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The Effects of Balance of Trade and Economic Development Factors on The Exchange rate: Case of Morocco

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This paper examines the various effects of Morocco's balance of trade and other economic factors on the exchange rate of the Moroccan Dirham (MAD) with respect to the American Dollar (USD). An annual time series data was collected from 1960 to 2018 from the World Bank Data Group concerning exports, imports, gross domestic product (GDP), inflation, and the official exchange rate. Johansen co-integration test, vector autoregressive (VAR) model, Vector error corrective model (VECM), and Granger Causality were applied to test the significance and impact of variables related to the trade balance and economic factors. Results revealed a cointegration association between the variables. This association is exhibited on both the short-run and the long-run. Only inflation displayed an association with the exchange rate on the short run. On the other hand, exports, imports, and GDP appeared to be cointegrated with the exchange rate on the long run. Unlike the trade balance components, GDP and inflation appeared to Granger-cause the exchange rate of Morocco.

Keywords: Balance of Trade, Exchange Rate, Granger Causality, Johansen Co-integration, VAR, VECM

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Introduction

Exchange rates can be considered as one of the determinants of an economy. A strong exchange rate can highlight the robustness of an economy and vice versa. However, exchange rates themselves are affected by other factors or economic determinants. Thus, creating inter-related bounds. Of these economic determinants, the balance of trade is one that affects the behavior or changes of the exchange rate of a country's currency against another one. Information related to the balance of trade of a country can provide useful insight related to both the supply and demand for a domestic currency and the performance of the concerned economy of such currency Aggarwal and Schirm, (1992). Both current and future information about the balance of trade might have an impact on the variations of the exchange rate of a country. Future information or prediction for any kind of economic factor relies on expectations. Therefore, if a factor happens to deviate, either positively or negatively, from expectations, it is going to generate new information that can be relevant to determining whether actual or upcoming changes in the exchange rate (Mussa, 1982). To better illustrate this idea, suppose a country registers an amazingly high performance in its balance of trade. Such experience can infer increased efficiency or productivity of the country's economy. As a result, these events can enhance the current balance of the economy, thus improving the domestic currency of the country (Doukas and Lifland, 1994). Therefore, it is worth investigating what impact the balance of trade might have on exchange rates.

Trade, whether it is unilateral or bilateral, happens almost between all countries of the world. However, the quantity exported or imported differ according to various specifications or requirements of each country. Morocco is a case of attention that deserves interest in terms of studies. Located in North Africa, this country has been going through a lot of ups and downs during the last 40 years. Due to a payment crisis in 1983, Morocco has massively reduced restrictions on trade and tariffs from 165% to 45% for a period that lasted 6 years (Currie and Harrison, 1997). Since then, in the mid to late 2000's, the country has been working on developing two main projects, Tangier Med and Casa Marina, which are two strategic ports that would enhance Trade operations of Morocco (Barthel and Planel, 2010). In terms of ports and maritime transportation, Morocco has been able to enhance its global position, moving from a worldwide rank of 84 to the 16th place, thanks to its new establishments of the Tangier Med port (El Imrani and Babounia, 2016). Thanks to its geographical location, Tangier Med has been able to link the Atlantic Ocean with the Mediterranean oceans. Certainly, such new operations have an impact on the balance of trade, which might affect the Moroccan exchange rate as a result.

Morocco's balance of trade has been experiencing deficits for years due to the country's high amounts of imports. The country's reliance on agriculture and tourism does not place its economy in a strong position to export its offerings to the external world. The lack of infrastructure and a healthy manufacturing industry is one of the weaknesses of the country. The lack of such industry plays a role within Morocco's GDP. In other terms, a manufacturing industry might contribute to the GDP of the kingdom and develop it. Somehow, it makes sense to say there can be a relationship between exports and GDP as the former contributes to the latter. However, GDP is not the only economic factor which can represent an economy's behavior. Inflation for instance reflects the purchasing power of consumers, thus their ability to impact an economy. A high inflation can affect the performance of an economy and hurt it. If all of these economic factors reflect a certain aspect of an economy, they might affect each other or display a relationship Lim and Sek, (2015). Instead of looking at the effects of balance of trade on the Moroccan exchange rate, the addition of other economic development factors, GDP, and inflation, can only be interesting. It might be interesting to generate new results to update the research conducted before, and perhaps provide new recommendations.

This paper examines the various effects of Morocco's balance of trade and some economic development factors on the exchange rate of the Moroccan Dirham (MAD) with respect to the American Dollar (USD). Over the years, the MAD have depreciated from a starting point of about 5 MAD/$ to a floating range between 9 and 10 MAD/$ in the 21st century. This currency devaluation is worth investigating which factors contribute to such negative result.

