

Analysis of the Influence of the Exchange Rate Reform and COVID-19 on the Real Exchange Rate of the Dirham using the BEER Methodology: Case of Morocco

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Abstract

This article assesses the deviation of Morocco's real effective exchange rate (REER) from its equilibrium, in the wake of the reform of the exchange rate regime and the COVID-19 crisis. Adopting the BEER approach, we examine the evolution of the dirham and discern the internal and external factors influencing its deviation. After elucidating the concept of the equilibrium rate, we detail the methodology employed. Our conclusions reveal the notable impact of the 2018 reform on the REER, marked by the widening of the dirham's fluctuation band, inducing a significant depreciation. In addition, the pandemic has accentuated economic vulnerability, with a recession of -7.2% in 2020. In short, economic equilibrium is essential if Morocco is to face up to the challenges that lie ahead. Competitiveness indicators must be rigorously monitored to guarantee Morocco's competitive position internationally.

Keywords: Real effective exchange rate; Equilibrium rate; BEER approach; Exchange rate regime reform; COVID-19.

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1. Introduction

In a constantly changing global and national economic environment, the analysis of competitiveness indicators is becoming an imperative for understanding and anticipating economic dynamics. This article aims to assess the degree of deviation of the real effective exchange rate (REER) from its equilibrium level, an assessment that is particularly relevant in the current context of constant monitoring of the external competitiveness of the national economy.

Our analysis takes place against a backdrop of major events. First, the exchange rate policy reform implemented on 15 January 2018, which saw the Central Bank widen the dirham's fluctuation band twice (from $\pm 0.5\%$ to $\pm 2.5\%$, then to $\pm 5\%$). Secondly, the negative repercussions of the Covid-19 health crisis on the national economy, which has led to a contraction in economic growth of -7.2% in 2022 according to the Ministry of the Economy and Finance, and worldwide (-3% in 2023 according to the World Economic Outlook report). Finally, galloping inflation, which has reached a worrying level of 6.2% in 2022 according to Bank Al-Maghrib (BAM), partly due to imported inflation.

These factors highlight the crucial importance of rigorous, ongoing analysis of competitiveness indicators. This is essential to maintain economic equilibrium and prepare the national economy to face future challenges. It is with this in mind that this article examines in detail the behaviour of the Real Effective Exchange Rate (REER). This key indicator functions as a warning system for assessing the level of vulnerability and the threshold of acceptable risk in the face of an uncontrolled exogenous shock.

The study has a dual objective. Firstly, it aims to calculate the phases in which the exchange rate deviates from its equilibrium level. Secondly, it seeks to quantify the contribution of the internal and external economy in explaining the deviation of the dirham from its equilibrium level.

To achieve these objectives, we will use the BEER (Behavioural Equilibrium Exchange Rate) approach, a method widely used in this field. This approach is particularly well suited to developing economies, such as Morocco's, and takes into account the dynamics of economic change.

In this study, we will undertake an in-depth methodological journey to decipher the concept of the equilibrium exchange rate, exploring both macroeconomic and econometric approaches. We will then delve into an exhaustive review of empirical studies on the subject, in order to identify the major trends and conclusions. In the estimation part, we will apply this knowledge to the specific case of Morocco, by closely examining the evolution of the Moroccan Dirham, focusing in particular on the impact of the exchange rate regime reform initiated by Morocco at the beginning of 2018 and the consequences of the COVID-19 pandemic on the national economy. This approach will enable us not only to understand the underlying mechanisms of the exchange rate, but also to shed relevant light on Morocco's current economic situation.

2. Explanation of methodology for determining the equilibrium exchange rate⁶

Before presenting the results obtained, it is imperative to discuss the conceptual and theoretical foundations underlying the determination of the equilibrium real exchange rate. The aim of this approach is not only to gain an intuitive understanding of this variable, but also to dispel certain prejudices commonly associated with the analysis of the exchange rate and the establishment of its equilibrium value.

In this subsection, we will focus on the approach we will take in this article to explore the concept of the equilibrium exchange rate. First, however, it is essential to define the equilibrium real exchange rate, which serves as the reference point for identifying imbalances.

2.1 Clarifying the concept of the equilibrium exchange rate

In the theoretical framework of international economics, the real exchange rate is considered an essential barometer for assessing a nation's competitiveness. The mathematical calculation of this rate is based on two fundamental elements: firstly, the consumer price index (CPI), which is frequently used as a reference for developing countries; and secondly, the unit labour cost (ULC), which is commonly applied in the context of developed countries⁷.

On the other hand, the real exchange rate is often considered to be one of the most reliable and relevant indicators for assessing a country's external position and, consequently, its competitiveness. It provides a synthetic representation of a nation's competitive position in relation to all its trading partners. It also serves as a guiding mechanism for the allocation of productive resources between nations (Obstfeld & Rogoff, 1996).

The real exchange rate is seen as a precise indicator of changes in an economy's international competitiveness. It provides a quantifiable measure of a nation's ability to position itself favourably on the world economic stage, taking into account the complex dynamics of the global economy.

From a pragmatic perspective, the exchange rate, which represents the relative price of two goods, can be defined from two different perspectives. The first perspective views the exchange rate as the relative price of non-tradable versus tradable goods within a given country. This approach emphasises the internal dynamics of the economy and the way in which market forces determine the exchange rate as a function of the relative availability of tradable and non-tradable goods (Balassa, 1964).

⁶ The notion of equilibrium linked to the value of the real exchange rate in the long-term stems from the idea that economies are operating at full capacity (i.e., that they cannot produce more without raising prices) and that their net foreign position is considered satisfactory.

⁷ In its article IV reports, the IMF uses this distinction to calculate the real effective exchange rate.

The second perspective, on the other hand, considers the exchange rate as the ratio between the foreign price level and the domestic price level, expressed in a common currency (such as the dollar, for example). This approach is then multiplied by the nominal exchange rate. This approach emphasises external forces and the way in which international price fluctuations and currency movements can influence the exchange rate (Samuelson, 1964).

These two perspectives offer complementary views of the exchange rate and underline the importance of understanding both internal and external dynamics when assessing an economy's competitiveness on the world market.

The equilibrium exchange rate is conceptualised as the rate that facilitates the simultaneous achievement of an economy's internal and external equilibrium. Following the abandonment of the Bretton Woods international monetary system (Bayoumi, T., & Eichengreen, B. 1998), and given its unobservable nature, the evaluation of the equilibrium exchange rate has emerged as a major concern in the economic literature (Clark P., MacDonald R., 1998). A multitude of studies have been devoted to investigating the various notions of the exchange rate and establishing its reference level (Clark P., MacDonald R., 1998). A considerable number of economists have focused their research on this issue, actively engaged in the development of solid instruments to trace the trajectory of the real exchange rate in the long term and to decipher its repercussions on external imbalances (Edwards, 1989; Williamson, 1994; Clark & MacDonald, 1998). These researchers have defined the equilibrium exchange rate on the basis of a set of fundamental macroeconomic indicators which exert a restoring force on the real exchange rate and which simultaneously influence internal and external equilibrium.

The concept of "exchange rate misalignment" is an important element in the analysis of international economic dynamics. It is defined as the gap between the observed real exchange rate and the equilibrium exchange rate, the latter being the rate that would allow an economy to achieve simultaneous internal and external equilibrium. Exchange rate misalignment can have significant consequences for a country's economic performance. For example, an overvalued exchange rate can make a country's exports less competitive on the world market, leading to a trade deficit and slower economic growth. Conversely, an undervalued exchange rate can boost exports and economic growth, but can also lead to higher inflation and excessive accumulation of foreign exchange reserves⁸.

