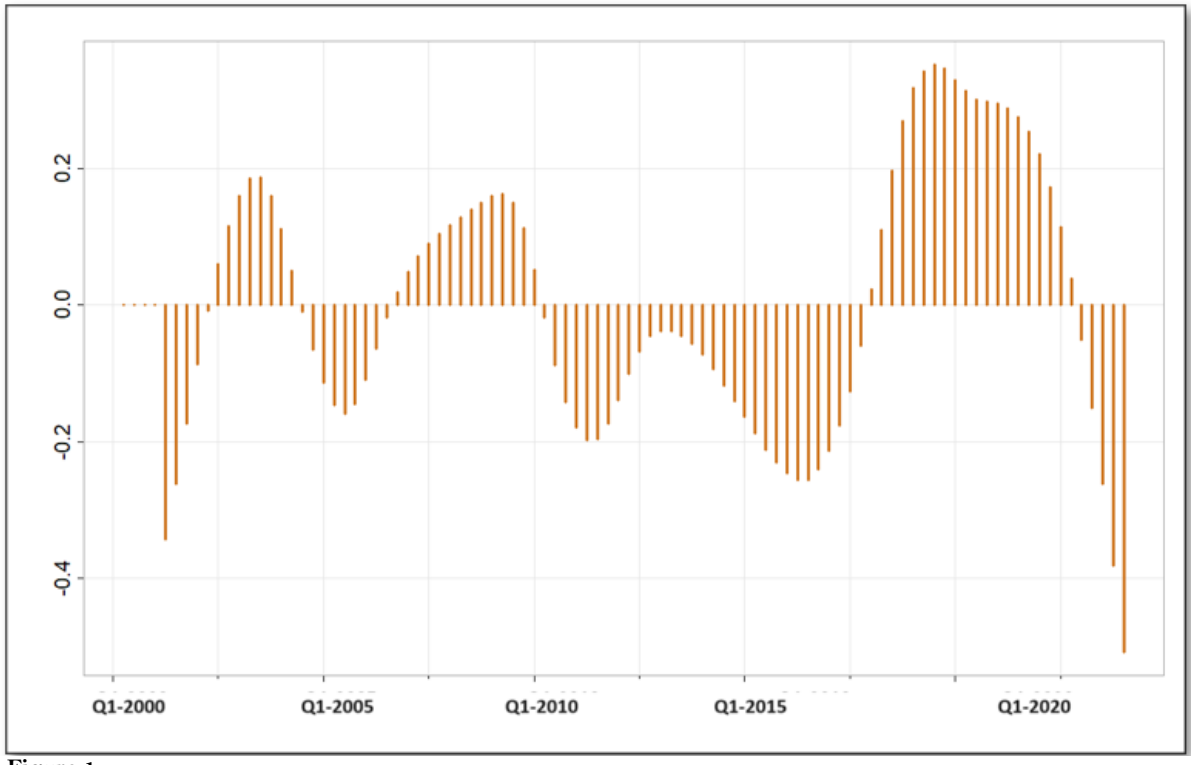

Figure 1.
Periods of misalignment of the real effective exchange rate of the Dirham.

4.2. Exchange Rate and Agricultural Sector Performance in Morocco: An Empirical Analysis

The analysis of the agricultural sector's contribution to GDP is a critical topic for Morocco's economy. As a fundamental pillar of the national economy, the agricultural sector plays a key role in rural development, food security, and income generation for a large portion of the workforce. However, the sector's performance is influenced by various macroeconomic factors, among which the exchange rate plays a central role.

The REER directly affects the competitiveness of agricultural products, especially in international markets, and indirectly influences investments and the cost of inputs. Therefore, prudent management of the REER is essential to ensure the stability and competitiveness of the agricultural sector. However, variations and misalignments in the REER whether they manifest as overvaluation or undervaluation can have differing impacts on agricultural performance.