Th

If Morocco's balance of trade recorded deficits over the same years the MAD depreciated, there might be a relationship between these factors. Thus, our interest into this study. In international trade, a devaluation of the domestic currency, the MAD in this case, tends to facilitate trade as exports become cheap and imports expensive, hence a better trade balance Arize, Malindretos, and Igwe, (2017). A literature review is provided as a first section to describe the various methods or models applied to conduct such research and analyze the obtained results to generate comparisons later. A second section describes the data collected as well as the methodology that will be applied. Furthermore, a third section analyzes the data collected to generate results. Finally, a fourth section involves the limitations, research implications and future research. Research concerning the trade balance and exchange rate is widely open and available to scholars. Jadoon and Guang (2019) investigated the effect of exchange rate fluctuations on trade of balance for Pakistan for instance. Before that, Arize, Malindretos, and Igwe (2017) published another study regarding the same topic, with eight countries of interest: China, Israel, South Korea, Malaysia, Pakistan, Philippines, Russia, and Singapore. Other than these countries, Bahmani-Oskooee and Saha (2017) provided an asymmetric study of the exchange rate changes and their effects on the US-India trade balance. Besides these studies, others are highlighted and elaborated on in the literature review.

However, only few of them tackle the subject in North African countries. Yol and Baharumshah (2005) conducted a research on the effects of the changes of exchange rate on balance of trade in Egypt, Morocco, and Tunisia. Moreover, Sadok (2018) published a study on the effect of exchange rate on trade balance in Morocco. Similarly, Ezzat (2018) developed another study, focusing on the relationship only in Egypt.

The previously mentioned research focused on the impact or effects of the exchange rate on the trade balance. However, the opposite impact was not deeply investigated, especially in emerging and African countries. In this essence, this research paper extends the literature by choosing Morocco as the case study of the research. As stated previously, the depreciation of the Moroccan exchange rate over years remarked a continuous increase of the balance of trade's deficit, even though the country's GDP and inflation have been floating in different ways. Thus, it would be interesting to focus on the trade balance, GDP, and inflation, to see if one, or many, has an impact of the exchange rate of the Kingdom of Morocco. Morocco's imports have been greater than exports over years, thus I suggest that the trade of balance might have a negative relationship with the exchange rate. This does not mean that exports will have a negative effect, but its positive impact might be shadowed by a bigger negative effect, the one of imports. An increase in GDP describes a development in the economy, thus a positive effect can be presumed to be on the Moroccan exchange rate with respect to the dollar value.

To enhance research in the Moroccan context concerning its economy, this paper aims at answering the following research question:

Is there an association or relationship between the balance of trade, the selected economic development factors, and the exchange rate?

This research contributes to the literature first by studying the opposite side of the relationship between trade balance and exchange rate as recent research is not widely available. Thus, it is interesting to update the literature regarding the subject matter, and perhaps offer new and different results. Second, the study includes other independent variables, GDP and inflation, which could impact the exchange rate and present new findings. Last but not least, the study is applied in the Moroccan context, in which very little research has been conducted, and especially regarding this topic. The practical impact of this study would be to shed light on the nature of the relationship, and if there is an impact, whether on the short- or long-run, this is something that would be of interest to economists and traders to account for when it comes to the time it would take the trade balance, GDP, and inflation to impact the exchange rate.

Literature Review

To examine the relationship between the trade balance, inflation, GDP, and the exchange rate of Morocco, a little throwback in history is necessary to dig into the results obtained by previous research studies. Previous literature review helps us understand how such relationship can be assessed through the various availability of models.

In addition to that, it offers us different results obtained by research for which a new debate can be created based on the findings of this research.

The relationship between accounts of trade balance and exchange rates has long been examined by previous studies, and the obtained results differ from one research to another depending on the methodology applied. The current account or trade balance of imports and exports was pointed out to be one of the major determinants of the exchange rate (Dornbusch and Fischer, 1980). In this essence, Doukas and Lifland (1994) investigated this relationship by analyzing the US balance of trade with various exchange rates. While the former consists of both the monthly announcements of the merchandise trade related to the US trade balance and the forecasted trade balance information, the latter involves six major currencies which are: the Canadian dollar, the British pound, the German mark, the French franc, the Swiss franc and the Japanese yen. The sampled data covers a period from 1986 to 1989 and required the usage of two procedures. The procedure to examine stock returns over an announcement period was the methodology applied to study the effect of the US trade balance announcements on exchange rates. In addition to that, the comparison period procedure was applied to the research to test the significance of the information period with respect to the behavior of the selected exchange rates. Finally, a regression analysis was applied on each of the six exchange rates changes with respect to the announcements related to the US trade balance. Doukas and Lifland (1994) concluded that deficit announcements triggered effects on daily changes related to exchange rates. The foreign exchange market was more responsive to increasing than decreasing trade deficit announcements. In other words, as the deficit of the balance of trade increases, exchange rates are more likely to fluctuate and thus depreciate the dollar value with respect to the chosen foreign currencies.

In the same context, Aggarwal and Schirm (1992) studied the impact of announcements and new information related to the balance of trade on various asset prices such as the US exchange rates. Monthly information of the US trade balance was considered into the research, under the assumption that only new information at the period of the announcement should impact exchange rates. On the other side, asset prices and exchange rates were assessed daily.

The main difference comes from the fact that trade balance announcements do not occur frequently, unlike the changes in asset prices in exchange markets and stock markets. Data was collected over a period from 1980 to 1988. As of this period, several policy regimes were forced by the Federal Reserve, therefore the overall time range was split into five subcategories: February 1980 to October 1982; November 1982 to February 1984; March 1984 to September 1985, October 1985 to February 1987, and March 1987 to December 1988. Regression models were the main statistical tool to conduct the study where the dependent variables were the asset prices, and the independent variables include the US trade balance announcements as well as dummy variables representing days of the week.

