INSTITUT DE FINANCEMENT DU DÉVELOPPEMENT DU MAGHREB ARABE

معهد تمويل التنمية للمغرب العربي

End of Studies Project

Topic :

Real exchange rate misalignment and economic growth in Tunisia

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ACKNOWLEDGEMENT

This research is carried out within the framework of the end of studies project of the Institute of Financing the Development in Arab Magreb. It was made possible thanks to the support, encouragement and advice of several people to whom I wish to express my gratitude.

First of all, I would like to express my gratitude to my supervisor, Mr. Chokri GHANMI, for having accepted to supervise me, for the trust he has placed in me, for his great availability, for his rigor and attention to detail, for his support and assistance, encouragement and all the arrangements he made so that I can always progress. Through this work, I hope to have been able to live up to the expectations he placed in me.

I would like to thank and express my gratitude to the administration of IFID and all my teachers and trainers for providing precious enlightenments, sharing their experiments, and giving inspiration in my quest of knowledge.

For my dear parents, to those whom I will never be able to give back what they have done for me, those who set me on the right path.

Finally, I would like to express my sincere thanks to the members of the jury for agreeing to judge my work.

LISTE OF ABREVIATIONS

AIC: Akaike Information Criterion

ADF: Augmented Dickey–Fuller

BEER: Behavioral Equilibrium Exchange Rate

CEEC: Central and Eastern Europe Countries

CPI: Consumer Price Index

DC: Developing Countries

DI: Domestic Investment

DIR: Domestic Investment RATE

EQREER: Equilibrium Real Exchange Rate

EN: Enrollment of higher education rate

EMCCA: Economic and Monetary Community of Central Africa

ERSAP: Economic Reform and Structural Adjustment Program

EU: European Union

FEER: Fundamental Equilibrium Exchange Rate

FDI: Foreign Direct Investment

FPE: Final Prediction Error

GDP: Gross Domestic Product

GDPC: Gross Domestic Product Per Capita

GGR: Guaranteed Growth Rate

GFCF: Gross fixed capital formation

HQ: Hannan-Quinn

HIRP: Hedged Interest Rate Parity

IMF: International Monetary Fund

KPSS: Kwiatkowski–Phillips–Schmidt–Shin

LEX: Life Expectancy

LMIC: Lower Middle-Income Countries

MID: Interbank Currency Exchange Market

MIS: Misalignment

MENA: Middle East and North Africa

NATREX: Natural Real Exchange Rate

NER: Nominal Exchange Rate

NEER: Nominal Effective Exchange Rate

NGO: Non-Governmental Organization

NGR: Natural Growth Rate

NSI: National Statistics Institute

OECD: Organization for Economic Cooperation and Development

OLS: Ordinary Least Squares

PE: Public Expenditure

PER: Public Expenditure Rate

PG: Population Growth

PP: Phillips Perron test

PPP: Purchasing Power Parity

PPI: Producer Price Index

RER: Real Exchange Rate

REER: Real Effective Exchange Rate

SAP: Structural Adjustment Program

SC: Schwarz Criteria

SDR: Special drawing rights

TE: Term of Trade

TER: Term of Trade Rate

TP: Trade Policy

TPR: Trade Policy Rate

UIRP: Unhedged Interest Rate Parity

UNDP: United Nations Development Program

UMIC: Upper Middle-Income Countries

VAR: Autoregressive Vector

VAT: Value Added Tax

VECM: Error Correction Vector Model

WB: World Bank

WAMU: West African Monetary Union

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SUMMARY

GENERAL INTRODUCTION

The interest in the issue of the influence of exchange rate misalignments dates back to the early 1970s with the official advent of the flexible exchange rate system, which proponents argue provides greater flexibility in monetary policy. This flexibility was intended to correct excessive movements in the real exchange rate (RER) or to accelerate its convergence to a so-called "equilibrium" level so as to promote growth. However, the growing process of financial integration has led to sustained fluctuations that have contributed to increased instability in the global economic environment, as illustrated by the financial and exchange rate crises in the European Monetary System (1992, 1993, 1995), Mexico (1994), Argentina (1998, 2001, 2014). It was this context of instability that renewed the interest of theorists in determining the so-called equilibrium level of exchange rates, since their knowledge presupposes the effectiveness of the exchange rate in equilibrium adjustment.

Among the most famous works are those of Dornbusch (1976), Williamson (1983, 1985), Stein (1997) or Clark and Mac Donald (1998). However, there is little unanimity on the different methods proposed in these works because of the abstract nature of the balance and the diversity of conception regarding its fundamental determinants. In any case, however, the determination of an equilibrium level for exchange rates remains important, particularly for assessing sustained fluctuations or deviations of the RER from its equilibrium level. These deviations, which are still referred to as "misalignments", are in fact likely to influence growth through, among other things, the profitability of trade or investment, and changes in the allocation of resources.

According to the joint study conducted in 2013 by the African Development Bank, the Tunisian government and the U.S. government to determine the major constraints to broad-based growth, the exchange rate generally affects growth in two ways. First, an overvalued currency reduces the profitability of exporting companies and companies competing with foreign products and consequently discourages private production and investment. Second, in a country with an open capital account, a misaligned real exchange rate can, promote the threat of financial crisis through a range of effects on the financial situation[1].

[1] To cite just one threat, a lagged real exchange rate may encourage domestic banks to borrow abroad in foreign currencies and use those funds to make loans in local currency. If the misalignments are too large, both banks and borrowing companies may fail if the exchange rate subsequently depreciates.

At the national level, the IMF views Tunisia's exchange rate policy as a stabilized management regime, which means that the government sets its monetary and fiscal policy, taking care to keep the exchange rate on a certain path. In this sense, Tunisia continues to exercise considerable restrictions on capital account transactions (inflows and outflows of financial assets), a policy that entails costs for domestic borrowers; the risk of a sudden reversal of short-term capital flows is therefore minimal. Thus, it should be mentioned that Tunisia is undergoing a historic period of transition requiring fundamental economic and social change. This situation is accompanied, at the international level, by major socioeconomic difficulties that are shaking the world (the legacy of the subprime crisis in 2008 followed at present by the sovereign debt crisis affecting a large majority of developed countries).

This situation should give rise to a new model of socio-economic development by imposing huge challenges on economic and political decision-makers. Establishing the attributes of a successful emergence refers to a set of issues, particularly about exchange rate policy.

Thus, the Tunisian reform of exchange rate policy led to positive developments recorded successively towards the end of the 1970s with the adoption of an administered floating regime and then in the mid-1980s following the implementation of the Economic Structural Adjustment Program. The end of the 1990s was accompanied by advanced liberalization aimed at giving exchange rate policy a more active role. From the 2000s onwards, a prudent exchange rate policy has been the concern of the Tunisian monetary authorities in an increasingly worrying international economic context. The objective sought was to improve the competitiveness of the national economy and stabilize the Tunisian dinar.

However, the political and economic uncertainty that set in after the January 2011 revolution has shaken macroeconomic stability. Social agitation, strikes, and protests have slowed production and discouraged tourists from visiting Tunisia. This has resulted in a sharp decline in domestic and foreign direct investment and the closure of some foreign-owned factories. At the same time, the ongoing revolution in Libya, a neighboring country and one of Tunisia's main trading partners, has led to a drop in demand for export goods and the return home of many Tunisian workers. Today we are in a process of liberalization that we find difficult to assume because in the meantime we are experiencing macroeconomic instability, with an inflation that is difficult to control, a trade and current account deficit in crescendo and a large budget deficit and specifically very heavily impacted by a rise in the wage bill that has more than doubled between 2010 and 2018.

Indeed, the distribution of wages, combined with an accommodating monetary policy after 2011, increased demand for local and imported consumption while local supply did not follow, which put pressure on prices and generated inflation that is beginning to take hold and become problematic, to which is added inflation fueled strongly by the depreciation of the dinar.

For all these reasons, it seems important to us to look at the question of the influence of exchange rate variability, which is represented by the misalignment of the exchange rate, on economic growth. To do so, we have organized a process that revolves around two main parts.

The first one, made up of two chapters, deals with the theoretical approach of the exchange rate and misalignment and the determination of the misalignment of the RER. The second is concerned with the determination of the influence of exchange rate variability, which is represented by the misalignment of the exchange rate on economic growth. This part also extends over two chapters. The first chapter, deals with the theoretical axis of growth, its relation with the variability of the exchange rate as well as the other determinants that allow its explanation. And the second, deals with the specification of the equation, the estimation of the relationship and the interpretation of the results.

Precisely, the architecture of our work is as follows:

The first chapter, of the first part, focuses on the analysis tools needed to build the whole of our demonstration. First of all, we are interested in the exchange rate as a central element of our process, since its various concepts generally define the value of a currency whose fluctuations are of concern to us. Specifically, we return briefly to the modes of quotation (to the certain and to the uncertain), as well as to the differences between indicators: nominal and real, internal and external or bilateral and effective, in order to highlight the relevance of the concept of real exchange rate (RER) that we have chosen. This prerequisite then allows us to focus our attention on the determinants of the value of a currency. Thus, we recall the different types of exchange rate regimes and the associated criteria of choice.

Secondly, we set out the main categories of equilibrium exchange rate theories, focusing on the model chosen in this work and the extracted variables that will be the subject of empirical analysis. Thus, in our study, we used the BEER method proposed by Clark and MacDonald (1997) to determine the value of the equilibrium real exchange rate. This method consists of estimating a composite model known as the behavioral equilibrium exchange rate model (BEER). The purpose of this model is to explain empirically the long-run evolution of the equilibrium exchange rate without seeking its theoretical fundamentals.

The second chapter, of the first part, is devoted to a series of empirical evaluations whose objective is to model and estimate the real behavioral equilibrium exchange rate and the degree of misalignment. This exercise was to search for cointegrating relations between the exchange rate and its variables that designate the vector of long- and short-term fundamentals using the (VECM) method.

Thus, **the first chapter,** of the second part, is devoted to the study of the theoretical mechanisms of economic growth, its relationship with exchange rate variability and its determinants.

To conceptualize the relationship between exchange rate variability and economic growth, we had to go through a review of the literature that allows us to distinguish the state of economic growth in Tunisia, the concept in terms of processors and models, as well as the theoretical relationship between exchange rate variability and economic growth and the determinants that allow us to explain it.

The last chapter, of the second part, is therefore logically dedicated to the empirical analysis of the relationship between the misalignment and growth.

First, we specify the equation to be estimated by identifying a set of potential determinants of growth in the light of the theory presented.

Continuing with this specification, we refine this specification by selecting the relevant determinants by referring to the model of Barro (1991), Loayza and al. (2005) or Dufrenot and al. (2010), since any specification that ignores uncertainty about the determinants of growth is likely to cause inference errors, thus calling into question the results of the estimates and the resulting policy implications. At the end of this preliminary step, we then proceed with the actual estimation of the growth equation using a technique that is otherwise commonly used for the same type of exercise. **Second**, we estimate the growth equation using the OLS method, and finally we interpret the results obtained.

PART ONE: DETERMINATION OF THE EQUILIBRIUM REAL EXCHANGE RATE AND MISALIGNMENT

The evaluation of the influence of real exchange rate misalignment on economic growth is subjected to the determination of misalignment, and to the determination of the associated models. Therefore, the first part of this work includes the following two chapters:

- Chapter 1: Theoretical approaches and concepts of the real exchange rate concept and misalignment

- Chapter 2: Modelling and estimating the real behavioral equilibrium exchange rate and the degree of misalignment

Introduction

The concept of exchange rates has so far been the subject of a large theoretical and empirical literature. It has its origins in the pioneering work of (Cassel, 1922) and (Nurkse, 1945) whose common objective was to determine the right parties. It was in 1944, when the Bretton Woods Agreement was signed, that the IMF (then a very young institution) was officially assigned the task of monitoring these good parities and that the fixed exchange rate system was established. The latter was supposed to ensure some exchange rate stability by fighting inflation, but it was characterized by large deviations and abrupt adjustments.

Thirty years later, the Jamaican agreements (1976) formalized not only the fall of the so-called "Bretton Woods" system, but also the birth of the floating exchange rate system which, according to its promoters, was to allow a more rapid convergence of exchange rates towards their equilibrium levels. However, since its inception, the flexible exchange rate system has rather favored general instability through increasing fluctuations and recurring exchange rate crises. The latter have then given exchange rate theories a profound renewal, and among the issues that are at the center of general attention, it seems that the issue of exchange rate misalignments is by far the one of greatest concern (especially for developing countries), because of the price distortions and macroeconomic imbalance they cause. However, the evaluation of these misalignments itself raises two main questions related to the definition and management of the exchange rate on the one hand, and to the determination of the so-called "equilibrium" level of exchange rates on the other.

Therefore, it is appropriate to present the different exchange rate concepts, so as to justify the choice of the concept we are making. These different concepts constitute the analytical tools that we will use to construct our demonstration throughout this study. To this end, this part will be divided into two chapters, the first one focuses on the analytical tools necessary to build the whole of our demonstration which leads to the choice of the real exchange rate (RER) as measure and the model for the estimation of the behavioral equilibrium real exchange rate (BEER), and the second chapter is devoted to a series of empirical evaluations whose objective is the modelling and estimation of the behavioral equilibrium real exchange rate and the degree of misalignment. This exercise is established by investigating the cointegrating relations between the exchange rate and these variables, which designate the vector of long-term and short-term fundamentals using the (VECM) method.

CHAPTER 1: THEORETICAL APPROACHES AND CONCEPTS OF THE REAL EXCHANGE RATE CONCEPT AND MISALIGNMENT

Introduction

Developing countries strive for fair exchange rate prices to ensure the equilibrium of their economies. These relative prices are of paramount importance at both the microeconomic and macroeconomic levels. Indeed, and given the decentralization of market economies, decisions on how much to produce or consume are made by economic agents and relative prices are the signals that guide these decisions, hence their crucial role in the allocation of resources.

Moreover, this relative price also has a macroeconomic dimension by guiding the allocation between production and consumption of these goods at the level of the economy between domestic and foreign goods. However, the theoretical and empirical literature on the real exchange rate and consequently the misalignments linked to it remain very problematic and still give rise to confusion. To this end, the objective of this chapter is to present the basic concepts of the real exchange rate (RER) and misalignment.

For this purpose, we begin by clarifying the exchange rate variable and its management in the first section. Next, we outline the main categories of equilibrium exchange rate theories by focusing on the model chosen in this work and the extracted variables that will be the object of the empirical analysis in the following chapter.

Section 1: The foreign exchange rate variable and its management within an exchange rate regime

Generally speaking, fluctuations in the value of a currency and its consequences determine the direction of economic policy since they define the relationship in which trade takes place or simply its profitability, which directly influences a country's growth and development. In the first section, our analysis leads us to ask ourselves beforehand about the expression of the exchange rate as an indicator of the value of a currency (A), the determinants of the value of a currency (B), and about its management according to the fixing modes defined by the exchange rate regime (C).

A-The exchange rate as an indicator of the value of a currency

As a measure of the value of a currency, the exchange rate can be expressed in different ways depending on whether a bilateral or multilateral definition is used, for example. But here we simply group together the measures or indicators: nominal on the one hand (1) and real on

the other (2). There are two types of nominal indicators: the nominal exchange rate (1.1) and the nominal effective exchange rate (1.2).

1- The Nominal Indicators

1.1- The nominal exchange rate

The nominal exchange rate simply refers to the relative price of one currency to another[2].

It can be also, «the act of converting and subsequently exchanging the currencies of different nations for an international payment or transfer of capital »[3]. Therefore, the nominal exchange rates make it possible to compare the prices of goods and services in different countries. They represent the rates that are determined in the foreign exchange market. These rates can be changed by changes in the supply or demand for currencies.

It is established on the foreign exchange market on the basis of two conventional systems that are inverse to each other, namely: the uncertain price and the certain price.

- **Certain quotation**

It is the amount of a foreign currency against a unit of national (domestic) currency.
Example: quotation at certain of dinars against the euro.

- **Uncertain quotation**

It is the amount of domestic currency against one unit (or 10 or 100) of foreign currency.
Example: quotation has the uncertain quotation of dinars against the euro.

1.2-The nominal effective exchange rate

The nominal effective exchange rate (NEER) describes "...the average bilateral exchange rate movements of a country's currency against the currencies of its major trading partners or competitors", which gives it the advantage of greater stability compared with the nominal (bilateral) exchange rate. The nominal effective exchange rate of a currency is defined as a weighted average of the bilateral exchange rates of a currency against those of its main trading partners and competitors. The NEER indicates the extent to which the nominal exchange rate of the national currency moves against these countries.

[2] Christian Bialès, the exchange rate, p.2.
[3] P.H.Lindert and T.Pugel, Economie Internationale, (Paris, Economica, 10eme ed, 1997), p : 456.

Formally, its expression depends on the mode of quotation, but above all on the type of average used (arithmetic or geometric). Indeed, the use of an arithmetic mean makes it possible to obtain the following arithmetic (NEER 1) and harmonic (NEER 2) indices:

$$NEER1_t = 100\sum_{i=1}^{n} K_j \overline{E}_{it} \qquad (1)$$

$$NEER2_t = 100/\sum_{i=1}^{n} K_j \overline{R}_{it} \qquad (2)$$

$\overline{E}_{it}$ and $\overline{R}_{it}$ are the bilateral exchange rates defined in relation to a reference period of 0. $\overline{R}_{it}=\frac{R_{it}}{R_{io}}$ and $\overline{E}_{it}=\frac{E_{it}}{E_{io}}$ with it R_{it}, the exchange rate quoted at the uncertain of the domestic currency with respect to its "j" partner at time "t" ; it E_{it} is the rate quoted at the certain[4] , and K_j designates the weighting coefficients. The use of geometric mean makes it possible to calculate two equivalent indices (NEER 3) and (NEER4) from the following formulae:

$$NEER3_t = 100\prod_{i=1}^{n} \overline{E}_{it}^{Kj} \qquad (3)$$

$$NEER4_t = 100/\prod_{i=1}^{n} \overline{R}_{it}^{Kj} \qquad (4)$$

The geometric mean is generally used in practice because it has the advantage of eliminating processing asymmetry. But in any case, the evolution of the NEER does not reflect the external competitiveness of the country and the purchasing power of its currency, hence the relevance of the real indicators.

2- The Real Indicators

The real exchange rate (RER) is a theoretical concept for which there are two main definitions: the first stems from purchasing-power-parity (PPP) theory and the second from international trade theory (Edwards 1988, 1989; Hinkle and Montiel 1999).

2.1- The external real exchange rate

The external RER of a given country as its nominal exchange rate (number of units of foreign currency for one unit of national currency) adjusted for the differential between its price level and that of other countries (ratio of price indices, expressed in a common currency, abroad and in the country). The external RER thus measures the relative price of the same basket of goods, locally and abroad; it is like an indicator of external competitiveness. A relative increase in the price index in the country concerned corresponds to an appreciation of the external RER.

[4] It should be remembered that these two exchange rates are linked by the inverse relationship: $E_{it}=1/R_{it}$

- **Measures**

The external RER is formally the product of the nominal exchange rate quoted with uncertainty (R) and the ratio of the foreign price index (P*) to the domestic price index (P), as indicated by the equation (5).

$$Q_{ext}=R\ \frac{P*}{P} \qquad (5)$$

Indeed, a logarithmic transformation allows equation (5) to be rewritten as follows:

$$q_{ext}= r -(p^* - p) \qquad (6)$$

where lowercase letters denote variables expressed in logarithm. If we consider that the domestic and foreign reference baskets are made up of both tradable and non-tradable goods, then the domestic (p) and foreign (p*) price indexes are respectively:

$$p \equiv (1-\alpha_t)p_t^T+\alpha_t p_t^{NT} \qquad (7)$$

$$p* \equiv (1-\boldsymbol{\alpha}_t^*)p_t^{T*}+\boldsymbol{\alpha}_t^* p_t^{NT*} \qquad (8)$$

where α and α * denote the shares of non-tradable goods in the domestic and foreign economies respectively. Replacing the price indices in equation (6) with their equivalents in equation (7) leads to:

$$q_{ext}= r -(p_t^{T*} + p_t^T) - [\boldsymbol{\alpha}_t^*(p_t^{NT*} - p_t^{T*})\text{-}\boldsymbol{\alpha}_t(p_t^{NT} - p_t^T)] \qquad (9)$$

This new relationship shows that the RER has two main components: the relative prices of tradable goods in the two economies and the difference between the relative prices of non-tradable goods in the two countries, each weighted by the respective shares of the sheltered sector. Simply put, there is a relationship between the two definitions of RER (if the distinction between the exposed and sheltered sectors is valid)[5]

Therefore, we will use the concept of the real exchange rate throughout this work for the discussed reasons.

[5] This relationship is proportional if one accepts that $\alpha = \alpha^*$

2.2- The internal real exchange rate

The second definition is derived from Salter-Swan's theory of the dependent economy and applies to small "price takers", the case of many developing countries. It defines RER, or internal RER, as the ratio within a country of the domestic prices of internationally tradable and non-tradable goods. This relative price is an indicator of internal competitiveness, i.e. the internal incentives of an economy to produce tradable rather than non-tradable goods (under the law of one price, internal competitiveness also automatically implies external competitiveness).

An increase in the relative price of tradable goods corresponds to a depreciation of the internal RER whichever definition is used, the RER is a real indicator and not a monetary one.

It is important to note, however, that depending on the type of definition used - PPP or international trade theory - the RER may evolve differently. Specifically, the internal real exchange rate (Q_{int})[6]expresses the ratio of the price of non-tradable goods (P_{NT}) to the price of tradable goods (P_T), that is:

$$\mathrm{Q_{int}} = \frac{\mathrm{P_{NT}}}{\mathrm{P_T}} \qquad (10)$$

If the assumption of the law of one price[7] is valid, this measure of the real exchange rate reflects the purchasing power of a currency and the international competitiveness of a country, since any increase in the real exchange rate (RER) alters the allocation of resources to the exposed sector so as to make domestic tradable goods cheaper (Joly and al., 1998; Hinkle and Nsengiyumva, 1999). Guillaumont Jeanneney (1993) even shows that these two real exchange rates can move in opposite directions if domestic prices of tradable goods are influenced by regulations. Domestic prices of tradable goods may, in fact, be disconnected from those prevailing on the international market because of a policy of price protection or price administration.

2.3-The real effective exchange rate

The real effective exchange rate (REER) is a weighted average of the bilateral RERs between a country and its main trading partners. It thus makes it possible to assess changes in

[6] This definition of the real exchange rate is used by authors such as Dornbusch (1980), Obstfeld and Rogoff (1996), and Lane and Milesi-Ferretti (2004).

[7] The law of one price stipulates that international competition leads to the equalization of prices for the same good everywhere in the world. From this point of view, the price of tradable goods is determined on the international market and domestic companies are therefore "price-takers".

the purchasing power of a currency over a given time interval, making it a reliable indicator of an economy's competitiveness. Its formal expression is obtained by correcting that of the NEER by an approximation of relative price changes. Specifically:

$$REER_t = 100 \prod_{i=1}^{n} \left[\frac{\overline{E}_{it}}{\overline{P}_{it}}\right]^{\overline{K}_{it}} \qquad (11)$$

where it $\overline{E}_{it}$ is the index of the exchange rate quoted at the certain of the currency of the reference country in relation to its $i^{éme}$ partner; it $\overline{P}_{it}$ is the ratio of the price index of the $i^{éme}$ partner at time t to the domestic price index at the same time[8] ; the $\overline{K}_{it}$ are the normalized weights of the currency of the partner "i "[9].

B-Determinants of the value of a currency

We are therefore interested in the determinants of the value of a currency, including the general price level and inflation as long-term determinants (1), and the interest rate as a short-term determinant (2).

1-The general price level and inflation as long-term determinants

The influence of the price level and inflation is formally described by the purchasing power parity (PPP) theory. In its modern formulation, PPP theory is based on Gustave Cassel's idea that the relative purchasing power of a currency[10] determines its value. To reflect this idea, two versions of PPP have been developed: the "absolute" version (1.1), and the "relative" version (1.2).

1.1- The absolute version of purchasing power parity

In its absolute version, PPP is based on the idea that arbitrage behavior in markets leads to adjustments that eventually lead to the equalization of domestic and foreign price indices. In other words, a basket of goods should trade for the same quantity of money everywhere in the world when expressed in the same unit.

Formally, the exchange rate that corresponds to the level of absolute PPP (R_{PPPabs}) is equivalent to the ratio of the domestic price index (P) to the foreign price index (P*)[11].

[8] E and it P are calculated in relation to the same reference period.
[9] More specifically, this is the effect on the domestic trade balance of a 1% change in each foreign currency.
[10] The quantity of goods or services it makes it possible to obtain in its country compared to abroad.
[11] Under the assumption that the reference periods and the composition of the baskets of goods are the same for both economies.

Let:

$$R_{PPPabs}=\frac{P}{P*} \qquad (12)$$

Expressed in this way, PPP necessarily implies the absence of transaction costs and barriers to trade, perfect substitutability between domestic and foreign goods, equality of weights used in the calculation of price indices, or more generally perfect competition in markets, which in turn implies the elimination of any opportunity for arbitrage[12] . These various hypotheses have led economists to develop a less restrictive version of PPP, still referred to as the "relative version", and which we presented in the following paragraph.

1.2- The relative version of purchasing power parity

The relative version of PPP incorporates transport costs, trade barriers and imperfect market information and shows that equality of price levels expressed in a common currency is implausible. Under these conditions, PPP is checked whether the change in the exchange rate relative to a reference period is equivalent to the relative change in domestic and foreign price levels. In other words, the exchange rate defined by the relative PPP moves or adjusts to compensate for the inflation differential between countries. Formally, if the constant K represents the set of impediments to pure and perfect competition, the exchange rate defined by relative PPP ($R_{ppp\ rel}$) is written as:

$$R_{Rppp\ rel}=K\frac{P}{P*} \qquad \text{or} \qquad r_{Rppp\ rel}=K+p+p^* \qquad (13)$$

where lowercase entries denote variables in logarithms. Considering the expression in logarithms, if we calculate the evolution of the exchange rate between two periods 0 and 1 we obtain:

$$r_1 - r_2 = (p_1 - p_0) - (p_1^* - p_0^*) \cong (p^* - p) \qquad (14)$$

This reflects the idea that the relative evolution of the exchange rate roughly corresponds to the difference in inflation rates. Overall, PPP is generally considered to be a theory of the nominal exchange rate in all versions. But it is more convenient to interpret it as a theory of the real exchange rate since it implies that the real exchange rate is constant. Specifically, in the case of the absolute version, it simply implies that the RER is constant and always equal to 1 (Taylor and al., 2001). Indeed, a transformation of equation (10) yields:

[12] We have already indicated that absolute PPP is the result of arbitrary market behavior. Indeed, any deviation of the exchange rate from PPP implies opportunities for agents who then buy goods in one country and resell them at a higher price in another. The mechanism continues until these opportunities disappear completely and the exchange rate then tends towards PPP.

$$R_{Rppp\ absl}\frac{P}{P*} = 1 \qquad (15)$$

On the other hand, the RER of the relative version is constant but not necessarily equal to 1 since relation (14) can also be expressed as follows:

$$r_1 - (p_1 - p_1^*) = r_0 - (p_0 - p_0^*) \qquad RER_1 = RER_2 \quad (16)$$

Although PPP is almost a reference in the literature, the exchange rate is, however, likely to deviate from it in the short term, mainly because of the evolution of the interest rate.

2- The interest rate: a short-term determinant

The inequality between supply and demand for currencies on the foreign exchange market generates arbitrary behavior with the aim of obtaining ever higher returns. The result is a simple principle which states that for a given exchange rate, the foreign exchange market is balanced if positions in different currencies offer a single rate of return: this is the principle of "interest rate parity". The latter is generally presented in two versions: hedged interest rate parity (2.1) and unhedged interest rate parity (2.2).

2.1-Hedged Interest Rate Parity (HIRP)

To explain the role of the interest rate in determining the exchange rate under the hedged version of the interest rate parity, consider an agent who has a choice between holding domestic currency and holding foreign currency, each remunerated at rates i and i^* respectively. To invest his assets abroad, he must first convert his currency into foreign currency at rate E, so that each unit invested earns $E(i^* + 1)$ in the following period.

2.2-Unhedged interest rate parity (UIRP)

To take into account the absence of a hedge against exchange rate risk, the UIRP assumes that agents engage in foreign exchange buying or selling transactions in a context of uncertainty about the future exchange rate of the national currency.

$$i = i^* - (e^a - e) \qquad (17)$$

More simply, this equality shows that the future conversion rate is:

$$e^a = (i^* - i) + e \qquad (18)$$

Overall, the practical verification of UIRP is controversial because it relates unobservable variables such as the expected exchange rate or the risk premium that risk-averse agents may require for spot market transactions (Driver and Westaway, 2005).

C. Managing the exchange rate within an exchange rate regime

An exchange rate regime is the set of rules that determine the intervention of the monetary authorities in the foreign exchange market, and thus the behavior of the exchange rate[13]. These rules are generally identified by the types of exchange rate regimes (1), and the classifications of exchange systems (2)

1-Types of exchange rate regimes

There is a very wide variety of exchange rate regimes, which can be divided into two extremes: fixed (1.1) flexible (1.2) exchange rates and intermediate exchange rate regimes (1.3).

1.1- Fixed exchange rate regime

A fixed exchange rate regime implies the definition of a reference parity between the currency of the country in question and a currency (or a basket of currencies), at which the central bank undertakes to exchange its currency. When the foreign exchange market is liberalized, the fulfilment of this commitment requires the central bank to intervene in the foreign exchange market as soon as the exchange rate deviates from the established parity, by buying the national currency if the currency tends to depreciate on the foreign exchange market, by selling it otherwise. When the foreign exchange market is controlled, the currency is inconvertible, the parity is arbitrarily defined and artificially supported.

1.2-Flexible exchange rate regime

In a flexible exchange rate regime, on the other hand, no commitment is made to the exchange rate, which floats freely (pure float), according to supply and demand in the foreign exchange market. Monetary policy then regains its autonomy, but the central bank gives up control of the nominal exchange rate, which is determined in the foreign exchange market. Thus, in principle, floating applies to a liberalized foreign exchange market, even if one can imagine an impure floating regime with exchange controls.

1.3- Intermediate exchange rate regimes

Between the fixed and floating exchange systems there is a continuum of intermediate regimes. In this category [14] are crawling pegs and crawling bands. In the former, the authorities

[13] DOHNI. L and HAINAUT, (2004), *exchange rates: determinants, opportunities and risk, De boeck & Larcier, P 19*

[14] Frankel (1999) also includes in intermediate exchange rate regimes, adjustable pegs, pegging to a basket of currencies and target zones or bands. But Obstfeld and Rogoff (1995) consider adjustable pegs to be fixed

target a fixed path for the nominal exchange rate (Obstfeld and Rogoff 1996), allowing a gradual adjustment of the exchange rate through devaluation. In a crawling band system, the central bank announces a wide band[15] of exchange rate fluctuation around a central parity that is itself periodically adjusted. These changes are relatively small and are intended to avoid or reduce the misalignment of the exchange rate (Williamson,1998) that would result from the accumulation of positive inflation differentials with the anchor country. The authorities also undertake to intervene to keep the exchange rate within the band. Changes in the parity or bands can be made ex ante or ex post. To varying degrees, intermediate regimes combine the presence of a nominal exchange rate peg with relative exchange rate flexibility. Indeed, the central exchange rate peg in relation to one or more currencies, the basket weighting or the fluctuation margins around the central parity can be modified.

This gives greater autonomy to the monetary policy in comparison with fixed exchange rate systems. Intermediate exchange rate regimes have been implemented in the past in several Latin American countries such as Argentina, Mexico, Chile, Bolivia. Another well-known example of bands is the European Monetary Exchange System which was implemented in 1978 and whose fluctuation bands around a central parity against the Deutsche Mark were substantially widened after the exchange rate crises of 1992-1993 in several member countries. (Obstfeld and Rogoff, 1995 and Edwards and Savastano, 1999).

2-Classifications of exchange systems

Two main approaches have been used to classify exchange rate regimes: the de jure approach (2.1), which is based on countries' statements, and the de facto classifications (2.2), which are based on their actions.

2.1-The de jure classification

For a long time, the "Exchange Arrangements and Exchange Restrictions" report published annually by the IMF since 1950 has been the primary source of information on exchange rate regimes. The report identifies the exchange rate and international payments policy statements of member countries. The IMF classification is known as the official or de

exchange rate systems if peg changes are infrequent. See Frenkel and Goldstein (1989) and Obstfeld and Rogoff (1995) for target zones.

[15] The fluctuation bands are wider than those in the conventional fixed exchange rates. According to Williamson (1998), the bands must be at least 5% wide.

jure classification. It required countries to notify the exchange rate regime they are implementing as belonging to one of the categories previously defined by the IMF.

In fact, the categories of exchange rate systems proposed by the IMF have evolved over time, as shown in Box 1, taken from Reinhart and Rogoff (2002). From two categories of exchange rate regimes until 1982, there was a shift to four from 1983 and then to eight from 1999. To describe how the different regimes were determined, consider the grouping into four main systems used in 1997 and 1998. Fixed exchange rate regimes include currency unions, dollarization, currency boards, and conventional fixed exchange rate systems. In the latter, the fluctuation margins of the nominal exchange rate around the reference parity (against a currency or a basket of currencies) are very narrow, less than 1%. A second possibility is that the maximum and minimum values of the exchange rate must remain within narrow bands of 2% for at least three months (Bubula and Ötker-Robe, 2002). The limited flexibility covers all regimes between the fixed and managed floating categories. The fluctuation bands are larger than those fixed systems. The limited flexibility includes horizontal band systems from fluctuations around a central parity, crawling pegs and crawling bands. Both The remaining categories are managed float and independent float.

In this regard, the following Table (1) shows the evolution of the categories of exchange rate arrangements according to the IMF's annual report on exchange arrangements and restrictions.

Table 1: Evolution of Exchange Rate Regime Categories in the IMF's Annual Report on Exchange Arrangements and Restrictions

Volumes 1950-1973
1. Par value or central rate exists--Par value of central rate applied
2. Effective rate other than par value or central rate applicable to all or most transactions: fixed rate or fluctuating rate

Volume 1974, (no mention of par values)
1. Exchange rate maintained within relatively narrow margins in terms of: US Dollar, Sterling, French Franc, group of currencies, and average of exchange rates of main trading partners.
2. Exchange rate not maintained within relatively narrow margins

Volumes 1975-1978
1. Exchange rate maintained within relatively narrow margins in terms of: US Dollar, Sterling, French Franc, South African Rand or Spanish Peseta, group of currencies (under mutual intervention arrangements), and composite of currencies.
2. Exchange rate not maintained within narrow margins

Volumes 1979-1982
1. Exchange rate maintained within relatively narrow margins in terms of US Dollar, Sterling, French Franc, Australian Dollar, Portuguese Escudo, South African Rand or Spanish peseta, a group of currencies (under mutual intervention arrangements), a composite of currencies, and a set of indicators.
2. Exchange rate not maintained within relatively narrow margins.