In this context, we have modeled three frameworks to evaluate the impact of REER dynamics on the agricultural sector's contribution to Morocco's GDP(AGCGP). The first model examines the direct effect of the real effective exchange rate on agricultural performance. The second model investigates the impact of REER misalignments, which represent the deviations of the real exchange rate from its equilibrium value. Finally, the third model analyzes the separate effects of REER overvaluation and undervaluation. These three models are estimated using the ARDL (AutoRegressive Distributed Lag) methodology, which is known for its robustness in analyzing long-term relationships.

Additionally, we include control variables to better isolate the effect of the REER and its components. These variables include GDP, which reflects overall economic dynamics, inflation, which

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
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influences production costs and agricultural prices, and foreign direct investment (FDI), which can support the sector through infrastructure and innovation.

The results of this analysis, which illustrate the impacts of the different REER dynamics on agricultural contributions, are summarized in the following table. These results provide valuable insights into the underlying mechanisms and help guide macroeconomic and sectoral policies toward sustainable and inclusive agricultural development in Morocco.

Table 7.
Results of the long-term equation estimation for AGCGP.

Variable	Model1 ARDL (3,3,1,3,0)	Model2 ARDL (3,0,3,3,1)	Model3 ARDL (3,3,1,3,0,0)
Constant	7,1316*	11,1580***	10,8923
GDP	0,1634**	0,1673*	0,1910*
FDI	-0,1512	0,0815	-0,1860
INF	0,1111	-0,1879	0,0788*
REER	0,0390	-	-
MIS	-	-0,5605*	-
OVEREV	-	-	-1,6945
UNDEREV	-	-	0,5313*
Jarque- Bera	0,0902	0,0877	0,1267
Breusch-Pagan-Godfrey	0,0756	0,1022	0,1538
Breusch-Godfrey	0,0670	0,0590	0,1680

Note: *, ** and *** represent significance level at 10%, 5% and 1% respectively.

Model 1: Direct effect of REER on AGCGP

$AGCGP_t = 7{,}1316 + 0{,}0390\ REER_t + 0{,}1634\ GDP_t + 0{,}1111\ INF_t - 0{,}1512\ FDI_t + \varepsilon_t$

Model 2: Impact of REER Misalignments on AGCGP

$AGCGP_t = 11{,}158 + MIS_t + 0{,}1673 GDP_t - 0{,}1879\ INF_t + 0{,}0815\ FDI_t + \nu_t$

Model 3: Separate effects of REER Overvaluation and Undervaluation on AGCGP

$AGCGP_t = 10{,}8923 - 1{,}6945 OVEREV_t + 0{,}5313\ UNDEREV_t + 0{,}1910\ GDP_t + \lambda_4\ INF_t\ -0{,}1860\ FDI_t + \xi_t$

The results of this study demonstrate that the REER plays a crucial role in the AGCGP while directly influencing agricultural product exports. With a positive coefficient of 0.0390, the REER shows a slightly favorable impact on the competitiveness of Moroccan agricultural products. A moderate depreciation of the REER enhances the price competitiveness of agricultural exports, thereby increasing their demand in international markets and, in turn, boosting the agricultural sector's share in GDP. Conversely, an appreciation of the REER reduces competitiveness, thereby limiting export performance and constraining the AGCGP.

However, MIS coefficient (-0.5605) has a significant negative impact, reflecting the adverse effects of prolonged deviations of the real exchange rate from its equilibrium value. These deviations disrupt the stability of the agricultural sector and diminish the competitiveness of Moroccan agricultural products in international markets. Specifically, overvaluation coefficient (-1.6945) exerts a marked negative effect by increasing the relative costs of Moroccan agricultural products compared to foreign competitors, thereby hampering exports and limiting the agricultural sector's contribution to GDP. Conversely, undervaluation coefficient (0.5313) has a significant positive effect, stimulating exports by making Moroccan products more attractive in global markets while encouraging investments in the sector and improving the productivity of agricultural operations.