Aggarwal and Schirm (1992) discover that before 1985, exchange rates were not affected by the announcements of the US trade balance. However, announcements appeared to have an impact in the period from 1985 to 1987, and their effect escalated in the last subcategory until the end of year 1988. Thus, it can be suggested that the US trade balance announcements started impacting exchange rates starting 1985.

Another similar study to Aggarwal and Schirm (1992) has been conducted by Irwin (1989) where he investigated the effects of trade deficit announcements on the dollar value. The same period, from January 1980 to only June 1988, applied to this research study. Monthly data of trade announcements were carried into the study. Several regression models were conducted to examine the change in exchange rates, considering both the unexpected and expected elements of the US trade balance announcements. Regardless of the expectations, Irwin (1989) claimed that announcements related to the balance of trade significantly impact the changes in the dollar value especially for unexpected values. Moreover, deficits of a certain value were reported to depreciate the dollar value. However, the effects of the US trade balance announcements on the dollar currency started having an impact only after the period of mid-1984. Therefore, this study joins that of Aggarwal and Schirm (1992) in the sense that trade balance announcements did not impact exchange rates changes prior to mid-1984.

The previously mentioned literature mostly discusses the impact of trade balance announcements on the exchange rate. However, other research found interest at testing the opposite side of the relationship. In other words, the effects of the exchange rate on trade balance has been tested as well to investigate the existence of an impact. Aziz (2008) analyzed the role of both the Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) on the trade balance of Bangladesh. Different models and techniques were used to test this relationship in both the short and long-run. Error Correction Mechanism (ECM) was applied in the former run while the Engle-Granger and Johansen techniques were tested in the latter run. In addition to that, the Impulse Response Function (IRF) was used to evaluate whether the Marshall-Lerner condition holds. A sample of 34 annual observations was collected, representing a period from 1972 to 2005. Aziz (2008) stated that the REER positively affected the balance of trade in both the short and long-run. Moreover, the study claimed that the REER "Granger causes" the Bangladeshi trade balance. The significant and positive impact of the REER on trade balance has been supported as well by the IRF.

A similar study has been conducted by Onafowora (2003) on three ASEAN countries, Thailand, Malaysia, and Indonesia. Bilateral trade balances with the USA and Japan of each country were included as variables of study. Cointegration was assessed using the Vector Error Correction Model (VECM), and the Marshall-lerner condition was tested by the generalized IRF. A quarterly data from 1980 to 2001 was included as a sample data for the research. Onafowora (2003) suggested that a long-run relationship exists between real trade balance and real exchange rate in the three ASEAN countries. For the short-run, J-curve effects appeared to exist in Malaysia and Indonesia in their bilateral trade with both USA and Japan. However, such effects for the case of Thailand appeared only in the bilateral trade with USA. Within ASEAN countries, Yusoff (2007) inspected the short and long-run relationships between the real exchange rate and the real balance of trade in Malaysia using the cointegration technique. ECM and IRF models are also applied within the study. Exports and imports data were gathered on a quarterly basis from the bulletin of the Central Bank of Malaysia, and the other variables, exchanges Rates, domestic and world incomes, were obtained from the International Monetary Fund (IMF) over a period from 1977 to 1998.

Yusoff (2007) claimed that a depreciation in the real ringgit exchange rate, with respect to the US dollar, promotes the balance of trade in the long run. In addition to that, the IRF revealed that impacts of the exchange rate on the trade balance extend for about three years.

On the other hand, other literature has proved to find little or no significant impact at all coming from the exchange rate on the balance of trade. Vural (2016) conducted a research to analyze the relationship between exchange rate and trade balance of Turkey. The concerned variables are obtained with respect to Germany, the major trade partner of Turkey. Data was collected monthly over a period from 2002 to 2014. Johansen cointegration technique and error correction model were the main statistical tools used to analyze the data. Vural (2016) presented evidence that no pattern has been detected between the real exchange rate and the balance of trade. In other words, there is no relationship between the two variables, and the exchange rate has no effects on the trade balance of Turkey with respect to Germany.

Another study has been presented by Liew, Lim, and Hussain (2003) in which they investigated whether variations in exchange rates have a direct effect on the balance of trade of five ASEAN countries and Japan. The main countries involved in the study are Indonesia, Japan, Malaysia, Philippines, Singapore, and Thailand. Balance of trade was based on the retrieval of imports from exports revenues. Exchange rates were estimated following the Consumer Price Indices (CPI) obtained by from the Purchasing Power Parity (PPP). While the trade balance was gathered from the Direction of Trade Statistics Yearbook, exchange rates were collected from the International Financial Statistics. Data was collected over a period from 1986 to 1999. Liew et al. (2003) concluded that the effects of exchange rates on trade balance have been exaggerated by previous literature. In other words, the desired or expected effects of the exchange rate on trade balance were not achieved.