Volumes 1983-1996
Exchange rate determined on the basis of :
1. a peg to: the US Dollar, Sterling, the French Franc, other currencies, and composite of currencies
2. limited flexibility with respect to: a single currency, cooperative arrangement
3. More flexible arrangements: adjusted according to a set of indicators, other managed floating, and
4. independently floating.

Volumes 1997-1998
1. Pegged to: single currency, composite of currencies
2. Flexibility limited
3. Managed floating
4. Independent floating

Volumes 1999-2001
1. Exchange arrangement with no separate legal tender
2. Currency board arrangement
3. Conventional pegged arrangement
4. Pegged exchange rate within horizontal bands
5. Crawling peg
6. Crawling band
7. Managed floating with no pre-announced path for the exchange rate
8. Independently floating

Sources: International Monetary Fund, Annual Report on Exchange Restrictions, 1950-1978 and Annual Report on Exchange Arrangements and Exchange Restrictions, 1970-2001.

Source: Reinhart and Rogoff (2002).

2.2- De facto classifications

While there are several classifications such as those of Bubula and Otker-Robe (2002) or Bailliu and al (2002), the most widely used in the empirical literature are those of Levy-Yeyati and Sturzenegger (2005) and Reinhart and Rogoff (2004). The former proposes to improve the new IMF classification based on a comprehensive statistical analysis of nominal exchange rate volatility and foreign exchange reserves. The latter integrate parallel market exchange rate data and introduce new categories, notably that of "free falling" regimes, which includes countries with annual inflation above 40%. The second set of proposals is based on a new classification of the IMF's nominal exchange rate volatility and foreign exchange reserves. Specifically, their classification includes 14 types of regimes that can be grouped summarily into 5 broad categories, as shown in Table (2).

Given the importance of the exchange rate for economic policy, the choice of an appropriate exchange rate regime is crucial for preserving the competitiveness and macroeconomic stability of a given economy. It is therefore appropriate to briefly present the criteria for choosing an exchange rate regime.

Table 2- Typology of exchange rate regimes according to Reinhart and Rogoff (2004)

"Gross" categories Type of exchange rate regime

Categories "raw"	Type of exchange rate regime
1	▪ Without separate official currency ▪ Currency board ▪ Fluctuation band less than or equal to ± 2% with prior announcement
2	▪ De facto stowage ▪ Slippery parity with prior announcement ▪ Slippery fluctuation band less than or equal to ±2% with pre-announcement ▪ Slippery Parity De facto ▪ Sliding fluctuation band less than or equal to ±2% De facto
3	▪ Fluctuation band greater than or equal to ± 2% with prior announcement ▪ Slippery fluctuation band De facto less than or equal to ±5%. ▪ Moving fluctuation band less than or equal to ±2%. ▪ Managed Flotation
4	▪ Free float
5	▪ "Free fall" regime

Note: Excerpt from Montiel (2011; pp. 14)

Section 2: Equilibrium exchange rate theories

Several attempts to model the dynamics of medium- and long-term equilibrium real exchange rate dynamics have been made. They can be classified into three families: Williamson's FEER (Fundamental Equilibrium Exchange Rate) model, MacDonald's BEER (Behavioral Equilibrium Exchange Rate) model, and Stein's NATREX (Natural Real Exchange Rate) model. The objective of these models is to determine the real exchange rate consistent with internal and external macroeconomic equilibrium. They follow on from the work of Nurkse (1945), Artus (1977) and various studies conducted by the IMF during the 1970s. Among these approaches, that of the BEER developed by MacDonald's.

In our paper, we used the BEER method proposed by Clark and MacDonald (1997) and the real exchange rate (RER) to determine the value of the equilibrium real exchange rate. This method consists of estimating a composite model known as the Behavioral Equilibrium Exchange Rate (BEER) model. The purpose of this model is to explain empirically the long-run evolution of the equilibrium exchange rate without looking for its theoretical underpinnings. The approach consists in selecting a set of fundamental variables that determine the long-term exchange rate and that generate the competitiveness of the economy.

A-Fundamental equilibrium exchange rate (FEER)

The FEER fundamental exchange rate approach Williamson (1985), is neoclassical in inspiration. It consists in interpreting the RER not as a relative price, but as an indicator of a country's overall competitiveness. The equilibrium real exchange rate appears as the real exchange value that simultaneously ensures internal and external equilibrium. The exchange rate is qualified as fundamental, because it is the exchange rate level that makes it possible to achieve the best allocation of resources at the international level without damaging the internal balances of the economies.

It is the real exchange rate which produces an external balance which is accurately matched with equilibrium medium-term capital flows. Keeping in mind the flaws and the imperfections of purchasing power parity concept, FEER shows that the value of exchange rate which is the result of current account assets or deficit which in turn is appropriate for the long-term structural inflow of the capital or economy outflow, assumes that the country does not have restrictions to trade freely and is also trying to attain internal balance.

A significant and a specified degree of judgment value are required to assess the levels of structural outflow or inflow of the capital. And if it did not assess, then it is assumed that such structural capital inflows or outflows should abide because of their occurrence in the past.

There are wide variations in the estimated values of fundamental equilibrium exchange rates. There are models developed on the concept of FEER and there is a wide use of these fundamental equilibrium exchange rate concept-based models in the private sectors for some time. Although, it is said that use of such type of an exchange rate model makes high degree of emphasis on the value judgment of the analyst who is concerned, which in the first place undermines the point of using the given model.

While discussing about the FEER and the exchange rate models that makes use of some variation of the current account approach, it can be noted that some "misalignments" in both the external balance and therefore in the exchange rates can stay over a considerable period of time. The probability factor for the presence of misalignments suggests that for a particular period of time the importance of the external balance to the exchange rate can be more than offset by capital flows. Eventually, the production of market losses and the outflows in capital are visible because of the level that external balance reaches as a result of misalignment. Reduction of the current account deficit occurs due to the capital outflows.

The hindrance is the varying or fluctuating nature of this point that caused loss of market confidence. Thus, for considering long term exchange rate; external balance focused models should be used and considered rather than using the exchange rate models which focus on the short term like all exchange rate models.

B-Natural real exchange rate (NATREX)

The NATREX is the equilibrium real exchange rate that satisfies both goods market and balance of payments equilibrium, when output is at its potential level and in the absence of speculative capital movements, cyclical factors and changes in foreign exchange reserves (Allen ,1995). Under the assumption of currency neutrality, only so-called "fundamental" real variables will affect investment and savings and hence the equilibrium real effective exchange rate. In fact, more than a model, we should speak of a class of NATREX models (Federici and Gandolfo, 2002) that can be adapted to the characteristics of economies: the size of the country relative to its main partners, the degree of substitutability of goods and financial assets, etc. (Federici and Gandolfo, 2002).

The NATREX approach can be summarized as follows:

1- NATREX is based on a rigorous theoretical construction using intertemporal optimization methods in situations of uncertainty to describe the behavior of different agents. While Edwards (1989) for a small country equilibrium real exchange rate model or Obstfeld and Rogoff (1995) for nominal exchange rate modelling have used such approaches, among others, the latest versions of NATREX (Stein, 2006) use more sophisticated methods of stochastic optimal control/dynamic programming in an environment of uncertainty that makes the future unpredictable.

2- Unlike competing models, NATREX explicitly distinguishes between medium-term equilibrium (medium-term NATREX) and long-term equilibrium (long-term NATREX). Let us start from the general case and consider the three horizons; the short, medium and long term. In the short run, the real exchange rate depends on exogenous fundamentals (denoted Z), endogenous fundamentals (denoted D), and cyclical and speculative factors (denoted U); i.e., R = R (Z, D, U). This means that the real exchange rate observed at date t is not always equal to its equilibrium value (NATREX), but can be decomposed into the sum of three terms.

Either:

$$R_t(D_t,U_t,Z_t)=[R_t(D_t,U_t:Z_t)-R_t^{MT}(D_t:Z_t)]+[R_t^{MT}(D_t:Z_t)-R_t^{LT}(Z_t)]+R_t^{LT}(Z_t) \quad (19)$$

The first term on the right-hand side represents the deviations of the short-term real exchange rate, affected by speculative factors, from the medium-term NATREX. The second term traces the deviations of the medium-term NATREX from the long-term NATREX, while the last term is the long-term NATREX which depends only on exogenous fundamental variables (ratio of aggregate productivity of the domestic and foreign economies, ratio of preferences for the present). This long-term equilibrium is reached when the effects of cyclical factors have faded and endogenous fundamentals (physical capital stock and external debt) have converged to their steady-state values. "The interaction of the medium and the long run is the contribution of the NATREX model", (Stein, 1994).

3. NATREX is part of a broader modelling exercise that seeks to account for financial crises. While it is now widely accepted that currency over-evaluation at least contributed to the crises of the 1990s (the Asian crisis in particular), by simultaneously addressing the dynamics of the real exchange rate and external debt, NATREX provides an explanation of the crises and proposes the development of warning indicators.

4. Unlike the FEER, NATREX refers to a positive concept of the exchange rate. "There is no welfare significance or value judgment" (Stein, 2002).

Finally, the NATREX approach links the real exchange rate to a set of fundamental variables, endogenous and exogenous in the medium term, exogenous in the long term, variables that explain savings, investment and the balance of payments. running. It is therefore necessary to clarify the basis for this.

C-Behavioral equilibrium exchange rate (BEER)

The econometric approach we use is the behavioral equilibrium exchange rate (or BEER) developed by Clark and MacDonald (1998). Unlike other models in the same class (e.g., FEER and NATREX), it focuses on empirically capturing exchange rate movements.

The starting point for the analysis is the equilibrium condition in the foreign exchange market, defined by the uncovered interest rate parity relationship (UIP). Formally, for a securities maturity horizon of "t + k" and under the assumption of risk neutrality, the absence of equilibrium arbitrage results in the following relationship:

$$E_t\ (\Delta s_{\ t+k}) = -\ (i_t - i_t^*) \qquad (20)$$

where s_t is the logarithm of the nominal exchange rate quoted with uncertainty; i_t is the domestic nominal interest rate; $i_t^*$is the foreign nominal interest rate; the difference operator and E is the mathematical expectation.

The integration of the expected inflation differential $E_t(\Delta p_{t+k}-\Delta p_{t+k}^*)$ leads to the following relationship between real variables:

$$q_t=E_t\ (q_{s+t})+\ (r_t - r_t^*) \qquad (21)$$

Where $r_t=i_t-E_t\ (\Delta p_{s+t})$ is the extant real interest rate, q_{ext}= r $-(p^* - p)$ is the extant real exchange rate. Expression (21) describes the current equilibrium of the real exchange rate as determined by two components, the expression of the real exchange rate in period "t + k": E_t (q_{s+t}) and the real interest differential with maturity $r_t - r_t^*$, the interest rate differential $(r_t - r_t^*)$.

The unobservable expectation of the exchange rate E_t $(q_{s+t)}$, is the "long term" equilibrium exchange rate, q_t.the current equilibrium rate is defined as q_t' to distinguish it from the actual rate

$$q_t' = \bar{q}_t+(r_t - r_t^*) \qquad (22)$$

In summary, there for our approach posits that the current equilibrium exchange rate given by (22) comprises two components: the systematic component, $\bar{q}_t$and real interest deferential.

But another way of translating the principle of the approach to determine misalignments is to consider that there is a set (Z_{1t}) of fundamental variables that influence the behaviour of the real exchange rate (RER) in the long run, and a set (Z_{2t}) of fundamental variables that have medium-term effects. Under these conditions, the formal expression of the observed RER (q_t) is as follows:

$$q_t = \beta_1' Z_{1t} + \beta_2' Z_{2t} + \alpha' T_t + \varepsilon_t \qquad (23)$$

where T_t is a vector of transient (or short-term) factors, and ε_t is an error term. Expression (23) then makes it possible to distinguish between the observed RER (q_t) and the current level of the equilibrium exchange rate (q_t'). The latter corresponds to the exchange rate that prevails when the effects of cyclical and transitory factors dissipate. In other words, it corresponds to the level $q_t$of given only by the variables Z_{1t} and Z_{2t}, i.e.:

$$q_t' = \beta_1' Z_{1t} + \beta_2' Z_{2t} \qquad (24)$$

The difference (cm_t) between the observed RER (q_t) and its current level (q_t') is considered the "current misalignment":

$$cm_t = q_t - q_t' = q_t - \beta_1' Z_{1t} + \beta_2' Z_{2t} = \alpha' T_t + \varepsilon_t \qquad (25)$$

Equation (25) shows implicitly that the determination of misalignments is closely related to the question of the choice of the fundamentals of the RER. Therefore, we make a choice informed by the empirical literature, considering the constraint related to the availability of data.

Since we were working on developing economies, we can do the work that's done on Latin America from the work that's done on African economies. On the one hand, we can note the contributions of Mulder and Baldi (2004) or Montiel (2007) for the work on Latin America. In general, these authors consider fundamentals such as productivity, public expenditure, terms of trade, net external position, openness and fixed exchange rate regimes. The former thus

confirm the impact of the exchange rate regime [16], while the latter analysis of the relative evolution of the competitiveness of the countries under consideration. On the other hand, for African countries, we note the pioneering contributions of Devarajan and Hinkle (1994) or Devarajan (1997), whose choice of fundamentals is almost identical to those of Montiel (2007).

We also note the study by IIMI (2006), which is based on the fundamentals of productivity, the net international investment position, the risk premium, and the real interest rate differential. This choice allows him to detect the phases of under-evaluation and over-evaluation of the Botswana pula between 1985 and 2004.This result is confirmed by Abdih and Tsangarides (2010) who study the behavior of the RER in the two monetary subsets of the Franc zone (EMCCA[17] and WAMU[18]), using the terms of trade, public expenditure, productivity, investment and the openness rate of the economy. Elbadawi (2012) link taxes on non-tradable goods and development aid flows to the above determinants in order to study the relationship between the latter and misalignments and growth in sub-Saharan African countries. The same set of fundamentals is also retained by Gnimassoun (2014) or Coulibaly and Gnimassoun (2013)[19].

In sum, this brief review of the literature shows that there is almost a consensus on some of the variables used in the evaluation of equilibrium exchange rates, despite the different levels of development of the economies under consideration. In the light of this literature, we then make our choice of fundamentals as described in the following paragraph.

In this work, we assume that medium-term real interest rates are equal, so that the medium- to long-term equilibrium exchange rate (x_t') is determined solely by the fundamentals in equation:

$$x_t' = [(r_t - r_t^*), ltnt_t, Tot_t, Nfa_t, \lambda_t] \qquad (26)$$

As equation (26) indicates, the equilibrium level of the real exchange rate depends on the terms of trade, trade policy, the foreign interest rate, foreign capital flows, and government

[16] Indeed, Mulder and Baldi (2004) show that the exchange rate regime is an important determinant of the exchange rate, not only because of its contribution to the stability of tradable goods prices, but also because of its quality as a factor attracting portfolio flows. Portfolio flows exert upward pressure on demand, thereby increasing the price of non-tradables.

[17] Economic and Monetary Community of Central Africa

[18] West African Monetary Union

[19] The first shows that developments in the anchor currency are not the cause of the misalignments of the CFA franc. The second studies the optimality of the Franc zone as a monetary union in terms of the misalignments of the RER. They show that the West African monetary union (WAMU) is the most homogeneous and can be extended by including countries such as Ghana or Gambia.

expenditure. Relationship (26) highlights, from a behavioral approach, the long-run macroeconomic determinants of the real exchange rate. In general, an increase in public consumption, and therefore public expenditure, increases demand for non-tradable goods whose prices will rise relative to the prices of tradable goods. The result is a depreciation of the real exchange rate Edwards and Savastano (2000), De Gregorio and al. (1994), Edwards (1994), Elbadawi (2000), Baffes and al. (1999), Roudet (2007)). Furthermore, the introduction of this variable, sometimes considered as a generalization of the Balassa-Samuelson approach, allows the effect of state size to be captured (Rogoff , 2004). According to this idea, public expenditure is carried out often to the benefit of non-tradable products and therefore an increase in the size of the of the State may cause a decrease in the relative price of the products exchangeable versus non-tradable, which has a consequent impact on the real exchange rate (Djoudad and Tessier (2000)).By distinguishing between tradable goods, exportable goods and importable goods, it is possible to identify trade policy (Baffes (1999), Edwards (1994), Elbadawi (1994)) among the fundamental determinants of the equilibrium real exchange rate. Increased trade liberalization (reduction of import taxes or export subsidies) tends to reduce the prices of imported products, increase demand for foreign products and thus worsen the trade balance deficit. The resulting real depreciation of the domestic currency, which is necessary to improve the country's competitive position, reduces the trade balance deficit and alleviates the external trade imbalance. On the other hand, an improvement in the current account balance is associated in the long term with an appreciation of the real exchange rate.

Empirical studies on the effect of the terms of trade often yield equivocal results (Edwards and Savastano (2000), Reinhart (1993), Chen and Rogoff (2003), Cashin and al (2004), Drine and Rault). Indeed:

- An increase in the terms of trade implies an increase in national income and domestic demand, leading to an appreciation of the real exchange rate.

- Whereas a deterioration in the terms of trade resulting, for example, from a fall in the prices of exports leads to an increase in the consumption of exportable products at the expense of demand for non-tradable products, the prices of which will tend to fall. This leads to a depreciation of the real exchange rate.

- The deterioration in the terms of trade may be caused by the increase in the price of imports. In this case, a substitution effect takes place in favor of non-tradable and, therefore, their prices increase while inducing an appreciation of the real exchange rate (Edwards, 1989a).

In this context, Elbadawi and Soto (1995) found, in a study of seven developing countries, that an improvement in the terms of trade induced a real appreciation of the national currency parity for three countries. For the other countries, a deterioration in the terms of trade leads to an appreciation of the real exchange rate. In studying the relationship between the terms of trade and the real exchange rate for the Finnish economy, Feyzioglu (1997) found a positive correlation. Drine and Rault (2005), using panel data for 45 developing countries, showed that an improvement in the terms of trade leads to real exchange rate appreciation for African and Asian countries, but this improvement has no effect for Latin American countries. Their conclusion on this point is that the elasticity of the real exchange rate with respect to the terms of trade depends on the economic structures of each group of countries.

The effect of capital movements on the equilibrium real exchange rate depends largely on the nature of capital flows. For FDI, an improvement in FDI leads to an increase in spending on non-tradable goods, which puts pressure on the prices of these products and leads to a fall in the real exchange rate. Empirical investigations often find a negative correlation between FDI and the equilibrium real exchange rate.

With respect to portfolio investment, and as Edwards (1994) points out, a liberalization of the capital account produces an appreciation of the equilibrium real exchange rate. Indeed, when the monetary authorities reduce taxes on external borrowing, future consumption becomes more expensive and encourages agents to substitute it for present consumption. Consequently, pressure is exerted on the price of non-tradable goods while appreciating the equilibrium real exchange rate. On the other hand, when there is a reduction in taxes on external borrowing, distortions within the economy are reduced, inducing a positive impact on economic welfare through a positive income effect. Still at this level, there will be an appreciation of the equilibrium real exchange rate. Besides these demand variables, in our empirical part we will add a supply indicator which is the gross domestic product per capita which empirically measures the productivity differential. The introduction of this variable represents what is called the Balassa-Samualson effect. It was in 1964 that Balassa and Samuelson proposed a model where productivity variations imply a change in the relative price between tradable and non-tradable goods. The Balassa-Samuelson effect appears when the economy is decomposed into the tradable and non-tradable sectors. The idea of these authors is that the said sectors have, in general, different productivity developments in the goods sectors, in the tradable sector, productivity generally increases faster than in the non-tradable sector.

The Balassa-Samuelson effect is often used in work on the determinants of the real exchange rate to explain, in particular, why the PPP hypothesis is not tested between emerging and advanced countries. Several works (Duval and Romain (2001), Ricci and al (2008), Coudert (1999)), confirm that the Balassa-Samuelson effect explains the trend appreciation of the real exchange rate during the catching-up process of developing countries.

Empirical work often shows that the relative coefficient on per capita income is negative since economic development is accompanied by a growing gap between relative productivity in the tradable goods sector and thus a real appreciation of the Tunisian dinar.

Then, following the intuition of Clark and MacDonald (1997), we selected variables that are believed to have an objective influence on the long-term real exchange rate.

- **Terms of trade (TE)**

The terms of trade are defined as the ratio of the export price index to the import price index. The impact of changes in the terms of trade (TE) on the equilibrium exchange rate is reflected in the relative prices of non-tradable goods compared to tradable goods. However, this impact is theoretically ambiguous, as shown by Baffes (1997), Elbadawi and Soto (1995), Aron (1997) and Edwards (1989a). This ambiguity manifests itself through two effects that can be produced by a terms-of-trade shock: a direct effect on income through the demand for non-tradable goods and an indirect effect of substitution through the production of non-tradable goods. In other words, the impact of a direct effect on income can be illustrated by the improvement in the terms of trade following an increase in export prices (with import prices remaining constant). This improvement in the terms of trade manifests itself through an increase in government income and helps to reduce the budget deficit of the country in question whose export prices have risen. Consequently, the increase in income increases the demand for all goods, imported goods and non-tradable goods. However, this higher demand for goods will not, by hypothesis, affect the price of imports, which are assumed to be fixed.

On the other hand, this increase in demand implies an increase in the prices of non-tradable goods and consequently a real appreciation of the exchange rate. At the same time, the growth in export prices leads to a positive flow of foreign exchange, caused by the improvement in the trade balance. This improvement in the trade balance leads to an improvement in the current account balance, which in turn leads to an appreciation of the equilibrium exchange rate. On the other hand, a deterioration in the terms of trade implies the opposite effect: a reduction in domestic income and a fall in demand for all imported and non-tradable goods, and

consequently a depreciation of the real exchange rate. However, the indirect substitution effect may be greater than the direct effect on income and leads to opposite results to those described above. Indeed, an improvement in the terms of trade provides producers of non-tradable goods with sufficient foreign exchange resources to enable them to increase their production and consequently lower their prices. In this case, an improvement in the terms of trade implies a real depreciation of exchange rates. Conversely, if the terms of trade deteriorate, producers are constrained by insufficient foreign exchange. Consequently, the acquisition of the inputs needed to produce non-tradable goods is constrained, which contributes to reducing the production of tradable goods and consequently to increasing the price of non-tradable goods, thus leading to a real appreciation of the exchange rate.

Elbadawi and Soto (1995) study seven countries and, in three cases, an improvement in the exchange rate is observed terms of trade results in a real appreciation of the exchange rate, while in the other four cases, an improvement in the terms of trade depreciates the real exchange rate.

- **Domestic investment (DI)**

The impact of the level of investment on the real exchange rate depends both on the relative importance of tradable and non-tradable goods in the economy and on capital intensity. Indeed, an increase in the share of investment in GDP changes the structure of expenditure in favor of tradable goods, resulting in a depreciation of the real exchange rate Baffes (1997), Edwards (1989a)). At the same time, a change in the level of investment in favor of non-tradable appreciates the real exchange rate. Thus, Baffes, Elbadawi and O'Connell (1997) found that the increase in the share of investment in GDP led to a depreciation of the real exchange rate in Ivory Coast. Note also that Edwards (1989a) found in his study of 12 developing countries that increases in the share of investment in GDP implied a depreciation of the real exchange rate.

- **Public expenditure (PE)**

The impact of government expenditure on the equilibrium real exchange rate depends on the relative importance of tradable and non-tradable goods in the economy. Edwards (1989), considers two periods, period (1 and 2), and assumes, for simplicity, that tax distortions do not exist. Assuming an increase in government expenditure on non-tradable in period 1, financed by public or international borrowing, the equilibrium of the real exchange rate is affected in two ways. On the one hand, period 1 reflects an increase in the demand for goods and services, and consequently an increase in the prices of non-tradable, which implies an appreciation of the

equilibrium real exchange rate. On the other hand, in period 2, the government may want to increase the level of taxes to pay its debt. This behavior reduces the level of disposable income and consequently aggregate demand. The fall in aggregate demand results in a fall in the prices of non-tradable goods, and thus in a depreciation of the equilibrium real exchange rate. As a result, it is difficult to determine a priori the impact of a change in government consumption of non-tradable on the equilibrium real exchange rate. However, the situation is similar when analyzing the impact of changes in government consumption of tradable goods on the equilibrium real exchange rate. As such, note that Edwards (1989) found an appreciation of the real exchange rate caused by an increase in government consumption in four of the equations he estimated for a group of 12 developing countries, while in two other equations an increase in government consumption depreciates the real exchange rate.

- **Trade policy (TP)**

The relaxation of trade restrictions through trade liberalization (trade policy) affects the real exchange rate. Indeed, an increase in import taxes can increase the domestic price of imports, which constitute a part of tradable goods. In return, the prices in domestic currency of tradable goods increase, which implies a depreciation of the real exchange rate.

On the other hand, a reduction in import taxes has the opposite effect: the real exchange rate appreciates because of the fall in the domestic currency prices of imports.

Baffes, Elbadawi and O'Connell (1997) find results confirming the theory in their study of Ivory Coast and Burkina Faso. Reforms whose objectives are to liberalize trade are compatible with a depreciated real exchange rate.

- **Long-Term Capital Movements (FDI)**

Net foreign assets or changes in foreign reserves have a significant effect on the real exchange rate. Indeed, an increase in net foreign assets leads to an appreciation of the real exchange rate, while a decrease in net foreign assets depreciates the real exchange rate. Aron and al. (1997) find results consistent with the theory. An increase in reserves appreciates the real exchange rate.

- **Gross Domestic Product Per Capita (GDPC)**

The income per head is used as a proxy to measure the Balassa-Samuelson effect (Balassa, 1964). Indeed, the coefficient on income per head is expected to be negative because

economic development is accompanied by a growing gap between relative productivity in the tradable goods sector, which is reflected in an appreciation of the real exchange rate.

To improve the justification of our choice, we summarize some empirical work on the estimation of the equilibrium real exchange rate in developing countries in (Appendix 1) where we present the authors, the countries and periods of analysis, the variables selected and the econometric methods.

Conclusion

The objective of this chapter was to determine a specific equilibrium RER model for Tunisia based on the fundamentals. To achieve this, we started from the presentation of the multiple exchange rate concepts, among which the real exchange rate appears to be the most relevant in the framework of this study. For this purpose, we have approached the determinants of the exchange rate as well as the exchange rate regime that allows its management.

The second section has just presented the models used to determine the value of the equilibrium real exchange rate FEER, BEER, NATREX. we have chosen the BEER model that seems to us the most relevant for the case of the Tunisia.

Based on this model, we will calculate the equilibrium exchange rate as well as its misalignment with that observed in the following chapter.

CHAPTER II: MODELLING AND ESTIMATING THE REAL BEHAVIOURAL EQUILIBRIUM EXCHANGE RATE AND THE DEGREE OF MISALIGNMENT

Introduction

The modeling of the equilibrium real exchange rate in relation to a developing country is initiated by the work of Edwards (1988, 1989), Clark and Mac Donald (1998) and Elbadawi (1994), and developed by the work of Hinkle and Montiel (1999), Kakkar and Ogaki (1999), Aglietta, Baulant, and Coudert 1999, Coudert 1999, Abdallah 2006,)), it brings out the specificities of the country during the modeling, which encourages us to draw inspiration from this work to determine the real equilibrium exchange rate of Tunisia.

Among this work, we have considered that of Clark and MacDonald (1997) who proposed a composite model called BEER (Behavioral Equilibrium Exchange Rate). The purpose of this model is less to explain theoretically the determination of the exchange rate than to report empirically on its evolution. Their approach consists in selecting a set of fundamental variables that can influence the real exchange rate in the long term, and then looking for cointegrating relations between the exchange rate and these variables that designate the vector of long-term fundamentals. Then, the estimation of the long- and short-term equations was done using the Vector Error Correction Model (VECM). The difference between the exchange rate and its estimated long-term value, according to the cointegrating relationship, makes it possible, according to the authors, to evaluate the misalignment of the current rate. In addition, and following the design of our model, we will adopt a research methodology to calculate the equilibrium real exchange rate (RER) and evaluate the degree of misalignment of the observed rate with respect to the long-run equilibrium rate. To this end, we will devote this chapter to the empirical part, in which the steps in our modeling will be presented in three parts or sections:

- Section 1: The empirical investigation

- Section 2: The Empirical application through modeling of the equilibrium short- and long-term real exchange rate and interpretation

- Section 3: The movements in the real long-term equilibrium exchange rate and misalignment.

Section 1: Empirical Investigation

In the first section, we present the steps in the empirical analysis by which we will determine the equilibrium exchange rate. To this end, our process begins with the presentation of the methodological process (A), followed by a more in-depth study of the steps of the empirical analysis (B).

A-The presentation of the methodological process

In practical terms, the study will cover the period from 1980 to 2018. The data used in this work consist of annual variations and come from the World Bank. The use of monthly or quarterly data would have significantly enriched the analysis and would have helped us better understand the behavior of the dinar's exchange rate. In the absence of data availability, we were satisfied with an annual database of 39 observations.

We recall that the fundamentals used in our model were chosen on the basis of theoretical analyses, variables recognized in the standard literature and on the intuition of Clark and MacDonald. This is the BEER approach, which consists in selecting a set of fundamental variables that can influence the real exchange rate in the long run and then looking for cointegrating relationships between the exchange rate and these variables. Moreover, as mentioned earlier, the unavailability of certain series requires the use of appropriate proxy variables.

Before beginning to outline the steps of our analysis, we proceed to report the definitions and the different measures of the variables used in Table (3).

Recalling that we have opted for the following variables: real exchange rate (RER), terms of trade (TE), Domestic Investment (DI), Public Expenditure (PE), Trade Policy (TP), Long-Term Capital Movements measured by the foreign direct investment (FDI), productivity measured with Gross Domestic Product Per Capita (GDPC).

Table 3: The identification of variables

The Real Exchange Rate (RER): it was calculated as the ratio of the consumer price index in the United States and that of Tunisia multiplied by the nominal exchange rate against the US dollar, and an increase implies a depreciation of the Tunisian dinar. **The Terms of Trade (TE):** it is calculated as the ratio between export prices (unit value index) and import prices (unit value index) of Tunisia. **Domestic Investment (DI):** this is capital accumulation measured by the ratio of gross fixed capital formation to gross domestic product in value terms. **Public Expenditure (PE):** to escape the problem of decomposing public expenditure into tradable and non-tradable products, we used as a proxy the share of total public consumption in value terms in the gross domestic product in value terms. **Trade Policy (TP):** we retained as a variable the degree of openness of the economy, approximated by the share of foreign trade in value in gross domestic product in value. It is the sum of imports and exports in relation to gross domestic product. In general, in the economic literature, this variable is used to measure the intensity of trade policy, since increased trade liberalization leads to increased trade and price convergence. **Long-Term Capital Movements (FDI):** these are approximated by net foreign direct investment flows which, unlike other financial flows, are more stable and satisfy, at least in theory, the production motives. **Gross Domestic Product Per Capita (GDPC):** this variable is an indicator measuring the productivity differential between the tradable and non-tradable goods sector in relation to the United States. One way of doing this is to consider the logarithm of real gross domestic product per capital.

B-The steps of the empirical approach

After the presentation of the modeling methodology, and before starting the empirical application we proceed to the drawing up of the empirical steps indicating the usefulness of each of these steps.

1-Logarithmic Transformation

The logarithm of the data must be taken before being subjected to formal econometric analysis because these series are not stable, and the mean is constantly increasing, but they are

not integrated either because no difference can make them stationary. Note that in the majority of cases, the logarithmic transformation is also very useful for the following reasons:

- The slope of the transformed series corresponds to the growth rate;

- The first difference in the series is more stable and

-The difference between two series can also be interpreted as a percentage of distance.

In fact, the logarithmic transformation frees us from units of measurement and introduces percentage units that are relative, a very useful feature when the data cover long periods of time. Thus, if we take the logarithm of a series, which has an average growth rate, we will transform it into a series that follows a linear trend and is integrated.

2- Testing the order of integration of all variables

2.1-Unit Root Tests

The presence of a unit root in the data has statistically significant consequences. They can be summarized in a few lines:

- The general asymptotic properties of the estimators (convergence speed, asymptotic normality) no longer hold. i.e., a special asymptotic theory must be used.

- The presence of regressors with a unit root in a regression can led to the estimation of apparently very good regressions between variables that are totally independent of each other.

- A trend stationary series and a difference stationary series behave in radically opposite ways in the long run, whereas:

A trend-stationary series tends to reposition itself around its deterministic trend after a random shock (this is called the "mean reversion" property).

And a stationary trend series in difference does not revert around its trend after a shock, since the shock also affects the stochastic trend of the series.

There are therefore a variety of statistical reasons to be interested in the presence (or absence) of a unit root in a series, for this we need to know if the root exists, and if so, in which part of the process.

The test procedure remains based on the three autoregressive models of the Dickey and Fuller simple test, described below, and consists in testing the existence of unit root [H0: = 0] against stationarity [H1: < 0].

2.1.1-Dickey-Fuller test increases ADF

As the error term is unlikely to be white noise, Dickey and Fuller extended their test procedure suggesting an augmented version of the test (hereafter refer to ADF test) which includes extra lagged terms of the dependent variable in order to eliminate autocorrelation in the test equation.

On the other hand, we find that Nelson and Plosser (1982) admit another point of view on the unit root hypothesis; they imply that random shocks have permanent effects on the macroeconomic level in the long term, that is to say that fluctuations are not transitory. These conclusions have been challenged by Perron (1989), who argues that in the presence of a structural break, standard ADF tests are biased in favor of not rejecting the null hypothesis. Perron argues that most macroeconomic series are not characterized by a unit root, but rather that persistence results only from large and infrequent shocks, and that the economy returns to the deterministic trend after small and frequent shocks.

2.1.2- Phillips test - Perron PP

If the ADF test brings a parametric correction to the simple Dickey - Fuller test considering the possible autocorrelation of errors, the Phillips - Perron (1988) test proposes a non-parametric correction to the simple Dickey - Fuller test in order to solve the problem of the heteroskedasticity of errors, without having to add endogenous variables in delayed differences as in the ADF tests.

2.1.3-KPSS tests

In econometrics, the KPSS test or Kwiatkowski-Phillips-Schmidt-Shin test is a statistical test that aims to know whether a time series is stationary, that in other words, whether its statistical properties (expectation, variance, auto-correlation) vary or not over time (Denis Kwiatkowski, 1992).

In contrast to most unit root tests, the presence of a unit root is not the null hypothesis but the alternative. Moreover, in the KPSS test, the absence of a unit root is not a proof of stationarity but, by design, of tendency-stationarity. This is an important distinction because it is possible for a time series to be non-stationary, to have no unit root but to be trend-stationary. In both unit-root and trend-trend-stationary processes, the mean may be increasing or decreasing over time; however, in the presence of a shock, trend-trend-stationary processes are mean-reversing processes (i.e. transitory, the time series will converge back to the increasing

mean, which has not been affected by the shock), whereas unit-root processes have a permanent impact on the mean (Heino Bohn Nielsen, 2005).