According to Sebastian Edwards, in his work "Exchange Rate Misalignment in Developing Countries" (Edwards, 1994), exchange rate misalignment has been a

⁸ The statement we have mentioned is generally accepted in the sense that the exchange rate is quoted to the certainty. That is, the exchange rate is expressed in terms of the quantity of domestic currency needed to buy one unit of foreign currency. In this context, an overvalued exchange rate means that the domestic currency is strong relative to the foreign currency. This makes the country's exports more expensive and therefore less competitive on the world market, which can lead to a trade deficit and slower economic growth. Conversely, an undervalued exchange rate means that the domestic currency is weak relative to the foreign currency. This makes the country's exports cheaper and therefore more competitive on the world market, which can boost exports and economic growth. However, it can also lead to higher inflation and excessive accumulation of foreign exchange reserves.

major concern in developing countries. It has been suggested that inappropriate exchange rate policies contributed to the international debt crisis of the 1980s. In addition, the World Bank (1984) reported that overvalued exchange rates in many African countries led to a dramatic deterioration in agriculture and external accounts.

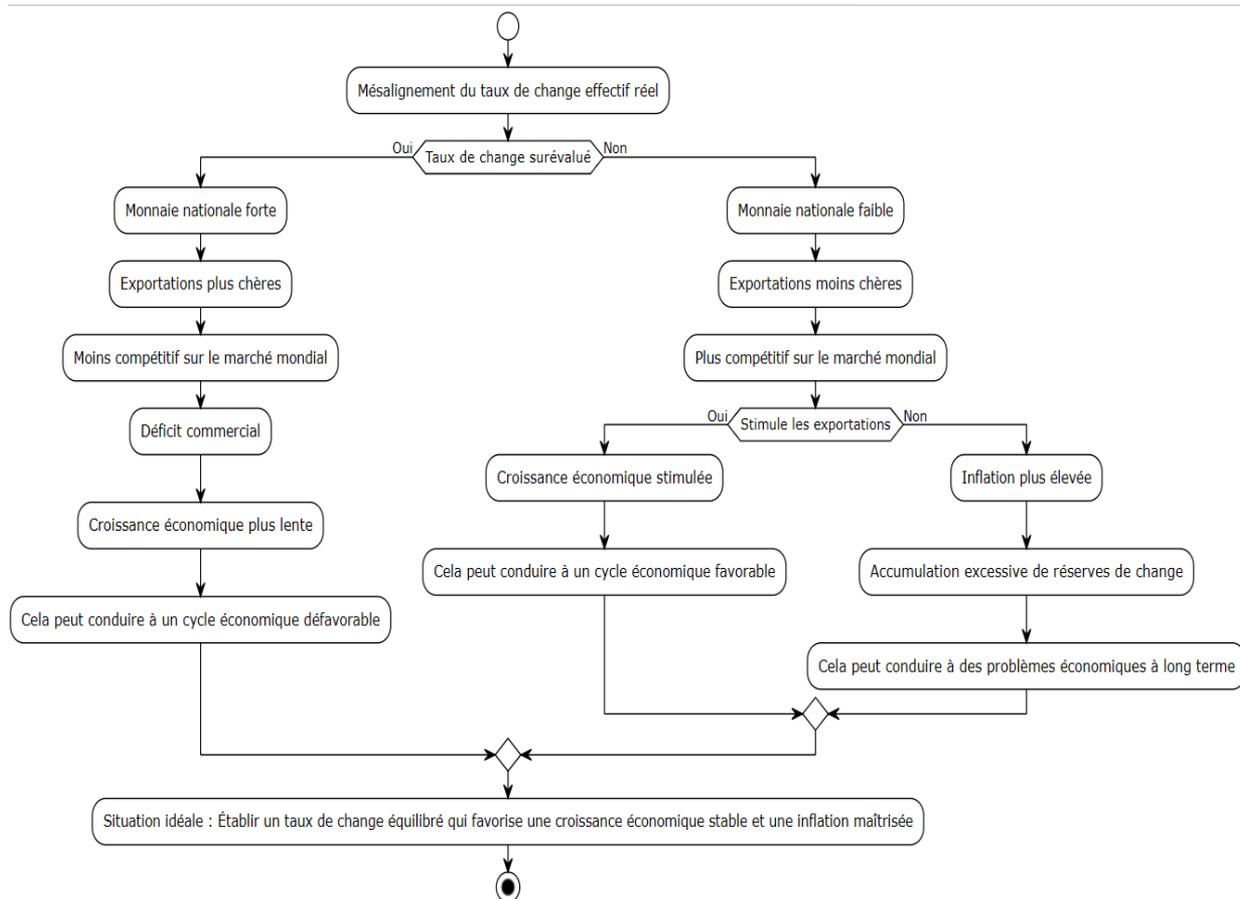


Figure 1: Diagram presenting different scenarios of the impact of Overvaluation and Undervaluation of Exchange Rate on a Country's Economy

Source: Established by the authors

How can we interpret fluctuations in the exchange rate in relation to its equilibrium level (misalignment)?

In more elaborate terms, the macroeconomic approach defines the real exchange rate as the price mechanism linking the domestic market to the international market. Its equilibrium value can be interpreted as the level of the real exchange rate that is

compatible with a situation of equilibrium, both internally and externally.

From an analytical perspective, the determination of the equilibrium real exchange rate can be visualised through a graphical representation, as illustrated below. This conceptual model is based on two essential principles: i) internal equilibrium, which corresponds to the potential level of economic activity, is independent of the real exchange rate (symbolised by the vertical axis in the graph) and ii) external equilibrium, which is an increasing function of the real exchange rate and the level of economic activity.

In the graph below, the horizontal axis denotes domestic gross domestic product (GDP), while the vertical axis illustrates the real exchange rate. The rising curve (CA^*) represents the external equilibrium, which is an increasing function of the real exchange rate and the level of economic activity.

The equilibrium exchange rate R^* is determined by the point of intersection of the internal equilibrium curve (Y^*) and the external equilibrium curve (CA^*). This point of intersection corresponds to the value of the real exchange rate that makes it possible to achieve a current account balance compatible with a non-inflationary level of potential output.

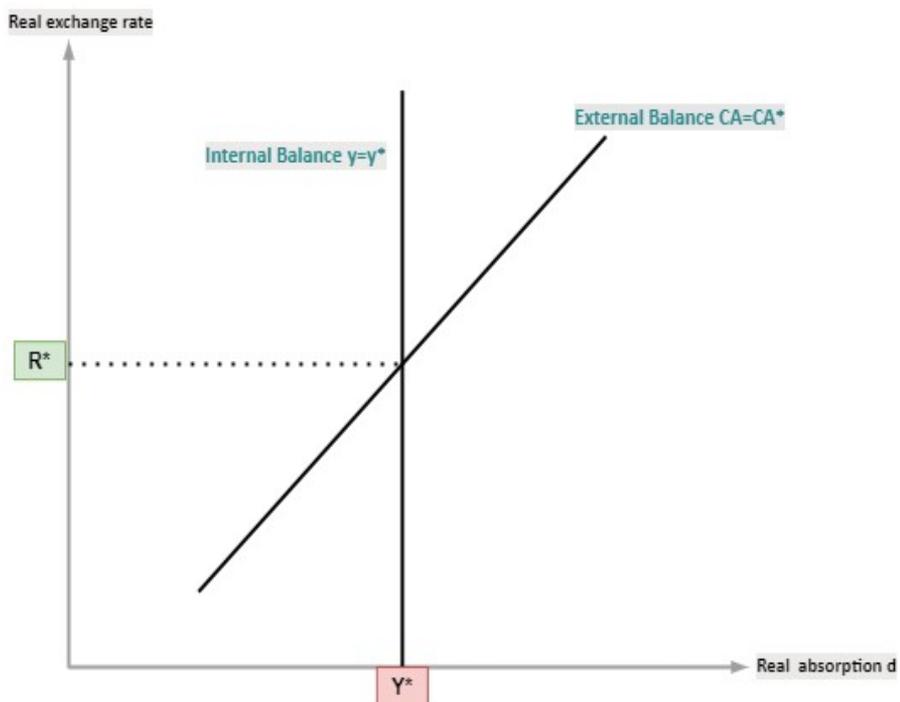


Figure 2: Determination of the Real Equilibrium Exchange Rate

Source: T. W. Swan, 1968

This quasi-equilibrium model provides a valuable analytical framework for understanding how internal and external forces interact to determine the equilibrium real exchange rate in an economy. According to this interpretation, this approach is generally accepted in countries with a fixed exchange rate regime. Indeed, a fundamental assumption is that monetary policy has no effect on gross domestic product (GDP) under a fixed exchange rate regime. This is because when the monetary authorities try to change the money supply by buying or selling domestic assets, this leads to an offsetting change in foreign exchange reserves, without changing the domestic money supply. As a result, the domestic GDP function remains constant.