Besides the trade balance, other factors or economic development indicators can be tested to see whether they have an impact on the exchange rate.

Among these indicators, some authors included the Gross Domestic Product (GDP) and inflation as independent variables.

Not a lot of recent studies have conducted such analysis, but most of the past research indicates that there is a relationship between balance of trade and exchange rate, and between GDP and exchange rate. In this essence, we might think that similar results will be obtained in our study. However, the combination of all variables into one model might lead to other results.

Abbas et al. (2012) examined the relationship between some these factors such as GDP, inflation, and real interest rate with the variations of the exchange rate of African countries. The countries of interest included Cameroon, Cape Verde, Comoros, Burundi, Ethiopia, Algeria, Gambia, Kenya, Egypt, and Angola. Annual time series data were gathered with 15 observations from 1996 to 2010. The analysis was carried through a series of regressions. Abbas et al. (2012) revealed that only the GDP exhibited a significant relationship with the exchange rate in 8 countries, expect for Ethiopia and Angola, while inflation and interest rate proved insignificant in this study. The reasons behind the absence of a relationship in Ethiopia and Angola was explained by the high variability of the data in these two countries during the selected period of study.

Not a lot of recent studies have conducted such analysis, but most of the past research indicates that there is a relationship between balance of trade and exchange rate, and between GDP and exchange rate. In this essence, we might think that similar results will be obtained in our study. However, the combination of all variables into one model might lead to other results.

Research methods

Data Collection

The aim of this paper is to test whether the balance of trade and other economic factors have an impact on exchange rate. Therefore, the trade balance of Morocco accounts for every import and export operations of the country with any other trade partner. The point behind is to measure the impact or effect, if any, of either one of these two components or both on the exchange rate.

Concerning the exchange rate, as Morocco has been

Following a fixed exchange rate regime, its own currency was related to the country's main trade partners and their currencies. The Moroccan Dirham (MAD) was mainly fixed to the Euro (€), with France as a European partner, and to the American Dollar (USD), with USA as the major trade partner. In such case, our data will mainly focus on the exchange rate between the MAD and the USD, as the former was fixed to about 60% of the latter. The official exchange rate was considered as a proxy measure of exchange rate in this study. GDP and inflation were added to this study to determine whether the impact of other factors, besides the components of the trade balance, on the exchange rate if existing. An annual time series data was collected from 1960 to 2018 from the World Bank Data Group concerning exports, imports, GDP, inflation, and the official exchange rate. In the following parts of the study, abbreviations for each variable might be used in modelling equations. Exports, imports, inflation, and exchange rate are denoted to as Exp, Imp, Inf, and ER, respectively.

Insert Table 1 here : Descriptive statistics

Almost all the variables of study are going towards one trend, which is an increase over time. Both the exports and imports recorded a low growth increase, with imports higher than exports in terms of value. This shows that Morocco has been experiencing a deficit in terms of trade balance since 1961. On the other hand, the logarithmic form of the GDP shows a considerable increase from 1960 to 2018 as it can be seen on figure 1. Concerning the exchange rate, it has been floating over the years. But in general, the Moroccan Dirham depreciated from 5.06 MAD/$ in 1960 to 9.39 MAD/$ in 2018. This would suggest that a trade balance deficit is more likely to depreciate the MAD. Finally, inflation encountered several fluctuations over the period. After the financial crisis of 2008, it started to decrease and fluctuate with a lower percentage change compared to previous years. A mean higher than standard deviation means that the included or selected data is normally distributed. This is the case in our study; thus, we can assume normality even though it will be tested later through appropriate statistical tests. Skeweness is a measurement of symmetry, which is obtained when the result is zero. All the selected variables indicate a negative skeweness with a value between -0.5 and 0, suggesting not only that the left-hand tail of the data is longer than the

Right-hand tail, but also the data is fairly symmetrical. Finally, kurtosis is a measurement of peaks or flat data. A negative kurtosis suggests that the distribution has light tails, which is our case in this study.

Insert the Fig 1 here: Logarithmic graphs of exports, imports, exchange rate, inflation, and GDP for Morocco, from 1960 to 2018

Models

Several models were used in the literature to assess the impact of the balance of trade on the exchange rate or vice versa. However, some common methodologies were repeated by various studies. This research paper will apply four main models, which are the Johansen Cointegration, the VAR model, VECM, and the Granger Causality.

Unit root test

The previously mentioned models require a prior step before applying the test. Stationarity of the concerned variables of study, balance of trade and exchange rate, is primordial. This step is checked or ensured using the Augmented Dickey Fuller (ADF) test, which involves three models. Each of these models has its own characteristics. The first model, or model 0, tests for stationarity of a variable with no constant or time trend to be detected. The second model, model 1, adds up the constant to the test. The last model, model 2, includes all the previous variables and the time trend to determine if the variables is stationary and follows a certain trend (Dickey and Fuller, 1981).

The ADF tests the null hypothesis of the existence of a unit root (Dickey and Fuller, 1981) through the following formula:

$\Delta Y_t = \varphi\ Y_{t-1} + \varepsilon$ (I)

The results are tested through an F test. In case the F test is within the range of the critical value(s), we augment the Dickey Fuller test by one level. In other words, a change of the previous change is calculated concerning the dependent variable. The process progresses until the test proves significant, thus the stationarity of the variable.