2.2- Breakpoint Unit Root Test

Christiano argues that data-based procedures are generally used to determine the most likely location of the rupture and that this approach invalidates the distribution theory underlying conventional tests. Since then, several studies have been conducted using different methodologies to endogenously determine the date of rupture. These include Banerjee, Lumisdaine and Stock (1992), Zivot and Andrews (1992), Perron and Vogelsang (1992), Perron (1997) and Lumsdaine and Papell (1998). These studies have shown that it is possible to reduce the bias in the usual unit root tests by endogenously determining the timing of structural breaks. Zivot and Andrews' (1992) endogenous structural breakage test is a sequential test that uses the entire sample and uses a different dummy variable for each possible breakage date. The break date is chosen when the t-statistic of the unit root ADF test is at a minimum (the most negative). Therefore, a break date will be chosen when the evidence is least favorable for the null unit root. The critical values of Zivot and Andrews (1992) are different from the critical values of Perron (1989).

3- Setting the appropriate lag length of the model

Choosing the optimal number p of delays is a critical step in the estimation process. Indeed, an insufficient number of lags causes the process under study to lose information (its memory is then not long enough) and will produce biased estimates of the parameters both in a small sample and asymptotically, while too many lags increases the number of parameters to be estimated and thus reduces the degree of freedom of the process.

4- Choosing the appropriate model regarding the deterministic components in the multivariate system

In general, five distinct models or five specifications can be considered. To perform this test, Johansen proposes the following cointegration vectors or series:

- **Absence of a linear trend in the data**

- Absence of a linear trend in the series and of a constant in the cointegrating relations;

- Absence of a linear trend in the series but presence of a constant in the cointegrating relations.

- **Presence of a linear trend in the data**

- Presence of a linear trend in the series and a constant in the cointegrating relations

- Presence of a linear trend in the series and in the cointegrating relations.

- **Presence of a quadratic trend in the data**

- Presence of a quadratic trend in the series and a linear trend in the cointegrating relationships.

The choice of one of these specifications depends on the data and the assumed shape of the trend.

5-Testing the number of cointegrating relationships

In order to determine the number of cointegrating vectors r, using the maximum likelihood method, Johansen proposes two tests to determine the non-zero eigenvalues corresponding to the cointegrating relations r:

$$\lambda_{trace}(\mathrm{r}) = -\mathrm{T}\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$$

$$\lambda_{max}(\mathrm{r}, \mathrm{r}+1) = -\mathrm{T}\ln(1-\hat{\lambda}_i)$$

The λ_{trace} (r) statistic is associated with the test where the null hypothesis assumes that the number of cointegrating vectors is less than or equal to r against the alternative hypothesis that they are greater than r (for the maximum eigenvalue test, H0: r = r against H1: r = r+1).

λ_{trace} (r) follows a probability law tabulated by Johansen and Juselius. And this test works by exclusion of alternative hypotheses:

Test 1: =

- H0: r = 0, the hypothesis no cointegrating relation
- H1: r > 0, there is at least one cointegrating relationship

- If λ_{trace} (0) is greater than the value read from the threshold table, we reject H0, there is at least one relation, we then go to the next step, otherwise we stop and r = 0.

Test 2: =

- H0 : r = 1, the hypothesis of a single cointegration relation
- H1: r > 1, there is more than one cointegrating relation

If trace (1) is greater than the value read from the table than the threshold, we reject H0, there are at least two relations, we then go on to the next step, otherwise we stop and r = 1.

And so on until the last step (if necessary):

Test n: =

- (H0: r = (n - 1), the hypothesis of (n-1) cointegration relations

- H1: r > (n - 1), there is at least (n-1) cointegrating relationship

- If λ_{trace} (n-1) is greater than the value read in the table at the threshold, we reject H0, there are at least n relations, (in fact in this case the n variables are I(0)) otherwise r = n - 1.

In conclusion, it should be noted that the interest of cointegration theory is that it provides a method for non-stationary time series analysis. Moreover, thanks to error-correction models, it allows the simultaneous modelling of long- and short-term dynamics of time series. where T is the number of observations, r is the number of cointegration vectors under the null hypothesis and $\hat{\lambda}_i$is the estimated value of the $\hat{\lambda}_i$eigenvalue of the matrix $\prod$. We will develop here only the trace test because it is the most widely used.

6-VECM Estimation

As long as there is a cointegrating relationship between the variables, the error-correction model can be derived from the autoregressive distributed delay model. And since the VECM represents the vector autoregressive model (VAR) and the vector error correction model (VEC),

it allows:

- In the VAR model, to consider each endogenous variable of the system as the lagged value of all endogenous variables of the system

- And by the VEC expressions to restrict the long-term behavior of endogenous variables and be convergent towards their cointegrating relationship when there is a wide range of dynamic short-term fluctuations. Error-correction models allow for a good specification of the adjustments towards a long-term equilibrium situation and show that the imbalances of a given period are corrected to a certain extent in the periods that follow. They are dynamic models that use both short-term and long-term developments. Consider two variables Xt and Yt which are CI (1,1). The error-correction model is written as follows:

$$\Delta Y_t = \alpha Z_{t-1} + \sum \beta_i \Delta X_{t-i} + \sum \delta_j Y_{t-i} + d(L)\varepsilon_t$$

X_{t-j} being considered as an endogenous variable, ε_t a white noise, the cointegrating relation residual and d a finite polynomial in L. This representation makes it possible to combine the short-term adjustments, represented by the variables in first differences, and the long-term relationship, defined by the cointegrating relationship. The coefficient α represents the recall force to the long-term target, which is determined by the cointegrating relationship and must be significantly negative to ensure the process of returning to equilibrium. Finally, we choose to

summarize the steps to be taken in the following section by expressing the usefulness of each in our study in the Table (4) bellow.

Table 4: The steps of the empirical approach

Steps	Utility
Logarithmic transformation	• Release of units of measure • Interpretation of the growth rate with slope
Testing the order of integration of all variables	• Determination of the degree of stationarity • Parametric correction • Solving the problem of error heteroskedasticity • Determine the date of rupture
Setting the appropriate lag length of the model	• Determine the number of delays in a staggered delay model
Choosing the appropriate model	• Determine the numbers of cointegrating relationships
VECM Estimation	• Estimation of the long-term relationship • Modeling short-term dynamics

Section 2: Empirical Application

This section then consists of applying the steps identified in the first section. Thus, the process to be followed in this section is divided into two parts. The first concerns the treatment and evolution of the variables (A) and the second concerns the application of cointegration and Johansen test (B) which leads to the long- and short-term estimation between the real exchange rate and its fundamental variables.

A-The treatment and the evolution between RER and the other variables

1- The treatment of variables

The graphical and statistical analysis of the data series begins with the processing of the variables, which will all be expressed in logarithm. Thus, the symbols and the significations of the variables used are described in the following table (5).

Table 5: The variables signification

Symbol of the variable	Signification
LRER	The logarithm of the real exchange rate quoted to the uncertain
LTE	The logarithm of the terms of trade
LDI	The logarithm of domestic investment as a percentage of GDP
LPE	The logarithm of public expenditure
LTP	The logarithm of trade policy
LFDI	The logarithm of foreign direct investment flows as a percentage of GDP
LGDPC	The logarithm of GDP per capita

In the following graphs, we can observe the evolution, over the study period, of all the previously defined variables.

- **The RER and the Terms of trade**

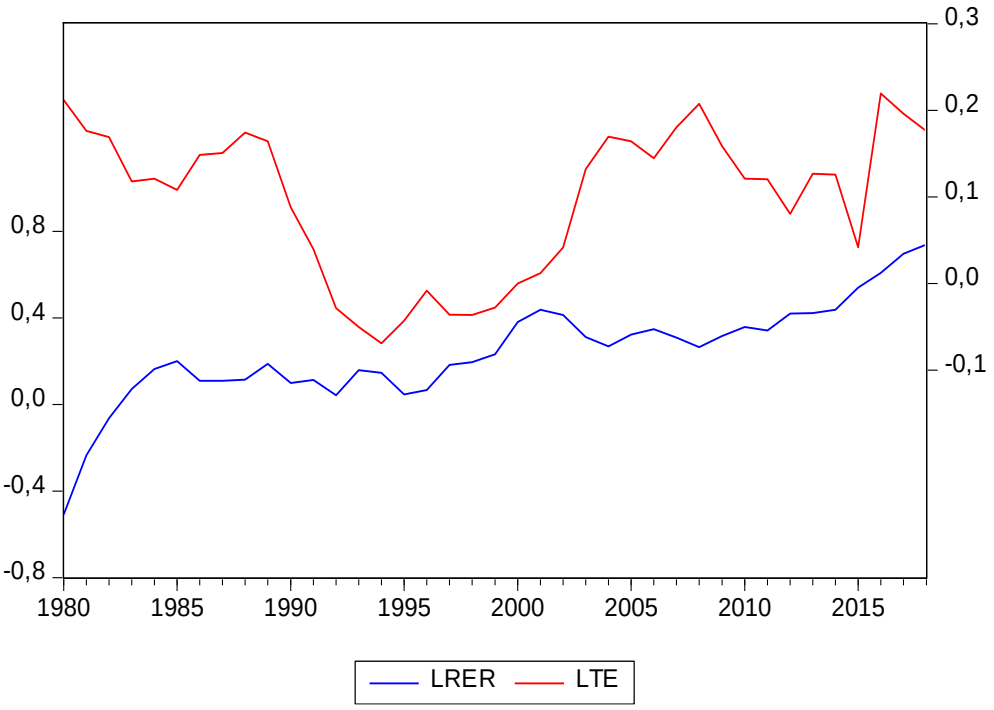

Figure 1: Evolution between LRER and LTE

We recall that the fundamental variable of the term of trade is defined as the ratio of the export price to the import price. The World Bank provides us with data from 1980 to 2018. Figure (1) shows that despite the fluctuations that continue from the logarithmic presentation of the term of trade (LTE), the path shows a slight upward trend.

- **The RER and the Domestic Investment (DI)**

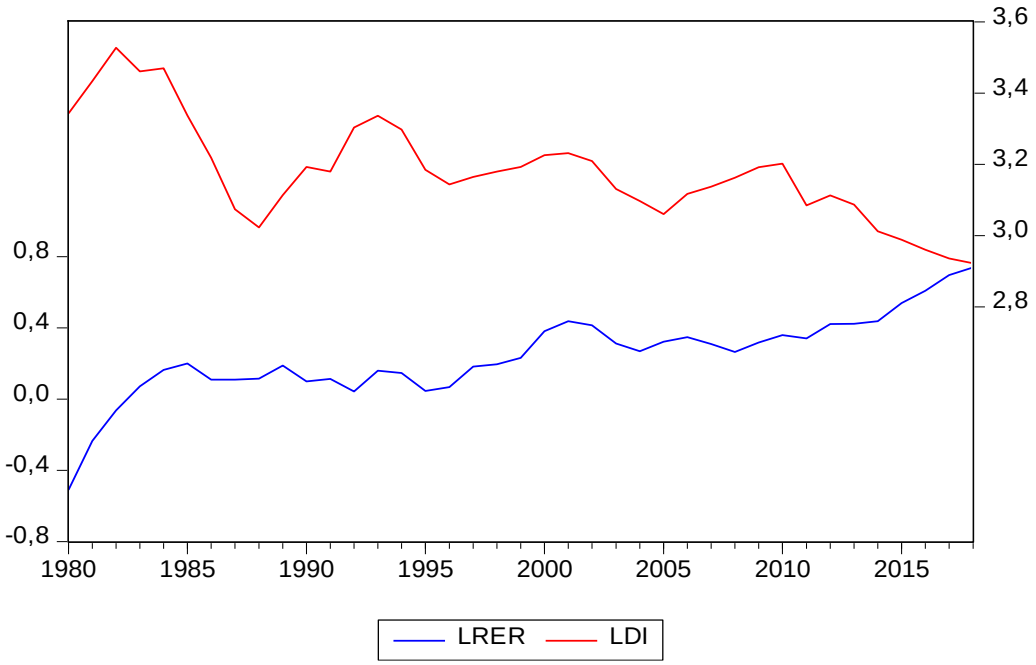

Figure 2: Evolution between LRER and LDI

We have mentioned that the domestic investment is measured by the ratio of gross fixed capital formation to gross domestic product in value terms. The figure (2) shows two opposite trends where domestic investment is still declining. The Investment is structurally low in Tunisia. It has fallen further since 2011 to reach only 19% of GDP in 2016. Since 2006, it has recovered but has not yet reached the level achieved at the beginning of the decade. During the post-revolutionary period, a significant drop in GFCF in relation to GDP was recorded under the effect of the economic, social and security instability that followed. The investment rate thus fell from 24.6% in 2010 to 19% in 2014. Moreover, the GFCF [20]gap between 2000-16 (percentage points of GDP) is (-6) These points are distributed as follows (-3.5) for private companies (-1,7) for public companies, Oil, natural gas and products (-1.5), Manufacturing industries (-1.2), Textile (0,6), clothing and leather, Mechanical and, electrical industries (-1.1), Tourism (hotels and restaurants) (-0.8), Transport (-1.5), Housing (-0.1).

[20] Gross fixed capital formation

- **The RER and the Public Expenditure (PE)**

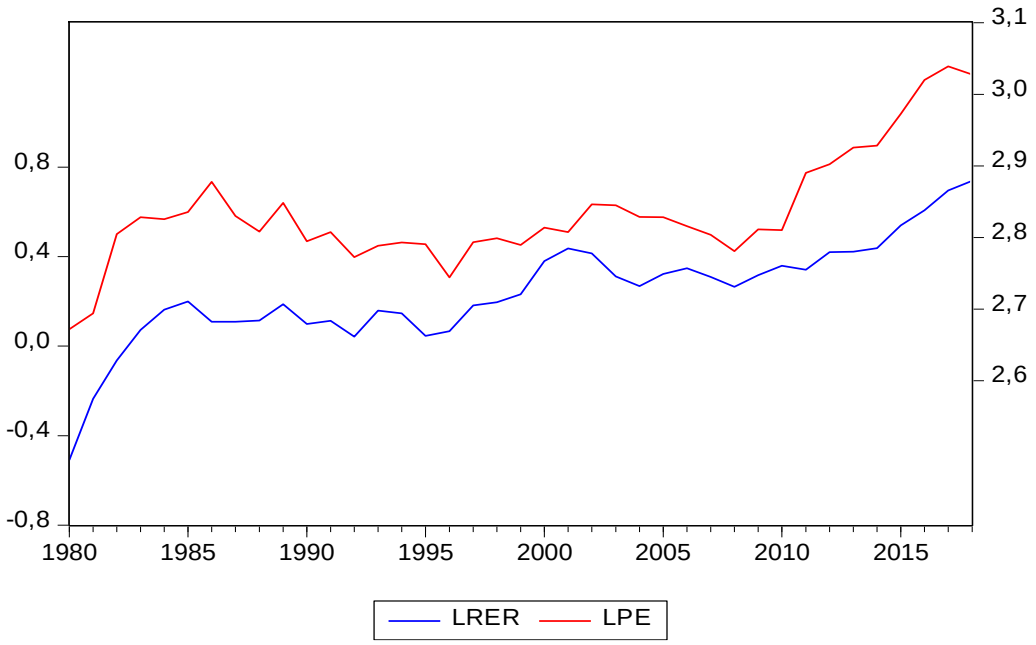

Figure 3: Evolution between LRER and LPE

This figure (3) shows that the curves for public expenditure and the RER are converging and still rising. we thus notice different fluctuations with a remarkable increase between since 2011. Post-revolutionary Tunisia continues to face a significant deterioration of its public finances. Since 2011, the finance bills adopted by the Assembly of People's Representatives (ARP) have been in deficit. Complementary finance laws have had to be systematically drafted in order to cope with changes in the economic environment, unforeseen expenditures and assumptions that are often too optimistic when preparing the budget. The composition of public spending favors current expenditure to the detriment of capital expenditure and is therefore not oriented towards supporting long-term growth. As the main component of current expenditure, the civil service wage bill in 2017 represented 41.5 % of the budget and 14 % of GDP, while public investment, although slightly increasing since 2015, accounted for only 16 % and 6.4 % of GDP respectively.

- **Trade Policy (TP)**

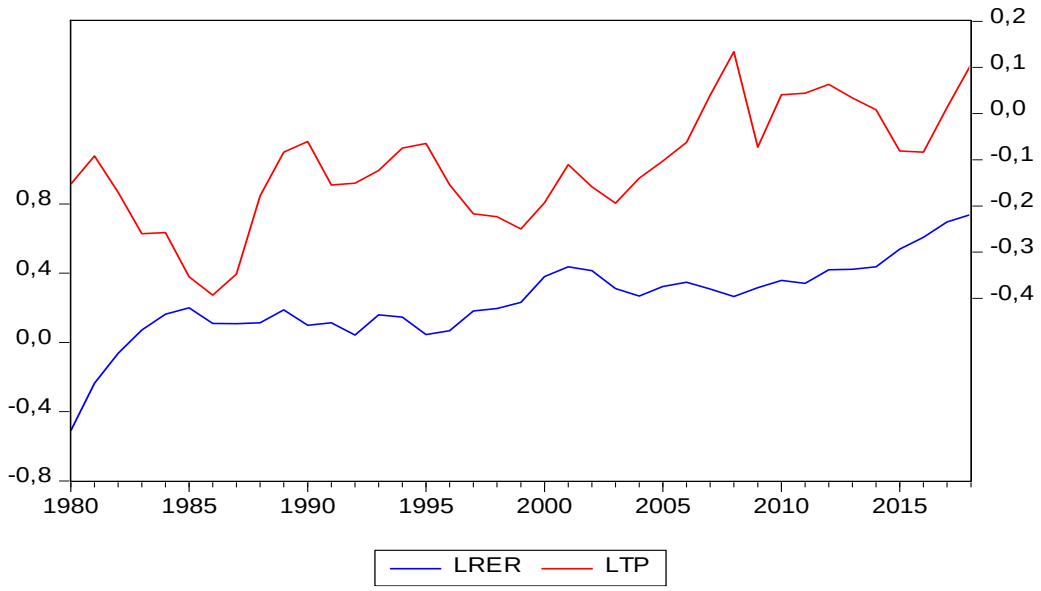

Figure 4: Evolution between LRER and LTP

The Trade is the sum of exports and imports of goods and services, measured as a percentage of gross domestic product. The trade line continues in a discontinuous upward trend that converges with the rise in the exchange rate (Figure 4). Thus, to promote free trade, Tunisia applies all kinds of policies, including price support, input subsidies, tax exemptions for import inputs, direct incentives for investment and production, marketing regulations, tariff quotas (under which customs duties increase above a certain import volume) and subsidized credit.

- **Foreign direct investment (FDI)**

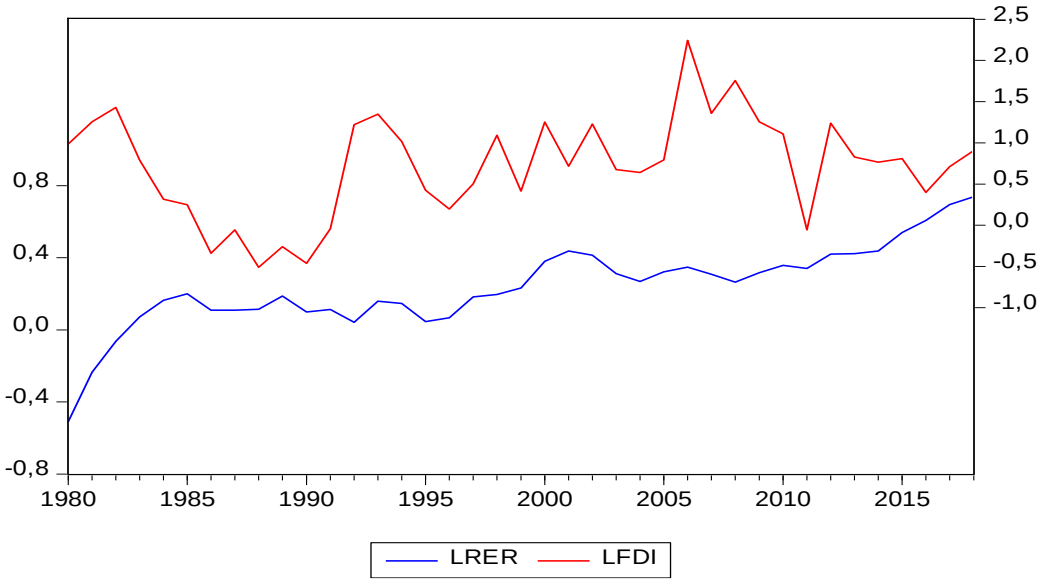

Figure 5: Evolution between LRER and LFDI

This series shows the sum of equity capital, reinvestment of profits, other long-term capital, and short-term capital as it appears in the balance of payments (inflows of new investment minus disinvestment) of the reporting economy from foreign investors, and is divided by GDP. It can be seen in (Figure 5) that FDI has not evolved steadily, but it remains slightly on the rise, converging with RER.

The evolution of FDI was generally timid during the 2000-2014 period. On average, they represent 3.5% of GDP and finance 15.7% of total GFCF. Compared to some competitors, the stock of FDI was, at the beginning of the decade 2000, lower than that of some Asian competitors (Malaysia, Thailand) and comparable to that of some Mediterranean countries (Morocco and Egypt) and other CEECs[21] (Romania, Czech Republic.). However, the gap has widened markedly since the second half of the decade in favor of these two groups of countries, due in particular to the industrial modernization characterizing their productive fabric. At that time, Tunisia has remained on stable and unsophisticated specializations.

- **The RER and the Gross Domestic Product Per Capita (GDPC)**

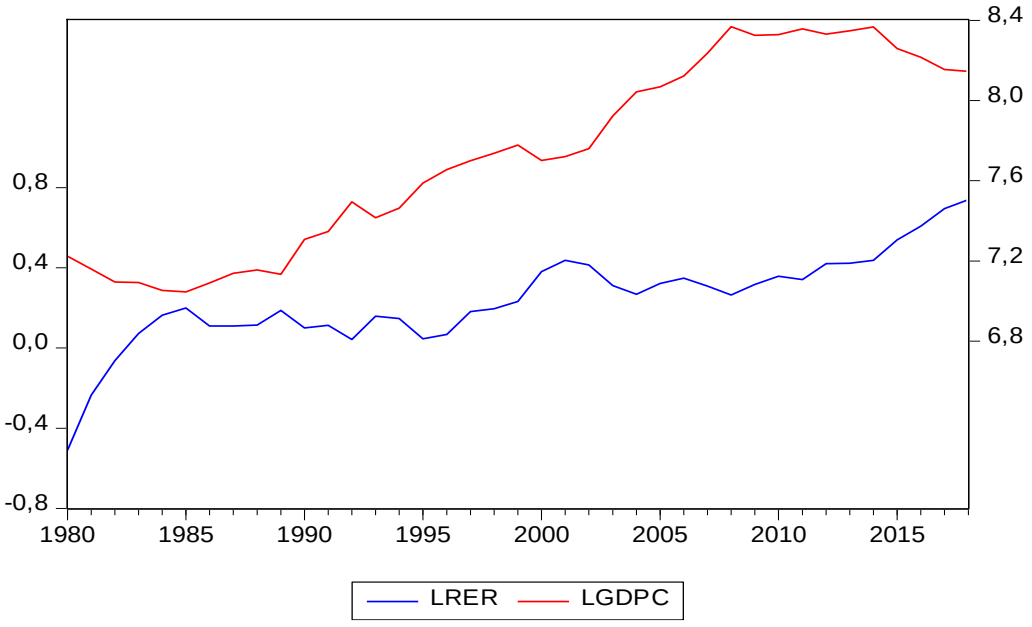

Figure 6: Evolution between LRER and LGDPC

Similarly, the RER curve is moving towards a slow growth in GDP per capita. Tunisia's economic growth per capita has generally accelerated through these reforms. Despite exogenous events - droughts, the attacks of September 11, 2001 and, more recently, the global

[21] Central and Eastern European countries

financial crisis - and the end of the Multifiber Agreement which, until 2005, allowed Tunisia to access the European market despite the presence of competitors from Asia and Eastern Europe, the country has managed to reduce the volatility of its growth since the late 1990s, in part by increasing its macroeconomic stability. Despite these advances, Tunisia's growth does not compare well with that of other similar countries. Moreover, we note that in the long term, Tunisia's growth is similar to that of Turkey and LMIC (lower middle-income countries) and of, but lower than that of the UMIC group (upper middle-income countries), whose average growth is dominated by that of China and which includes fast-growing countries such as Malaysia and Thailand[22].

2- Analysis of the statistical properties of the series

These unit root test tests whether time series are non-stationary, integrated first-order variables. Thus, to test whether the variables are non-stationary and I (1), we used the Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test.

2.1- Unbroken unit root test

The ADF test is the standard test that is generally used to determine the order of integration of time series, but reported that this test has low power because it does not distinguish a time series containing a jump, change or break. (Denni and Frewer ,2006). Such an approach has been developed by Phillips (1987), Phillips and Perron (1988) and Perron (1986, 1988): the assumptions made about errors are much less restrictive. The idea is that recent errors may be dependent, but errors that are very distant from each other over time are independent. We use the PP unit root test, which is more powerful than the ADF test. But the ADF test, can lead to distortions of significant size and the presence of negative autocorrelation. To minimize this risk, we use the KPSS test to determine whether a variable is stationary or non-stationary. The ADF and Phillips-Perron (PP) tests determine, under the null hypothesis, whether the level variables are integrated of order 1 (I (1)), while the KPSS stationarity test verifies, under the null hypothesis, whether the level variables are stationary or integrated of order 0 (I (0)):

- Hypotheses of the Dickey-Fuller and Phillips-Perron tests:

H0: The series are I(1). The series are stationary

[22] World Bank ranking

H1: The series are I (0). They are not stationary

- Hypotheses of KPSS test:

H0: The series are I (1). The series are stationary

H1: The series are I (0). the series are not stationary

The tables (6,7) below summarize the results obtained by applying the ADF and pp unit root tests in level and 1st difference to the different variables:

Table 6: Results of ADF tests

Variables	T-statistics	Results	Stationarity	Integration order
LRER	-4.151994	0.0118	Non-Stationary	I (1)
Δ LRER	-4.914268	0.0017	Stationary	
LTE	-2.006407	0.5792	Non-Stationary	I (1)
Δ LTE	-6.338075	0.0000	Stationary	
LDI	-2.078008	0.5410	Non-Stationary	I (1)
Δ LDI	-4.247620	0.0095	Stationary	
LPE	-1.595149	0.7762	Non-Stationary	I (1)
Δ LPE	-6.169455	0.0001	Stationary	
LTP	-2.837299	0.1936	Non-Stationary	I (1)
Δ LTP	-5.361817	0.0005	Stationary	
LFDI	-3.477313	0.0564	Non-Stationary	I (1)
Δ LFDI	-8.454334	0.0000	Stationary	
LGDPC	-1.117129	0.9127	Non-Stationary	I (1)
Δ LGDPC	-4.736903	0.0027	Stationary	
The critical values from Mackinnon (1996) with the inclusion of the constant for the 1%, 5% and 10% limtss are respectively -4.219126, -3.533083, -3.198312.				

Table 7: Results of Phillips and Perron tests

Variables	T-statistics	Results	Stationarity	Integration order
LRER	-4.108405	0.0132	Non-Stationary	I (1)
Δ LRER	-6.328483	0.0000	Stationary	
LTE	-2.063714	0.5487	Non-Stationary	I (1)
Δ LTE	-6.332546	0.0000	Stationary	
LDI	-2.433853	0.3573	Non-Stationary	I (1)
Δ LDI	-4.211675	0.0104	Stationary	
LPE	-1.866699	0.6519	Non-Stationary	I (1)
Δ LPE	-6.169727	0.0001	Stationary	
LTP	-2.630529	0.2698	Non-Stationary	I (1)
Δ LTP	-5.346873	0.0005	Stationary	
LFDI	-3.410959	0.0649	Non-Stationary	I (1)
Δ LFDI	-9.646624	0.0000	Stationary	
LGDPC	-1.709102	0.7276	Non-Stationary	I (1)
Δ LGDPC	-4.697928	0.0030	Stationary	
The critical values from Mackinnon (1996) with the inclusion of the constant for the 1%, 5% and 10% limits are respectively -4.226815, -3.536601, -3.200320.				

- **Interpretation of results**

In order to interpret the springs of these two tables, there are two conditions to be checked, namely:

- If the absolute value of the T statistic of the ADF or PP is higher than the absolute values of its critical values in the three degrees 1%, 5% and 10%, we reject H0 and accept H1. On the other hand, if the absolute value of the T statistic of the ADF or PP is lower than the absolute values of its critical values in the three degrees 1%, 5% and 10%, we reject H1 and accept H0.
- If the value of the critical probability is less than 0.05, we accept H1 and reject H0. On the other hand, if the value of the critical probability is greater than 0.05, we accept H0 and reject H1.

Applying these conditions, on the results obtained we distinguish that, the augmented Dickey-Fuller test (ADF) and the Phillips and Perron test (PP) indicate that the e series are integrated of order I (1), since we cannot reject the null hypothesis (with a confidence level of at least 95%) and that these variables contain a unit root. Moreover, after expressing these series

as first difference, these two tests indicate (with a confidence level of 95%) that all the variables are stationary (I (0)), as first difference.

Table 8: Results of KPSS tests

Variables	LM-Statistics	Stationarity	Integration order
LRER	0.069484	Stationary	I (0)
∆ LRER	0.141759	Non-stationary	
LTE	0.159493	Non-stationary	I (1)
Δ LTE	0.071628	Stationary	
LDI	0.066488	Stationary	I (0)
Δ LDI	0.062580	Stationary	
LPE	0.148390	Non-Stationary	I (1)
Δ LPE	0.140802	Stationary	
LTP	0.068971	Stationary	I (0)
Δ LTP	0.081980	Stationary	
LFDI	0.086905	Stationary	I (0)
Δ LFDI	0.500000	Non-Stationary	
LGDPC	0.106171	Non-stationary	I (0)
Δ LGDPC	0.179506	Stationary	
The critical values for the Kwiatkowski-Phillips-Schmidt-Shin (1992) with the inclusion of the constant for the 1%, 5% and 10% thresholds are respectively 0.216000, 0.146000, 0.119000.			

- **Interpretation of results**

The authors of the KPSS test extracted one-tailed LM statistics for the test. If the LM statistic is above the critical value (shown in the table below for the alpha levels of 10%, 5% and 1%), then the null hypothesis is rejected; the series is non-stationary. After applying this condition, we found that five variables, which are the exchange rate, domestic investment, exchange rate policy or openness and public expenditure (LRER, LDI, LTP, LFDI and LGDPC) are of order (0), while the other three variables LTE, LPE, are of order (1).

2.2-Break point unit root test

Table 9: Results of Break point tests

Variables	Break Date	T-statistic	Results	stationarity	Integration order
LRER	1989	-3.776631	0.5150	Non-stationary	I (1)
Δ LRER	2015	-6.834001	< 0.01	Stationary	
LTE	1989	-3.776631	0.5150	Non-stationary	I (1)
Δ LTE	2015	-6.834001	< 0.01	Stationary	
LDI	2015	-4.213399	< 0.01	Non-stationary	I (1)
Δ LDI	1997	-5.937175	0.0170	Stationary	
LPE	2010	-4.447625	0.1039	Non-stationary (10%)	I (1)
Δ LPE	1984	-8.364092	< 0.01	Stationary	
LTP	2007	-4.568886	0.1131	Non-stationary (10%)	I (1)
Δ LTP	1988	-5.965475	< 0.01	Stationary	
LFDI	2014	-4.353626	0.1864	Non-stationary	I (1)
Δ LFDI	2006	-9.515074	< 0.01	Stationary	
LGDPC	2014	-2.993661	0.9133	Non-stationary	I (1)
Δ LGDPC	2008	-6.772440	< 0.01	Stationary	
The critical values from Mackinnon (1996) with the inclusion of the constant for the 1%, 5% and 10% thresholds are respectively -5.347598, -4.859812, -4.607324					

From the table (9), we see that this test confirms the results of the ADF and the Phillips and Perron test, which imply that the variables tested are integrated of order one.

B-Cointegration and Johansen Tests

At this level, we can confirm the existence of a long-term stationary relationship between the real exchange rate (RER) and its fundamental determinants. Moreover, the results of the stationarity tests carried out have shown that all the variables under consideration are integrated of order one, which allows us to look for possible cointegration relations, known as long-term relations between the variables.

1-Lag Order Selection Criteria

To determine the number of lags, it is usual to refer to the information criteria of Schwarz (SC), Hannan-Quinn (HQ), Akaike (AIC) or the final prediction error (FPE) and the sequential modified LR test statistic.

Table 10: Lag Order Selection

Lag	Log L	LR	FPE	AIC	SC	HQ
0	170.4101	NA	2.69e-13	-9.078338	-8.770431	-8.970870
1	386.2623	335.7701*	2.67e-17*	-18.34790	-15.88465*	-17.48816*
2	432.0626	53.43374	4.42e-17	-18.17014	-13.55155	-16.55813
3	505.9468	57.46550	3.07e-17	-19.55260*	-12.77866	-17.18831
* indicates lag order selected by the criterion						

According to the table (10), all the most part of selection criteria indicated that the number of delays is equal to 1, so it seems to us that this number is the most adequate with the adjustment delays.

2- The number of cointegrating relationships

The table (11) summarizes the results of the Trace and maximum likelihood tests performed in the five specifications of the Johansen test, the existence of at least one cointegrating relationship between the variables in the model.

Table 11: Results of Trace and Maximum Eigenvalue tests

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	3	1	1	1
Max-Eig	0	1	1	1	1
*Critical values based on MacKinnon-Haug-Michelis (1999)					

Indeed, these tests reveal the following relationships in each specification:

1) In the absence of a linear trend in the series and of a constant in the cointegrating relationships, we obtain in the trace test 2 cointegrating vectors at 5% without vector in the maximum likelihood test.

2) In the absence of a linear trend in the series but presence of a constant in the cointegrating relations, we record the best results with 3 cointegrating vectors at 5% in the trace test and 1 cointegrating vectors for the maximum likelihood test.

3) In the presence of a linear trend in the series and a constant in the cointegrating relations, the trace test did not give only 1 cointegrating vectors at 5% and the maximum likelihood test only 1 cointegrating vector.

4) In the presence of a linear trend in the series and in the cointegrating relations, the trace test did not give only 1 cointegrating vectors at 5% and the maximum likelihood test only 1 cointegrating vector.

5) In the presence of a quadratic trend in the series and a linear trend in the cointegrating relations, the trace test did not give only 1 cointegrating vectors at 5% and the maximum likelihood test only 1 cointegrating vector.

This test gives us the best result at the level of the second Johansen specification in the absence of a linear trend in the series but presence of a constant in the cointegrating relations.