However, recent research has enriched the macroeconomic approach by showing that exchange rate volatility has significant repercussions both on the readjustment of the external equilibrium and on the restoration of the internal equilibrium of the economy. In this context, Hervé Joly, Alain Quinet and Nicolas Sobczak (1998) examined this question in a joint scientific work, showing the repercussions that the real exchange rate can have on the internal equilibrium, and particularly on the labour market. They showed that depreciating the real exchange rate can be a way of correcting labour market imbalances and thus finding a solution to the unemployment problem.

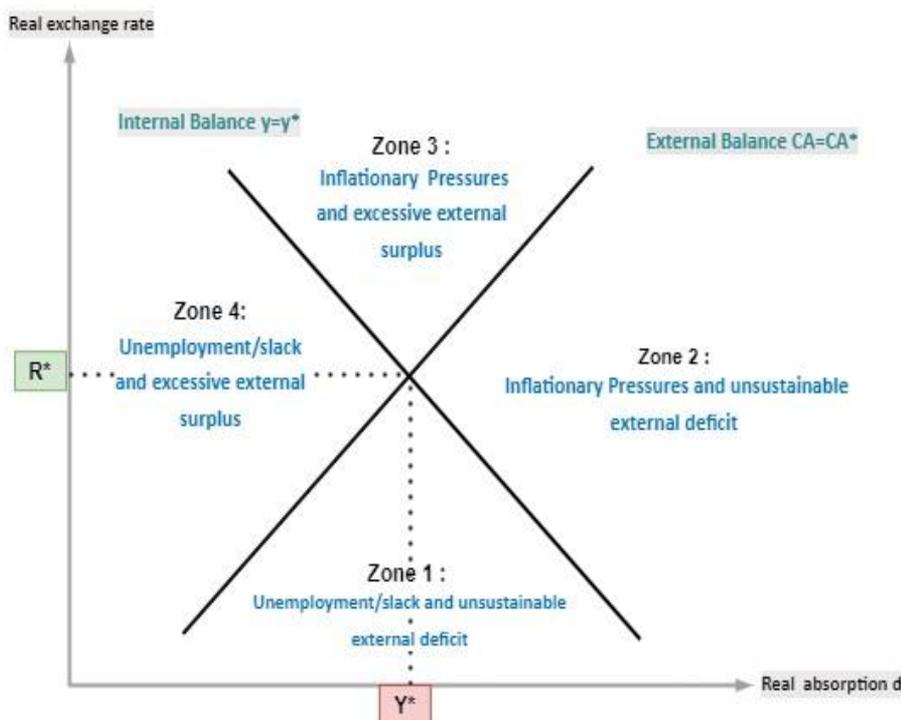


Figure 3: Determination of the real equilibrium exchange rate and identification of the four economic discomfort zones

Source : Joly Hervé, Quin Alain, Sobczak Nicolas (1998)

In reality, under the impact of globalisation, a country's economy is not entirely independent of the rest of the world, insofar as its internal and external imbalances coexist with those of other countries. In this respect, the deviation of the real exchange rate from its norm (equilibrium value) can be expressed analytically as a linear combination of the output gap and the gap between the underlying current account and its norm.

However, if we compare the second graph with the first, we can see that the line describing the internal equilibrium is modified and has a negative slope, meaning that the achievement of macroeconomic equilibrium is also conditioned by the achievement of domestic equilibrium, which is linked to the real exchange rate. Its negative slope can be explained by a devaluation of the domestic currency (higher exchange rate) and an expansionary policy. In addition, the use of fiscal policy and exchange rate policy can place the economy at the intersection of the lines. This is the macroeconomic equilibrium point from which we can deduce the equilibrium real exchange rate and the potential level of GDP.

As a result of this change, the decreasing shape of the line (negative slope) indicates that the appreciation (depreciation) of the real exchange rate depresses (strengthens) potential supply and therefore increases (decreases) equilibrium unemployment. The principle is based on the fact that nominal wages are indexed to consumer prices, so a depreciation in the real exchange rate leads to an increase in domestic inflation (the pass-through effect), so that the nominal cost of labour also rises relative to producer prices. The real cost of labour (for the employer) is then higher, leading to a fall in demand for labour and a rise in unemployment. If we think in terms of prices, an increase in the money supply has an expansionary effect on the economy and increases total demand for goods and services. To meet this demand, domestic producers of goods and services will have to work overtime and hire new workers to increase production. This situation of increased demand for extra labour then pushes wage earners to demand higher wages. The capitalists, for their part, must accept this offer to increase wages because they know that, in a growing economy, they will be able to easily pass on these wage costs to consumers by increasing the price of goods and services.

The table below presents the interpretations of Joly, H., Quinet, A., & Sobczak, N. (1998) on the effects of fluctuations in the real exchange rate in relation to its equilibrium level, taking into account internal and external movements.

Table 1 : Analysis of Economic Balance Zones: Employment and Current Account

Zone	Economic situation	Employment rate	Current account	Interpretation
Zone 1	Economic under-activity	Underemployment	Significant surplus	The economy is underperforming, but with a large current account surplus. This could indicate that the economy is producing more than it is consuming, potentially leading to overproduction and underconsumption.
Zone 2	Economic overheating	Overemployment	Excessive Deficit	The economy is overheating, but with a large current account deficit. This could indicate that the economy is consuming more than it is producing, potentially leading to an accumulation of external debt.
Zone 3	Economic overheating	Overemployment	Significant surplus	The economy is overheating, with employment above its natural level, which may lead to higher inflation. A large current account surplus suggests that the economy is exporting much more than it is importing, indicating possible domestic underconsumption.
Zone 4	Economic under-activity	Underemployment	Excessive Deficit	The economy is under-performing, with employment below its natural level, which may lead to higher unemployment. A large current account deficit suggests that the economy is importing much more than it is exporting, indicating possible over-consumption relative to domestic production.

Source: Established by the authors

Building on the work of Joly, H., Quinet, A., & Sobczak, N. (1998), the diagram below is a visual representation of the relationship between the exchange rate and various other macroeconomic fundamentals, although it is an extension of the first diagram, which presented a simplified view of the relationship between the exchange rate and economic growth.

In this more complex diagram, we take into account other macroeconomic factors such as inflation, the cost of labour, supply and demand for goods and services, and the accumulation of foreign exchange reserves. We also show how these factors can be affected by the strength or weakness of the national currency, i.e. by an over- or undervalued exchange rate.