Unit roots or stationarity was tested for each variable as the following:

$\Delta ER_t = \varphi\ ER_{t-1} + \varepsilon$ (1)

$\Delta Exp_t = \varphi\ Exp_{t-1} + \varepsilon$ (2)

$\Delta Imp_t = \varphi\ Imp_{t-1} + \varepsilon$ (3)

$\Delta GDP_t = \varphi\ GDP_{t-1} + \varepsilon$ (4)

$\Delta Inf_t = \varphi\ Inf_{t-1} + \varepsilon$ (5)

Johansen Cointegration Test

Johansen cointegration test is part of the models that will assess the impact of the Moroccan balance of trade and economic development factors on the exchange rate of the country with respect to the USA. Cointegration was first developed by Granger (1981) and then extended by Johansen (1991) by applying regression with integrated regressors. Vector Autoregressive (VAR) models were developed by Johansen as statistical tools for econometric situations for time series data and other parametric variables (Kitamura, 1998). The Johansen cointegration test requires the determination of the optimal lag of variables. This requirement is mainly to avoid statistically insignificant coefficients, in the case there are many lags, or specification errors, in the opposite case. Of the various models that can perform such analysis, the Akaike's Information Criterion (AIC) is considered as one of the most efficient models as it minimizes error predictions (Bozdogan, 1987). Moreover, Hacker and Hatemi-J (2008) claimed that the AIC possesses interesting and good forecasting properties and lag-determination parameters.

The formula of the Johansen cointegration test is based on the VAR model:

$$Y_t = M + \sum_{i=1}^{n} \Pi_i Y_{t-i} + \varepsilon_t \quad \text{(II)}$$

Where Y represents the logarithmic form of all variables. In this case, we will consider only the impact on exchange rate.

Therefore, Johanesen cointegration test will be demonstrated as the following:

Insert Equation 6 Here

VAR Model and VECM

Johansen cointegration test can determine the existence of a cointegration relationship between various variables. However, whether the relationship exists on a short-run or a long-run

Basis, other models are required to determine such time basis relationship.

While Vector Autoregressive (VAR) models determine the short-run relationship between variables, Vector Error Correction Models (VECM) adjust the previous model to claim whether long-run relationships exist or not. The VECM is obtained by differencing the VAR model. Thus, the following formula:

Insert equation 7 here

Where ECT represents the Error Correction Term and its coefficient represents the adjustment speed.

Granger Causality

If a certain variable Y can be better predicted using the combined previous data of both Y and variable X than using only the variable Y's historical data, then variable X can be claimed to Granger cause the variable Y and vice versa (Oluwapelumi and Olaride, 2017). The concept has first been suggested by Granger in 1969, and the test can be used to explain whether a causal relationship exists among the chosen variables or not. In this essence, two types of relationships can be concluded from the Granger Causality test, a unidirectional relationship or bidirectional. A unidirectional Granger causality exists when a variable X causes Y alone. A bidirectional Granger causality, or feedback as the author mentioned it, occurs when the two variables of study affect each other at the same time (Granger, 1969).

Granger causality test is performed through a series of regressions. The first step, the restricted model (r), involves the regression of the dependent variable Y on its lags alone through the following formula:

Restricted Model

$$(R): Y_t = a_1 + \sum \gamma_j Y_{t-j} + \varepsilon_t \quad \text{(III)}$$

Therefore, the restricted model for all Granger causalities that will be tested is the following:

$$\text{Ln (ER)} = a_1 + \sum \gamma_j \text{Ln (ER)}_{t-j} + \varepsilon_t \quad (8)$$

The second is like the previous one, but it includes the lagged data of the independent variable X through a regression. This model is referred to as the Unrestricted Model (ur) and is expressed as:

Unrestricted Model

$$(R): Y_t = a_1 + \sum \beta_i X_{t-i} + \sum \gamma_j Y_{t-j} + \varepsilon_t \quad \text{(IV)}$$

The unrestricted model will include as independent variable exports, imports, GDP, and inflation to test whether they Granger-cause the exchange rate or not on an individual basis. This model can be translated as the following:

$$\text{Ln (ER)}_t = a_1 + \sum \beta_i \text{Ln (Exp)}_{t-i} + \sum \gamma_j \text{Ln (ER)}_{t-j} + \varepsilon_t \quad (9)$$

$$\text{Ln (ER)}_t = a_1 + \sum \beta_i \text{Ln (Imp)}_{t-i} + \sum \gamma_j \text{Ln (ER)}_{t-j} + \varepsilon_t \quad (10)$$

$$\text{Ln (ER)}_t = a_1 + \sum \beta_i \text{Ln (GDP)}_{t-i} + \sum \gamma_j \text{Ln (ER)}_{t-j} + \varepsilon_t \quad (11)$$

$$\text{Ln (ER)}_t = a_1 + \sum \beta_i \text{Ln (Inf)}_{t-i} + \sum \gamma_j \text{Ln (ER)}_{t-j} + \varepsilon_t \quad (12)$$

Testing the Granger Causality, through an F test, between the two variables is the final step.