3- Estimation and interpretation of the long-term relation between the RER and fundamental variables

3-1. The Results of long-term Estimation

The study of long-term relationships using cointegration techniques has, since the end of the 1980s, taken on a special place in econometrics. We distinguish essentially two main approaches. The first approach is that of Engel and Granger (1987) and Phillips and Ouliaris (1990), based on two-stage residuals to test the null hypothesis of non-cointegration. The second approach is that of Johansen (1991, 1995) who describes a system regression based on a reduced rank. However, Johansen's (1988) and Johansen and Juselius (1990) test proves to be the most efficient because it has the advantage of identifying the number of cointegrated vectors between non-stationary level variables in a VECM. In our case we will perform Johansen's test applicable to the multivariate case.

Thus, after obeying the condition of integration of the first order variables and determining the number of lags, we performed preliminary tests to detect a cointegrating relationship.

These tests indicated the existence of a cointegrating relationship in the model studied. The trace test indicated the existence of three cointegrating relationships. The maximum eigenvalue (LR Ratio) test indicates a single cointegrating relationship. This allows the existence of at least one cointegrating relationship in the model. At this stage, we are interested in interpreting the meaning of the coefficients of the long-term relationship after the adjustment coefficient.

We now examine the significance and coefficients of the long-term relationship after the adjustment coefficient. Thus, the model to be estimated for the long term is as follows:

$$\text{Log}\, RER_t = \beta_0 + \beta_1 * \text{Log}\, TE_t + \beta_2 * \text{Log}\, DI_t + \beta_3 * \text{Log}\, PE_t + \beta_4 * \text{Log}\, TP_t + \beta_5 * \text{Log}\, FDI_t + \beta_6 * \text{Log}\, GDPC_t + \varepsilon_t$$

The cointegration test provides the table (12) below:

Table 12: Estimation of the long-term relation

Variables	LTE	LDI	LPE	LTP	LFDI	LGDPC	C
Coefficient	0,450482	-0,819528	-3,838899	1,872331	-0,063915	-0,547162	17,70407
T-statistics	**2,32791**	**-3,07704**	**-10,1323**	**7,89275**	-1,236	**-5,89267**	

This table (12) (Appendix 2) discusses the results of estimating the long-term relationship between the real exchange rate and its fundamental determinants. It shows the coefficients for each variable and provides the following equation:

$$\text{Log}\, RER_t = 17{,}70407 + 0{,}450482 * \text{Log}\, TE_t - 0{,}819528 * \text{Log}\, DI_t - 3{,}838899 * \text{Log}\, PE_t + 1{,}872331 * \text{Log}\, TP_t - 0{,}063915 * \text{Log}\, FDI_t - 0{,}547162 * \text{Log}\, GDPC_t + \varepsilon_t$$

Similarly, this table reveals that the significance of the model seems to be satisfactory overall with respect to student t. Therefore, these variables have an impact on the real exchange rate. Except the direct and foreign investment (FDI), we record a non-significant statistical t value. In what follows, we will analyze the alignment of the results obtained with the theoretical predictions. We have to remind that the RER is an uncertain quotation, and an increase implies a depreciation and a decrease implies an appreciation.

3.2- Interpretation of the long-term relation between the RER and fundamental variables

- **The relation between RER and TE**

The coefficient of the LTE variable representing the terms of trade is positive and significative. So, the results confirm that an improvement in the terms of trade leads to a depreciation of the exchange rate in the long run. Specifically, the results provided in the table above indicate that a 1% increase in the terms of trade leads to almost 0,45% depreciation in the real value of the Tunisian dinar. This is explained by the improvement in the price of exports, which can generate an increase in the general price level, so that the previous income

effect is replaced by a substitution effect in favor of imported goods (which become cheaper), leading to a real depreciation. However, empirical work such as Dufrénot and Yehoue (2005) generally underlines the superiority of the income effect. On the other hand, several authors argue that an increase in the terms of trade can lead to an increase in the volume of exports, an improvement in the trade balance, and finally a real appreciation of the national currency.

- **The relation between RER and DI**

Conversely, the coefficient of the LDI variable representing domestic investment is negative, confirming that the 1% increase in domestic investment leads to an appreciation of close to 0,819% in the real value of the Tunisian dinar. This contradicts the work of Edwards (1989) and Baffes and al (1999) on the case of developing countries, who found that an increase in the investment rate is accompanied by depreciation.

- **The relation between RER and PE**

Regarding public expenditure, the results confirm what the theoretical analyses predict. We found that an increase in public demand leads to an appreciation of the real exchange rate. According to Froot and Rogoff (1995), this expenditure can be mainly devoted to the acquisition of non-tradable goods. Under these conditions, the increase in spending leads to an increase in the demand for these goods, which in turn leads to an increase in their relative price and the real appreciation of the currency. It is also noted that the impact of public consumption, relative to the other determinants of the equilibrium real exchange rate, is the most important, since its 1% increase leads to a 3,8% appreciation in the value of the Tunisian dinar.

- **The relation between RER and TP**

The coefficient of the variable representing trade policy confirms that Tunisia's trade openness is positive and accompanied by a depreciation of the real exchange rate. This depreciation can reach more than 1,87% for a degree of openness of 1 %. This confirms the work of other authors who admit that greater trade openness promotes the moderation of domestic price increases, which in turn leads to the real depreciation of the currency. (Goldfajn and Valdes, 1999). Similarly, Elbadawi (1994) finds that trade liberalization leads to depreciation for both the Ivory Coast and the Chile. This result is confirmed by the study of Baffes and al (1999) for the Ivory Coast and Burkina Faso and that of Michaël Goujon for the case of Madagascar between 1972 and 2003.

- **The relation between RER and GDPC**

The relative productivity as expressed by GDP per capita income has a remarkable effect on the real exchange rate, contributing to long-term changes in the real exchange rate. Its negative coefficient, implies that the more productivity increases in Tunisia, the more the real exchange rate appreciates. As indicated by the estimates provided in the table above, a 1% increase in productivity generates almost a 0,547 % appreciation in the real value of the Tunisian dinar. This result is consistent with the effect of the Balassa-Samuelson phenomenon, which predicts that countries with relatively lower productivity in tradable goods than in non-tradable goods and subsequently have lower price levels than abroad (as is the case in developing countries), which causes an appreciation in the RER due to an increase in the NER and subsequently "price competitiveness" deteriorates. Thus, the "Balassa Samuelson" effect predicts a trend appreciation of the RER that occurs during development due to faster relative productivity gains in the tradable goods sector than in the non-tradable goods sector.

4- Estimation and Interpretation of the short-term relation between the RER and fundamental variables

4-1. The Results of short-term Estimation

The result of the estimation of cointegrating relationship thus confirms the existence of a long-term relationship between the exchange rate and its fundamentals. However, to complete the analysis, it is necessary to ensure that this relationship is dynamically stable. The shocks that cause the exchange rate to deviate from its equilibrium level in the short term must produce a possible convergence to the long-term relationship in the absence of new shocks. This phenomenon can be represented by the error-correction model. To estimate the state of dynamic stationarity we adopt the following correction model:

$$D(lRER)_t = \mathrm{C}_0 + \alpha\,[Coint\ equ1] + \mathrm{C}_1 D(LRER)_{t-1} + \mathrm{C}_2(\,DLTE)_{t-1} + \mathrm{C}_3 D(LDI)_{t-1} + \mathrm{C}_4 D(LPE)_{t-1} + \mathrm{C}_5 D(LTP)_{t-1} + \mathrm{C}_6 D(LFDI)_{t-1} + \mathrm{C}_7 D(LGDPC)_{t-1} + \mu_{t-1}$$

The analysis of short-term dynamics not only ensures the stability of the long-term model presented, but also allows us to see the influence of variables other than long-term fundamentals on the exchange rate. In this sense, the table (13) (Appendix 3) below clarifies the characteristics and significance of the VECM estimate obtained.

Table 13: Estimation of the short-Term relation

	Coefficient	T-Statistic
CointEq1	**-0.164953**	**[-2.09291]**
D (LRER (-1))	0.635922	[2.31426]
D (LTE (-1))	0.043043	[0.16092]
D (LDI (-1))	0.296987	[1.28525]
D (LPE (-1))	-0.535928	[-1.18830]
D (LTP (-1))	0.094089	[0.47454]
D (LFDI (-1))	**-0.039996**	**[-1.78792]**
D (LGDPC (-1))	0.415323	[1.28012]
C	0.003056	[0.14093]

The VECM test provides the following relation:

$$D(lRER)_t = -0.164953[Co\ int\ équ1] + 0.635922D(LRER)_{t-1} + 0.043043(DLTE)_{t-1} + 0.296987D(LDI)_{t-1} - 0.535928D(LPE)_{t-1} + 0.094089D(LTP)_{t-1} - 0.039996D(LFDI)_{t-1} + 0.415323D(LGDPC)_{t-1} + 0.003056$$

4.2-Interpretation of the short-term relation between the RER and fundamental variables

The CointEq1 is the vector associated with the cointegrating relationship containing coefficients of the error-corrected terms. We observe that this coefficient, which is associated with recall strength, is negative (-0.164953) and significantly different from zero (between [-1;0]) at the statistical limit of 5% (his student t is higher than the tabulated value).

There is therefore an error correction mechanism, which indicates the convergence of the trajectories of the real exchange rate series towards the long-term objective. Thus, the shock to the exchange rate in Tunisia is corrected to 16.4953% by a feedback effect.

In our case, we can deduce that the speed of the return to equilibrium is fast and that the correction of the exchange shock by feedback effect is high.

In terms of the coefficients obtained in comparison with the permanent behavior of the equilibrium real exchange rate, the short-term dynamics of this variable differ. Indeed, although four independent variables (the terms of trade, government consumption, trade policy where the degree of openness and GDP per capita) retain the same signs of coefficients already observed in the long-run relationship, but they are not statistically significant in terms of t-statistics. On the other hand, we find that FDI keeps the same negative effect on the RER with a significance of 5% threshold and an acceptable statistical t-value.

Section 3: The movements in the real long-term equilibrium exchange rate and misalignment

At this stage, we focus on the movement of the real exchange rate observed in relation to the equilibrium exchange rate (A). This allows us to determine the misalignment of the real exchange rate observed in relation to the equilibrium exchange rate (B). Next, we highlight the periods of over-evaluation and under-evaluation of the rate and seek the major factors relating to these deviations throughout the study period (1980-2018) in Tunisia.

A-Evolution of the real exchange rate observed in relation to its equilibrium value

According to what has already been mentioned, the behavioral approach to the real equilibrium exchange rate consists in describing the evolution of the real exchange rate by means of a reduced equation, using the long-term relationship existing between the real exchange rate and various macroeconomic variables influencing internal and external equilibria. These variables are the fundamental determinants that we have represented in the following equation:

$$\text{Log}\, RER_t = 17{,}70407 + 0{,}450482 * \text{Log}\, TE_t - 0{,}819528 * \text{Log}\, DI_t - 3{,}838899 * \text{Log}\, PE_t + 1{,}872331 * \text{Log}\, TP_t - 0{,}063915 * \text{Log}\, FDI_t - 0{,}547162 * \text{Log}\, GDPC_t + \varepsilon_t$$

So, to determine the misalignment, we must first obtain the equilibrium real exchange rate from the long-run equation by replacing the fundamentals of the estimated relationship with their long-run equilibrium values.

After applying this method, we can establish the evolution of the observed real exchange rate and the equilibrium real exchange rate to highlight periods of under-evaluation and over-evaluation between 1980 and 2018.

- **The RER and EQRER**

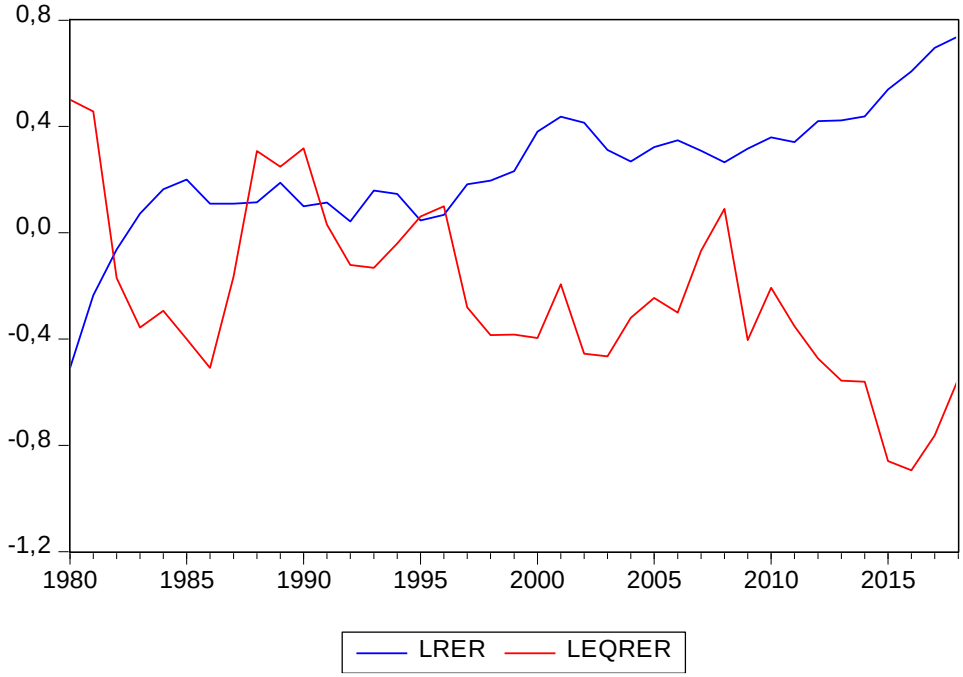

Figure 7: Evolution between the observed LRER and the LEQRER

This (Figure (7)) shows that the dominance was for periods of over-evaluation of the Tunisian dinar, which was interspersed by short periods of under-evaluation, in other words, periods when the real exchange rate observed was lower than the equilibrium real exchange rate.

Specifically, the periods of under-evaluation where the observed real exchange rate was below the equilibrium real exchange rate are: 1980-81, 1988-90, 1995-96. And the periods of over-evaluation where the observed real exchange rate was higher than the equilibrium real exchange rate are: 1982-87,1991-1994,1997-2018.

Table 14: Evolution between the ORER and EQRER

Periods	Number of years	Evaluation	Evolution
1980-1981	2 years	Under Evaluation	ORER <EQRER
1982-1987	6 years	Over evaluation	ORER <EQRER
1988-1990	3 years	Under Evaluation	ORER <EQRER
1991-1994	4 years	Over evaluation	ORER <EQRER
1995-1996	2 years	Under Evaluation	ORER <EQRER
1997-2018	22 years	Over evaluation	ORER <EQRER

B-The misalignment of the observed real exchange rate to its equilibrium value

The Misalignment refers to "sustained deviations of the observed real exchange rate from its long-run equilibrium level" (Edwards 1989, pp. 8). Thus, and from the estimated long-term relationship, it is possible to calculate this existing relative deviation, using the following misalignment indicator:

MIS= (ORER-EQRER) /EQRER

For this purpose, the current degree of real misalignment represents the percentage deviations of the observed real exchange rate (ORER) from the equilibrium real exchange rate (EQRER). A positive deviation implies a depreciation of the RER relative to the EQRER, while a negative deviation implies an appreciation of the RER relative to the EQRER. When the difference between these two variables is zero, the real exchange rate is said to be aligned. The situations of over-evaluation and under-evaluation are due to economic causes that differ according to the period. Whether positive or negative, misalignment reflects a bad exchange rate policy, which is costly in terms of external balance, allocation of productive resources and welfare and can lead to crisis (Asian crisis of the 1990s). This misalignment encompasses all the factors that can influence the observed real exchange rate without influencing the RER. Misalignment can, therefore, be attributed to structural changes in the country and to the choice of economic policy (Cottani and al., 1990).

- **Effect of over-evaluation**

The over-evaluation or depreciation of a country's equilibrium exchange rate is related to:

- The decline in its relative productivity,

- or a deterioration in its net international investment position generally resulting from the accumulation of external deficits. Precisely, the starting point of the argumentation is the definition of the RER. If we consider the relative price of tradable goods compared to non-tradable goods, then the increase in the price of the latter leads to an increase in wages in all sectors and the over-evaluation of the currency, at a given level of productivity. The result is a fall in the margins of firms, as well as in the investment rate, which in turn causes the displacement of savings and indebtedness to finance consumption, thus posing the threat of a balance of payments crisis, all the more so as the debt dynamic becomes unsustainable. Moreover, by eroding the profitability of investments by firms in the open sector in which

technology returns are increasing, over-evaluation leads to a sub-optimal reallocation of resources in favor of the sheltered sector in which labor returns are decreasing, thus affecting productivity dynamics in all sectors (Gala,2008). Thus, an overvalued exchange rate can widen the current account deficit and drain foreign exchange reserves abroad (e.g. Mexico in 1994, Asian countries: South Korea, Malaysia, the Philippines and Indonesia in 1997, Brazil in 1999).

- **Effect of under-evaluation**

Conversely, under-evaluation favors employment and investment through the increase in the productive capacity utilization rate induced by exports. It also contributes to a better allocation of the labor force between sectors, which protects the economy. Indeed, the competitiveness induced by under-evaluation acts as a stimulus for the development of an open sector independent of natural resources. In other words, real under-evaluation increases national output and employment in all sectors of the economy, promoting the competitiveness of manufactured goods on world markets. Similarly, an undervalued exchange rate can generate a current account surplus by making exports more profitable and imports more expensive, which would generate inflationary pressures (the case of Yugoslavia and Brazil during the 1980). The misalignment indicator provides us the following figure, which highlights the periods of peaks of under- and over-evaluation.

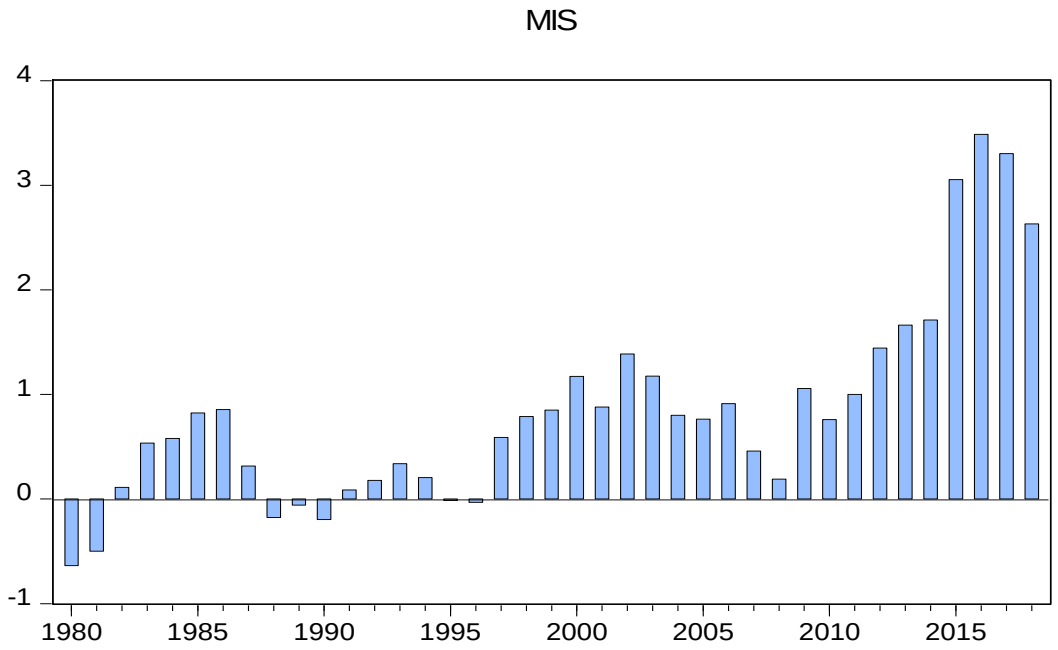

Figure 8: The misalignment of the observed real exchange rate to its equilibrium value

The graph (8) clarifies the variations in the three periods of under-evaluation and three periods of over-evaluation. In order to better analyze this graph, we have disaggregated these periods in terms of variation and relative peak for each period in table (15) below.

Table 15: The misalignment of the observed real exchange rate to its equilibrium value

Periods	Number of years	Evaluation	Variation	Peak
1980-1981	2 years	Under evaluation	[-0,6359; -0,4994]	-0,6359 (1980)
1982-1987	6 years	Over evaluation	[0,1126; 0,8545]	0,8545 (1986)
1988-1990	3 years	Under evaluation	[-0,1956; -0,05895]	-0,1956(1990)
1991-1994	4 years	Over evaluation	[0,0860; 0,3375]	0,3375(1993)
1995-1996	2 years	Under evaluation	[-0,0314; -0,0148]	-0,0314 (1996)
1997-2010	14 years	Over evaluation	[0,1910 ;1,3866]	1,3866 (2002)
2011-2018	8 years	Over evaluation	[1,0004 - 3,4863]	3,4863 (2016)

The period from 1978 to 1980 was characterized by the adoption of the basket system by the Tunisian authorities. The basket is supposed to consist mainly of dollars, French francs, German marks, Italian lira, and pounds sterling, which are the main settlement currencies for external transactions. The principle of pegging to a basket of currencies is to keep the value of the currency in question fixed (Charfi Marrakchi F, 2009). In this case, the aim is to fix the value of the Tunisian dinar in relation to the basket of currencies when the value of the latter changes. The value of the dinar is represented by the index of the nominal effective exchange rate weighted by their weights in the dinar anchor basket. The adoption of a basket as an anchor and not a single currency mainly avoids floating.

At that time, the monetary authorities, by moving increasingly towards an export promotion policy aimed at improving the competitiveness of Tunisian products, were led to let the dinar depreciate and to reduce the share of the dollar in the basket of anchorage (OCDE ,2018)[23]. This explains **the under-evaluation of the dinar between 1980 and 1981**, which represented the highest peak of under-evaluation in the graph (8) **amounted to -0.6359 in 1980 and -0.4994 in 1981.** Moreover, and given that the dollar's share is very important in the dinar's peg basket, the strong appreciation of the dollar between 1981 and 1985 due to the drop in oil prices would have led to an appreciation of the dinar that would be in contradiction with the

[23] OCDE (2018), OECD Economic Studies: Tunisia 2018, OECD Publishing, Paris.

export promotion policy encouraged by the government (Charfi Marrakchi F, 2009). This appreciation was presented by a period of over evaluation which lasted, according to graph (8), six years between 1982 and 1987. The persistence of the relative price gap between Tunisia and its partners led the BCT to devalue in 1986, in an attempt to restore price competitiveness with regard to partner countries, and then to allow the dinar to slide towards depreciation until 1988. **In 1988**, Tunisia then adopted a **structural adjustment plan**, conducted under the impetus of the IMF[24], to improve the macroeconomic situation and rebuild foreign exchange reserves at least in the short term. This plan was accompanied by a nominal devaluation of the dinar by about 7% against foreign currencies, which allowed the balance of goods and services to be in surplus for the first time in 1988. This represents **the second peak of under-evaluation, which reached -0,1956 in 1990**. Consequently, the CBT declares that it targets a rule of real exchange rate constancy, which consists in allowing the value of the dinar to depreciate whenever the inflation rate in Tunisia exceeds the inflation rate abroad: this is **the sliding parity** (Charfi Marrakchi F, 2008). The depreciation of the dinar in accordance with the economic reform program has enabled it to stabilize around its equilibrium value. In fact, it should be recalled that a **rise in inflation** translates into an increase in export prices and could harm the competitive position of the national product. Thus, and to contain this inflationary pressure, the authorities could act, among other things, on exchange rate policy by depreciating the currency in the absence of an improvement in productivity.

This justifies **the over-evaluation recorded in 1992**, which is intended to alleviate the inflationary pressures caused by the under-evaluation between (1998-1991) which amounted to 0,0860 **in 1991**, and to allow the value of the dinar to depreciate in such a way that the depreciation compensates for the difference between the domestic inflation rate and the inflation rate abroad. This interrupted the continuous devaluation by a slight degree **of over-evaluation in 1992 of 0.177which continued to peak in 1993 at 0.337.** This brought inflation down to 4.6% in 1994. This period was characterized by the declaration of the current convertibility of the dinar in 1992. This decision was accompanied by **the creation of the interbank foreign exchange market in March 1994**, with the aim of conferring greater flexibility on the determination of the exchange rate (Domac and Shabsigh, 1999). In order to avoid the risk of overvaluation once the foreign exchange market is free, the authorities started

[24] IMF (2007), National Economies, Report, N°. 07/302. "IMF exchange rate arrangements and exchange restrictions"

from an undervalued rate (Corden, 1993), in the following phase, which lasted for two years between 1995 and 1996. This also explains the rebound in inflation to 6.3% in 1995. The last phase was characterized by an over-evaluation that lasted from 1997 to 2018. However, we prefer to divide this period into two sub-periods because of the difference in the magnitude of the fluctuations. The first period was between 1997 and 2010 when Tunisia sharply reduced fluctuations in the value of its dinar (a misalignment ranging between 0.19 and 1.4). And the second period between 2011 and 2018 which is characterized by fluctuations with more intense magnitude or the misalignment always exceeds unity (a misalignment ranging between 1.4 and 3.48). The start of the first sub-period (1997-2010) corresponds to the date from which Tunisia effectively began to open its foreign exchange market by completing the first phase of liberalization of its financial market.

Despite decisions that allowed for greater flexibility in the real exchange rate in the early 2000s, **the pursuit of a real exchange rate targeting rule has been successful in Tunisia, given the absence of significant shocks in the period following devaluation (1997-2010)**, the adoption of a rigid price and wage policy and a prudent macroeconomic policy. However, the limits of this rule are beginning to emerge in the context of an economy that is opening up more and more whether through its trade (free trade agreements with the Maghreb countries or with Europe) or its capital. The need to relax capital controls to diversify external sources of financing within the framework of full convertibility of the dinar and to opt for a clear monetary policy targeting price stability as its main objective, requires the Central Bank to reduce its interventions on the foreign exchange market with the possible objective of letting the dinar float. Indeed, the new environment would not only have a significant impact on the real equilibrium exchange rate but would also make it more complicated to evaluate. It is for these reasons that monetary authorities would find it increasingly difficult to defend a real exchange rate anchorage, which leads them to consider the adoption of alternative exchange rate regimes, moving increasingly toward a more flexible rate that they consider more appropriate.

Thus, the relaxation of the objective of real stability, combined with the appreciation of the euro, led to a real depreciation of the exchange rate of the dinar.

In addition, **the date of the 2002 peak (1.386)** is indicative of a major event that adds to these reasons: the terrorist attack in Djerba in April 2002 caused a dramatic drop in tourism receipts (a fall of 13.7%) leading to a continuous depreciation of the dinar in both nominal

(especially against the euro) and real terms (IMF,2015)[25]. This resulted in an initial phase of over-evaluation with **a misalignment variation between 0.1910 and 1.386** which represents the post-revolutionary phase which is less intense than the following phase. What also marks this phase is the important turning point in 2005 for the exchange rate regime in Tunisia.

The gradual transition to managed floating is taking place. Thus, the IMF's classifications of de facto exchange rate regimes on December 31, 2005 and April 30, 2007 show the transition of Tunisia's exchange rate regime from the category "managed floating exchange rate regime with sliding exchange rate parity" to the category "managed floating regime without a predetermined exchange rate path». The regime adopted between 2000-2010, has relatively allowed controlling the evolution of inflation reveals, not exceeding the bar of 3.3% on average per year.

Until the period of revolution, that was marked by the rise in the inflation rate continued in 2012 and 2013 reaching record levels not seen since 1995 (6.2%). This high inflation reflects a significant increase in food prices, following the insufficient supply of fresh products on the markets and some disruptions in supply and distribution channels. It should also be noted that the Libyan crisis has had a considerable impact on inflation. On the one hand, illegal exports to the country have led to a shortage of several basic food products. On the other hand, the access of thousands of refugees to the national territory has only increased demand. In addition, other factors related to the Tunisian revolution could explain this inflationary pressure. In fact, the events that accompanied the revolution in 2011 resulted in a worsening of the security situation, a proliferation of the informal sector, and the establishment of a new social balance of power, leading to disproportionate wage revisions.

In 2012, the authorities loosened fiscal policy to address the immediate impact of the 2011 revolution before embarking on medium-term consolidation. As a result, the authorities implemented an expansionary fiscal and monetary policy mix that included increasing wages and subsidies, reducing policy rates and reserve requirements, and easing regulatory constraints to mitigate the effects of the recession on households and meet social demands. A widening current account deficit, coupled with exchange rate defense, has led to a 20 % loss of reserves in 2011, despite substantial bilateral and multilateral budget support.

[25] IMF (2015), Report N°. 15/285, *Sixth Review Of The Confirmation Agreement And Request For Rearrangement*. Washington, D.C.

Faced with these repercussions, the dinar has entered a depreciation phase that has been corroborated by **the deterioration of the economy's fundamentals and that begins with small fluctuations between 2011 and 2014 (1.000455; 1.712688).** This period was marked by **the stand-by arrangement with the IMF** covering 24 months from June 2013 to June 2015, and IMF resources amounted to SDR[26] 1.15 billion (400 % of quota, equivalent to about $1.75 billion) IMF (2013). The quantitative performance criteria will cover fiscal, monetary, and external objectives. They are complemented by indicative targets to monitor domestic arrears and preserve social expenditures. The structural reference will focus on maintaining macroeconomic stability, strengthening the monetary policy framework, reducing the fragilities of the banking system, and strengthening social safety nets. To this regard, Tunisia has favored, within the framework of stand-by credit, the accumulation of foreign exchange reserves to the detriment of exchange rate fixity IMF (2013). **Between 2011 and 2014, the dinar has lost 29% of its value against the US dollar and 18% of its value against the euro**. This depreciation has had the effect of fueling inflation via the transmission of exchange rate variations to domestic prices: this is the "pass-through" from exchange rate to price. Admittedly, it appears that the pass-through from the exchange rate to the consumer price index is low, that it is moderate on the producer price index, and that it is highest on the import price index (Charfi and Kadria, 2016). **The deterioration in the fundamentals of the economy worsened in 2015 with two terrorist attacks**. The first was in March 2015 at the Bardo Museum: 21 foreign tourists and a Tunisian policeman were killed and 52 injured. And the second was in June 2015: (Terrorist attack in a hotel in Sousse: 38 European tourists killed and 39 wounded); this is the deadliest attack in modern Tunisian history and the most serious for the tourism sector since 2002. As a result, a state of emergency was declared and several countries recommended to their nationals not to travel to Tunisia in July 2015. **This translates into a drop in tourism revenues of 33% between 2014 and 2015 and another 4% in 2016**, which means that the deterioration of tourism activity may also be the cause of modest growth in 2016 (IMF ,2016)[27].

As far as inflation is concerned, the upward trend, which has been noted since the revolution, has begun to gradually decline since 2014. However, the level of inflation rebounds at the end of 2016. The rise in consumer prices is a brake on household consumption, which negatively affects growth. Thus, the trade deficit increased from 12.6 billion dinars in 2016 to

[26] Special drawing rights (SDRs) are supplementary foreign exchange reserve assets defined and maintained by the International Monetary Fund (IMF)

[27] IMF (2016), Report N°. 16/138 , *Tunisia Request For An Expanded Agreement Under The Extended Credit Facility*

15.3 billion dinars. Despite the significant reduction in the energy bill due to the drop in oil prices, the food deficit, in particular, widened to nearly 1 496 MTD in 5 months.

Then, after the terrorist attacks of 2015, the tourism recovery was cut in its momentum and the year 2016 was characterized by a policy mix strongly calling for a decline in the dinar (real effective term of 14% in 2016 and 13% in 2017). The accumulation of these factors marked **the over-evaluation by the largest peak of misalignment of 3.053 in 2015 and 3.48 in 2016.** The BCT's economic note on the results of foreign trade for fiscal year 2017 emphasizes that the widening of the deficit in the balance of trade in goods and services was also dependent on the depreciation of the TND, which contributed negatively to the widening of the deficit by 2.7 billion dinars between 2016 and 2017. In addition, the decline in exports of goods (phosphates and derivatives, textiles, mechanical and electrical tools) and services (tourism) has aggravated the trade (more than 15 billion dinars over 2017) and current account deficits, and has also been accompanied by a decline in domestic and foreign investment and recourse to external debt. According to the Tunisian observatory of the economy, Tunisia has entered a vicious circle where each devaluation of the dinar ordered by the IMF leads to an increase in the trade deficit, which in turn leads to a larger devaluation of the dinar. The IMF is putting pressure on the BCT to lower the value of the dinar, with the aim of improving the competitiveness of exporters, which is able to boost exports and consequently reduce the trade deficit in the medium term. What is actually happening is that the negative effect of the increase in the value of imports due to the decline in the value of the dinar outweighs the positive effect of the increase in the value of exports due to this decline. In other words, instead of reducing the trade deficit as projected by the IMF, the decline in the value of the dinar has, on the contrary, increased this trade deficit. **In 2018, we note that the over-evaluation value decreased by 2.629 compared to 3.3013 in 2017**.In fact, this appreciation is due to the sale of Tunisian assets to foreign investors. Such as the assets of Bank Zitouna and Zitouna Takaful. It is also due to credits that have been contracted, generating foreign exchange inflows. Logically, these foreign currency inflows should have been allocated to foreign exchange reserves to bolster them. And this, given Tunisia's very high level of indebtedness. However, the Tunisian authorities concerned have carried out massive interventions on the foreign exchange market. This was done by intervening with banks to offer them foreign currency at reduced prices[28]. This has helped to gradually recover the dinar. In fact, the foreign exchange from debts or asset disposals have been used to artificially reverse the dinar curve.

[28]Béchir Trabelsi le DG des finances extérieures à la BCT pour African manager

Finally, we summarize the major factors at each of the relative deviations by period in the table (14) below.

Table 16: Synthesis of misalignment factors

Periods	Evaluation	Major factors
1980-1981	Under evaluation	Export promotion, aimed at improving competitiveness
1982-1987	Over evaluation	The strong appreciation of the dollar by the fall in oil prices
1987-1991	Under evaluation	The structural adjustment plan
1992-1994	Over evaluation	The of rising inflation in 1992
1995-1996	Under evaluation	Avoiding the risk of over-evaluation once the foreign exchange market is free
1997-2018	Over evaluation	- The terrorist attack in Djerba in April 2002 - Period of revolution: a deterioration in the security situation, a deceleration of growth, an increase in inflation and unemployment and a concomitant increase in deficits, new social demands, expansionary fiscal and monetary policies - Two terrorist attacks in March and June 2015 - Standby credit and pressures of the IMF arrangement

Conclusion

The objective of this chapter was to determine the equilibrium real exchange rate and the degree of misalignment of the exchange rate observed from the equilibrium rate over the period 1980 to 2018. These objectives were accomplished by estimating the rate based on the BEER method and Johansen's cointegration method. These methods allowed us to calculate the equilibrium real exchange rate via the long-run relationship. The result obtained allows us to observe long periods of over-evaluation which are interspersed by short periods of under-evaluation. Thus, for long-term relationship was found between the exchange rate and its determinants, illustrating that the variables selected (terms of trade, domestic investment, public expenditure, trade policy, and per capita domestic product) have a significant influence in determining exchange rate policy in Tunisia.