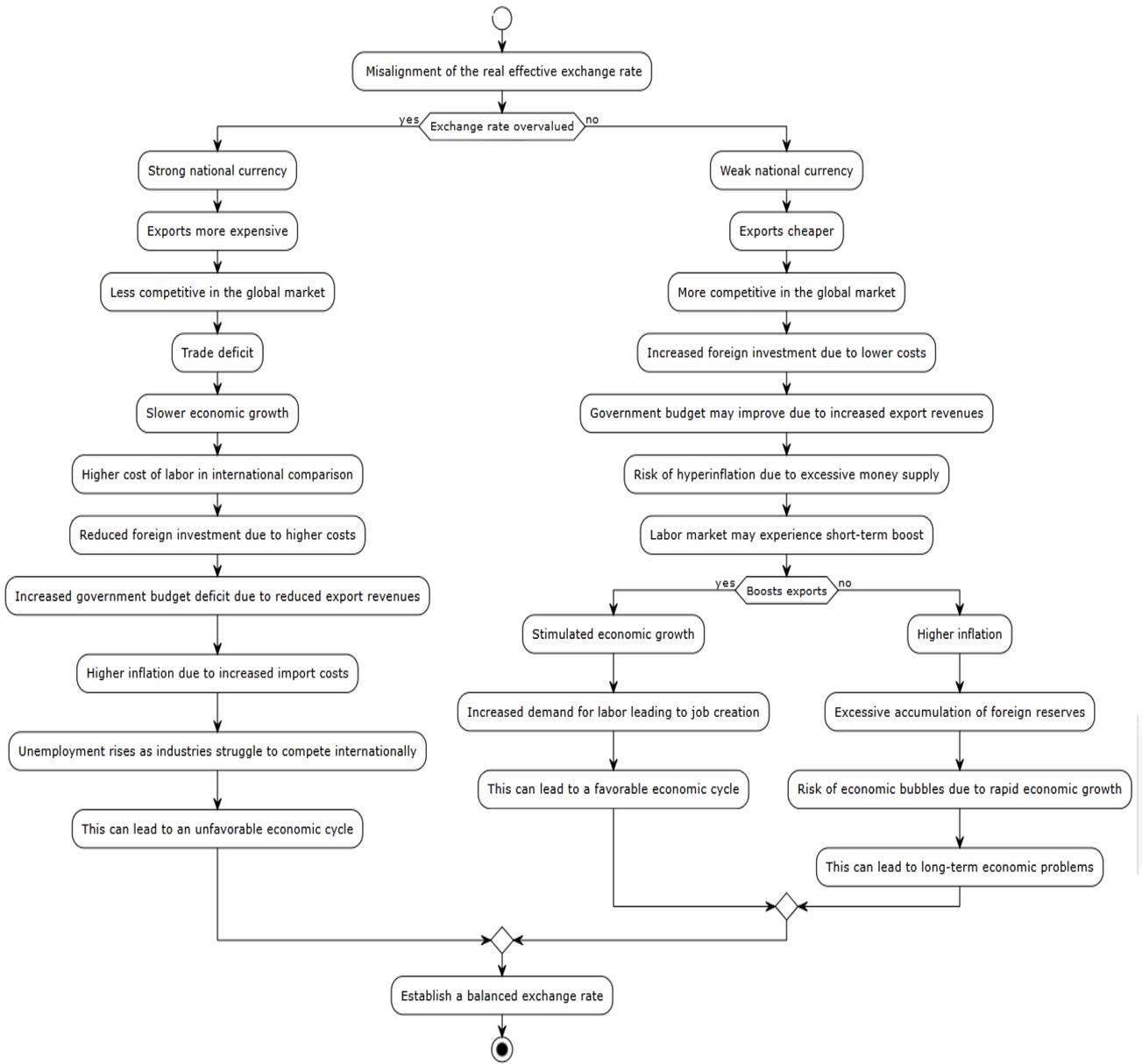


Figure 4: Macroeconomic Analysis of Exchange Rate Impacts - An Integrated Approach

Source: Established by the authors

The diagram above offers a more detailed explanation of the impact of the exchange rate on a country's economy, taking into account various macroeconomic fundamentals. It begins with a question: is the national currency strong (overvalued exchange rate) or weak (undervalued exchange rate)?

In the case of a strong national currency (overvalued exchange rate), there are several possible consequences:

- The country's exports become more expensive, reducing its competitiveness on the world market;
- This can lead to a trade deficit and a slowdown in economic growth;
- Domestic inflation can rise, as can labour costs;
- Demand for labour may fall, as may supply and demand for goods and services.

If the national currency is weak (undervalued exchange rate), other consequences can occur:

- The country's exports become cheaper, increasing its competitiveness on the world market;
- This can stimulate exports and economic growth;
- However, it can also lead to higher inflation and excessive accumulation of foreign exchange reserves;
- Domestic inflation can rise, as can labour costs;
- The demand for labour can increase, as can the supply and demand for goods and services.

The ultimate goal is to establish a balanced exchange rate that promotes stable economic growth and controlled inflation. However, this diagram highlights the complexity of economic interactions and the challenge of managing these different factors to achieve this balance.

2.2 Macroeconomic and econometric approaches

Faced with the predictive limitations of traditional theory (PPP and its variant, the B/S model)⁹, innovative methodologies have been developed. These are based on the real and monetary dimensions of the economy, seeking to refine and enrich the instruments used to determine the equilibrium exchange rate. The aim is to assess deviations in the real exchange rate and to determine whether the real exchange rate is over- or undervalued over a prolonged period. These methodologies aim to establish a medium- and long-term reference value for the real exchange rate (the norm), by modelling its relationship with macroeconomic fundamentals guaranteeing internal and external equilibrium.

For the Fundamental Equilibrium Real Exchange Rate (FEER) and the Behavioural Equilibrium Real Exchange Rate (BEER), these models aim to estimate equilibrium exchange rates. These estimates are then juxtaposed with actual values to identify

⁹ For more information on this point, see the thesis written and defended by Mr. ICHOU Mohammed on the subject "Competitiveness and external position of Morocco: An empirical investigation via the EBA and BEER approaches".

periods of currency overvaluation or undervaluation. These models are in line with theoretical and empirical studies that initially focused on analysing the equilibrium ERER of large economies, before extending their scope of analysis to developing countries and smaller economies, based on pioneering work such as that by Joly, H., Quinet, A., & Sobczak, N. (1998).

In addition, the FEER and BEER approaches offer equilibrium theories that define reference values for the real exchange rate, in line with a macroeconomic equilibrium. They provide a robust analytical framework for studying trends in the real exchange rate and the mechanisms that influence its future values. They also allow us to assess its real deviations (misalignments).

In the context of our work, the BEER model, introduced by Edwards (1989) and perfected by Clark P and MacDonald R., (1998), seems particularly relevant for studying exchange rate misalignment phases, especially for Morocco. The BEER provides an in-depth analysis of the factors determining the long-run equilibrium exchange rate and its short-run dynamics. Moreover, it offers a more advantageous perspective than other models, providing a more robust explanation of the causes of real exchange rate misalignments. Technical reasons, such as the availability of data and the use of advanced tools such as Eviews and R, also reinforce our choice of the BEER model as the basis for our analysis.

Analysis of the Behavioural Equilibrium Exchange Rate (BEER): An Econometric Perspective

The study of exchange rates has always been at the heart of economic debate, because of its direct impact on international trade and monetary stability. Among the various approaches adopted to analyse this phenomenon, the Behavioral Equilibrium Exchange Rate (BEER) approach stands out for its empirical nature.

The BEER, initially introduced by Edwards (1989) and Elbadawi (1994), and subsequently refined by McDonald (2000), departs from traditional theoretical models. It aims to determine the equilibrium exchange rate through econometric analysis, without relying on a pre-established theoretical framework. This approach, known as the Behavioural Equilibrium Exchange Rate (BEER), focuses on macroeconomic determinants, often referred to as "fundamentals", to estimate the reference value of the exchange rate.