A null hypothesis, $\beta i = 0$, determines whether the independent variable X Granger causes Y or not. The Granger causality F test can be obtained by the following formula:

$$F\ test = \frac{SSEr - SSEur / Lags\ X}{SSEur / n - lags\ X - lags\ Y - 1}$$

Empirical Results

Unit Root Test

Testing the stationarity of the desired variables of study is a requirement to the Granger causality test. Through the Augmented Dickey Fuller test, all variables tested significant after one level augmentation of the test. Table 2 displays information on the outcome of the ADF test.

Insert table 2 here: Stationarity results

All the variables have been augmented by one level to be stationary except for inflation. Such result enables us to perform the optimal lag to proceed for testing for cointegration. As stated before, lag optimality can be determined by different models, but this study will rely on the results of the AIC obtained. Table 3 shows the optimal lag under different models. An optimal lag of 2 years is obtained by different models, but the AIC displays the highest test score in absolute value.

Insert Table 3 here: Lag optimality results

Johansen Cointegration Test

Based on the results obtained, the Johansen cointegration test can be applied under 2 years of the lagged independent variables. Table 4 displays the existence of a cointegration equation between exchange rate and one or both components of the trade balance.

Insert table 4 here : Johansen Cointegration test results

In this case, both the trace and max statistics are higher than the 5% critical value. Therefore, the null hypothesis is rejected. In other words, the variables of study are cointegrated and exhibit a long-run relationship. Maximum ranks of 1 or higher generally test for the maximum existence of cointegration equations within the model as a null hypothesis. As the trace and max statistics are higher than the critical value at the maximum rank of 1, it can be stated that there exists more than one cointegrating equation within the model. Both test statistics are lower than the 5% critical value at the maximum rank 2. Therefore, a maximum of two cointegrating relationships can be exhibited in this model.

VAR model and VECM

If there is a Johansen cointegration between the variables, which is the case in our study, both the Vector Autoregressive model and VECM should be tested. The VAR model investigates the short-run relationship between the exchange rate, and the independent variables, exports, and imports. Table 5 displays the lagged values, of the two years, of the independent variables in equation (6) as well as the results statistics. Besides inflation, P-values of the lagged variables of the remaining independent variables are insignificant. Therefore, a short-run association appears to exist between the inflation and the exchange rate. This association is low with the first lagged year of inflation, but highly significant with the 2-year lagged variable.

Insert Table 5 here : VAR model results on ln (ER)

As only one short-run association is statistically significant, it is worth testing for long-run relationships through the VECM. Table 6 indicate the coefficients of each independent variable along with their significance level. Results show that exports, imports and GDP exhibit a long-run Association with the exchange rate at 1% significance level. The long-run association of the inflation however is only significant at 10%. While exports have a positive impact on the exchange rate, imports have a negative impact, both in the long run. In other words, an increase in exports of Morocco are more likely to appreciate the MAD with respect to the US dollar, with a one-year lag, and vice versa. The adjustment term is insignificant in the VECM. Therefore, we cannot claim that any deviation will be adjusted in the long-run equilibrium.

Insert Table 6 here : VECM results

Granger Causality

Granger causality remains the last test to be performed to see whether one of the trade balance's components, or one of the economic development factors, causes the exchange rate to vary across time. As the AIC displayed an optimal lag of 2 years, Granger causality will follow the same result and test for causality for a maximum of 2 years lag. Using the Granger causality formula, results on table 7 indicate that exports and imports do not cause the exchange rate to fluctuate at the 5% significance level. In other terms, exports and imports are not the only variables affecting the Moroccan exchange rate. However, the logarithmic form of both the GDP and inflation appear to Granger cause the exchange rate with a 2-years lag. This means that any change in the GDP or inflation is likely to have an impact on the exchange rate 2 years later.

Insert Table 7 Here : Granger Causality results

Discussion

This paper investigates the association between the balance of trade of the Moroccan Kingdom, some of its economic development factors, and the exchange rate of the Moroccan Dirham with respect to the American Dollar. The additional value of this research comes from the addition of the GDP and inflation variables as most literature included in the research focused either on the imports and exports, or the announcement of the trade balance of certain economies. Moreover, the research papers included in the literature mainly studied such association in the US economy, ASEAN countries, Turkey, and others. However, the existence of such study in North African countries barely exists.

On the long-run study, exports, imports, and GDP seem to have an impact on the exchange rate. Both exports and GDP have a positive impact on ER, with a higher effect for exports than GDP. However, imports display a negative impact which his higher, in absolute value, than the exports'. In other words, an economy whose trade balance exhibits a deficit, with imports higher than exports, is more like to have its exchange rate depreciate in the long run. This study extends literature concerning the balance of trade and exchange rate on a North African basis, especially for Morocco. The GDP displays similar results to the exports, accompanied with a Granger causality with a lag of 2 years. This means that a positive change in GDP recorded in a year t will appreciate the MAD with respect to USD at year t+2. On the short run, the obtained results indicate that inflation has a lagged positive impact of 2 years on the exchange rate supported with a Granger causality.