Moreover, the obtained results show that an improvement in domestic investment, an increase in the degree of openness, an increase in public expenditure and a rise in GDP per capita income led to a long-term appreciation of the real exchange rate. On the other hand, a rise in the terms of trade, an increase in the degree of openness in the long term leads to a depreciation of the real exchange rate. For the short-term we find that the FDI has an effect on

the RER in such a way that it allows the real exchange rate to appreciate. However, the other variables have no effect for the short term.

The deviation of the observed real exchange rate of the dinar from its equilibrium level, obtained by calculating the so-called misalignment indicator, shows three remarkable periods of under-evaluation of 0.635 (1980-1981), 0.1956 (1987-1991), 0.0314 (1995-1996) and three over-evaluations of 0.8545 (1982-1987), 0.3375 (1992-1994) and 3.4863 (1997-2018).

Thus, the second major stage of our process was devoted to the analysis of the relationship between specific misalignment and economic growth, both theoretically and empirically.

PART TWO: EVALUATION OF MISALIGNMENT INFLUENCE ON ECONOMIC GROWTH

The second part entirely dedicated to the actual evaluation of the influence of misalignment on economic growth. This evaluation can be considered on both theoretical and empirical levels, which is why we propose the following two chapters:

Chapter 1 - Theorical approach of economic growth, its relationship with the variability of the exchange rate and its determinants

Chapter 2: Empiric approach of the relation between exchange rate variability and economic growth

Introduction

In the previous section, we determined the misalignment of the exchange rate between 1980 and 2018. Among other things, we highlighted the periods of under- and over-evaluation during the study period. Following on from the previous section, we will study the relationship between the variability of the exchange rate represented by the misalignment determined on economic growth.

Indeed, economic growth is a complex and multidimensional concept where the determinants of growth vary according to the country. The integration of the RER (and of misalignment) in the analysis of growth is a complex exercise, yet it has been neglected, since neoclassical and endogenous growth models traditionally focus on the potential sources of growth: competition, technological diffusion, savings or capital investment in the broad sense. It is only recently that some authors have attempted to give a central role to the RER (Rodrik, 2008; Gala, 2008; Razmi and al., 2012). To explain the economic growth and its relationship with exchange rate variability, we draw inspiration from the model of ((Barro (1991), Loayza and al. (2005) or Dufrenot and al. (2010) Ferdinand Owoundi,) which allows these determinants to be grouped according to their relevance.

To do so, we proceeded with a standard approach which consists in first analyzing the existing theory, secondly the empirical results and finally the final conclusions. Consequently, the first chapter part will be devoted to a review of various theoretical works on economic growth and the relationship of exchange rate variability to this growth. The second chapter will analyze the long-run empirical estimation of the relationship between growth and exchange rate variability represented by the misalignment using the ordinary least squares (OLS) method.

CHAPTER 1 - THEORICAL APPROACH OF ECONOMIC GROWTH, ITS RELATIONSHIP WITH THE VARIABILITY OF THE EXCHANGE RATE AND ITS DETERMINANTS

Introduction

Economic growth is a complex and multidimensional concept: geographically, institutionally, economically etc. Moreover, the sources of productivity and economic growth are complex and varied. They depend on several variables and differ from one country to another. In the same way, the integration of the RER in the analysis of growth is a complex exercise.

Indeed, to conceptualize the relation between the variability of the exchange rate and economic growth, we had to go through a literature review which allows us to distinguish the concept of economic growth in terms of the authors processors and models and the state of economic growth in Tunisia, as well as the theoretical relation between the variability of the exchange rate and economic growth, and the determinants which allow us to explain it.

To this end, this first chapter is composed of two sections:

- Section 1: Theoretical approach of economic growth
- Section 2: Theoretical Basis for the relationship between variability of exchange rate and economic growth

Section 1: Theoretical approach of economic growth

This section is divided into two parts: the first represents the state of economic growth in Tunisia (A) and the second is concerned with a literature review on economic growth (B).

A-State of economic growth in Tunisia

1- Overview of economic policy developments

The general orientation of Tunisia's economic policies has changed several times since the country gained independence in 1956. The first phase, launched in 1961, was characterized by the domination of the economy by the state, which nationalized many industries, imposed wage and price controls, and adopted protectionist trade policies. In 1969, this orientation was replaced by a strategy that was still protectionist towards domestic producers, but promoted export growth through the implementation of technical and budgetary support measures. Heavy industry, transport, and electricity remained under government control, but the government encouraged private investment in other sectors, including textiles and tourism. In 1972, Tunisia

began offering a wide range of measures to encourage private investors to participate in approved industrial projects, particularly in the field of production for export. It is reasonable to believe that these incentives contributed to the rapid growth of Tunisia's GDP and exports, even if the country could not sustain them over time.

The excessively large public deficits led to a rapid increase in the country's external debt, which reached an unsustainable level of 65.9 % of GDP in 1986. It also seems that during this period, public borrowing stifled national investment, which rose from 34 % of GDP in 1982 to 25 % in 1986. It was in that year that Tunisia was no longer able to service its external debt or finance essential imports. The next policy change began with the 1987 structural adjustment program (SAP). Unable to honor its external debt and in the midst of a national political crisis, the country requested assistance from the World Bank and the International Monetary Fund (IMF) in 1986 under the Economic Reform and Structural Adjustment Program (ERSAP). This program included the reduction of tariffs and non-tariff barriers to imports, the implementation of a value added tax (VAT) and compensatory reductions in personal income tax, currency devaluation, and the privatization of some state-owned companies. The period following the implementation of the ERSAP generally coincided with an increase in average productivity. The year 1997 marked the start of another important phase of new policies, with the launch of an ambitious reform program divided into three national development programs focused (in order) on: integrating Tunisia into the world economy; strengthening the private sector; adapting the country to economic openness, mainly by strengthening competitiveness; and developing infrastructure; strengthening social cohesion and reducing regional disparities. The second phase, from 2002, the focus was on growth; employment; export development; and preservation of macroeconomic balance. And finally, from 2007, the third, was on consolidation of macroeconomic stability; continued gradual opening of the economy; increased investment in high value-added sectors; and education reform.

Following the 2011 revolution, Tunisia has experienced the most important period of political and economic instability in its recent history. During the political transition, seven heads of government succeeded one another, without managing to put in place a real economic transition policy.

2- The evolution of economic growth rate in Tunisia between 1980 and 2018

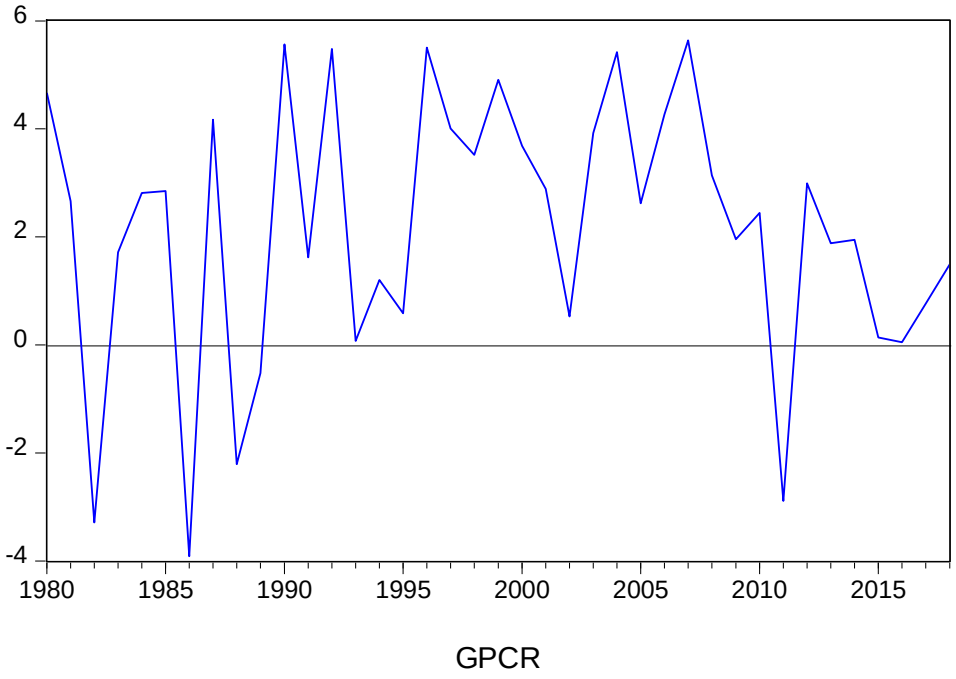

Figure 9: Evolution of GPCR between 1980 and 2018

2.1- Growth evolution between from:1980 to 1995

- The volatility of the Tunisian growth rate has slowly declined, although it remains at a relatively high level. **The lowest growth rate was recorded in 1986, with -3.91%, and the highest in 1992, with -3.28%** (Figure (9)). In the late 1970s and early 1980s, the Tunisian economy was characterized by continued subsidization of the prices of basic necessities. The financial sector is entirely managed by the government and the economy is protected by very high customs duties and import restrictions, despite the declared policies of openness and competition (Ben Romdhane, 2011; Morrisson and Talbi, 1996). Between 1979 and 1981, **the annual growth rate was higher than the average rate, ranging between 2.9% and 4%** (Figure (9)).

  These "positive results" were largely the consequence of **the second oil shock, after the Iranian revolution (1979), which led to an increase in oil and phosphate prices.** The Tunisian economy has also seen an **increase in agricultural production and tourism receipts** (Morrisson and Talbi, 1996). Between 1981 and 1986**, Tunisian state revenues became highly dependent on oil prices.** Customs duties increased for all categories of goods. In 1986, effective protection of the domestic market reached an average of 84% (Ben Romdhane, 2011). Taxes on imports are mainly intended to

compensate for budget deficits and the fall in foreign exchange reserves. In 1982 and 1986, growth rates (Figure (9)) were at their **lowest levels since 1973, reaching -3.91% and -3.28% respectively.** This criticized situation of the Tunisian economy, particularly in 1986, is referred to by Ben Romdhane (2011) as **the "great crisis".**

- At the beginning of 1985, the drop **in oil prices increased the burden of public finances,** which throughout the 1975-1980 period was a source of wealth for the economy through its oil exports. Foreign exchange reserves were depleted, making it impossible to pay the country's debt and the bill for the import of goods and services. Investments of public enterprises are reduced and household consumption is also reduced, with the measures taken to reduce wages. Ben Romdhane (2011) pointed out that public investment recorded a sharp decline in 1985, falling by 17.8% from the 1984 level and by 17.2% in 1986. The agricultural sector, during the year 1985-1986, was marked by a drought affecting the country. In June 1986, Tunisia had no other means than to turn to the International Monetary Fund. This allowed Tunisia to benefit from financial assistance while imposing a structural adjustment plan. This plan consists of an agreement on an 18-month economic recovery program.
- The program aims **to restore the major structural balances such as maintaining the inflation rate at 5% and a significant improvement in economic competitiveness while reducing dependence on oil exports**. Structural adjustment measures reduce the role of the public sector in favor of market mechanisms and the private sector (Brack, 1997). From 1987 onwards, privatization initially took the form of the sale of small and medium-sized enterprises. The sectors concerned are mainly tourism, building materials, textiles, the food processing and fishing industry, mechanics and electrical engineering. From 1990, the Tunisian economy began to emerge from the crisis and reached positive growth rates with a peak amplitude of 5.56% in 1992. But this economic recovery did not last. The gap in growth rates narrowed in 1993, reaching a level of -3.2% (Figure (9)). From 1995 onwards, (Figure (9)) shows **the beginning of a period of expansion in the Tunisian economy**, but the gap in growth rates in relation to its average still remains negative. Between 1990 and 1995, Tunisia entered a phase of **developing the competitiveness of its products and export efforts**. Tunisia is committed to a free trade agreement with the European Union, signed in 1995, which consists of a gradual dismantling of customs duties on industrial products until 2008.

2.2- Growth evolution between 1996 and 2010

- From 1996 to 2009, the Tunisian economy experienced a positive growth rate and a low degree of volatility. The Tunisian economy enters a recessionary phase in 2010, with a decline in GDP of more than 3%. It can be said that during this period, two main facts have marked Tunisia: **the free trade agreement with the European Union and the beginning of protests against unemployment and the political regime in 2010**. In Figure (9) the period 1996-2008 as a title (from 5.5 in 1996 and 3,139 in 2008) is marked by a growth rate above average, except for its decline in 2001-2002 as a title (5.28 in 2001 and 0.528 in 2002), as a result of the severe drought that has raged for three consecutive years and the decline in tourism revenues. According to the World Bank (2004), during the period 1997-2001, Tunisia's growth rate exceeded that of MENA and middle-income countries on average.
- According to Ben Romdhane (2011), the period 1996-2008 is **characterized mainly by trade liberalization**, the establishment of a free trade area for manufactured products with the European Union following the agreements signed in 1995, the policy of upgrading industrial enterprises and the privatization process. Initially, the signing of the Association Agreement with the European Union was widely disputed in Tunisia. This was supported, firstly, by **the lack of competitiveness of industrial products compared to the products of European companies.**
- Then, because of the **increase in the budget deficit that could result from the dismantling of customs duties**, which were a major source of government revenue. However, Tunisian industry has denied these scenarios by showing resistance to strong European competition. An upgrading of the industrial fabric has been achieved in large part thanks to subsidies granted to companies by the state. As for the deficit generated by the reduction in customs duties, the State has moved towards better fiscal control and an increase in the rate of value added tax (Ben Romdhane, 2011). According to this author, it should be stressed that despite this resistance to trade opening, Tunisia has not been immune to the adverse effects of the dismantling of the Multifiber Agreements and the opening of European markets to Asian textile products. Given that half of industrial jobs were in the textile sector, this sector has suffered on the foreign market as well as on the domestic market. Another hoped-for spin-off from the free trade agreement with the European Union has not been sufficiently realized: increased attraction of foreign direct investment**. After the growth peak in 2008 (4.1%), which corresponds to**

(3.139%) per capita GDP, the Tunisian economy is entering a recessionary phase that will last until the end of 2010 (2.44%) (Figure(9)).

The financial situation of several hotels seems precarious. The Tunisian financial system is dominated by a banking sector characterized by weak competition and a lack of innovation and uncertainty about debt collection" (Haddar 2013). In addition, 2008 and 2009 were marked by a deep economic crisis, known as the "Great Recession" in the United States. The Great Recession is the consequence of the financial crisis of 2007, which originated in the collapse of the real estate market and the subprime credit crisis in the United States. As a result, mortgage and derivative securities fell sharply, jeopardizing the solvency of banks and financial institutions in the United States and Europe. Despite massive state support (rescue packages) to mitigate the threat of bankruptcy, the result was a global recession that led to a slowdown in international trade and rising unemployment.

2.3-Growth evolution between 2011 and 2018

- Following the 2011 revolution, Tunisia has experienced the most important period of political and economic instability in its recent history. During the political transition, seven successive heads of government have succeeded one another, without managing to put in place a real economic policy of transition. These repercussions are reflected, according to figure (9), **the growth of GDP per capita which fell from 2.44% in 2010 to -2.89% in 2011. Even with its recovery in 2012 as 2.98%, the rate marked a drop of one point between 2012 and 2013 (1.89%)**.
- Thus, between 2013 and 2014 economic growth remained low at the same level 2014(1.9%), the unemployment rate worsened, macroeconomic imbalances worsened, This weak performance is mainly due to the excessive regulatory environment that has blocked the functioning of all markets and which has led to the following observation: Weak competition, heavy bureaucracy, rent-seeking behavior, low and poor quality investment, the formation of interest groups, poor quality of services, low productivity of firms, a rigid labor market that discourages hiring, an industrial policy that encourages low value-added activities, and an inappropriate agricultural policy that favors the production of continental varieties.
- Between 2014 and 2015, **the rate recorded a marked decline of -1.80743 between 2014 (1.94) and 2015 (0.13%), mainly due to the successive attacks in 2015.** In fact, the deterioration of tourism activity may also be the cause of the modest growth in 2016.

Security instability and the series of attacks that hit the country in 2015 resulted in a 33% drop in tourism revenues between 2014 and 2015 and a further 4% in 2016. Yet at the beginning of 2016, economic growth forecasts were optimistic (around 2.5% according to the World Bank). At the end of the year, a downward revision was recorded. Economic growth in 2016 is expected to be limited to 1.5 % (according to the IMF). This is partly due to a decline in the agricultural sector and a decline in the value added of non-manufacturing industries, particularly in the hydrocarbons sector and mining (by 3% and 3.3% respectively).

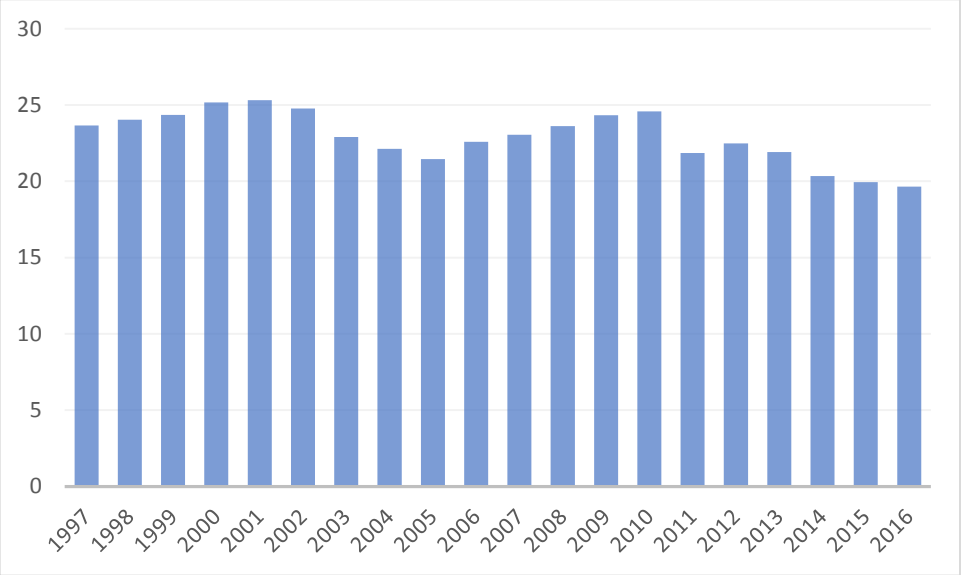

Figure 10: Evolution of the investment rate

Source: MDICI, Compilation ITCEQ

The investment rate has been on a downward trend (Figure (10)) since the start of the century, and is currently low. To date, public investment has been for the most part preserved. On the other hand, business investment has suffered from excessive regulations on product markets, as well as complex administrative procedures which can encourage corruption, unpredictable taxation, increasing problems with customs clearance and the shipping of goods, and a financial system which does not particularly favor start-ups and growing companies. In order to revive business investments, these restrictions need to be lifted, which will also help revive productivity, job creation and the purchasing power of all Tunisians. Housing investment has been underpinned by financial and tax incentives which have moved savings away from

more productive investments. The current reform process, kicked off by the new law on investment, needs to be continued.

- Lower investment may also explain the weak performance in terms of economic growth. Since 2011, instability and the security and economic climate have been sources of reluctance for investors. Since the revolution, the country's economy has been burdened by a low level of investment and a decline in factor productivity, which have affected the country's competitiveness and weighed on potential growth. The country's attractiveness is also affected by cumbersome administrative procedures. Private activity also suffers from a lack of openness: barriers to the exercise of many activities generate rent. The financial system is struggling to fulfill its role as a financier of the economy. Growth also suffers from the development of the parallel economy.

  By comparing the contribution of investment to growth compared to competitor countries in the ICOR indicator area, we find that Tunisia's contribution is lower than that of Morocco.

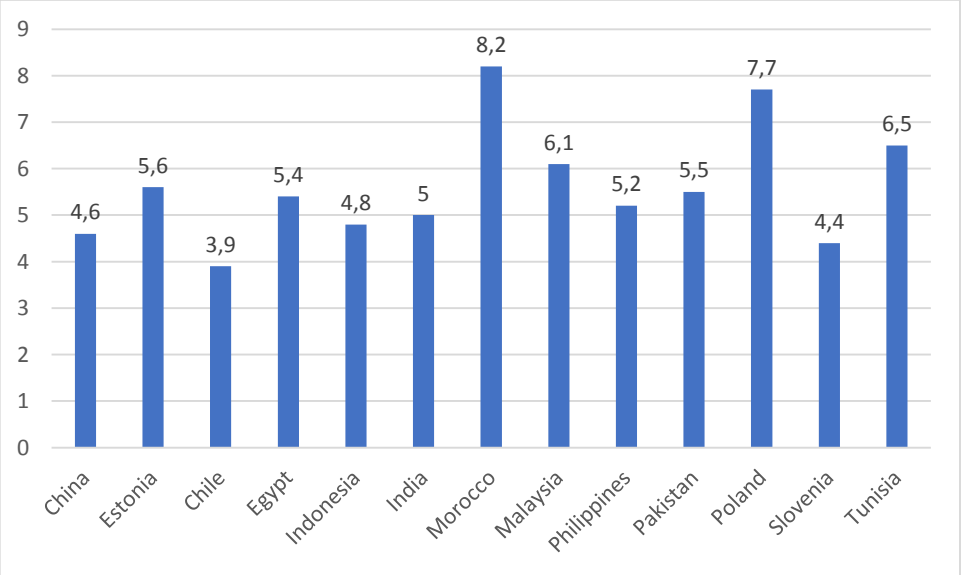

Figure 11: Evolution of the ICOR average in Tunisia and for some competitors between 2000 and 2013

Source: MDICI, Compilation ITCEQ

- **The L'ICOR (Incremental Capital Output Ratio)** measures the degree of efficiency in the use of capital in an economy. The higher the marginal coefficient of capital, the less efficient capital is. It is obtained by relating the investment to the change in value added. It makes it possible to assess the marginal efficiency of capital. The contribution of investments to growth is structurally weak, and even negative in 2013 and 2014. This

weakness is consistent with the limited efficiency of investment as evidenced by the upward trend of the ICOR in the period 2003-2014 and its relatively high level compared to several competitors, especially if 2011 is excluded.

Moreover, since 2011, Tunisian growth has been essentially supported by household consumption. As such, we present the contribution of demand components to GDP growth (Figure (12)).

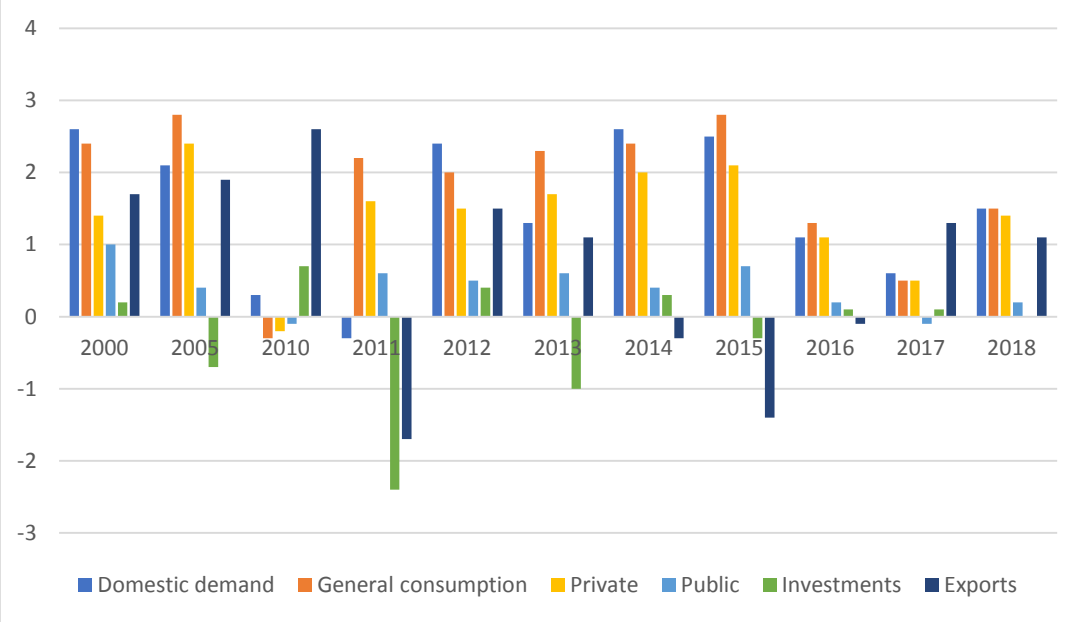

Figure 12: Contribution of Demand Components to GDP Growth

Source: MDICI, Compilation ITCEQ

- The (Figure (12)) above shows the low contribution of investment demand to GDP and gives four negative values in 2005 (-0.7), 2011 (-2.4), 2013 (-1) and 2015 (-0.3), while the contribution of exports is low, with a drop of (-0.9) between 2010 and 2011 and another drop of (-3.1) between 2012 and 2015. Domestic demand and global consumption represent the main contribution to growth demand, especially private consumption. However, we note that these consumptions have been reduced due to inflationary pressures.
- After slowing for three consecutive years, inflation has been on the rise since the end of 2016. At the end of November 2017, inflation stood at 6.3% for one year, against 4% for the same period in 2016. The depreciation of the dinar 20% against the euro over the year) reinforces this trend by generating imported inflation. This leads Tunisians to feel a sharp increase in the cost of living. While they represented more than 23 % of GDP in 2011, investments accounted for only 21.9 % of GDP in 2015 and 21.7 % in 2016.

- The unemployment rate has been stagnating since 2013 at around 15% of the active population, with strong disparities (between regions, sexes, age groups, education levels), which have increased with the crisis. The poverty rate is nevertheless declining, estimated at 15% of the population in 2015, against more than 20% in 2010 - but also characterized by strong disparities, especially between the interior regions where it is around 30% and the coastal areas (5% in Tunis).
- The current account deficit is a growing source of concern. It is expected to reach about 10 % of GDP in 2017, on the other hand, compared to 5 % in 2010 (up another one percentage point compared to the last three years). The surplus in the balance of services (slight recovery of the tourism sector), has not been able to offset the sharp increase in the trade deficit - the depreciation of the dinar has little impact on the real sphere, the competitiveness of Tunisian products for export continues to erode. In the absence of local substitutes, consumption is greedy of imported products.
- These imbalances are largely responsible for the persistent tensions on the dinar, which have increased since April 2017, with parity now reaching nearly 3 TND for one EUR. At the same time, the Central Bank of Tunisia (BCT) has little room for maneuver: at the beginning of 2018, net foreign exchange assets represent only 96 days of imports, compared to 113 at the same time in 2016.
- While there has been some stabilization of the fiscal situation in 2014 and 2015 (with a deficit of close to 5% all the same), the Tunisian budget has slipped sharply in the last two years. In 2017, the deficit amounted to 6.1% of GDP, compared to the 5.4% forecast in the Financial Law on the other hand. For 2018, the FL was ambitious. It forecasts a deficit of 4.9% of GDP, proposing a larger deficit reduction than the projections made by the International Monetary Fund (IMF) in the framework of its aid program. Payroll of the civil function still growing to increase to nearly 15% of GDP.
- The increase in public debt is all the more worrying since it is used in particular to finance operating expenses. It is expected to reach 70% of GDP in 2017, against 40% in 2010 at the central government level. Tunisia's public debt is still considered sustainable by the IMF. This is due in particular to relatively long maturities and a low average interest rate, as Tunisia is indebted to international donors on favorable terms. However, a large part of this debt is denominated in foreign currency (about 70%), which calls for increased vigilance, especially given the rate at which the dinar is depreciating.

B- Generality on economic growth

1- The precursors of growth

1.1- The international division of Adam Smith (1776)

In his Research on the Nature and Causes of the Wealth of Nations (1776), Adam Smith highlights the role of the division of labor (surplus, market, productivity gains) as a factor of growth. This division of labor is reinforced by the country's participation in international trade (theory of absolute benefits). Smith's optimism appears through the features of unlimited growth (it lasts as long as the division of labor and the market can be extended).

1.2- The population principle of Thomas Malthus (1796)

In his Essay on the Principle of Population (1796), Thomas Malthus considered that growth was limited because of galloping demography. He attributed the misery in England to the discrepancy between two laws: the law of arithmetic progression of subsistence and the law of geometric progression. The exit from this state is through mortality, a falling birth rate and celibacy.

1.3- The diminishing returns of David Ricardo (1817)

In his Principles of Political Economy and Taxation (1817), David Ricardo points out that growth is limited by the law of diminishing returns. Value added is distributed among three agents: landowners (land rent), wage earners (living wage) and the capitalist (profit). It should be noted that the capitalists' profit is residual, that is to say that it is generated once the salary and land rent have been paid. When the population increases, agricultural production must be increased, but the new land under cultivation is less and less productive. The cost of production will therefore rise, inevitably leading to higher wages and land rents. Profits will decrease until the capitalists will no longer have the incentive to invest. The economy will reach the situation of a stationary state. In order to delay this situation, Ricardo advocates increasing productivity gains in agriculture through technical progress and opening up to international trade (theory of comparative advantage).

1.4- The destruction of capitalism according to Marx (1844)

Karl Marx was the first economist to propose a formal model of growth, using his extended replication schemes. He considered growth to be limited in the capitalist mode of production because of the tendency of profit rates to fall (1867, Capital). Indeed, the search for ever-increasing surplus-value (especially through low wages, which Marx calls Minimum

Subsistence) and competition between capitalists should cause an impoverishment of the workers and a blockage in the development of the capitalist system (crisis).

1.5-The businessman role Schumpeter (1911)

In his book, Capitalism, Socialism and Democracy, Joseph Schumpeter (1942) makes industrial progress the key to change. The fundamental impulse that sets and keeps the capitalist machine in motion is impressed by new objects of consumption, new methods of production and transport, new markets, new types of industrial organization - all created by capitalist initiative. In other words, industrial progress is driven by innovators seeking to win the jackpot (Schumpeter compares the game of business to poker). The Schumpeterian analysis is interesting because it is not only based on technical progress, the evolution of knowledge or great inventions (with the cycle of successive industrial revolutions). Schumpeter adds a hero - the entrepreneur who takes the risk of launching a new product or a new way of producing, and a structure (monopolistic competition) that ensures that those who succeed in their wager will receive a financial reward. But beware, there will be few elected officials for many conscripts. The "Creative Destruction" will leave some behind, but it will end up being beneficial for all. The whole system will produce more wealth.

2- Economic growth models

2.1- Post-Keynesian growth models

Following the 1929 crisis, many economists, inspired by the work of J.M. Keynes, questioned the possibilities of balanced growth. The Domar and Harrod models sought to account for the essential conditions and characteristics of the equilibrium of a growing capitalist economy. Domar's (1946) starting point is to consider that investment exerts a double influence on the economy (Muet, 1993). On the demand side (and in the short term), the variation in investment determines, via the Keynesian multiplier principle (IYRC and S), the level of income and global demand. The income effect associated with a mention of investment I is equal to I [1/ (1-c)], i.e. I [1/s] where s= (1-c), where c and s represent respectively the marginal propensities to consume and to save. On the supply side (and in the long run), investment increases productive capacity. The capacity effect stipulates that the investment must generate a stimulation of productive capacity, via the gas pedal mechanism.

Investment increases production capacity in a proportion equal to 1/v where v is the coefficient of capital and corresponds to the inverse of the average productivity of capital. v = K/Y (where K is the stock of capital and Y is production). The capacity effect is therefore equal

to I (1/v). The Domar problem thus takes the following form: under what condition is the increase in demand resulting from the change in investment compatible with the increase in production capacity resulting from the investment? For balanced growth to occur, the additional income generated by the multiplier effect must be sufficient to absorb the additional production obtained. In other words, the income effect must be equal to the capacity effect. This condition is verified if investment increases at an observed rate equal to the ratio between the marginal propensity to save and the capital coefficient, i.e. I/I = s/v. While Domar highlights the need for capital and production to grow at a constant rate, Harrod show that growth is inherently unstable.

According to Pierre Alain Muet (1993), Harrod would have been led to pose two problems "one of which is the stability of growth, the other is the possibility of maintaining full employment.

By introducing growth expectations into the determination of investment, Domar concludes that the relationship determining the growth rate by the ratio of the savings rate to the capital coefficient (guaranteed growth rate) is fundamentally unstable. The reason for this instability will be that the multiplier effect would be uncommon with the gas pedal effect, except for a very particular value corresponding to the balanced growth regime. By comparing the guaranteed growth rate, GGR (which balances supply and demand in the goods market) and the natural growth rate, NGR (which balances supply and demand in the labor market), Harrod highlights a paradox of Keynesian theory. If GGR is higher than NGR, the high rate of growth may reduce unemployment. But when the economy tends toward full employment, the effective growth rate g will be limited by the natural rate. Real growth becomes lower than the guaranteed rate. Harrod concludes that the economy will gradually tend toward depression because of insufficient demand. Thus, a high (or insufficient) savings rate would be detrimental to full employment. Saving is a virtue if GGR is less than NGR.

2.2- The Neoclassical model: Solow's approach

The neoclassical growth theory developed by Solow (1956) offers a much more satisfactory approach than the Harrod and Domar model. Moreover, it identifies two sources of growth: an "endogenous" source, the accumulation of capital, and an "exogenous" source, the quantity of available labour. However, capital accumulation is determined by the model (it is the unconsumed share of output). In contrast, this is not the case for available labor. If, in

Solow's model, production tends to "run out of steam" and even to stop growing at all, it is for two essential reasons:

- the production function is at constant returns to scale, and
- the marginal productivity of capital is decreasing and tends towards zero.

Under these conditions, capital accumulation increases output, but more and more slowly because labor is constant. For long-term growth to occur, however, increasing returns to scale are required. Thus, we have the Cobb-Douglas production function below:

$$Y = AK^{\alpha}H^{1-\alpha}$$

With $0< \alpha < 1$, = elasticity, Y= production, A= technology, H= human capital and K= capital.

Solow's model stipulates that the long-term growth rate is equal to the population growth rate plus a technical progress that is a function of technology. In other words, in the long run, economic growth depends only on demographic and technological change. There would be no economic growth for countries that have a constant population and level of technology. Solow describes a world where growth is natural. This implies that it does not depend on the economic sphere. But Solow's theory will take time to influence development policies. Economists using Solow's model to measure the sources of growth are convinced that technological progress depends on economic research and behavior. These economists argue that the supply of labor depends quantitatively and qualitatively on economic behavior. However, the growth model described by Solow can only be optimal thanks to external interventions and the leading roles of the State. The new theories of endogenous growth challenge Solow's model.