One of BEER's major strengths lies in its ability to examine the trajectory of the real exchange rate as a function of various factors: level of development, economic policy adopted, and position on the international scene. Moreover, unlike other methods such as the FEER, the BEER is based on a simplified theoretical framework, making it easier to apply empirically. This approach is particularly well suited to developing economies, reflecting the dynamics of fundamental changes and analysing the behaviour of the exchange rate in the face of these developments. Implementing BEER requires advanced econometric expertise. Thanks to advances in technology, particularly econometric software, it is now possible to estimate the equilibrium exchange rate using dynamic models. The aim is to analyse the gap between current exchange rates and their equilibrium values, highlighting the long-

term relationship between the real exchange rate and the macroeconomic variables influencing an economy's internal and external balances.

The real exchange rate misalignment is given by the following expression:

$$\left[Mis_{tcr}(en \%) = \left(\frac{REER(t) - BEER(t)}{REER(t)} * 100 \right) \right] \text{ avec } BEER(t) = f(x_t) = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \varepsilon_t \quad (1)$$

Mis_{tcr}: real exchange rate misalignment with respect to its equilibrium value; REER(t): real effective exchange rate observed at date t; BEER(t): behavioural real effective exchange rate at date t, x_t represents the vector of macroeconomic fundamentals influencing internal and external equilibria (Z_{1t} corresponds to the vector of economic fundamentals with persistent long-term effects and Z_{2t} is a vector of economic fundamentals that affect the real exchange rate in the short/medium term); β_i (i=(1,2)): vectors of coefficients; ε_t: the error term.

In the case of Morocco, the BEER approach is based on estimating the dynamics of the exchange rate as a function of a set of fundamental determinants. Econometrically, this method highlights the force of the real exchange rate towards equilibrium, which could then be considered as the long-term equilibrium value.

After examining the order of integration of the statistical series, the specification adopted is an ARDL model of the form:

$$\Delta y_{it} = \phi_i y_{i,t-1} + X_i \beta_i + \sum_{j=1}^{p-1} \gamma_{ij}^* \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \Delta X_{i,t-j} \gamma'_{ij} + \theta \mu_{t-1} + \varepsilon_{it} \quad (2)$$

y_{it}=(y_{i1},y_{i2},...,y_{iT})' is a format matrix (T*1), X_i=(X_{i1},X_{i2},...,X_{iT})' is a format matrix (T*K), θ is the error correction term (adjustment coefficient or recall force).

The model, as estimated, was statistically tested to ensure its goodness of fit and predictive power.

There are two important steps in determining the BEER. The first is to identify the variables that influence the exchange rate, distinguishing long-term fundamentals from short-term cyclical influences. The second step is to estimate the 'sustainable' value of these fundamentals, either by econometric estimation or by decomposition techniques such as the Hodrick-Prescott filter.

Formally speaking, the determination of the behavioural equilibrium exchange rate (BEER) is based on a reduced-form equation of the real exchange rate and its macroeconomic fundamentals, which can be expressed as follows:

$$BEER = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \tau T_t + \varepsilon_t \quad (3)$$

Z1: Vector of economic fundamentals with persistent long-term effects; Z2: Vector of economic fundamentals that affects the real exchange rate in the short/medium term; $\beta_{(i=1,2)}$: Vector of economic fundamentals that affects the real exchange rate in the short/medium term; $\beta_{(i=1,2)}$: Vector of coefficients; T: Vector of transitory factors affecting the real exchange rate in the short term; ε : Error term. In practical terms, the long-run equilibrium level of the real exchange rate is given by the current values of all the fundamental determinants¹⁰:

$$BEER' = \beta_1' Z_1 + \beta_2' Z_2 \quad (4)$$

It must be concluded that the BEER approach offers a rich perspective for exchange rate analysis, by focusing on macroeconomic determinants and adopting a robust econometric methodology¹¹.

3. Summary of the main empirical studies on BEER: A scholarly review

The empirical dimension of the exchange rate remains a major question for researchers. Indeed, the empirical literature reveals the inherent complexity of forecasting and explaining exchange rate fluctuations. With this in mind, a plethora of studies has been devoted to analysing real exchange rate misalignment in various countries. We present here a summary of the most salient works, providing an overview of the literature while shedding light on the specification of the models and the methodologies adopted.

¹⁰ In his model, Clark and MacDonald (1998) considers the terms of trade, aggregate productivity, the budget balance expressed as a ratio of GDP and net foreign assets to be part of the Z1 group of fundamentals. The real interest rate differential is an element of the Z2 group. Clark and Macdonald (1998) defined T as a vector of temporary factors affecting the TCR in the short term. ⁶ However, it should be noted that, like any approach, it has its limitations and should be interpreted with caution

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Table 2 : Summary of studies on exchange rates and their methodologies

Authors	Study	Method used	Main conclusions
Sebastian Edwards (1989)	Reduced-form dynamic equation to study long-term exchange rate trends	Beveridge Nelson technique	Study of long-term exchange rate trends and deviations from its equilibrium level.
Chinn and Meese (1995)	Examination of the performance of multiple exchange rate determination models	BEER model	The BEER model is useful in explaining long-term exchange rate movements, but is not necessarily superior in short-term forecasting.
Egert et al. (2004)	Equilibrium exchange rates of the Czech crown	BEER model and cointegration techniques	In-depth study of equilibrium exchange rates of the Czech crown.
Alain Bénassy-Quéré et al. (2009)	Equilibrium exchange rates: a question of horizon	BEER model	Observed real exchange rates tend to converge towards their long-term equilibrium level, but this convergence can be slow.
Driver and Westaway (2004)	Concepts of equilibrium exchange rates and estimation	BEER model	Movements in the UK's real exchange rate can be largely explained by movements in economic fundamentals.
GuldeWolf et al. (2005)	Movements of the real effective exchange rate in relation to its long-term equilibrium value	Fundamental approach to real effective exchange rate based on BEER	Analysis of movements of the real effective exchange rate in relation to its long-term equilibrium value.
ClaudioPaiva and RodrigoMoita (2006)	Factors influencing Brazil's external accounts improvement and TCR fluctuations since 1999	BEER model	Study of factors influencing Brazil's external accounts improvement and TCR fluctuations since 1999.
Faruqee and Isard (1998)	BEER model for a group of seven large economies	BEER model	Deviations of the real exchange rate from its equilibrium level can be significant and persistent.
Coudert and Coharde (2008)	Tests for comparing misalignment averages between different exchange rate regimes	-	Comparison of misalignment averages between different exchange rate regimes in a sample of emerging and developing countries.
HadjAmor and ElAraj (2009)	Macroeconomic model for developing countries, particularly the Southeast Mediterranean countries	-	Examination of the exchange rate of these countries.
MohammedAmineLEZAR (2011)	Analysis of the evolution of the real exchange rate of the dirham	-	Analysis of the evolution of the real exchange rate of the dirham inspired by previous studies.
Saadaoui (2011)	Global imbalances, equilibrium exchange rates and coherent stock-flow modeling	BEER model	Global imbalances were partly due to deviations of exchange rates from their equilibrium level.
Maeso-Fernandez, Osbat, and Schnatz (2001)	Equilibrium exchange rates in EU accession candidate countries	BEER model	Real exchange rates in several candidate countries were close to their equilibrium level.

ICHOU Mohammed Adil et al. (2021)	Estimation of dirham exchange rate misalignment with its equilibrium level by the BEER method	BEER model	The degree of exchange rate misalignment is influenced by previous and current policies and practices. The value of the dirham remains stable and evolves in accordance with its norm. Misalignment is not static.
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Source: Established by the authors

This scholarly review of empirical work on the EREER provides an illuminating perspective on the different approaches and methodologies adopted by researchers in this field. It also highlights the significant contributions of these studies to our understanding of the underlying mechanisms governing exchange rate fluctuations.