The analysis conducted supports the results obtained by Irwin (1989), Doukas and Lifland (1994) as the trade balance exhibited a long-run association with the exchange rate. In addition to that, this study supports the results obtained by Tunaer Viral (2016) in the sense that a relationship seems to be existing between the balance of trade and the Moroccan exchange rate, but the adjustment pattern is not clear to determine. As for the economic development factors, this research paper both supports and contradicts the analysis done by Abbas et al. (2012) as both GDP and inflation rate displayed an association with the exchange rate, while in the latter research inflation did not display a significant relationship with the exchange rate.

The practical implications of this study come from the association between the trade balance and exchange rate. In other words, if the Moroccan trade balance experiences deficits, the country's exchange rate is more likely to depreciate. To avoid such problem in the long-run, policy makers or the Moroccan government can reduce imports to avoid the depreciation of the MAD. The production of imported products can be a starting point for the country as it will allow the country to rely on its industry, and perhaps later export those manufactured products and move towards a trade balance surplus.

Conclusion

Exports and imports, as components of the trade balance, are some indicators that can reflect the robustness of an economy. Exchange rates reflect the value of a currency with respect to another. However, these three indicators can impact each other. This paper examined the impact of the balance of trade, mainly exports and imports, on the exchange rate of Morocco with respect to the US dollar. Results revealed a cointegration association between the variables in the short-run and the long-run. However, the short-run association is exhibited only by one variable, inflation. As for the long run, all independent variables display an association with the exchange rate of Morocco, with a presence of causality going from each of the GDP and inflation to the exchange rate, with a lag of 2 years. The use of the official exchange rate can be mentioned as a limitation as other studies applied the real effective exchange rate instead. However, there is not sufficient data related to the real effective exchange rate of Morocco, which might result in erroneous results, claims or residuals which might weaken our models. This association was only tested on a unidirectional basis. However, other research claimed a bidirectional relationship between their variables of study, either between trade balance announcements and exchange rate, or both exports and imports with the exchange rate. As a future research, scholars might be interested at studying the existence of a bidirectional relationship between the variables of study. Moreover, it might also be interesting to make the same study on other North African countries such as Algeria or Tunisia, or other economies with almost the same GDP as Morocco's to compare. Moreover, the same study can be replicated but with the use of real effective exchange rate instead of the nominal. A conversion analysis including inflation of some countries, which currencies are linked to the Moroccan exchange rate, can be done to determine a strong and accurate measurement of this new variables to include in the study.

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Appendix

Equation (6)

$$Ln\ (ER)_t = M + \sum_i^n \varphi_i Ln\ (ER)_{t-i} + \sum_i^n \beta_i Ln\ (Exp)_{t-i} + \sum_j^n \gamma_j Ln\ (Imp)_{t-j} + \sum_k^n \alpha_k Ln\ (GDP)_{t-k} + \sum_l^n \lambda_l Ln\ (Inf)_{t-l} + \mu_t$$

Equation (7)

$$\Delta Ln\ (ER)_t = M + \sum_i^{n-1} \varphi_i \Delta Ln\ (ER)_{t-i} + \sum_i^{n-1} \beta_i \Delta Ln\ (Exp)_{t-i} + \sum_j^{n-1} \gamma_j \Delta Ln\ (Imp)_{t-j} + \sum_k^{n-1} \alpha_k \Delta Ln\ (GDP)_{t-k} + \sum_l^{n-1} \lambda_l \Delta Ln\ (Inf)_{t-l} + \vartheta ECT_{t-1} + \varepsilon_t$$

Table 1. Descriptive statistics

Variable	Obs	Mean	Std.dev.	Min	Max	Skeweness	Kurtosis
Ln (Exp)	59	22.33	1.47	19.88	24.54	-0.23	-1.12
Ln (Imp)	59	22.55	1.52	19.95	24.79	-0.33	-0.96
Ln (GDP)	59	23.76	1.26	21.43	25.49	-0.4	-1.05
Ln (Inf)	59	1.08	0.94	-0.83	2.87	-0.16	-0.91
Ln (ER)	59	1.95	0.33	1.36	2.43	-0.43	-1.43

Table 2. Stationarity results

Variables	Observations	T-stat	Critical value at 5%
Exports (Ex)	57	-7.202	-1.947
Imports (Imp)	57	-7.121	-1.947
Trade Balance (TB)	57	-7.326	-1.947
GDP	57	-5.881	-1.947
Inflation	58	-3.3	-1.947
Exchange Rate (ER)	57	-5.065	-1.947

Model: 0, ADF level: 1 (0 for inflation)

Table 3. Lag optimality results

Lag	AIC	HQIC	SBIC
0	2.756	2.827	2.939
1	-7.355	-6.932	**-6.260**
2	**-7.862**	**-7.086**	-5.855
3	-7.699	-6.540	-4.750
4	-7.511	-6.030	-3.679

Table 4. Johansen Cointegration test results

Max. rank	eigenvalue	Trace statistic	5% critical value	Max statistic	5% critical value
0	-	100.95	59.46	57.35	30.04

1	0.63	43.60	39.89	28.08	23.80
2	0.39	**15.52**	24.31	**9.15**	17.89
3	0.15	6.37	12.53	5.88	11.44