2.3 The theory of endogenous growth

This theory emerged in the mid-1980s with the publications of Romer (1986). This theory seeks to explain the causes of the increase in the economic growth of the domestic product per capita from the very process of accumulation without recourse to external (exogenous) factors. The objective of this theory (endogenous growth) is to show that technical progress "does not fall from the sky" but results from the economic choices of agents. Thus, it considers growth as an economic phenomenon. Growth results from investments made by agents motivated by earnings. Thus, the rate of growth of the economy is determined by the behavior of agents and by macroeconomic variables. The theory on endogenous growth is in total rupture with neoclassical theory. The new theories on endogenous growth are based on the

achievements of industrial economics and the new theories on international trade. Indeed, the main characteristics of endogenous growth are increasing returns to scale, imperfect competition.

The starting point for endogenous growth is the hypothesis that the marginal productivity of capital does not cancel out when the capital stock becomes large. Thus, technical progress makes it possible to improve the supply of labor (health, training), and to innovate new production techniques and products. Thus, there is a big difference between Solow's (1956) growth model and Romer's (1986) endogenous growth model. Thus, for Solow, the production function is at constant returns to scale and the marginal productivity of capital is decreasing and tends towards zero. In contrast, for Romer, the production function has increasing returns to scale and the marginal productivity of capital is constant.

We thus group together the growth theory in the form of a summary table on growth theorists, origins of the theory and its characteristics.

Table 17: Summary of growth theories

Theories	Origin of growth	Characteristics
Adam Smith (1776)	Division of labor	Unlimited growth
Robert Malthus (1798)	Productive reinvestment of surplus	Limited growth due to population law
David Ricardo (1817)	Productive reinvestment of surplus	Limited growth due to declining land yields
Karl Marx (1867)	Capital Accumulation	Limited growth in the world of capitalist production due to the tendency of the rate of profit to fall
Joseph Schumpeter (1911), (1939)	Role of the Contractor Innovation clusters	Instability of growth, Explanatory theory of the Kondratiev type long cycle
Harrod (1973) ; Domar (1957)	The growth rate is a function of the ratio between the savings rate and the rate of investment	Instability of growth
Solow (1956, 1957,1966)	Population and exogenous technical progress	Transient nature of growth in the absence of technical progress
P. Romer (1986) R.E Lucas (1988) R. Barro (1990	Physical capital, technology, human capital, public capital, financial intermediaries	Endogenous nature of growth, rehabilitation of the State, taking into account history

Section 2: Theoretical basis for the relationship between variability and economic growth

To conceptualize the relation between the variability of the exchange rate and economic growth, we had to go through a literature review which allows us to distinguish the concept of the theoretical relation between the variability of the exchange rate and economic growth (A) and the determinants which allow us to explain it (B).

A- The relationship between variability and economic growth

1- General effect of the exchange rate variability

Indeed, empirical studies raise the strongly negative relationship between exchange rate variability and economic growth (Bosworth, Collins, and Chen in 1995). There may be long-term consequences that go beyond the current short-term impact on the competitiveness of firms in the country under consideration. Very significant over-evaluation will tend to slow growth, while significant, but not excessive, under-evaluation will accelerate growth (Collins and Razin 1997). Large movements in the real exchange rate are associated with greater uncertainty about relative prices, which in turn leads to greater risks and shorter investment horizons. This leads to very high adjustment costs: a decline in output, a shift from the tradable to the non-tradable sector, and increasing interest rate volatility, even leading to financial instability. Exchange rate misalignment, often an over-revaluation unfavorable to the activities of the tradable sector, is thus widely referred to in the study of economic performance and is considered harmful (Edwards in 1988; Cottani, Cavallo and Khan in 1990; Sekkat and Varoudakis in 1998). It can lead to a reduction in economic efficiency, misallocation of resources, capital flight, and weakened profitability in industries where relative prices are reduced. It can lead to a reduction in economic efficiency, misallocation of resources, capital flight, and weakened profitability in industries where relative prices are reduced. This is why this phenomenon has received special attention as a major source of macroeconomic imbalance, the correction of which is one of the crucial conditions for improving economic performance and ensuring macroeconomic stability (Domaç and Shabsigh in 1999). Policies aimed at stabilizing the real exchange rate around a realistic level could, through this mechanism, encourage growth. It is argued that as much as real exchange rate instability is detrimental to the growth of economic activity, so too is the case for a country's exports.

2- The role of the RER through the relative price of human capital

To formally explain the effects of the appreciation and/or depreciation of a currency, Briones (2001) proposed to take into account the role of the RER in a growth model, via the relative price of human capital. To this end, he assumes a relative deficit of physical capital in order to take into account the specificity of developing countries, which allows him to determine the formal expression of the growth rate of the ratio and indirectly that of the growth rate of output. It is able to show that the growth at a decreasing rate of output during transition also implies the growth at a decreasing rate of the relative price of human capital. It is this last implication that allows the introduction of the RER into the analysis.

To this end, we must necessarily relax the hypothesis of the uniqueness of the good produced in the economy to consider this time a tradable good intensive in physical capital, and a non-tradable good intensive in human capital. Under these conditions, the increase in the profitability (and price) of human capital during the transition leads to an increase in the marginal cost of production of the non-tradable good, and ultimately in its price. By defining the RER here as the ratio of the price of tradable goods to that of non-tradable goods, the increase in the profitability of human capital during the transition leads on the one hand to real appreciation and a decreasing rate of increase in the product.

In sum, the growth model proposed by Briones (2001) attributes a role to the RER through the modification of the price of human capital. If the argument is interesting from an intuitive point of view, it remains difficult to translate it into formal terms because the introduction of the RER into the analysis imposes simplifying hypotheses that lighten this formal framework.

3- The role of the RER through capital investment in a broad sense

Approaches that are based on the role of capital investment in a broad sense also attempt to incorporate the effects of over- and under-valuation into the analysis. Gala (2008) proposes, for example, to explain the influence of misalignments through domestic (1) and foreign investment.

3.1 The influence of misalignments through domestic investment

Gala (2008) attempted to distinguish between the two types of misalignments by proposing an approach that argues that the transmission of their effects to growth occurs through the channel of investment (and indirectly through productivity).

Indeed, the starting point of the argumentation is the definition of the RER. Precisely, if we consider the relative price of tradable goods compared with non-tradable goods, then the increase in the price of the latter leads to higher wages in all sectors and the overvaluation of the currency, at a given level of productivity. The result is a fall in the margins of firms, as well as in the rate of investment, which in turn leads to the displacement of savings and indebtedness to finance consumption, thus posing the threat of a balance of payments crisis, all the more so as the debt dynamic becomes unsustainable. Moreover, by eroding the profitability of investments by companies in the open sector, in which returns on technology are increasing, overvaluation leads to a sub-optimal reallocation of resources in favor of the sheltered sector, in which returns on labor are decreasing, which affects the dynamics of productivity in all sectors (Gala, 2008, p. 275).

Conversely, under-valuation promotes employment and investment through the export-induced increase in the productive capacity utilization rate. It also contributes to a better allocation of the labor force across sectors, which protects the economy from Dutch disease. Indeed, the competitiveness induced by under-valuation acts as a stimulus for the development of an open, resource-independent sector, and thus removes the specter of deindustrialization resulting from Dutch disease. In other words, real under-evaluation increases national output and employment in all sectors of the economy by promoting the competitiveness of manufactured goods in world markets.

3.2 The influence of misalignments through foreign direct investment

According to modern organizational theory, the rationale for FDI derives from the practices of internalization or vertical integration within multinational companies, where the aim is to reduce transaction costs and limit excessive risks associated with international price fluctuations. However, financial movements between the mother companies and their foreign subsidiaries necessarily take into account the exchange rate between the two countries concerned. As a result, it is conceivable that the undervaluation of the country's currency acts as a tax that increases the cost of adjustment and de facto reduces its return. In other words, the misalignment of the exchange rate is directly responsible for the variation in the return on adjustment.

Indeed, it seems that two types of results can be broadly distinguished in the literature. The first emphasizes the existence of a "wealth effect" through which the depreciation of a currency would lead to an increase in inward FDI (Froot and Stein, 1991; Klein and Rosengren,

1994), while the second emphasizes, conversely, the positive effect of appreciation from the point of view of the increase in repatriated profits (Campa, 1993; Gold-berg, 1993). However, the argument that we support here is preferably based on the hypotheses formulated by Grossmann and al. (2009), which show that, in addition to the two effects noted above, it is important to also consider the state of over- or undervaluation of the currency at the time of the investment decision. They thus associate the wealth effect with the undervaluation of the currency rather than with its simple depreciation, because the depreciation of an overvalued currency does not necessarily mask the high cost of domestic assets compared with foreign assets. Moreover, they argue that the appreciation of the domestic currency has two effects on FDI performance: the increase in repatriated profits and the simultaneous reduction in production costs if imported intermediate goods are used in the process. By a similar reasoning, it can be assumed that under the conditions of an undervaluation of the currency of the second country, the appreciation has a total positive effect on FDI since the cost of adapting innovations remains low and the amount of profits repatriated increases.

Conversely, depreciation has two opposite effects. On the one hand, the fall in the cost of adaptation (increase in FDI) through the wealth effect and, on the other, the reduction in repatriated profits which lead to the fall in FDI. The total effect is therefore uncertain a priori. Similarly, the appreciation of an overvalued domestic currency generates an increase in the cost of adaptation (a drop in FDI), but it can also play a beneficial role by increasing repatriated profits. In this case, the total effect is uncertain a priori. Depreciation, on the other hand, has a total negative effect on FDI, since the cost of adjustment is always high from the point of view of foreign investors, and they obtain mainly lower repatriated profits.

4- The exchange rate and the determinants of growth

The effect of exchange rate variables on a country's growth rate can be somewhat pronounced in the presence of one category of variables rather than another. Take the example of openness to international trade, which endogenous growth theory attributes a positive link to economic growth. It has become conventional that the openness of an economy promotes economic growth, and such a relationship is even considered a stylized fact (Romer, 1989). In addition to comparative advantages and economies of scale, the most open economies are the most able to integrate technological progress and take advantage of expanding markets (Barro and Sala-i-Martin ,1995). The nature of the link between foreign exchange and growth is clarified through the exchange rate (Busson and Villa 1997).

A low real exchange rate makes it possible to increase exports through the effect of competitiveness, their development loosens the external constraint and makes it possible to import capital that is not produced locally, thus promoting growth. Conversely, a high real exchange rate favors the traditional sector for developing countries. Similarly, a high exchange rate variability increases uncertainty about export performance and risks hampering it by making domestic producers play an important role in export profitability when they are risk averse.

The exchange rate regime can also affect growth through openness to capital flows that can generate investment with positive spillovers (Bailliu in 2000). The effects on growth through international trade would be more pronounced for the most open countries. It is widely believed that capital flows would favor growth under a floating regime, since a more rigid regime would lead to increased speculative flows. Indeed, some, such as Dooley (1996), argue that the large capital flows to emerging markets in the 1990s were largely encouraged by the implicit guarantees represented by fixed or quasi-fixed exchange rate regimes. Krugman (1998) and Corsetti, Pesenti and Roubini (1999) highlight the role of local banks in their allocation and that of the state in implicit guarantees. Another example of the interaction of the exchange rate with other variables concerns the presence of a more or less developed financial market.

The assumption is that for a country to benefit from a floating regime, it must have a sufficiently developed financial market. Such a regime is usually accompanied by increased nominal rate volatility, which can dampen growth by reducing investment and the level of foreign trade. Thus, a country should have higher growth in a floating regime if it has a financial system that is sufficiently developed to absorb exchange rate shocks and to provide instruments to hedge against volatility. This is not the case in DCs, which have less developed financial markets. To finance their capital needs, producers rely mainly on the domestic market, often separated from the international market because of the high level of country-specific risks.

A more stable exchange rate leads to a reduction in interest rates, by lowering the risk premium, and thus to an increase in production. Better access to international financial markets, however, reduces this effect and thus increases the optimal degree of exchange rate flexibility. Although the effects of financial development on growth may be more pronounced for countries with a floating regime, a healthy and well-developed financial sector is conducive to growth under any regime. The development of the financial system, as measured by its ability to mobilize savings, facilitate capital allocation, and improve risk management, can promote growth through its effects on capital accumulation and resource allocation, providing

opportunities for the firms most dependent on it (Rajan and Zingales (1998); Levine (2004); Fisman and Love (2004)). Empirical studies confirm that an efficient system contributes to growth. Causality is not unidirectional, however. The level of economic activity and technological innovations influence the structure and quality of financial systems.

B- The Determinants of Economic Growth

Economic growth is a complex and multidimensional concept. We therefore find it necessary to present the determinants of economic growth according to their relevance by putting in front the effect of exchange rate variability represented by misalignment.

1-The effect of exchange rate variability

1.1- The negative effect of misalignment

The first evidence of the link between the RER and economic growth was proposed in the work on export-led growth strategy (Krueger, 1983; Williamson, 1990; Dollar, 1992; Sachs and Warner, 1995). The starting point for these analyses is the idea that misalignments are, by definition, macroeconomic imbalances that are harmful to growth; this is also what has been called the "Washington Consensus". In particular, a lax monetary policy, which leads to real over-evaluation in fixed exchange rates, can lead to the contraction of domestic activity and the volume of imports, thereby limiting openness to trade and ultimately growth. Similarly, the competitive devaluation of a currency leads to undervaluation, but it can also encourage imported inflation and jeopardize, at least in the short term, economic growth. In this sense, overvaluation and undervaluation are dangerous, although the latter is less harmful. This is what Williamson (1990) indicates in the manifesto of the Washington Consensus, when he stresses that for a developing country the RER must be sufficiently competitive to allow the economy to achieve its potential growth rate while maintaining its current account at a sustainable level. This RER must not be more competitive because it would generate unnecessary inflationary pressures that would eventually limit investments and growth.

To achieve this result at the practical level, Cottani and al. (1990) construct an indicator of exchange rate disequilibrium with reference to PPP, for the period 1960-1983. They thus show that persistent misalignment is detrimental to the development of agriculture in African countries. Dollar (1992), on the other hand, proposes a compo-site indicator of the level of the RER and its variability to measure the effects of external openness on the growth of 95 developing countries over the period 1976 to 1985. He then shows that exchange rate distortion is negatively related to growth. By way of extension, Ghura and Grennes (1993) extend the list

of indicators of the two previous authors by adding three evaluations of misalignment with reference to PPP[29], the nominal exchange rate and the black-market exchange rate premium. Each of these indicators confirms the negative link between misalignment and growth for the 33 Sub-Saharan African countries in their sample.

The black-market exchange rate premium was also used as an indicator by Easterly and al. (1997) to study the response of growth to different economic policy reforms in Latin American countries between 1960 and 1993. Their results show that there is indeed a negative link between exchange rate distortion and economic growth. In the same vein, Shabsigh and Domaç (1999) proved this negative relationship using the three indicators of Ghura and Grennes (1993) over the period 1970 to 1996, for a sample of 4 countries including Egypt, Jordan, Morocco and Tunisia. More generally, Acemoglu and al (2003) show that the countries most affected by macroeconomic volatility and whose growth has been slower since the end of the Second World War are also those whose macroeconomic policies have been distorted in terms of inflation, budget deficits, and exchange rate misalignments.

However, they point out that these macroeconomic policies appear to be symptoms of an underlying institutional problem, rather than the primary cause of economic volatility. Yet, if previous analyses were able to reach a consensus during the 1990s, they have gradually been subject to important amendments, namely to take separate consideration of the effects of over- and under-evaluation.

1.2- The distinction between over-evaluation and under-evaluation

A consensus seems to have emerged from the initial work on the negative influence of misalignment on growth. However, later on, many others suggested that the effect of overvaluation should be distinguished from that of undervaluation in order to refine the interpretation of the resulting results. On the one hand, Loayza and al (2005) highlighted the negative static link between overvaluation and growth by constructing an indicator that captures the effect of monetary and exchange rate policies and the disruption they induce in terms of resource allocation between the domestic and export sectors. In fact, these disruptions generate imbalances, the resolution of which often leads to a balance of payments crisis. To shed additional light on this issue, we first propose an econometric estimation of growth, using various techniques that take into account practical aspects such as uncertainty about the "real" determinants of growth and membership of a fixed exchange rate regime.

[29] parity purchasing power

Specifically, the erroneous appreciation of a currency in an economy can affect economic growth. For example, an overvaluation of the currency in an economy negatively affects the international competitiveness of the domestic products of that economy in the short term. This overvaluation can weaken business and consumer confidence, reducing the rate of savings and investment, which in turn hinders economic growth. Similarly, in the long term, a strong exchange rate leads to lower inflation, thus promoting the competitiveness of industrial sectors dependent on imported raw materials.

An under-valued currency, on the other hand, can stimulate external trade and encourage domestic demand, thus accelerating economic growth. This is particularly the case when there is an efficient elasticity of demand for exports and imports and excess capacity in the economy. An undervalued exchange rate can, however, increase production costs and have inflationary effects on the real growth rate.

2- The effect of the term of trade

As for the impact of the terms of trade, it is empirically indeterminate. For example, Easterly and al. (1993) indicate that the terms of trade play a role in explaining the variance of growth, while in a later study, Easterly (2001) shows that the relationship between these two variables is only weakly significant. Even more generally, Mendoza's (1997) stochastic model of endogenous growth shows that fluctuations in the terms of trade promote or affect economic growth depending on the degree of risk aversion or uncertainty induced by the fluctuation.

But other factors, such as the rent-seeking behavior of the exploitation of raw materials, also explain the uncertainty about the influence of the terms of trade. Indeed, these behaviors reduce incentives to invest in the productive sector and thus limit growth, whereas the initial improvement in the terms of trade should be favorable, acting as an incentive mechanism through the relative price signal of exports.

3- The effect of trade openness

An important literature has developed around the relationship between trade openness and growth. Despite the uncertainty about the direction of causality, we expect to observe a positive correlation because of the higher returns due to specialization, or more generally, because of the benefits from international competition (Dollar and kraay, 2002; Frankel and Romer, 1999). In other words, the difference in factor endowments or production technology generates comparative advantages that themselves generate gains from exchange in accordance with the neo-classical theory of international trade. indeed, proponents of the endogenous

growth theory argue that trade openness has a positive effect on per capita income through technological diffusion and economies of scale (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991; Romer, 1992; Barro and Sala-i-Martin, 1997).

However, a body of theory has also developed around North's (1990) proposals to introduce the idea that the effect of trade openness is conditional on the institutional framework, the business climate, infrastructure or social norms (Krugman, 1990; Dollar and Kraay, 2003). As an illustration, Devarajan and Rodrik (1989) propose a general equilibrium model to show that trade liberalization can increase or reduce welfare in the context of imperfect competition

4-The effect of the investment

In terms of expected effects, neoclassical theory generally emphasizes the positive role of investment through capital accumulation.

But it seems that this positive effect on growth diminishes as the country becomes richer, so that it can become negative. This is in any case the opinion of Cheung and al (2012) who highlight the heterogeneous effect of investment by empirically studying the case of developed and developing countries. This effect weakens over time, particularly for the richest countries, which leads to the conclusion that public policies to promote investment or increase capital flows can be associated with zero or even negative returns. These results are moreover similar to those of Barro (1991), Barro and Lee (1993), who confirm the positive relationship, or to those of Attanasio and al. (2000) who show that delayed investment causes growth in the Granger sense with a negative coefficient. The study by Aghion and al. (2006) also corroborates that of Cheung and al. (2012) since it shows that growth in the poorest countries is associated with high savings rates, while the same relationship is significantly less conclusive or even insignificant for rich countries.

5- The effect of consumer expenditures

Similarly, it appears that the correlation between government consumer expenditure and growth can be both positive and negative. Indeed, the latter reduces private investment through the crowding out effect, but it can also promote capital accumulation through the modification of the consumption behavior of agents according to the Ricardian equivalence principle.[30]

[30] In his 1821 book "Principles of Political Economy and Taxation," David Ricardo shows that the multiplier effect of fiscal stimulus through borrowing is exactly equivalent to that of financing spending through additional taxes. The choice between the two methods of financing has no effect on household preferences, because if their behavior is rational, they anticipate a future increase in taxes when the government decides to reduce the tax burden in the present period. As a result, they save the earnings supplement equivalent to the tax reduction in order to pay the higher amount in the future. This behavior negates the effect of the original policy.

However, we expect to observe a negative correlation between the two variables under consideration, since increased government spending reduces the incentives to produce and thus results in a lower growth rate, all other things being equal.

6- The effect of FDI

In addition, FDI flows can be seen to reflect economic (or political) uncertainty, which itself has adverse effects on growth (Lensink and Morrissey, 2006). Indeed, some studies such as those of Guillaumont and Chauvet (2001) show that uncertainty determines both investment productivity and growth in developing countries.

Uncertainty refers to vulnerability to external shocks or natural disasters, which has an immediate impact on income distribution and the level of private investment. The negative link between FDI volatility and growth is thus shown by considering that private investment and FDI have the same determinants (Aizenman and Marion, 1999). However, since distinguishing between the different channels of technology diffusion (imitation or adaptation) is difficult from an empirical point of view, we simply introduce the FDI variable into the group of control variables as is customary in the literature. Thus, we assume that its effect on growth depends strongly on the conditions prevailing in the recipient country.

7- The effect of inflation

In contrast to the cases of the previous determinants, that of inflation has met with less opposition in the empirical literature, since the vast majority of studies agree that it has a negative effect on growth in the medium and long term (Bruno and Easterly, 1996; López-Villavicencio and Mignon, 2011). Indeed, in endogenous growth models, inflation acts as a tax that affects the rate of return on physical or human capital (Gillman and Kejak, 2005). For Motley (1998), if inflation has negative long-term effects, it is because of its impact on aggregate supply rather than aggregate demand. Two arguments support his view.

First, inflation blurs price signals and disturbs agents' expectations, since they can no longer clearly distinguish changes in relative prices from changes in the price level in the economy as a whole. As a result, prices no longer play their role in market adjustment because their information content is unreliable, which effectively limits the signing of nominal contracts and ultimately hinders growth. Second, inflation generates additional costs such as the costs of "re-labelling", higher taxation or fiscal laxity where the tax system is not fully indexed to price movements, or the social cost of protecting against inflation. These different conclusions have been confirmed by authors such as Kormendi and Meguire (1985) or Gylfason and Herbertsson

(2001). However, Fischer (1993) studies the non-linearity of the relationship and suggests that there would be a beneficial effect for low levels of inflation but a negative or insignificant effect for higher levels (Judson and Orphanides, 1999; Burdekin and al., 2004).

8- The effect of Population Growth

The rate of population growth is negatively related to growth. Solow's model formally justifies this intuition by showing that the change in the capital stock per capita is a decreasing function of the population growth rate. But empirically, Simon (1989) shows that the effect of population growth on growth is insignificant. Similarly, studies by many economists such as Ojo and Oshikoya (1995) and Hadjimichael and al. (1996) have confirmed the influence of the population growth rate on real per capita income. Industrialized countries with a rate of economic growth much higher than that of population growth have a rapid increase in gross domestic product per capita.

9- The effect of life expectancy

Conversely, however, the influence of life expectancy seems less obvious according to Acemoglu and Johnson (2006). Indeed, the latter show that an increase in life expectancy is not accompanied by a significant increase in per capita income.

10-The Effect of education

Initially, Solow was looking for the relationship between human capital and economic growth. For their part, Becker, Kevine and al (1990) look for the economic reasons for human capital accumulation. The production of human capital requires factors such as teachers, libraries, and study time, etc. The production of human capital requires factors such as teachers, libraries, and study time, etc. The production of human capital requires factors such as teachers, libraries, and study time. Learning by doing refers to forms of knowledge growth derived from productive activity as opposed to specific activities such as education and research. Learning-by-doing thus generates dynamic returns to scale that can lead to growth in the number of people who are able to learn. Lucas (1988) has shown that growth is related to human capital. Similarly, he showed that knowledge generates positive externalities on production and the economy. As for Romer (1990), technology generates positive externalities. Furthermore, Guellec and Ralle (1997) tested a structural equation of endogenous growth, namely a relationship between the number of researchers and the growth rate over a century in the USA. The estimation results showed a statistically significant relationship between the number of researchers and economic growth. Dasgutpta and Stiglitz (1988) have shown that learning allows the accumulation of knowledge that leads to technical progress. Based on the literature, five groups of determinants

of growth and their possible measures can be identified in Table (18): Solow determinants, natural resources infrastructure, internal stability, external stability, and institutional determinants.

Table 18: Different groups of determinants of growth and their measures

Determinants of Solow	
Initial wealth	Initial GDP per capita (Heston and al., 2001).
Human capital	- Life expectancy at birth (Barro and Lee, 1993, 2000) - Enrolment in education (school, high school, post-secondary) (Barro and Lee, 1993, 2000). - Public expenditure on education (total or %) (Barro and Lee, 1993, 2000).
Investment	- Gross fixed capital formation as a percentage of GDP (World Bank). - Average level of investment prices (Heston and al., 2001).
Demographic growth	- Population growth (Barro and Lee, 1993, 2000).
Internal stability	
Stability of prices	- Inflation rate (Levine and Renelt, 1992). - Total debt service (World Bank) Fiscal balance
Public finance equilibrium	- General government final consumption expenditure (% of GDP) (Heston and. 2002) - Fiscal balance (% of GDP) (Heston and al., 2001).
External stability	
Integration (commercial and financial) to the international economy	-Ratio to GDP of the sum of exports and imports (Heston and al., 2002) - Fare restriction (Lee, 2011) - Incoming Foreign Direct Investment (% of GDP (World Bank) - The number of years an economy has been open (Sachs and Warner, 1997)
Stability of exchange rate relationships	- Monetary under-evaluation as measured by the residual of the period regression on the logarithm of GDP in PPP (Busson and villa, 1997). - Real Exchange Rate Distortions (Levine and Renelt, 1992)
Terms of trade	- Changes in the terms of trade (Barro and Lee, 1993)

Conclusion

This chapter has been devoted to the study of the relationship between exchange rate variability represented by misalignment and economic growth, as envisaged theoretically and empirically in the literature.

The objective was to describe the various underlying mechanisms in order to better explain the empirical results that will be obtained in the following chapter.

To do so, we first presented the economic state through the evolution of growth during the study period. Next, we focused on the theoretical basis of the relationship between the exchange rate and misalignment on economic growth. And finally, we distinguished the determinants of economic growth that allow us to explain it.

The next chapter deals with the empirical estimation of this relationship, which allows us to integrate these determinants.

CHAPTER II: EMPIRICAL APPROACH TO EXCHANGE RATE VARIABILITY AND ECONOMIC GROWTH

Introduction

This final chapter focuses on estimating the relationship between the exchange rate variability represented by misalignment and economic growth. Thus, continuing from the previous chapter in which we highlighted the determinants of growth, we opt for the model of Barro (1991), Loayza and al. (2005) Dufrenot and al. (2010), which allowed us to draw up the model that combines these determinants with the misalignment.

For this purpose, our process is first dedicated to the specification and estimation of the growth equation. Then, the estimation of this equation and finally the interpretation of the result.

So, this exercise would extend in two sections which are:

- Section 1: Specification and Estimation of the Growth Equation
- Section 2: Analysis and Interpretation of Results

Section 1: Specification and estimation of the growth equation

Our process consists of two main steps: the first is dedicated to the specification of the equation to be estimated (A) and the second concerns the actual estimation of this equation (B).

A- The specification of the equation to be estimated

We write the equation linking the growth rate of GDP per capita to the misalignment of the RER and to a set of control variables, then we proceed to the empirical estimation of this equation by the OLS method. For the purpose of clarity, we first present the equation to be estimated and our variable of interest (1), as well as we then identify the potential control variables[31] for the evaluation of growth (2), and finally the sources and trajectories of the model series (3).

[31] For the Monte-Carlo method, a control variable can be used to obtain a reduction in variance by exploiting the correlation between several statistics.

1- Equation and variables presentation

We draw on the work of (Barro (1991), Loayza and al. (2005) or Dufrenot and al. (2010) Ferdinand Owoundi, and propose a growth analysis based on the estimation of the following equation:

$$\Delta y_t = \alpha \text{Mis}_t + \delta X_t + \varepsilon_t$$

where y_t is the of GDP per capita; Δy_t is the growth rate of GDP per capita; X is a matrix of control variables (including the initial GDP); and $\varepsilon_t$is a term of error.

Mis_t our variable of interest, represents the misalignment studied in the previous chapter of the RER and whose influence on the dependent variable. Taking into account the different explanations that have been given elsewhere in the literature, we make the hypothesis that misalignments exert an asymmetric effect on the dependent variable. The relative price distortions generated by overvaluation can indeed have potentially harmful repercussions, in the form of a fall in the productivity of capital and labor[32] or a low return on investment for exporting industries, with a consequent return on the protectionist measures (Mengistae and Pattillo ,2004). Conversely, the under-evaluation can help to improve the profitability of investments in the goods sector exchangeable, through the creation of production incentives in this sector. Also generate inflationary pressures that make imports more expensive and weaken growth through lower investment.

Following this brief reminder of the role of our variable of interest, we continue the analysis by identifying the potential control variables contained in the matrix it X_t.

X_t is the matrix of control variables that can explain the rate of growth of the economy

Here we want to clarify that these control variables are simply variables that are added by the economist in a regression in order to avoid a bias in the estimation of the parameter of interest. Salai-i-Martin (1997) identified more than sixty (60) variables with a significant effect on economic growth in at least one regression equation. However, in the present analysis, we limit their number in order to better appreciate the influence of our variable of interest. This matrix includes the so-called environment variables precisely designating the domestic investment in GDP (DI), government final consumption expenditure or public expenditure (PE), the rate of openness of the economy or the trade policy (TP), foreign direct investment (FDI), the terms of trade (TE), and the human capital indicators such as the growth rate of the

[32] Since part of the invested capital is diverted from the production process

consumer price index (Inflation), the growth rate of the population (PG) the gross secondary school enrollment rate (EN) and life expectancy (LEX) .

2- The variables presentation

However, in order to facilitate the reading and the interpretation of the results tables, we take the misalignment as a dummy variable so that both under- and over-evaluation indicators are defined as positive. The latter two are constructed using an indicator variable $D_t$which takes the value 1 in the case of under-evaluation (Mis<0) and 0 otherwise.

$$\begin{cases} D_t = 1 \text{ if (Mis>0)} \\ D_t = 0 \text{ if (Mis<0)} \end{cases}$$

In the same way, to guarantee a better and more significant result, we opt for the calculation of growth rates for certain variables, namely the terms of trade (TER), the degree of openness or trade policy (TPR), domestic investment (DIR) and public expenditure (PER). Thus, the Table (19) below represents a list of the variables.

Table 19 : The variables presentation

- **Endogenous variable**

GPCR: The growth rate of GDP per capita

- **Exogenous variables**

$\mathbf{Mis_t}$our variable of interest is a dummy variable that represents the misalignments of the RER whose influence on the dependent variable was studied in the previous chapter

$\mathbf{TER_t}$: The growth rate terms of trade [33]

The ratio between export prices (unit value index) and import prices (unit value index) of Tunisia.

$\mathbf{TPR_t}$: The growth rate of the trade policy [34]

The degree of openness of the economy, approximated by the share of foreign trade in value in the gross domestic product in value. It is the sum of imports and exports relative to the gross domestic product.

$\mathbf{DIR_t}$: The growth rate of the domestic investment in GDP [35]

This is the accumulation of capital measured by the ratio between gross fixed capital formation and gross domestic product in value terms

[33] $TER = \frac{(\mathrm{TER}_t - \mathrm{TER}_{t-1})}{\mathrm{TER}_{t-1}} * 100$

[34] $TPR = \frac{(\mathrm{TPR}_t - \mathrm{TPR}_{t-1})}{\mathrm{TPR}_{t-1}} * 100$

[35] $DIR = \frac{(\mathrm{DIR}_t - \mathrm{DIR}_{t-1})}{\mathrm{DIR}_{t-1}} * 100$

PER_t: The growth rate of the government final consumption expenditure [36]

INF_t: Inflation Rate

It is the variation of a lasting (one year) and general increase in the prices of goods on the market. The data were derived from the Consumer Price Index (CPI).

PG_t: The growth rate of the population

The annual population growth rate for year t is the exponential mid-year population growth rate from year t-1 to t, expressed as a percentage.

EN_t: The School enrollment, higher education rate

It's the human capital indicators and it is the total enrolment in tertiary education, regardless of age, expressed as a percentage of the total population in the five-year group after leaving secondary school.

LEX_t: Life expectancy

Life expectancy at birth indicates the number of years that a newborn baby would live if the general rules of mortality at birth were to remain the same throughout its life.

FDI_t: Foreign direct investment (FDI)

The Net Foreign direct investment flows

3- Sources and trajectories of the model series

The main source of data was international statistics from the World Bank to do the empirical work for this chapter. Thus, we used the CBT reports for some missing variables. These data are annual and cover a period of 39 years, from 1980 to 2018.

The trajectories of the variables in the model evolve in a disparate manner; the amplitudes of these variables provide sufficient evidence of the dysfunction of the Tunisian economy. The graphical representation of these variables is given in the Figure (13) below.

[36] $PER = \frac{(\mathrm{PER}_t - \mathrm{PER}_{t-1})}{\mathrm{PER}_{t-1}} * 100$

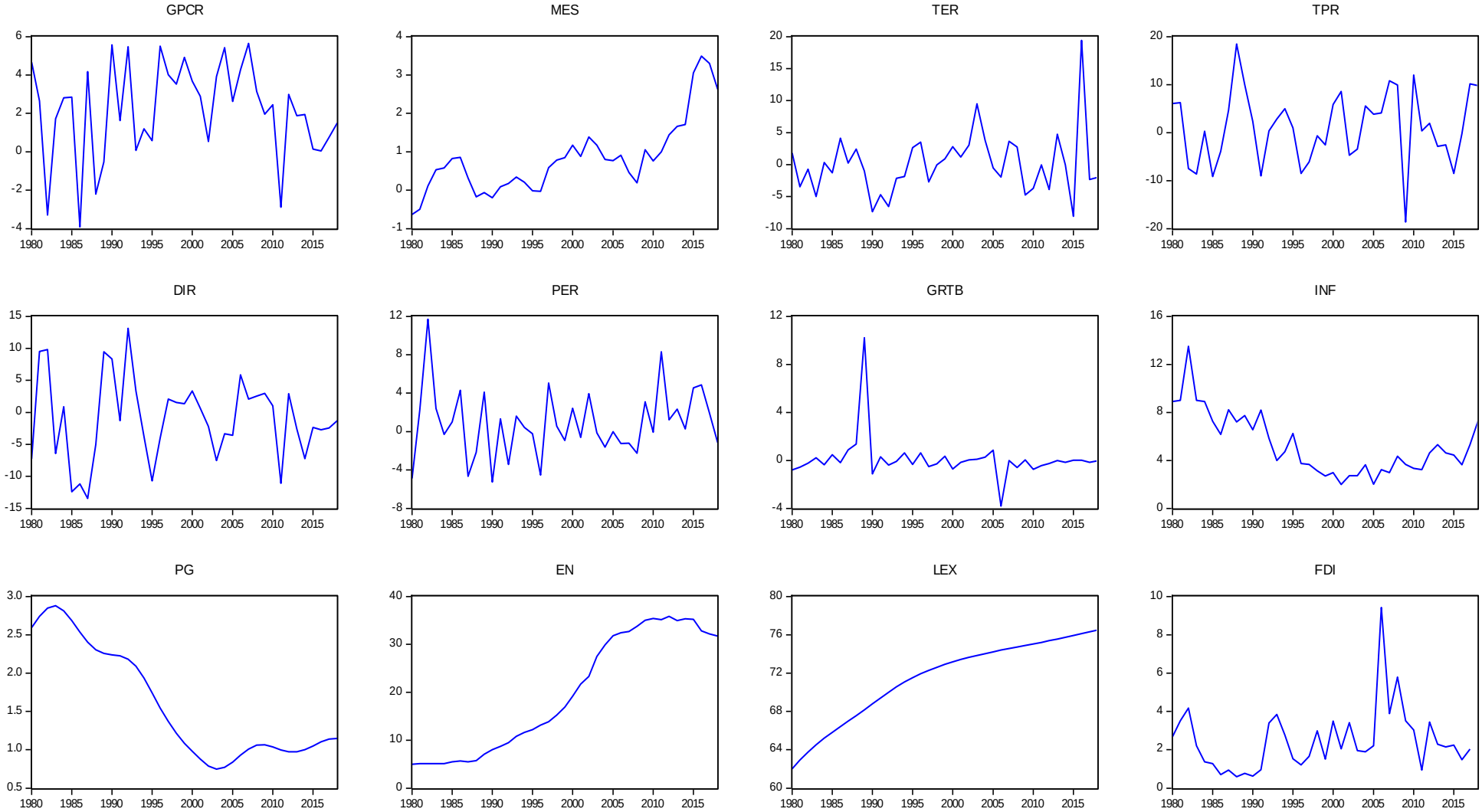

Figure 13: Graphical representation of the different variables

B-The estimation of the equation

1-Econometric tests of the model

The objective of this section is to determine the relationship between the variability of the RER represented by the misalignment calculated in the first part and the other control variables on the per capita growth rate in Tunisia. To do so, we will test the stationarity of the variables and evaluate model bias. After, we will estimate the equation of the model. The analysis of these estimated equations allows us to pass or not to pass the next step. When the equations tests give satisfactory results, we will move on to the analysis of the econometric estimation for long-term model by OLS.