4. Application of the BEER approach to Morocco

4.1 Methodology: Sources of the database and Analytical approach

When we talk about econometric analysis, we immediately refer to the use of a database. In the context of our research, which is characterised by a strong econometric dimension, the relevance and completeness of the data are essential. We have therefore attached the utmost importance to building an exhaustive database, ensuring that it faithfully reflects the theoretical concepts addressed.

Our data comes from major Moroccan institutions, such as the Ministry of the Economy and Finance, Bank Al Maghreb, the Office des Changes, and the Haut-Commissariat au Plan.

- The Real Effective Exchange Rate (REER) : This rate is calculated as the geometric average of bilateral real exchange rates, based on consumer price indices provided by the Haut-Commissariat au Plan. The weights are determined according to the trade weight of each of Morocco's partners. REER data are taken directly from the Treasury and External Finances Directorate;
- The Terms of Trade: These data are compiled by the Treasury and External Finances Directorate, based on detailed information provided by the Office des Changes concerning foreign trade;
- Openness rate: this assesses Morocco's integration into the world economy. These data are provided by the Office de Changes;
- Net foreign assets: this information is obtained directly from Bank Al Maghreb;
- Productivity (Balassa-Samuelson effect): This is defined as the ratio of output to factors of production. In the absence of a direct measure of this variable, we have opted for a substitute commonly used in the literature, namely GDP;
- Foreign Direct Investment (FDI): These data are provided by the Office des Changes;
- Data on Savings and Investment: These are taken from HCP publications

The primary objective of this empirical analysis is to exploit recent advances in non-stationary time series econometrics to study the major determinants of the real exchange rate in Morocco. We adopt the BEER approach, recognised for its

relevance and flexibility, particularly for developing economies.

The cointegration model is preferred because it allows us to define the dynamics of the exchange rate. It establishes a relationship between the exchange rate and its fundamentals, while analysing the short-term dynamics of the real exchange rate in relation to its long-term value.

The shaping of the real exchange rate is carried out in several stages. The first step is to study the order of integration of the series used. The second stage is devoted to estimating the model using the ordinary least squares (OLS) method. To do this, we used Eviews12, a software package specially designed for this type of analysis.

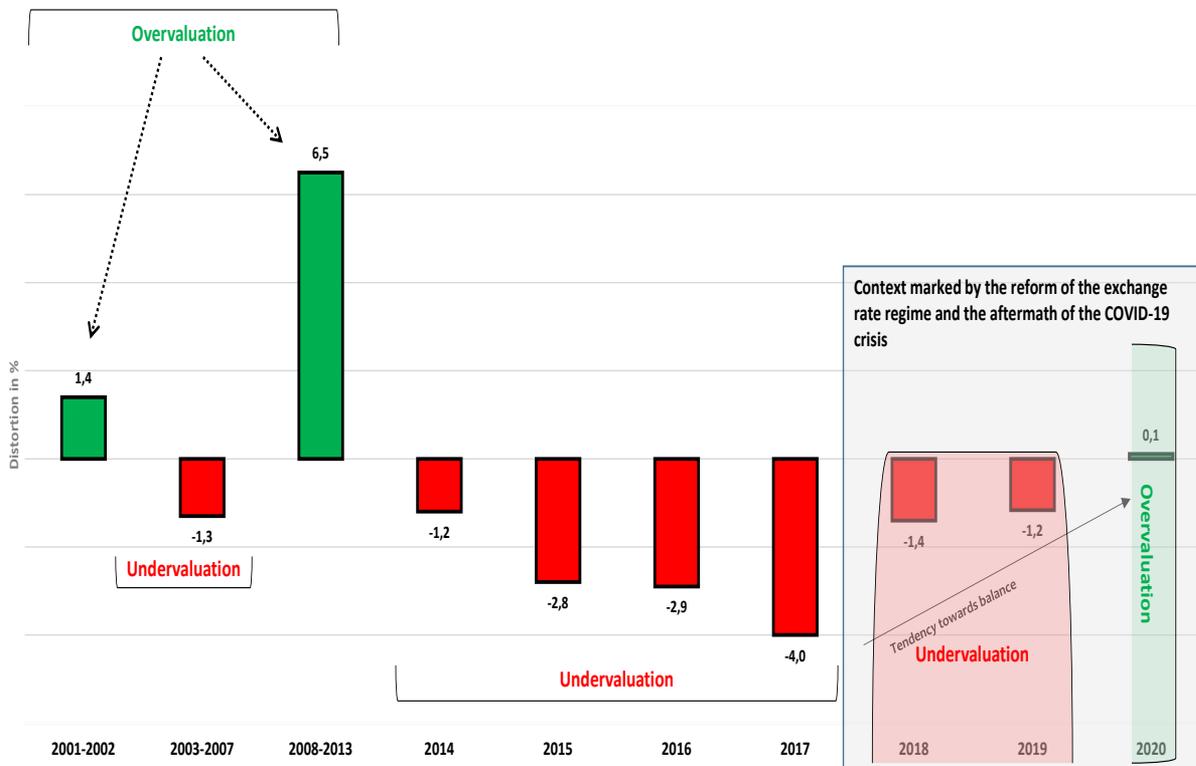
Finally, this approach enables us to identify the main determinants of the real exchange rate of the dirham and to determine whether the national currency has experienced phases of misalignment. It also gives us the opportunity to assess the relevance of a possible devaluation of the dirham.

4.2 Estimation, interpretation and discussion of the results: The Moroccan dirham is becoming increasingly stable as the exchange rate regime becomes more flexible

Applying the BEER approach to Moroccan data¹² has made it possible to estimate the misalignment of the exchange rate in Morocco over the period 2001-2020.

The graph below shows the gaps between the observed real effective exchange rate and the equilibrium real exchange rate. Positive values of these deviations correspond to an overvaluation of the dirham, while negative values indicate an undervaluation of the currency relative to the equilibrium exchange rate.

¹² For more details on the method and its implementation for the Moroccan case, see the appendix.



Graph 1: Analysis of deviations between observed real exchange rate and equilibrium rate

Source: Established by the authors

Analysis of the evolution of the REER's misalignment in relation to its equilibrium level over the period 2001-2020 has enabled us to distinguish four key sub-periods: 2001-2002: a period characterised by a modest overvaluation of the dirham (+1.4% on average). This relative stability of the national currency can be largely explained by the surpluses generated by the external balance (+4.3% and +3.6% respectively in 2000 and 2001) in a context marked by the good performance of transfers from Moroccans living abroad, travel receipts and FDI. It should be remembered that 2001 was characterised by a major privatisation operation which brought in DH23.5 billion for the State budget and foreign exchange reserves; 2003-2007: the dirham undervalued by 1.3% on average over this sub-period. This occurred against a backdrop of external surpluses (1.7% of GDP on average), a controlled budget deficit (2.2% of GDP), low inflation (2%) and a strong appreciation of the euro, which accounts for the majority of the dirham basket, against the dollar; 2008-2013: this sub-period was marked by a strong overvaluation of the dirham (+6.5% on average). This unfavourable trend is mainly attributable to the depreciation of the euro against the dollar and the deterioration in macroeconomic

balances, including the current account and budget balances, which recorded average deficits of -6.7% and -4% of GDP respectively over this period, as well as the fall in external assets (from 184MM. DH in 2008 to 153 MM.DH in 2013, a drop of 17%), in relation to the exogenous shocks that prevailed over this period, naming the international financial crisis, the European debt crisis and the surge in commodity prices ;

2014-2020: over this period, the dirham became undervalued once again, deviating from its equilibrium level by an average of -1.9%, a much smaller deviation in absolute terms than that recorded over the 2008-2013 sub-period (+6.5%). The main factors behind the favourable trend recorded between 2014 and 2019 are the improvement in the current account deficit of the balance of payments compared with the previous period (to -4.1% of GDP on average), the relative stability of the Treasury's external debt around an average level of 30% of GDP, the reconstitution of a relatively comfortable cushion of reserves (rising from MAD 183 billion in 2014 to MAD 254 billion in 2019) and the control of inflation around an average of 1%.