Exports thus play a catalytic role: their performance is directly tied to the international competitiveness of the agricultural sector, which is, in turn, influenced by exchange rate fluctuations and deviations. Improved export performance through strategic management of the REER can not only

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
DOI: 10.55214/25768484.v8i6.3731

enhance the AGCGP but also diversify national revenue sources and reduce dependency on other sectors.

Other key variables complement this analysis. Economic growth coefficient (0.1910) positively supports the agricultural sector and its exports, highlighting a strong synergy between overall economic development and agriculture. However, foreign direct investment coefficient (-0.1860) shows a negative effect, suggesting that these flows are insufficiently directed toward agricultural infrastructure or export-driven initiatives. Finally, inflation coefficient (0.0788) has a moderate but positive effect, possibly reflecting adjustments in agricultural prices that can support exports despite rising production costs.

In conclusion, this analysis highlights that the exchange rate and agricultural exports are critical levers for maximizing the AGCGP. Prudent exchange rate policies to maintain a competitive REER and limit misalignments, combined with strategies to support agricultural exports, are essential to strengthening the sector's competitiveness and ensuring its long-term sustainability.

5. Conclusion

This study highlights the fundamental role of the REER in the economic dynamics of Morocco's agricultural sector and its contribution to national GDP. As a key variable in open economies, the exchange rate profoundly influences the competitiveness of agricultural products in international markets and the sector's attractiveness to investment. Based on the estimation of three models, we demonstrated that fluctuations in the REER, its structural misalignments, and periods of overvaluation and undervaluation significantly impact agricultural performance. These results also underscore the importance of maintaining a competitive exchange rate to boost exports, attract investments in strategic sectors, and mitigate the adverse effects associated with prolonged overvaluation or economic imbalances such as "Dutch disease."

To estimate REER misalignments, we used the BEER methodology, which allowed us to identify the gaps between the observed real exchange rate and its theoretical equilibrium value. The analysis was conducted using quarterly data covering the period from 2000 to 2023. Variables initially available on an annual basis were converted into quarterly series to ensure consistency and accuracy in the estimates. The results reveal seven periods of misalignment where the real exchange rate of the Moroccan Dirham deviated from its equilibrium value, with an overall average of 0.16%. These deviations fall within a range of [-0.508%, +0.352%], highlighting periods of overvaluation and undervaluation that have varied impacts on overall economic competitiveness and, by extension, on the agricultural sector.

Subsequently, we analyzed the impact of REER dynamics on the contribution of the agricultural sector to GDP using ARDL models. The results show that :

- A moderate depreciation of the REER positively impacts price competitiveness, stimulating agricultural exports and increasing the sector's share in GDP.
- Conversely, REER misalignments, particularly overvaluation, have a negative effect by reducing the competitiveness of Moroccan agricultural products.
- Undervaluation, on the other hand, emerges as a favorable factor, boosting exports, attracting investments, and improving productivity in the agricultural sector.

Additionally, control variables such as GDP, FDI, and INF provide complementary insights. Economic growth positively supports the agricultural sector, reflecting a strong synergy between overall economic development and agriculture. However, FDI showed a limited effect, likely due to insufficient targeting toward agricultural development. Inflation, meanwhile, has a moderate but positive effect, potentially linked to favorable price adjustments in agricultural markets that help offset production costs.

These findings underline the importance of maintaining a competitive and stable REER to foster the growth and sustainability of the agricultural sector. Strategic exchange rate policies, combined with measures to enhance the performance of agricultural exports and attract targeted investments, are essential for maximizing the sector's contribution to the national economy. These conclusions, enriched by the analysis of REER misalignments conducted using the BEER methodology, provide a valuable

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
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foundation for policymakers in designing macroeconomic and sectoral strategies for sustainable and inclusive agricultural development in Morocco.

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Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 7939-7950, 2024
DOI: 10.55214/25768484.v8i6.3731