1.1-Tests of stationarity of the variables

The tables (20), (21) and (22) give the results of the different unit root tests. We performed the three tests: ADF, PP, and KPSS. For all series we adopt a model with trend and constant.

The results of the ADF and Phillips-Perron tests provided the same spring where some variables are not stationary at level (PG, EN, INF), although there are variables at level I (0) in some cases at a level of 10%.

As for the KPSS tests presented in the table (22), they indicate that all the variables are level-stationary, which means that they are integrated at level I(0). Consequently, the hypothesis H1 is valid for all the variables of the model: GPCR, MIS, TER, TPR, DIR, PER, INF, PG, EN, LEX, FDI which are level-stationary.

Finally, as we can consider from these different tests that all the variables are stationary at level I (0). Then we can move on to the analysis of the results of the econometric estimation of the long-term model by OLS.

Table 20: Results of ADF tests

Variables	T-Statistic	P-Value	Result
GPCR	-5.983949***	0.0001	I(0)
MIS	-5.072421***	0.0011	I(0)
TER	-6.590737***	0.0000	I(0)
TPR	-5.172397***	0.0008	I(0)
DIR	-4.519522***	0.0046	I(0)
PER	-6.499753***	0.0000	I(0)
INF	-1.974042	0.5964	Non stationary
PG	-1.507385	0.8079	Non stationary
EN	-1.282071	0.8769	Non stationary
LEX	-4.714204***	0.0032	I(0)
FDI	-4.262357***	0.0092	I(0)

Note:
- (***) stationarity of the variable at 1%.
- (**) stationarity of the variable at 5%.
- (*) stationarity of the variable at 10%.
- The critical values from MacKinnon (1996) for the 1%, 5%, and 10% thresholds are -4.219126 ;-3.533083 ;-3.198312 respectively.

Table 21: Results of PP tests

Variables	T-Statistic	P-Value	Results
GPCR	-6.008125***	0.0001	I(0)
MIS	-3.608503**	0.0424	I(0)
TER	-6.596305***	0.0000	I(0)
TPR	-5.372829***	0.0005	I(0)
DIR	-4.576916***	0.0040	I(0)
PER	-6.487581***	0.0000	I(0)
INF	-1.632216	0.7611	Non stationary
PG	-0.632075	0.9710	Non stationary
EN	-1.293807	0.8744	Non stationary
LEX	-3.753497**	0.0306	I(0)
FDI	-4.309145***	0.0081	I(0)

Note:
- (***) stationarity of the variable at 1%.
- (**) stationarity of the variable at 5%.
- (*) stationarity of the variable at 10%.
- The critical values from MacKinnon (1996) for the 1%, 5%, and 10% thresholds are -4.219126 ;-3.533083 ;-3.198312 respectively.

Table 22: Results of KPSS tests

Variables	T-Statistic	Results
GPCR	0.172621***	I(0)
MIS	0.089124*	I(0)
TER	0.063625*	I(0)
TPR	0.105371*	I(0)
DIR	0.046876*	I(0)
PER	0.099581*	I(0)
GRTB	0.070742*	I(0)
INF	0.212749***	I(0)
PG	0.168632***	I(0)
EN	0.104020*	I(0)
LEX	0.202683***	I(0)
FDI	0.093183*	I(0)

Notes :
- (***) stationarity of the variable at 1%.
- (**) stationarity of the variable at 5%.
- (*) stationarity of the variable at 10%.
- The critical values from Kwiatkowski-Phillips-Schmidt-Shin (1992) for the 1%, 5%, and 10% thresholds are 0.216, 0.146, and 0.119 respectively.

- **Writing the general linear model**

Thus, our general linear model is written as follows:

$$GPCR_t = \beta_0 + \alpha \text{Mis}_t + \beta_1 TER_t + \beta_2 TPR_t + \beta_3 DIR_t + \beta_4 PER_t + \beta_5 INF_t + \beta_6 PG_t + \beta_7 EN_t + \beta_8 LEX_t + \beta_9 FDI_t + \varepsilon_t$$

1.2-Evaluation of model bias

The Jarque-Bera statistic indicates whether the residual values (the values of the known/observed dependent variables minus the predicted/estimated values) are normally distributed. The null hypothesis for this test is that the residual values are normally distributed. The graph below represents a histogram from these residual values, it would look like a classic bell curve, or Gaussian distribution. The result of this test covering the period from 1980 to

2018 shows that the series studied follow a normal distribution at the 5% threshold because JB = 0.453 < 5.99, or equivalently Prob = 0.796> 0.05.

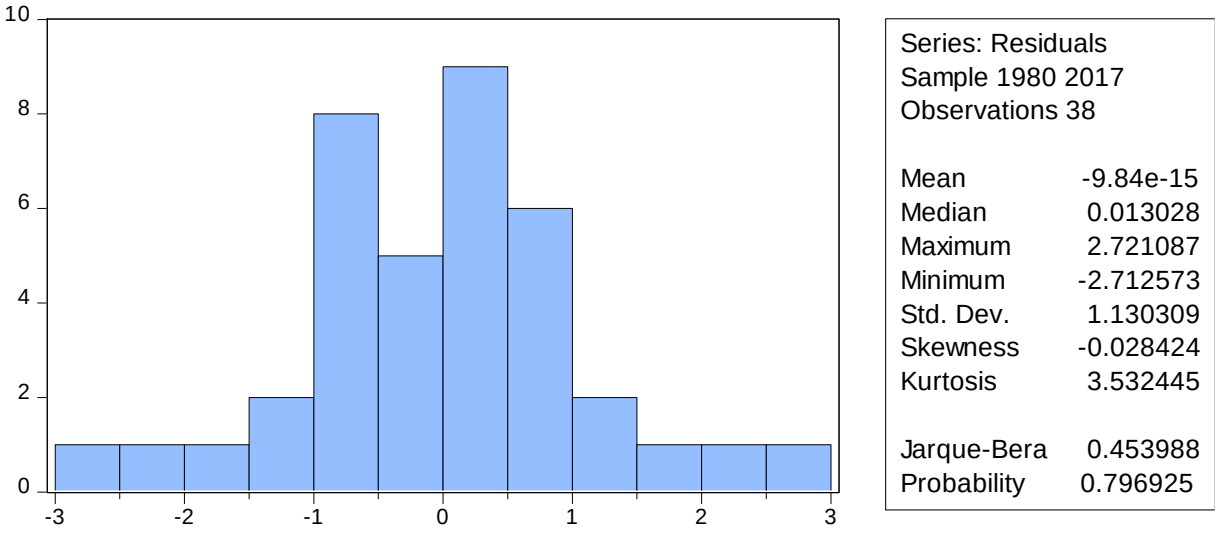

Figure 14: Jarque-Bera Normality Test

2-Estimation of long-term relation of the model

Table 23: Estimation of OLS model for long-run relation

OLS Estimation	$GPCR_t = \beta_0 + \alpha \text{Mis}_t + \beta_1 TER_t + \beta_2 TPR_t + \beta_3 DIR_t + \beta_4 PER_t + \beta_5 INF_t + \beta_6 PG_t + \beta_7 EN_t + \beta_8 LEX_t + \beta_9 FDI_t + \varepsilon_t$			
	Coefficients	**Standard error**	**T-Student**	**Probability**
$\boldsymbol{\beta_0}$	**40.12347**	**14.69981**	**2.729524**	**0.0110**
$\boldsymbol{\alpha}$	**-1.405341**	**0.726169**	**-1.935281**	**0.0635**
β_1	0.002036	0.052318	0.038916	0.9692
$\boldsymbol{\beta_2}$	**-0.095852**	**0.033514**	**-2.860026**	**0.0081**
$\boldsymbol{\beta_3}$	**0.146099**	**0.043960**	**3.323484**	**0.0026**
$\boldsymbol{\beta_4}$	**-0.647388**	**0.076691**	**-8.441462**	**0.0000**
β_5	0.066389	0.214409	0.309638	0.7592
$\boldsymbol{\beta_6}$	**-3.163014**	**1.209132**	**-2.615937**	**0.0144**
β_7	0.007857	0.053401	0.147138	0.8841
$\boldsymbol{\beta_8}$	**-0.447720**	**0.193992**	**-2.307932**	**0.0289**
β_9	-0.142707	0.180075	-0.792486	0.4350
R^2	0.795317			
R^2Ajusté	0.719509			
Prob(F-Statistic)	0.000001			

3- Evaluation of the model performance

The two values Multiple R-Square and Adjusted R-Square are measures of model performance. The possible values range from 0 to 1. The Adjusted R-Squared value is always slightly lower than the Multiple R-Squared value because it reflects the complexity of the model (number of variables) as it relates to the data and is therefore a more accurate measure of model performance. Adding an additional explanatory variable to the model will likely increase the multiple R-squared value, but may reduce the fitted R-squared value.

Thus, the OLS estimation gives us an $R^2$of 0.795317 and an adjusted $R^2$of 0.719509, indicating that the model is performing well. Then, we can say that the distribution of the means of the errors of the model are normal, so we can move on to the Student test.

3.1- Test of significance of the explanatory variables (Student)

We also find that the constant and the variables $\boldsymbol{\beta}_0$,MIS, TPR, PER, DIR, PG, have a significant influence on the GPCR variable because the associated probability is less than 5% (where the t-statistic is outside the interval [-1.96;1.96]). As well, the MIS is significant at 10%. On the other hand, the variables TER, FDI, IN and EN, have no significant influence on the endogenous variable GPCR.

3.2- Evaluation of the significance of the model

For a 95 % confidence level, a p-value (probability) of less than 0.05 indicates a statistically significant pattern. This is the case for our model with a Prob(F-statistic) of 0.000001, so there is at least one non-zero coefficient.

3.3-Evaluation of the spatial autocorrelation of residual values

In a good model, we find that the p-value associated with the Breusch Godfrey serial correlation LM test statistic is greater than 0.05. Then, according to the results provided by this test the Prob. Chi-Square is equal to 0.1412>0.05 so the errors are not auto-correlated.

Table 24: Result of Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.510396	Prob. F(1,25)	0.2305
Obs*R-squared	2.165001	Prob. Chi-Square(1)	0.1412

3.4-Test of White's heteroskedasticity

The errors in the model are homoscedastic because Prob = 0.1461 > 0.05. In linear regression, the fact that the errors (or residuals) of the model are not homoscedastic means that the model coefficients estimated by the ordinary least squares method are unbiased and those of minimal variance and the estimation of their variance is reliable.

Table 25: Results of White's Heteroscedasticity Test

F-statistic	1.637687	Prob. F(11,26)	0.1461
Obs*R-squared	15.55288	Prob. Chi-Square(11)	0.1586
Scaled explained SS	9.219351	Prob. Chi-Square(11)	0.6017

3.5-Test of Heteroskedasticity: Breusch-Pagan-Godfrey

Table 26: Results of Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.715746	Prob. F(11,26)	0.7134
Obs*R-squared	8.832405	Prob. Chi-Square(11)	0.6374
Scaled explained SS	5.235625	Prob. Chi-Square(11)	0.9192

The errors in the model are uncorrelated because Prob = 0.7134 > 0.05, so the ordinary least squares estimates are optimal.

3.6-Test de Ramsey RESET

Table 27: Results of the Ramsey test

Specification: GPCR C MIS TER TPR DIR PER INF PG EN LEX FDI
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.607397	26	0.5489
F-statistic	0.368932	(1, 26)	0.5489
Likelihood ratio	0.535418	1	0.4643

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.667517	1	0.667517
Restricted SSR	47.70999	27	1.767036
Unrestricted SSR	47.04247	26	1.809326

LR test summary:

	Value
Restricted LogL	-58.24320
Unrestricted LogL	-57.97549

The dummy variable introduced into the model is not significant at the 5% threshold, (Prob = 0.5489> 0.05).

Consequently, the specification of this model on the determinants of the economic growth is complete and includes all the relevant variables that can explain the variation of the real gross domestic product per capita in Tunisia.

Section 2: Analysis and interpretation of model estimation results

After estimating the relationship between the growth of GDP per capita, the misalignment and the different determinants that explain it, we proceed in this last section to interpret the results obtained. First, we recall the details that justify the performance of the model(A), then we analyze the relationship between the growth of GDP per capita and the variables qualified as significant in the model (B) and finally we try to explain the non-significance of the other variables (C).

A- Global performance

The results obtained following the econometric estimation of the model's long-term relationship show that exogenous variables explain 79.53 % of the variations in real GDP per capita in Tunisia (Appendix 4). Thus, the Breusch-Godfrey test (Prob = 0.713 > 0.05) confirms the non-correlation of errors. The values of the Fisher statistic and its probability indicate that the model is significant overall (Prob (F-statistic = 0.000001< 0.05)). Despite the multiplicity of variables and dimensions that can influence the real gross domestic product per capita in Tunisia, Ramsey's test confirms that all the determining variables are taken into account in this model (Prob = 0.5489> 0.05).

Now, we focus on the nature of the relationship between the exogenous variables that have been qualified as significant (MIS, TPR, DIR, PER, PG, LEX) and the endogenous variable which is the growth of GDP per capita.

B-Significant variables

1-Relation between MIS and GDP per capita growth

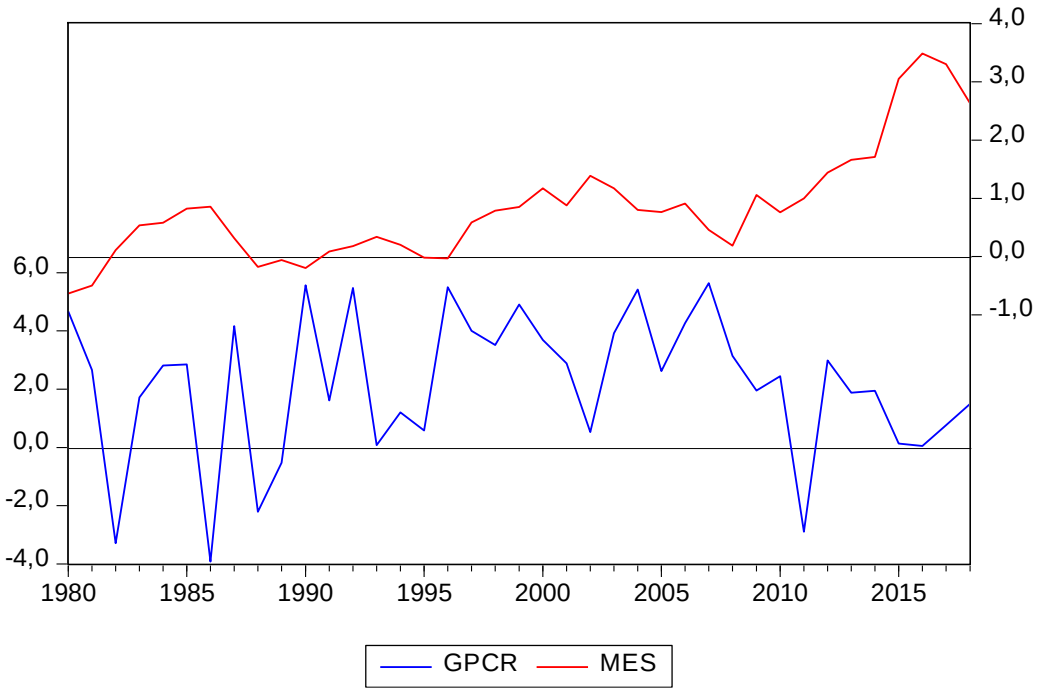

Figure 15: Relation between MES and GDPC

According to the estimation made, we find that there is a negative coefficient (Coef = -1.405341) and significant relation at the 10% threshold with a ((Prob = 0.0635 < 0.05); (t of student = -1.933295)) between the variability of the exchange rate represented by the misalignment and the GDP per capita growth. We recall that misalignment represents the difference between the real equilibrium exchange rate and the observed exchange rate, and this result is also confirmed in figure (15) by the inverse fluctuations between misalignment and GDP per capita.

Based on the misalignment exercise carried out in the first part, we found that this misalignment was characterized by long periods of over-evaluation [1982-1987] [1991-1994] [1997-2018] which are interspersed by short periods of under-evaluation [1980-1981] [1988-1990] [1995-1996]. Indeed, the springs of the results obtained from the OLS estimation were logical and conform with the theoretical predictions because, in general, the analyses of (Krueger, 1983; Williamson, 1990; Dollar, 1992; Sachs and Warner, 1995) put forward the idea that misalignments are, by definition, macroeconomic imbalances that are harmful to growth. Thus, these long periods of depreciation or over-evaluation reduce the profitability of exporting companies and companies competing with foreign products, and consequently discourage private production and investment. Since, the purpose of this depreciation was in the majority

of cases to take advantage of lower export prices, export quantities and price competitiveness. However, this was not the case. Quite the contrary, it had the opposite effect, and for obvious reasons of instability of all kinds, lack of preparation of our productive apparatus, which was under pressure, and a real supply of exportable goods and services, imports jumped to 40 billion dinars (Charfi.M, 2017). For Tunisian companies, the causes of this difficult economic situation are first of all numerous. It is due in part to the rigorous measures taken by the State such as the generalized increase in VAT[37], the increase in customs duties for imported products, the rise in the cost of company salaries, etc. On the side of the central bank economists, believe that it is short of foreign exchange reserves and that if it does not allow this devaluation, the country would no longer be able to meet its debts and imports. In order not to sink into deficit, small and medium enterprises are then forced to readjust their selling price in relation to inflation. Yet, the problem lies at the market level. The market is limited, and it is difficult to adopt a price-competitive strategy by competing with the competition. As far as companies in the foreign trade sector are concerned, which seem to be the most advantaged by this crisis, it must be said that they are not doing any better because France, which is their main partner, is not as spared by this change in the general cost of living.

On the other hand, this economic downturn is causing the bill for imported products to skyrocket, especially with the price of a barrel of oil continuing to fall. There is also the decline in cereal production and the reduction in the volume of demand for Tunisian products. The most affected by this crisis are obviously the companies importing luxury goods (car concessionaires), but also importers of medicines and products useful in everyday life. Similarly, for SMEs in the tourism sector, the episodes of terrorist attacks in 2002 and 2015 is far from giving a boost to the development of this sector. In fact, there is a regression in the ranking of Tunisian tourism whereas Tunisia was previously a preferred destination for Europeans (IMF,2016)[38]. These circumstances have also caused a drop in foreign exchange earnings. Additionally, the country's phosphate production has also led to a decline in exports. All these dysfunctions could disrupt the balance of Tunisian small and medium enterprises in the long term. Thus, analysts believe that the constant fall of the dinar against the euro is leading not only to inflation but also to rising unemployment. The rate of people who cannot find a job is close to 35 % for young people under 24 years old, against 15.4 % for the labor force on the other hand[39]. As for foreign investments, they could be attracted by such a situation to inject

[37] Value added tax
[38] IMF (2016) , *Tunisia Request For An Expanded Agreement Under The Extended Credit Facility*
[39] The employment portal in Tunisia

cash because investments come back cheaper in euros. Nevertheless, investors study several elements such as political stability, the duration of this economic crisis, and promising sectors before investing their first euro. For the country, this opportunity is interesting because there is already talk of a shortage of currency in agencies and foreign exchange services. But if the country has more resources and foreign exchange reserves, it may not let the local currency fail. In any case, the government has thought it advisable to encourage citizens to put in place import restrictions to reduce the balance of trade deficit. Similarly, the competitive devaluation of a currency leads to under-evaluation, but it can also encourage imported inflation and jeopardize, at least in the short term, economic growth. In this sense, both under and over-evaluation represent a danger, although the latter is less harmful. This is what Williamson (1990) indicates in the manifesto of the Washington Consensus, when he stresses that for a developing country the RER must be sufficiently competitive to allow the economy to achieve its potential growth rate while maintaining its current account at a sustainable level. This RER must not be more competitive, because it would generate useless inflationary pressures that would limit investments and growth in the long run.

2-Relation between TPR and the rate of GDP per capita

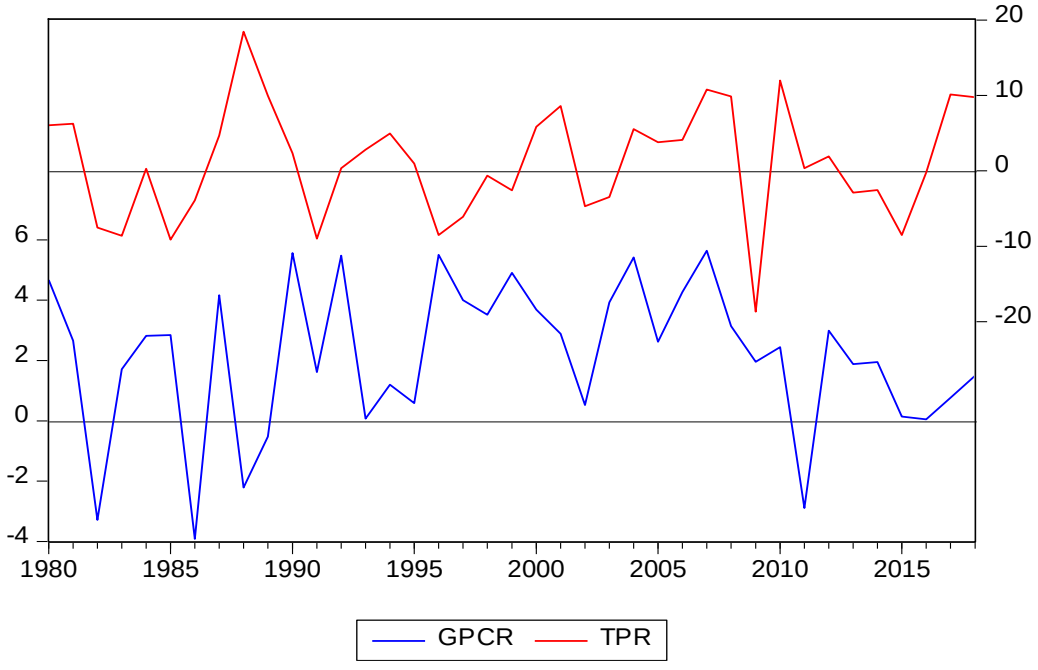

Figure 16: Relation between TPR and GPCR

The degree of openness, which is represented by the growth of trade policy (TPR), is significant ((Prob = 0.0081< 0.05); (t of student= -2.860026)) and influences negatively with a low coefficient (-0.095852) the growth rate of real GDP per capita (Appendix 4). Likewise, the evolution of the degree of openness or where the trade policy in Figure (16) confirms the results

obtained in the estimation. But this result contradicts the theoretical predictions that the degree of openness increases the social well-being of the population. Although Tunisia's foreign trade policy is well developed, it is based on three principles: liberalization, diversification of the export base and diversification of partners, however, this policy has not been in favor of growth.

Indeed, since the early 1990s, Tunisia has opted for integration into the global economy. This integration has resulted in the gradual liberalization of its foreign trade and the establishment of free trade areas with several countries.

Today, Tunisia is linked with trade agreements with 50 countries in the region, representing more than 800 million consumers. Thus, this legislative framework makes Tunisia a favorable ground for investors, in addition to the factors of proximity to the European market and political and social stability. Thus, given the importance of foreign trade in economic activity (the third engine, alongside investment and consumption), Tunisia has chosen to better diversify its export base, with an option for sectors with high added value and a strong knowledge component.

And in terms of diversification with trading partners, Tunisia has begun a program to promote and already deployed to develop trade with the Nordic countries, the countries of Central and Eastern Europe, with the Arab Free Trade Area and especially with Africa [40].

However, we find that the country gains nothing in return for this opening because it imports more goods and services than it produces and exports. However, the import capacity depends in principle on the export capacity, which is not the case for Tunisia with a balance of trade deficit that continues to grow (Charfi.M, 2017).

Moreover, despite the fact that exports of goods and services constitute an important source of external financing for sustainable growth, Tunisia has not been able to take advantage of it.

The trade policy implemented is static and is not the subject of an overall development strategy.

[40] Ministry of Foreign Trade

3- Relation between DIR and the rate of GDP per capita

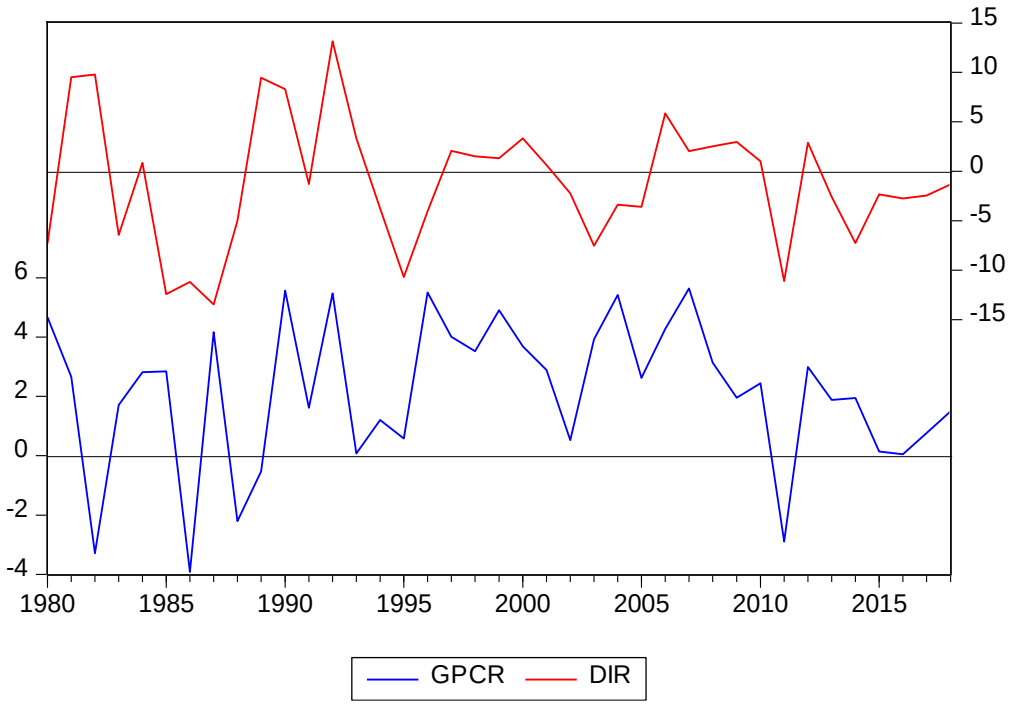

Figure 17: Relation between DIR and GPCR

The resort of (Figure (17)) indicates that the fluctuations obtained in the growth of domestic investment converge in most of the study period except for the first years between 1980-1985. According to the International Labor Organization, total investment in Tunisia has fallen sharply since the early 1980s. Investment peaked at 34 % of GDP in 1982, but fell sharply in the late 1980s to 21 % of GDP in 1988. This is explained by the privatization measures that were taken in the mid-1980s, where the public sector in Tunisia constituted the bulk of the economy, accounting for about 40 % of total investment, 30 % of total value added, and 33 % of total official employment. At the same time, public enterprises were incurring losses and had accumulated a debt of 3 billion Tunisian dinars (US$3.6 billion), or 35 % of the country's GDP.

Starting in 1987, the government undertook to reduce the size of the public sector by restructuring, privatizing and liquidating public enterprises, mostly small and medium-sized enterprises in the textile, tourism and construction sectors. As for large public enterprises such as the national airline Tunisair and the insurance company Star, their shares have been sold on the stock exchange to private investors[41].

[41] International Labour Organization, International Institute for Social Studies (2011), *Studies on Growth and Equity Tunisia A New Social Contract for Fair and Equitable Growth*

Focusing on the econometric estimation, we find results that confirm the fluctuations of the figure. Thus, the growth rate of domestic investment (DIR) represented by gross capital formation is significant ((Prob = 0.0026< 0.05); (t of student = 3.323484)) and positively influences the growth rate of real GDP per capita but with a low coefficient (0.146099).

This result confirms the theoretical predictions that capital accumulation positively influences the growth rate of real GDP per capita. According to the empirical study carried out by Bassanin, and Scarpetta (2001) in OECD countries have shown that human and physical capital are the engines of growth.

Indeed, for self-sustained growth to occur, there must be growth in the marginal return on capital. Massive investment by firms in physical capital such as machinery, equipment, materials, tools, ... etc. is considered as one of the engines of growth and production according to Ahn and Hemmings (2000), Harris (1999), De Long and Summers (1992). This investment in the quantity and quality of physical capital increases labor productivity by increasing capital intensity. Although the result obtained is positive, it remains low, so to better understand it we focus on gross fixed capital formation, which has experienced an overall upward trend during the period of the study between 1980 and 2018, averaging 1.7 % year between 2000 and 2014.

However, this evolution has not been steady during this period and the rate of progression has varied over time. A decline was thus perceived between 2002-2004, followed by an upturn until 2010. During the post-revolutionary period (2011-2014) and under the effect of the economic, social and security instability that followed it, GFCF fell again (-4.3% on average per year). This decline was so pronounced in 2011 (-12.6%) that the recovery recorded in 2012 was not enough to offset it and even continued continuously until 2014. Correlatively, the investment rate, reflecting the country's effort to accumulate capital, is estimated at 22.5% on average over the period 2000-2014. An examination of its evolution over the decade reveals a decline over the period 2002-2005, from 25.3% in 2001 to 21.4% in 2005. (Zribi .Y, Dhaoui. S, Faydi. N ,2016). Starting in 2006, it recovered but did not reach the level achieved at the beginning of the decade. During the post-revolutionary period, a significant decline in GFCF relative to GDP was recorded under the effect of the economic, social and security instability that followed.

The investment rate has declined since the early 2000s and is low. It fell from 24.6% in 2010 to 19% in 2014, reaching 18.4 in 2018. Public investment has so far been largely

preserved. (Zribi .Y, Dhaoui. S, Faydi. N, (2016)[42]. On the other hand, business investment has suffered from excessive regulations in the product market, combined with complex administrative procedures that can generate corruption, unpredictable taxation, increasing difficulties in customs clearance and shipping, and a financial system that is unfavorable to young and growing companies. Removing these constraints is essential to boost business investment and, with it, productivity, job creation and the purchasing power of all Tunisians. These repercussions help explain the weak effect of domestic investment in Tunisia.

4-Relation between PER and GDP per capita rate

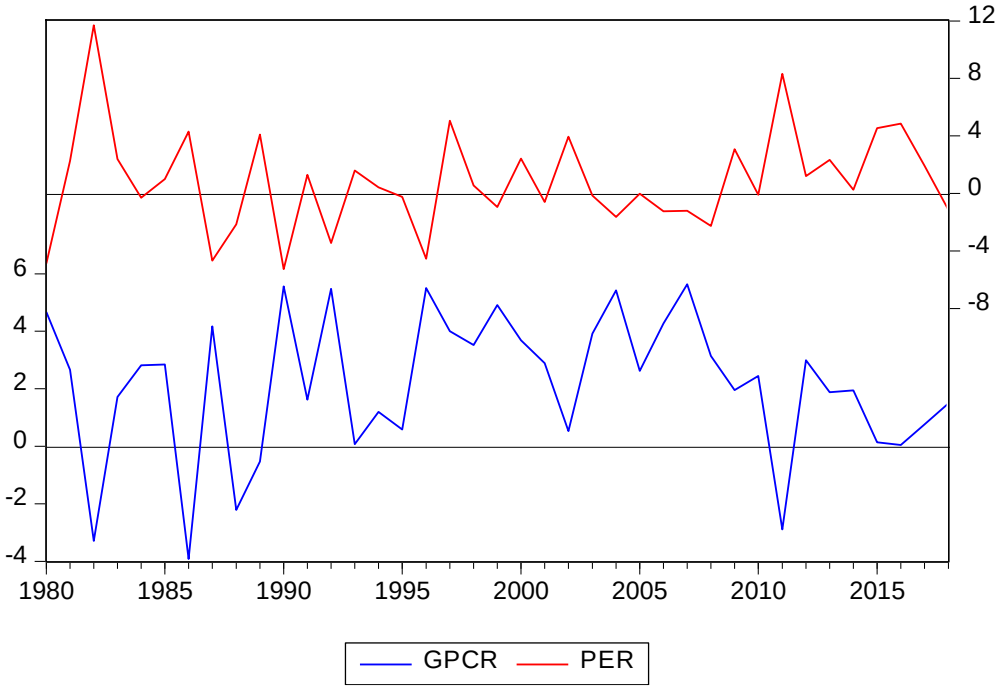

Figure 18: Relation between PER and GPCR

The growth rate of public expenditure (PER) is the variable that shows the highest significance ((Prob = 0.000 < 0.05) (t of student = -8.441462)) and negatively influences the growth rate of real GDP per capita by a coefficient of -0.647388 (Appendix 4). In the same way, the inverse fluctuations are clearly presented in Figure (18). According to theoretical predictions, we have found that the effect of public expenditure or public consumption on the growth rate of real GDP per capita can be negative as well as positive. Indeed, public expenditure contributes to the distribution of income and the maintenance of purchasing power. They contribute to the growth of human capital, the development of infrastructure, and the development of research.