It is important to remember that the undervaluation recorded in 2017 (-4.0%) could be explained, in part, by the announcement effect of the reform of the exchange rate regime, putting pressure on the dirham through speculative attacks by banks which anticipated a depreciation of the dirham.

It should also be noted that since 2018, the year in which Morocco took the first step towards a more flexible exchange rate regime, the behaviour of the dirham has shown a sustained trend towards its equilibrium path. In fact, during the first year of the reform, the dirham's misalignment recovered significantly, rising from -4% in 2017 to -1.4% in 2018, before continuing to improve in 2019 (-1.2%) and 2020 (+0.1%). It should be noted that the level of misalignment recorded in 2020 is consistent with the appreciation of the dirham, relative to the central rate of the basket, observed during the same year.

Particularly for 2020, although it was characterised by the widening of the dirham's fluctuation band (± 5 instead of $\pm 2.5\%$ previously) and by the partial halt in economic activity following the health crisis caused by COVID-19, the degree of misalignment of the dirham remained under control overall (+0.1%). This balanced situation can be explained, in particular, by:

- Proactive and rigorous management of the health crisis, resulting in courageous decisions by the public authorities. Indeed, in order to counter the effects of the Covid-19 pandemic on Morocco's foreign exchange reserves, following the negative impact that this pandemic would have on sectors and activities oriented towards the outside world, In April 2020, the public authorities drew on the Precautionary and Liquidity Line (LPL) for an amount of nearly 3 billion dollars, as well as raising the ceiling on external borrowing, which in turn enabled the mobilisation of other external financing (from the international market and bilateral and multilateral financing) ;
- Other factors relating, in particular, to the significant reduction in the trade deficit (-23.1% or the equivalent of DH47.8 billion), in connection with the

greater fall in imports than in exports, the resilience of remittances from Moroccans living abroad (+5%) and, to a lesser extent, the positive behaviour of FDI flows (+1%), which largely offset the fall in tourism receipts (-53.8% or the equivalent of DH42.4 billion).

All these factors have contributed significantly to maintaining foreign exchange reserves at a comfortable level, in excess of 7 months of imports of goods and services, and to ensuring, by ricochet, the stability of the dirham.

4.3 Contribution of fundamentals to the worsening misalignment of the real effective exchange rate with its equilibrium

In the context of our economic study, having measured the degree of deviation of the exchange rate from its equilibrium level, it has become imperative to understand the underlying factors that influence this deviation. Our objective here is to quantify the contribution of each indicator to explaining the exchange rate misalignment. This is essential to determine the driving forces behind exchange rate fluctuations and to formulate appropriate policy recommendations.

The analysis has proved particularly relevant in the light of two major recent events in the global economy: exchange rate reform and the COVID-19 crisis. Exchange rate reform, aimed at modernising the monetary system and making it more flexible, has had a significant impact on the behaviour of the exchange rate. On the other hand, the COVID-19 pandemic, with its unprecedented economic consequences, has added a further layer of complexity to the analysis.

The table that follows details the key periods and highlights the effects of the various indicators on the misalignment of the exchange rate. An accurate interpretation of this data will enable us not only to understand past trends, but also to anticipate future movements in the exchange rate, taking into account the lessons learned from these two crucial events.

Table 3: Effects of fundamentals in terms of contribution to the widening of real effective exchange rate misalignment from its equilibrium level

		Opening rate	Investment rate	Savings rate	Economic growth	Terms of trade	FDI/GDP	Foreign exchange assets (AOR)
2018Q1	Period of the Exchange Reform	-2,47	-0,46	1,54	-0,684	5,0	-0,12	-0,50
2018Q2		-2,48	-0,43	1,48	-0,191	5,0	-0,11	-0,49
2018Q3		-2,34	-0,42	1,35	-0,441	5,0	-0,17	-0,48
2018Q4		-2,44	-0,48	1,59	0,893	5,0	-0,25	-0,48
2019Q1		-2,63	-0,44	1,52	-0,232	5,2	-0,10	-0,47
2019Q2		-2,42	-0,44	1,53	0,030	5,2	-0,11	-0,48
2019Q3		-2,31	-0,40	1,37	-0,522	5,2	-0,12	-0,49
2019Q4		-2,48	-0,45	1,56	0,708	5,2	-0,11	-0,51
2020Q1	Exchange Reform and the Outbreak of COVID-19 Crisis	-2,47	-0,41	1,37	-0,619	5,0	-0,08	-0,53
2020Q2		-2,54	-0,40	1,56	0,708	5,2	-0,10	0,71
2020Q3		-2,79	-0,36	1,45	-0,375	5,3	-0,08	0,67
2020Q4		0,66	-0,36	1,46	0,047	5,3	-0,09	0,71

Average contribution: Opening rate (-2.23), Investment rate (-0.42), Savings rate (1.48), Economic growth (-0.06), Terms of trade (5.13), FDI/GDP (-0.12), AOR currency holdings (-0.54)

Average contribution of the domestic economy: 0.335

Average contribution of the external economy: 0.560

Source: Established by the authors

The analysis reveals several crucial factors that influence the misalignment of the real effective exchange rate relative to its equilibrium level. Through examining the mean contributions of distinct macroeconomic fundamentals, the underlying forces shaping movements in the national currency can be identified:

Openness rate: The persistent negative contribution of the openness rate reflects a tendency towards economic closure or less integration into world trade. This could reflect a protectionist policy or a reluctance to enter into international trade agreements;

Investment rate: The negative contribution from the investment rate suggests a decrease in investment, perhaps due to economic uncertainty or unfavourable conditions for investors. This could have long-term implications for economic growth and development;

Savings rate: The positive contribution of the savings rate is an encouraging sign, indicating an increased propensity to save. This could reflect prudent monetary policy or increased household confidence in the economy;

Economic growth: Economic growth shows a mixed contribution, with periods of negative contribution followed by periods of positive contribution. This could reflect economic fluctuations, with periods of slowdown followed by upturns;

Terms of trade: The consistently positive contribution from the terms of trade

suggests that the economy has benefited from favourable trading conditions, perhaps due to increased demand for its exports or a reduction in the cost of its imports;

FDI/GDP: The negative contribution of FDI as a percentage of GDP could indicate a decline in foreign investor confidence or barriers to foreign investment;

Foreign exchange assets (AOR): A negative sign on foreign currency assets AOR signifies their contribution to currency stability by minimizing the misalignment gap. Foreign currency holdings can act as a reserve, offering coverage against undue pressures on the exchange rate. When an economy holds substantial foreign currency reserves, it can intervene in the foreign exchange market to stabilize its currency in the face of significant fluctuations.

Average contribution from the domestic economy¹³: The positive contribution of 0.335 suggests that domestic factors, such as economic growth, investment and savings, have had a stabilising impact on the exchange rate.

Average contribution from the external economy¹⁴: The positive contribution of 0.560 indicates that external factors, such as trade conditions, foreign investment flows and global economic conditions, also played a stabilising role.

By way of conclusion, analysis of the contributions of economic fundamentals to the misalignment of the real effective exchange rate offers an illuminating view of the economic health and underlying trends of the economy. It is clear that both internal and external factors have played a key role in determining the path of the exchange rate.

The positive contribution of the domestic economy, at 0.335, testifies to the robustness of the internal mechanisms of economic regulation. This suggests that, despite external challenges and global fluctuations, domestic economic policies have managed to maintain a degree of stability. This could be attributed to a sound monetary policy, renewed consumer confidence and prudent management of public finances.

On the other hand, the positive contribution of 0.560 from the external economy indicates that, despite global challenges, the economy has been able to take advantage of the opportunities offered by international trade, foreign investment and other global economic interactions. The terms of trade, in particular, have played a key role, perhaps reflecting a successful export strategy or comparative advantages in certain key sectors.