The maximum rank of zero implies the following hypothesis:
H_0: There is no cointegration among variables
H_a: There is cointegration among variables

Table 5. VAR model results on ln (ER)

Independent variable	Lagged value	Coefficient	Standard Error	z	P-value
Ln(Exp)	L1	0.031	0.120	0.26	0.794
	L2	0.040	0.119	0.33	0.738
Ln(Imp)	L1	-0.100	0.119	-0.83	0.406
	L2	-0.080	0.105	-0.76	0.447
Ln(GDP)	L1	0.272	0.228	1.19	0.233
	L2	-0.101	0.208	-0.48	0.630
Ln(Inf)	L1	-0.028	0.015	-1.89	0.058**
	L2	0.035	0.013	2.75	0.006*

* Significance at 1% level

** Significance at 10% level

Table 6. VECM results

Independent variable	Coefficient	Standard Error	z	P-value
ΔLn(Exp)	1.770	0.343	-5.16	0.000*
ΔLn(Imp)	-2.488	0.285	8.74	0.000*
ΔLn(GDP)	1.202	0.375	-3.20	0.001*
ΔLn(Inf)	-0.096	0.054	1.79	0.073**
ECT	-0.045	0.035	-1.32	0.188

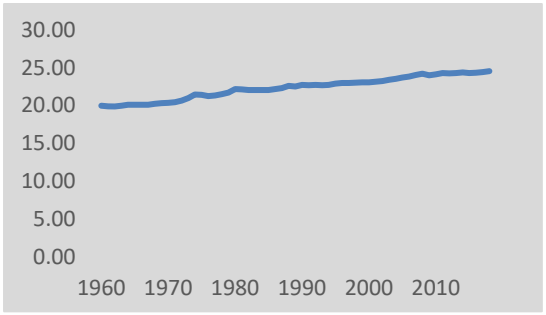
* Significances at 1% level

** Significance at 10% level

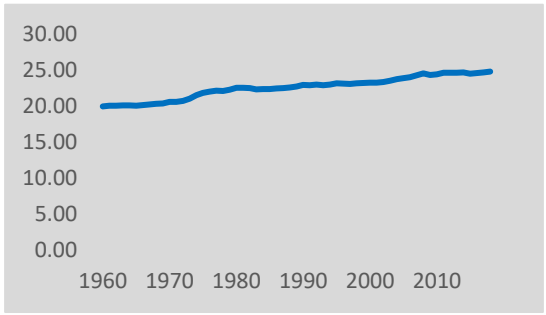
Table 7. Granger Causality results

Independent variable	Ln (Exp)	Ln (Imp)	Ln (GDP)	Ln (Inf)
Obs	58	58	57	57
SSE_r	0.35	0.35	0.48	28.76
SSE_{ur}	0.33	0.33	0.43	25.78
Lags of IV	1	1	2	2
Lags of DV	1	1	1	1
F statistics	3.39	3.5	**6.74**	**6.23**
Critical value at 5%	4.03	4.03	4.03	4.03

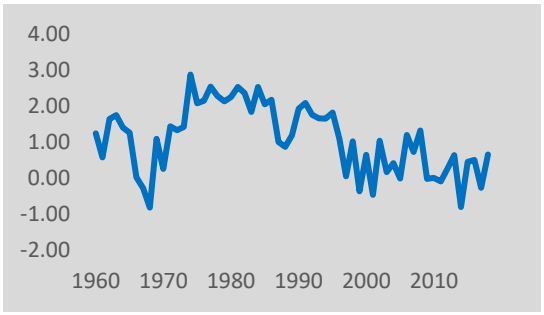
Fig. 1: Logarithmic graphs of exports, imports, exchange rate, inflation, and GDP for Morocco, from 1960 to 2018



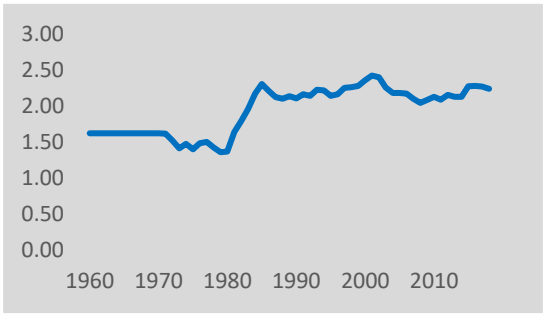
Logarithmic graph of exports



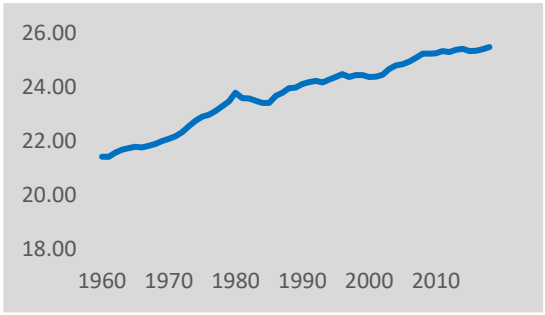
Logarithmic graph of imports



Logarithmic graph of exchange rate



Logarithmic graph of inflation



Logarithmic graph of GDP