It is also essential to recognise the impact of major events, such as exchange rate reform and the COVID-19 crisis. These events have undoubtedly introduced disruption and uncertainty, but their impact has been modulated by the underlying economic fundamentals. Exchange rate reform, for example, may have been a catalyst for greater global economic integration, while the COVID-19 crisis highlighted the importance of a resilient and adaptable economy.

¹³ The average contribution of the domestic economy is measured by the average of the contributions of the indicators reflecting domestic equilibrium (growth, investment and savings).

¹⁴ The external contribution is measured by the average of the contributions of the indicators reflecting the external balance, in particular FDI, the terms of trade, the opening rate and official foreign currency assets.

Overall, this analysis highlights the importance of a balanced approach that takes account of both internal and external factors in managing the exchange rate. It also highlights the need for strategic planning and preparation for external shocks, while capitalising on internal strengths to ensure inclusive and sustainable economic growth.

5. Conclusion

The dirham showed strong resilience in 2020, remaining almost at its equilibrium level. This situation was made possible by the decisions taken by the public authorities to protect themselves against external risks (drawing on the LPL and removing the ceiling on external borrowing) and by the external trade situation in 2020 (significant reduction in the trade deficit, resilience of transfers from Moroccans living abroad). It should be noted that the slight overvaluation of the dirham, in relation to its equilibrium level, recorded in 2020 remains consistent with the appreciation of the dirham, in relation to the central rate of the basket, observed during the same year.

The factors that enabled the dirham to remain stable in 2020 are not structural in nature and conceal certain short- and medium-term risks:

- While the significant improvement in the trade balance was due primarily to a fall in imports, the prospects for a recovery in the national economy are likely to be accompanied by a sharp upturn in imports, especially of semi-finished products and capital goods, given the high degree of import penetration in our economy. This situation would undoubtedly lead to a widening of the trade deficit in the short and medium term;
- The drawdown on the LPL and Morocco's exit from the international market should result, in the medium term, in a reduction in fiscal room for manoeuvre and pressure on foreign exchange reserves, through debt servicing.

Since 2014, the value of the dirham has been broadly in line with macroeconomic fundamentals, showing a significant improvement compared with the period 2008-2013. Indeed, the average misalignment posted over the period 2014-2020 (-1.9%) is significantly lower, in absolute terms, than that recorded over the period 2008-2013, marked by an average overvaluation of 6.5%.

In particular, since the first flexibilisation of the exchange rate regime initiated in January 2018, the dirham has become more stable and is increasingly close to its equilibrium level. The degree of misalignment recorded over this period (2018-2020) has not exceeded -0.8% on average. A priori, this situation heralds favourable conditions for greater flexibility in Morocco's exchange rate regime.

The sustained appreciation of the nominal exchange rate against the central rate derived from the basket, observed since the beginning of the second half of 2020 (approaching the lower limit of the fluctuation band), in conjunction with the weakness of the misalignment calculated for that same year, suggests:

review the method for calculating the reference price used to determine the central rate. This could be envisaged by increasing the number of banks with "market

maker" status and/or extending the time slot for observing quotations, with a view to providing better coverage of economic activity transactions and, by extension, better reflecting real fluctuations in the dirham;
to consider the possibility of opting for greater flexibility in the exchange rate regime, once the uncertainties relating to the implications of the health crisis on the fundamentals of the national economy are under control. This will give the dirham more freedom to fluctuate in line with market mechanisms. In this respect, it should be remembered that pressure on the foreign exchange market eased significantly during the reform period. This was relatively evident in the behaviour of the dirham, which depreciated at the start of the health crisis before appreciating just after the LPL was drawn down.

References

- [1] Agnès Bénassy-Quéré, Sophie Béreau & Valérie Mignon. Taux de change d'équilibre. Une question d'horizon. *Revue économique*. 2009; 60:657-666.
- [2] Balassa, B. The purchasing-power parity doctrine: A reappraisal. *Journal of Political Economy*. 1964; 72:584-584.
- [3] Bayoumi, T., & Eichengreen, B. Exchange rate volatility and intervention: Implications of the theory of optimum currency areas. *Journal of International Economics*. Date not provided. 1998, Vol. 45, Issue 2, 191-209.
- [4] Chinn, M., & Meese, R. Performances de plusieurs modèles de détermination du taux de change. *Revue d'Économie Financière*. 1995;33(2):169-185.
- [5] Clark P., MacDonald R., « Exchange rates and economic fundamentals: a methodological comparison of beers and feer s », IMF Working paper 98/00. 1998.
- [6] Coudert, V. & Cohard, C. Currency Misalignments and Exchange Rate Regimes in Emerging and Developing Countries. CEPII Working Papers. 2008; No. 2008-07.
- [7] Driver, R., & Westaway, P. Concepts de taux de change d'équilibre et estimation. *Revue d'Économie Financière*. 2004;74(1):9-32.
- [8] Edwards, S. Real and monetary determinants of real exchange rate behavior. *Journal of Development Economics*. 1988; 29:311-341.
- [9] Edwards.S. «Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Country.» 1994.
- [10] Elbadawi, A. Estimating Long-Run Equilibrium Real Exchange Rates. Washington: Institute for International Economics. 1994.
- [11] Faruqee, H., & Isard, P. Modèle BEER pour un groupe de sept grandes économies. *Revue d'Économie Financière*. 1998;49(3):77-93.
- [12] GuldeWolf, A. M., Tsangarides, C., & Eichengreen, B. Mouvements du taux de change réel effectif en relation avec sa valeur d'équilibre de long terme. *Revue d'Économie Financière*. 2005;77(2):209-226.
- [13] HadjAmor, H., & ElAraj, B. Modèle macroéconomique pour les pays en développement. *Revue d'Économie Financière*. 2009;94(1):67-85.

- [14] ICHOU, M. A., CHAGRAOUI, W., BAKOUR, C., & ICHOU, R. Estimation du désalignement du taux de change du dirham par rapport à son niveau d'équilibre par la méthode BEER à l'aune de la mise en œuvre de la réforme de change. *African Scientific Journal*. 2021;5(3):546-581.
- [15] LEZAR, M. A. Analyse de l'évolution du taux de change réel du dirham. *Revue d'Économie Financière*. 2011;104(4):53-68.
- [16] Maeso-Fernandez, F., Osbat, C., & Schnatz, B. Taux de change d'équilibre dans les pays candidats à l'adhésion à l'UE. *Revue d'Économie Financière*. 2001;63(2):107-126.
- [17] Maurice Obstfeld & Kenneth S. Rogoff, 1996. "Foundations of International Macroeconomics," MIT Press Books, The MIT Press, edition 1, volume 1, number 0262150476, February.
- [18] Paiva, C., & Moita, R. Facteurs influençant l'amélioration des comptes extérieurs du Brésil. *Revue d'Économie Financière*. 2006;82(3):87-105.
- [19] Ronald MacDonald. Concepts to calculate equilibrium exchange rates: An overview. Economic research group of the Deutsche Bundesbank. 2000.
- [20] Saadaoui, J. Déséquilibres globaux, taux de change d'équilibre et modélisation stock-flux cohérente. *Revue d'Économie Financière*. 2011;102(2):23-38.
- [21] Samuelson.P. «Theoretical notes on trade problems.» *The Review of Economic and Statistics* VOL.46, n° 2 (1964).
- [22] Hervé Joly, Alain Quinet, Nicolas Sobczak. Taux de change et chômage: un exemple d'application de théorie du change réel d'équilibre. *Revue française d'économie*. 1998; VOL.13, n° 3:151-175.
- [23] Williamson. J. «Estimating equilibrium exchange rates.» Institute for International Economics, 1994.