[42] Zribi .Y, Dhaoui. S, Faydi. N (2016), Private Investment in Tunisia: Review and Prospects, Tuisian Institute of Competitiveness of Quantitative Studies, P 8-17

Public expenditure contributes to the creation of public goods that promote growth. On the other hand, public expenditure has in return a share of compulsory levies. These levies have a negative effect on output. Above a certain limit, public spending has a deterrent effect on economic growth, since public spending absorbs a large share of available savings to the detriment of the private sector (crowding out effect)[43]. Too much public expenditure requires more taxes. Beyond a certain limit, the tax yield decreases. "Too much tax kills tax", an idea put forward by Arthur Laffer.

On the other hand, public expenditure remains a powerful instrument for combating the scourge of poverty and increasing the social well-being of the population. Since, public investments in education, health and infrastructure contribute to poverty reduction directly and indirectly by giving the poor access to basic public services and promoting economic growth. But this depends on the distribution of these investments; in particular, the structure and distribution of public expenditure.

Unfortunately, in Tunisia, the composition of public expenditure favors current spending to the detriment of capital spending and is therefore not oriented towards supporting long-term growth. The main component of current expenditure, the civil service wage bill, represented 41.5% of the budget and 14% of GDP in 2017. Between 2010 and 2018, the wage bill in Tunisia increased by 118%, while public investment, although slightly increasing since 2015, represented only 16% and 6.4% respectively. State expenditure has increased from 14 to 31 billion DT between 2010 and 2018. The operation from 10 to 25 (remuneration from 6.7 to 16 and compensation from 2.3 to 7) and equipment from 4 to 6 billion TND. Revenues increased only from TND 12 to 24 billion during the same period. Income tax and indirect taxes were each multiplied by three. The last exit had as objective to raise 500 million Euros to cover the last two months of 2018. It raised only 100 million. The deterioration of public finances is also linked to the continuation of the policy of subsidizing certain commodities and energy, as well as to large social transfers which in 2017 accounted for about 16% of the budget (Tunisian institute of strategic studies,2018).

So, public deficits are undoubtedly today a brake on the recovery of our economy. However, we should not expect the return of growth alone to automatically restore our public finances.

[43] The crowding-out effect is an economic phenomenon characterized by a decrease in investment and private consumption that would be caused by an increase in public expenditure.

5-Relation between PG and GDP per capita rate

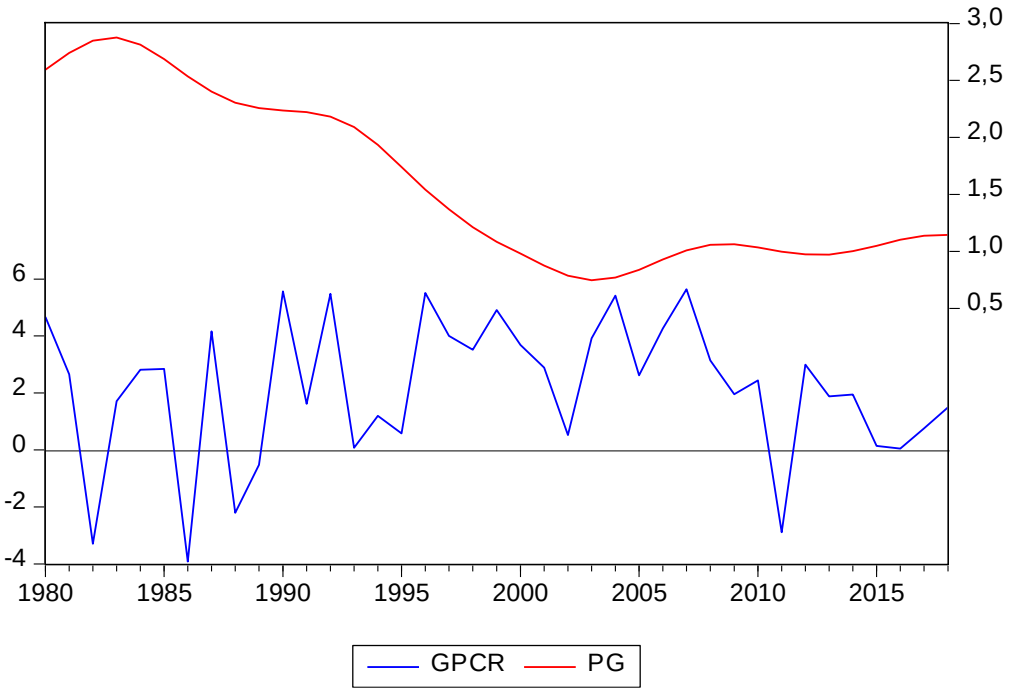

Figure 19: Relation between PG and GPCR

According to Figure (19), the trend of population growth has been downward since 1980, with only a slight increase between 2008 and 2009, which converges with the downward trend of growth. However, the econometric estimate contradicts this convergence.

In fact, the population growth rate is a significant variable ((Prob = 0.0144< 0.05) (student t = -2.615937)) and negatively influences the growth rate of real GDP per capita by a coefficient of (Coeff = -3.163014) (Appendix 4). According to theoretical predictions, the population growth rate is important for the annual determination of real GDP per capita.

Empirical studies of the relationship between population and economic growth by Blanchet (1996), Brander and Dowrick (1994), and Kelley and Schmidt (1994) have shown a negatively significant relationship. According to Romer (1986), endogenous growth depends on the size of the population, which can be perceived as reflecting the scale of the economy. Similarly, studies by many economists such as Ojo and Oshikoya (1995), Hadjimichael and al (1996) have confirmed the influence of the population growth rate on real per capita income. Thus, Romer's thesis seems credible for developing countries such as Tunisia because the population growth rate must be lower than the economic growth rate; this population must be well educated to be optimal. To be more specific, the total Tunisian population corresponds to a growth rate of 1.03% between 2004 and 2014, this figure has slightly increased to 1.145% in 2018, the lowest level recorded since independence. Generally speaking, Tunisia's demography

is ahead of the country's economy and the political perception of demographic changes. Indeed, Tunisia's main demographic indicators place it much closer to developed societies than to emerging countries of the same economic age. Yet, demography is not simply a matter of abstract figures but also a qualitative approach to populations and their dynamics.

On this point, much remains to be done since the policy is still at the stage where it is concerned about the low birth rate, while school enrolments have started to decline since 1995-1996, secondary school enrolments have followed since 2005/2006 and the number of students is beginning to decline (349,142 students in 2008-2009 against 315,513 in 2012-2013). The same phenomenon affects the additional demand for employment, the satisfaction of which has shifted in recent years from a mass to a qualitative problem. More than half of this demand concerns higher education graduates (poorly trained, however), while the state of the Tunisian economy and its structure do not allow it to cope with a flow of more than 70,000 new graduates per year[44]. we can obviously wonder whether this unfilled gap at the level of conceptualization, at the level of politics and its socioeconomic choices, is a uniquely Tunisian characteristic or the direct consequence of a growth model (and not development, contrary to the propaganda conveyed) that has not had the time or the means to reach maturity without suddenly coming up against demographic changes, as was the case in the industrialized world. In this world, in fact, industrialization preceded demographic transition, whereas we have witnessed the opposite phenomenon in Tunisia. In any case, our country is less harassed at present by the constraints of numbers. This should encourage it to recast its development plan on other bases, otherwise demographics, particularly the aging and concentration of the population in certain areas, could risks undermining the entire societal edifice built over the past sixty years.

Therefore, the importance here is not only in numbers, but also in quality. Then, it is indispensable for the State to invest massively in the education and training of its population so that it is efficient for its economy.

[44] Results of Population Census (INS,2014).

6-Relation between LEX and the GDP per capita rate

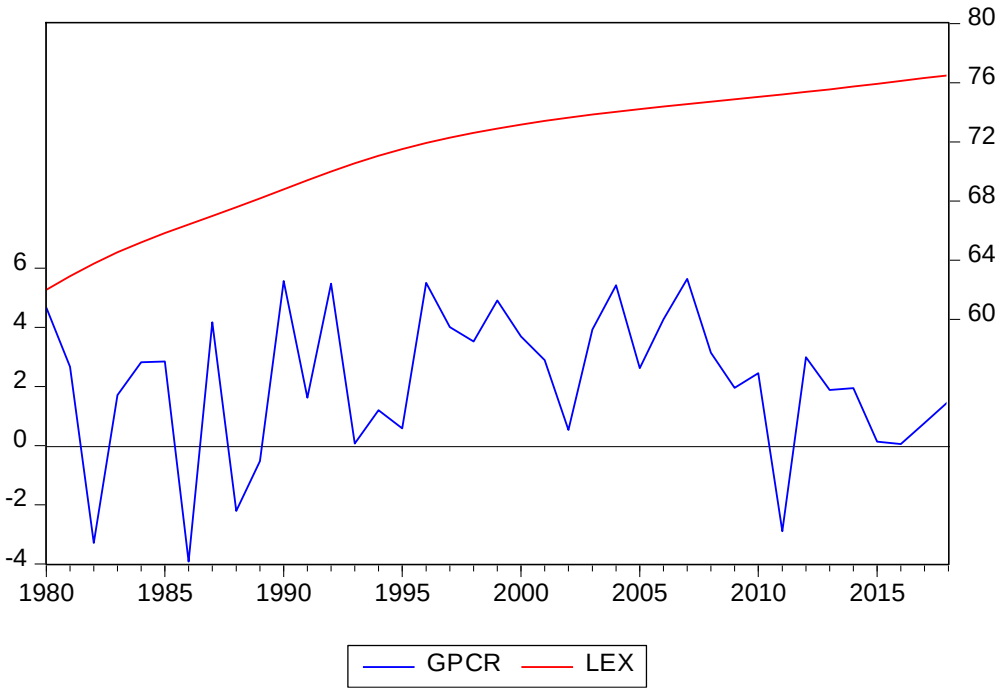

Figure 20: Relation between LEX and GPCR

The trajectories of life expectancy and growth in Figure (20) are different. In fact, the growth rate of real GDP per capita shows intense fluctuations with a downward trend, on the other hand life expectancy was always on a continuous upward trend. This result invalidates some theoretical predictions but confirms the empirical estimate obtained.

Life expectancy is a significant variable at the 5% threshold ((Prob = 0.0289< 0.05) (t of student = -2.307932)) and negatively influences the growth rate of real GDP per capita by a coefficient of (Coeff= -0.447720) (Appendix 4). Remembering that, life expectancy at birth represents the average lifespan - in other words, the average age at death - of a fictitious generation subject to the mortality conditions of the year. It characterizes mortality independently of age structure[45].

Conversely, however, the influence of life expectancy seems less obvious according to this Acemoglu and Johnson (2006). Indeed, the latter show that the increase in life expectancy is not accompanied by a significant increase in per capita income.

In fact, position in the socio-economic hierarchy is a crucial determinant of health status: "the higher one is in the income hierarchy, the lower the mortality, the longer the life expectancy and the longer the life expectancy in good health". (Acemoglu and Johnson ,2006).

[45] World Bank

In addition, to the positive effect of disposable income on health through access to care, health status has an inverse effect on labor income. In health capital models (Grossman, 1972, Erlich and Chuma, 1990), health status determines an individual's working time since his or her level of health capital defines the healthy time available for work, consumption of goods or investment in health capital. In a labor-leisure trade-off, the supply of labor is partly determined by health status, in the sense that poorer health status makes work more arduous. This is not the case in Tunisia, where there is a lack of appreciation of classic health parameters by socio-professional category and income level. Thus, the health system needs a serious improvement in terms of quality and equity of care[46].

According to the World Health Organization, there is a regional imbalance manifested by a higher life expectancy in the coastal regions than in the western and southern regions. The system suffers from a poor geographical distribution of specialized resources to the detriment of the western regions of the country, with problems of adequate and effective availability of services for first- and second-line public structures. Specifically, the health system is managed by the Ministry of Public Health based in Tunis. In the public sector, Tunisians have almost universal access to basic health care, although access to specialized care in rural areas is more limited. Most of the best specialists in the public sector work in university hospitals associated with the country's universities located in major cities.

Furthermore, according to (OCDE,2017)[47] non-medical lifestyle determinants, in particular, play an important role. They include major risk factors such as smoking, alcohol consumption and unhealthy diet and, conversely, health-promoting activities such as physical activity.

However, the broader social determinants of health also come involved, income, education, working and living conditions all play a major role. Having sufficient income enables individuals to purchase the essential goods and services that maintain or improve health nutritious food and housing, for example; however, higher income may be associated with increased work time and stress (Fuchs, 2004). The better educated, who are also often the wealthiest, may be better informed about activities that promote health (Mackenbach and al., 2008). Unemployment and poor working conditions have a pernicious effect on mental health, and some occupations are more exposed to the risk of injury (Bassanini and al., 2008). (Caroli,

[46] « Tunisia Health Insurance » (consulted on July 23, 2018).
[47] OECD (2017), Health at a Glance 2017, What are the factors behind the gains in life expectancy in recent decades? International analysis of OECD member states

2014). Living in an unhealthy, dangerous or polluted environment also increases the risk of illness or death (Gibson and al., 2011; Deguen and Zmirou-Navier, 2010).

7-Unexplained part

Indeed, the analysis of the results of the econometric estimation of the model by long-term OLS mainly seeks to explain the low real GDP per capita in Tunisia. The constant C = represents the residuals of all the variables used in the model. This constant is the share of growth not explained by the data of the variables in the model. It also represents autonomous growth. It is significant and has a positive influence on real per capita income, (Prob = 0.01 < 0.05). This result is evidence that technology determines the amount of production of goods and services in an economy. Furthermore, it is an important indicator of how efficiently an economy streamlines its production process by limiting "waste" through a better combination of variables. Thus, the increase in value added is explained by the efficiency with which workers with their equipment create the added value in an economy. Consequently, the standard of living of a country's population depends on its productive capacity. Thus, the more a country has a high-performance technology with a skilled labor force, the more the real domestic product per capita increases.

C- Non significant Variables

1-The Inflation

Despite its consideration as a threat to economic growth, we have found that inflation is insignificant and therefore it has no effect on economic growth.

This is explained by the fact that the period of the study runs from 1980 to 2018, during which inflation represents a downward trend as shown in Figure (21). Thus, the average inflation value recorded between 1980 and 2018 is 5.298.

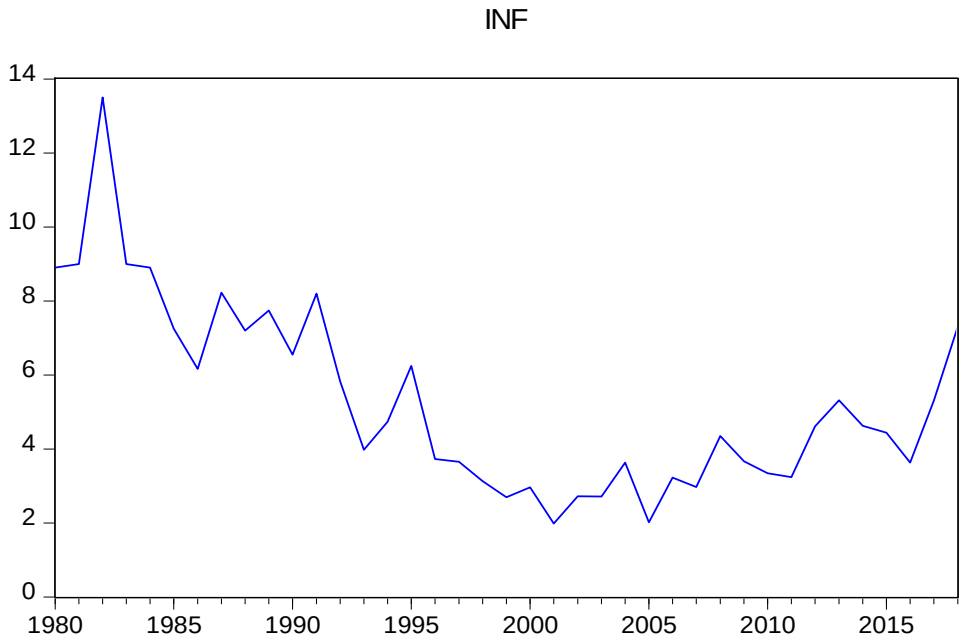

Figure 21: Evolution of inflation

Therefore, we can admit that inflation in Tunisia can negatively affect economic growth at a certain threshold. Moreover, according to the work of Sweidan (2004), who seeks to verify whether or not the relationship between inflation and economic growth has a structural break point effect or not in the Jordanian economy over the period between 1970 and 2003. He finds that this relationship tends to be positive and significant below the inflation rate of 2% and the structural break point effect occurs at an inflation level equal to 2%. Above this threshold level, inflation affects economic growth negatively.

Similarly, Khan and Senhadji (2000) conducted a study in which they not only examined the relationship between low or high inflation and economic growth, but they also evoked an inflation threshold level for industrialized and developing countries over the period from 1960 to 1998. Their result strongly suggests the existence of a threshold above which inflation has a negative effect on economic growth. In particular, the thresholds are between 2 and 3% and between 7 and 11% respectively for industrialized and developing countries.

2-The Term of trade

Similarly, we have recorded that the growth of the term of exchange (TER) is insignificant and does not contribute to economic growth. This can be explained by the superficial integration of Tunisia into the world economy, both in terms of quantity and sophistication of exports. In a way, Tunisia does not "produce" its exports of manufactured goods: it serves mainly as a platform for re-exporting products manufactured and sold

elsewhere, mainly in France and Italy. This particularly unbalanced trade structure reflects the duality of the Tunisian economy, which is increasingly focused on low value-added activities.

In practice, Tunisia has not experienced an increase in manufacturing exports, unlike many other countries. The value added of its manufacturing industry as a percentage of GDP has stagnated after reaching 19% in the early 1990s.

We must mention that, among the countries in the reference group, East Asian countries have the highest share of manufacturing in GDP, with peaks of 31% and 36%, respectively, for Malaysia and Thailand in the 2000s, before declining to 24 % and 34 %, respectively, in 2012. The share of Tunisia's services sector in GDP has steadily increased from 47 % in 1980 to 60 % in 2010, a performance comparable to that of Chile and Mexico, but lower than that of Bulgaria, Mauritius, and Turkey. (Zribi .Y; Dhaoui. S; Faydi. N, 2016).

But, the Tunisia's export performance has been mixed. Tunisian export growth has been positive, but slower than in most countries in the reference group, and its exports as a percentage of GDP have declined from 38 % to 35 % over the last two decades, with a limited increase in the 1990s and a decline in the last decade. There have been no large increases like those observed in East Asia, Bulgaria, or Mauritius in the 1990s. Moreover, Tunisia's imports continued to exceed exports, reflecting a structural deficit in its trade structure. Finally, the share of Tunisian merchandise exports in world trade declined slightly between 2002 and 2010, while most countries in the reference group experienced an increase in their share of world exports[48].

3- The Enrolment rate in university education

As for higher education enrollment rates, they are also insignificant and have no effect on per capita economic growth in the long term. This comes back to the massive orientation of the flow of school success from basic education to secondary education and then from this cycle to higher education, which has led to the massification of the latter cycle. In the context of weak growth in highly qualified employment, the strong growth in the number of graduates poses a problem of professional integration. The qualitative and quantitative mismatch between the needs of the economy and higher education became apparent in the mid-1990s, but it began to grow at the end of the decade, making the employment of higher education graduates a topical issue and a political priority. Thus, the problem of unemployment is particularly acute among young university graduates, as they are unable to find suitable jobs corresponding to their

[48] World Bank Group Middle East and North Africa (June, 2015)

qualifications after graduation. Thus, unemployment is most acute among those with the highest level of education: for example, while it was decreasing among young people with primary education or where they had no education, it was increasing among those with secondary or tertiary education (Kthiri W,2019)[49].

4-The Foreign Direct Investment

In theory, we find a perspective that suggests that FDI does not have an "independent" positive effect on economic growth. Indeed, the impact of FDI on growth depends largely on the conditions of the host country and its absorptive capacity. More specifically, a number of macroeconomic studies have shown that FDI can have a positive impact on economic growth under a number of specific conditions. For example, Blomstrom and al (1994) show that FDI has positive effects on growth when the host country is sufficiently wealthy. In other words, countries must have a certain level of income to be able to absorb new technologies and reap the benefits of FDI. Lautier and Moreaub (2012) show that FDI inflows are strongly influenced by the lagging local investment, which suggests that domestic investment is a powerful catalyst for FDI in developing countries. Both authors conclude that investment promotion policies oriented towards domestic firms are a key and effective factor in attracting foreign investors. In our case, foreign direct investment (FDI) in Tunisia lags behind that of neighboring countries.

For example, in 2007 it represented 4 % of GDP, on the other hand, it was 15 % in Jordan, 13% in Lebanon, and 9 % in Egypt. Recently announced incentives to stimulate investment are moving in the right direction, but more needs to be done to promote competitiveness and facilitate the entry of new firms into the market.

Moreover, according to research conducted at the Tunisian Institute of Competitiveness and Quantitative Studies in 2015 Trabelsi C.H (2015)[50], Foreign Direct Investment in Tunisia is inefficient: it has benefited from advantages without being able to achieve the expected objectives. Seeking to attract more without thinking about its costs would be an unjustified investigation. One must believe Porter's idea that "the factors of production are created, not inherited"; raw materials, skilled labor, infrastructure can be created. The world is dynamic, nations must be at the same level of mutations, companies must keep their level of productivity and therefore be innovative. This is only possible if States act as a catalyst, to help companies

[49] (Kthiri W,2019) Skills mismatch in Tunisia: what are the determinants of underemployment? ITCEQ

[50] Trabelsi C.H (2015), "*Investissement Direct Etranger : une analyse critique pour la Tunisie*", Tunisian Institute for Competitiveness and Quantitative Studies

raise their aspirations, promote competition, and facilitate the exchange and circulation of information. It would be appropriate to stimulate local rivalry by limiting intervention but imposing regulation. In other words, in order to boost economic growth and reduce unemployment, problems must be solved locally; external flows are only complementary. We must rely on national resources; we must frame them in order to benefit from them. Building a new investment code would be an unprofitable investment since foreign investment has shown its limits in achieving the objectives and all the more so since the incentives have had no effect on economic growth.

GENERAL CONCLUSION

« The dinar is a reflection of the health of our economy and we should not believe that depreciation is inevitable. A negative change in the fundamentals of the economy can only lead to a more depreciated dinar. » (Charfi .F,2017).

Since the exchange rate represents a fundamental and strategic macroeconomic variable for public authorities, contributing to the external competitiveness of the economy, it has long been and remains an essential element of monetary policy. Indeed, an unbalanced evolution of its value often has repercussions on the domestic economy in different ways. This is particularly the case of a long-term distortion with adverse consequences for domestic and international competition.

Tunisia is at a crossroads and has a unique opportunity to make radical changes in its economic policies. A new vision is needed for the country's economic development that is shared by a majority of Tunisians and that is then capable of advancing the nature of the reforms needed compared to the current system. This requires strong political leadership to drive a national dialogue on how to create a healthier economic environment, one that can promote investment and enable companies to increase productivity and be highly competitive internationally, while accelerating job creation and at the same time putting in place a system that allows the benefits of this growth to be shared equitably and ensures that no one is left behind.

The objective of this paper was to determine the impact of exchange rate misalignment on economic growth in Tunisia.

At the end of our research, the main finding is that the deviation of the real exchange rate of the dinar from its equilibrium level obtained after calculating the so-called misalignment indicator has a negative impact on per capita economic growth in Tunisia. This main result follows logically from the aggregation of the specific results obtained at the end of the two main stages of our analysis. The first stage involved determining the equilibrium real exchange rate and calculating the misalignment of the exchange rate.

In this context, we sought to identify the determinants of the equilibrium real exchange rate for Tunisia. On the basis of theoretical approaches generally used in the literature, we have estimated an equilibrium behavioral exchange rate model (BEER). The long-term relationship was found between the exchange rate and its determinants, illustrating that the variables

selected (terms of trade, domestic investment, public expenditure, trade policy, and per capita domestic product) have a significant influence in determining exchange rate policy in Tunisia. Our study shows that an improvement in domestic investment, an increase in the degree of openness, an increase in public expenditure and a rise in per capita income led to a long-term appreciation of the real exchange rate. On the other hand, a rise in the terms of trade, an increase in the degree of openness in the long term leads to a depreciation of the real exchange rate. For the short-term we find that the FDI has an effect on the RER in such a way that it allows the real exchange rate to appreciate. However, the other variables have no effect for the short term.

The deviation of the observed real exchange rate of the dinar from its equilibrium level, obtained by calculating the so-called misalignment indicator, shows three remarkable periods of under-evaluations of 0.635 (1980-1981), 0.1956 (1988-1991), 0.0314 (1995-1996), and three over-evaluations of 0.8545(1982-1987), 0.3375 (1991-1994), and 3.4863 (1997-2018).

Thus, the second major stage of our process was devoted to the actual analysis of the relationship between specific misalignment and growth, both theoretically and empirically.

First, at the theoretical level, the idea was to study the theoretical mechanisms of economic growth, its relationship with exchange rate variability and its determinants. Then, at the empirical level, we estimated a growth equation in which misalignment formed the variable of interest, within the group of relevant explanatory variables that we constituted. For this purpose, we first identified the said variables by referring to the model of Barro (1991), Loayza and al. (2005) or Dufrenot and al. (2010). This preliminary step allowed us to estimate the growth equation for the first time. Thus, the omission of some important variables in the specification, or more generally due to the increasing integration of markets and spatial spillover effects, was avoided.

At the end of this preliminary step, we then proceed to the actual estimation of the growth equation using the OLS method. The results show that misalignment has a negative effect on growth precisely in the study period between 1980 and 2018. Similarly, we were able to reveal that the growth rate of the degree of openness and the public expenditures, the population growth and the life expectancy have a negative influence on per capita economic growth. For the domestic investment it has a positive influence on per capita economic growth rate. On the other hand, the rate of term of trade, the inflation, the enrolment rate in university education, and the foreign direct investment have no effect on the per capita economic growth rate.

In fact, we have extended the last section to interpret these results for both variables that showed an effect on growth and those that did not.

Finally, this work shows that the study of the relationship between misalignment and growth still needs to be deepened. Indeed, the review of the literature has revealed that the theoretical explanation of the relationship between misalignment and economic growth does not necessarily find its direct extension in the empirical applications that we have identified. This could explain why results such as ours do not fully converge with those established elsewhere in the literature. Under these conditions, several avenues for improvement can be envisaged.

At the theoretical level, the analysis could be enriched by the construction of a growth model that fully integrates the effects of under- and overvaluation.

Then, at the empirical level, the conclusions of this work could be refined by an analysis that includes the other countries of the Arab Maghreb, namely Algeria, Morocco, Libya and Mauritania. In this case, we can apply an econometric process using the heterogeneous dynamic panel method.

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APPENDICES

APPENDIX 1: Synthesis of some empirical work on the estimation of the equilibrium real exchange rate in developing countries

Authors	Country and period of analysis	Selected variables	Econometric method
Edwards (1989)	12 countries: Brazil, Colombia, El Salvador, Greece, India, Malaysia, Philippines, South Africa, Sri Lanka, Thailand, Yugoslavia (1962 - 1984)	Terms of trade, capital flows, import tax, government spending, productivity differential, excess domestic credit, nominal devaluation, investment over GDP.	Panel data ; Equation of the adjustment dynamics of the short-term effects of the nominal variables, including the devaluation rate. Long-term RER influenced by real fundamentals. Beveridge-nelson technique used to compute the transitory and permanent components of the fundamentals.
Cottani, Cavallo and Khan (1990)	24 countries, including: Argentina, Bolivia, Chile, Colombia, Jamaica, Peru, Urguay, Cote d'Ivoire, Ethiopia, Mali, Somalia, Sudan and Zambia. (1960- 1983)	Terms of trade, degree of openness, net capital flows, excess domestic credit, GDP, growth, foreign inflation, and linear trend.	Estimated by weighted least squares (pooled OLS) ; Three-year moving averages for some fundamentals used as proxies for the permanent component.
Ghura and Grennes (1993)	33 countries in Saharan Africa. (1970- 1987)	Terms of trade, flows of instrumental variables over time series, including country-specific dummy variables (fixed effect).	Estimation of instrumental variables over time series, including country-specific dummy variables (fixed effect).
Elbadawi (1994)	3 countries: Chile, Ghana and India. (1967 - 1990) .	Terms of trade, capital inflows, openness, import tax, government expenditure, productivity differential, domestic credit, nominal devaluation.	Cointegration and ECM; Beveridge-Nelson technique used to calculate permanent components for some fundamentals and 5-year moving average for others.

Soto (1996)	Chile (1978- 1994) quarterly data.	Terms of trade, government expenditure, capital flows, import tax, degree of openness, external debt, interest rate differential, financial disturbance index, terms of trade.	Beveridge-Nelson technique for decomposing fundamentals. Cointegration and ERM. Endogenous transition model.
Feyzioglu (1997)	Finland (1975 - 1995)	Terms of trade, world interest rate, productivity differential.	Cointegration and ECM
Baffes, Elbadawi and O'Connell (1999)	Two countries : Ivory Coast : 1965- 1993 Burkina Faso: 1970- 1993	Terms of trade, degree of openness, trade balance, GDP per capita, investment/GDP, price level abroad.	ECM ;Three-step procedure: order of integration, estimation (Engel- Granger, Johensan), calculation of the equilibrium RCR using the Beveridge-Nelson technique.
Sundararajan and al (1999)	Iran (1970 - 1995)	Terms of trade, GDP per capita, budget deficit, oil prices, net foreign assets, money supply, short-term capital flows, current account balance.	Cointegration and ECM; OLS.
Sinzogan (2000)	Benin (1970 - 1996)	Terms of trade, public spending, money supply and indirect taxes	Johansen's method of cointegration.
Institute of Quantitative Economics (Tunsie) (2001)	Tunisia (1961-2000)	Degree of openness, terms of trade, public consumption, capital accumulation.	Johensan cointegration. Hodrick-Prescott filter
Kalinda mkenda (2001)	Zambia (1965 - 1996)	Terms of trade, degree of openness, ratio of public expenditure to GDP.	Cointegration and ECM
Xiaopu (2002)	Chine. (1980 -1999)	Terms of trade, public expenditure, investment, foreign exchange reserves, indirect taxes, long-term real growth rate.	Johansen's method of cointegration. ECM.

Amel Allahoum (2002)	Algeria. (1973 – 1999)	Target current account, potential output (domestic and foreign), long-term elasticities of foreign trade.	Cointegration by the Johensan method ; Hodrick Prescott filter;
MacDonald and Ricci (2003)	South Africa. (1970- 2001)	Real foreign interest rate, real GDP per capita, wholesale prices, degree of trade openness, fiscal balance relative to GDP.	Johansen.ECM cointegration method.
Ali Abdallah (2004)	Maghreb: Algeria, Morocco, Tunisia. 1965 - 2003	REER index, relative price of agricultural goods, level of specialization of the economy, productivity gaps, foreign production index, FDI in relation to the value of the debt.	VECM.
Mustapha Kamel Nabeli and al World Bank (2004)	53 countries, including 10 from the region MENA (Middle East & North of Africa): Bahrain, Algeria, Egypt, Morocco, Tunisia, Iran, Jordan, Kuwait, Syria, Malta. (1970 – 1999)	Investment/GDP, degree of openness, terms of trade, capital flows, debt service.	Engel and Granger's method of cointegration ;.
Taline Korachelian FMI (2005)	Algeria (1970 - 2003) .	REER, Real GDP (proxy: productivity differential), Real oil price	VECM Cointegration using Johensan's method.
Charfi (2008)	Tunisia (1983-2009)	terms of trade, net capital flows and productivity differential	Cointegration technique
Chnaina Khaled (2013)	Tunisia (1977-2009) annual observations	productivity, terms of trade, the real interest rate of the united states, public consumption, net position of foreign assets and economic openness	Johannsen cointegration technique Saikkonen and Lutkepohl technique

APPENDIX 2: The Long-term Estimation of EQRER

Vector Error Correction Estimates
Date: 10/10/20 Time: 02:15
Sample (adjusted): 1982 2018
Included observations: 37 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LRER(-1)	1.000000
LTE(-1)	0.450482 (0.19351) [2.32791]
LDI(-1)	-0.819528 (0.26634) [-3.07704]
LPE(-1)	-3.838899 (0.37888) [-10.1323]
LTP(-1)	1.872331 (0.23722) [7.89275]
LFDI(-1)	-0.063915 (0.05171) [-1.23600]
LGDPC(-1)	-0.547162 (0.09285) [-5.89267]
C	17.70407

APPENDIX 3: The Short-term Estimation of EQRER

Error Correction:	D(LRER)	D(LTE)	D(LDI)	D(LPE)	D(LTP)	D(LFDI)	D(LGDPC)
CointEq1	-0.164953	-0.097224	0.186096	-0.007313	-0.104025	0.640061	0.222059
	(0.07882)	(0.05888)	(0.06884)	(0.03882)	(0.09549)	(0.73967)	(0.07859)
	[-2.09291]	[-1.65112]	[2.70327]	[-0.18836]	[-1.08941]	[0.86533]	[2.82546]
D(LRER(-1))	0.635922	-0.089856	0.416076	0.272985	-0.337523	1.797757	-0.361539
	(0.27478)	(0.20529)	(0.24001)	(0.13535)	(0.33291)	(2.57882)	(0.27401)
	[2.31426]	[-0.43769]	[1.73358]	[2.01690]	[-1.01385]	[0.69712]	[-1.31946]
D(LTE(-1))	0.043043	-0.155443	0.091421	-0.036834	0.130310	0.255615	0.193003
	(0.26748)	(0.19984)	(0.23363)	(0.13175)	(0.32407)	(2.51032)	(0.26673)
	[0.16092]	[-0.77783]	[0.39130]	[-0.27957]	[0.40211]	[0.10183]	[0.72360]
D(LDI(-1))	0.296987	-0.111322	-0.027339	0.037228	-0.001253	-0.591805	-0.185977
	(0.23107)	(0.17264)	(0.20183)	(0.11382)	(0.27995)	(2.16861)	(0.23042)
	[1.28525]	[-0.64483]	[-0.13545]	[0.32708]	[-0.00447]	[-0.27290]	[-0.80712]
D(LPE(-1))	-0.535928	-0.220287	0.181329	-0.335546	-0.487170	2.283598	0.781903
	(0.45100)	(0.33695)	(0.39393)	(0.22215)	(0.54641)	(4.23263)	(0.44973)
	[-1.18830]	[-0.65377]	[0.46031]	[-1.51046]	[-0.89159]	[0.53952]	[1.73862]
D(LTP(-1))	0.094089	0.112989	-0.205901	0.013091	0.232170	-1.058305	-0.248487
	(0.19828)	(0.14813)	(0.17318)	(0.09766)	(0.24022)	(1.86080)	(0.19771)
	[0.47454]	[0.76275]	[-1.18892]	[0.13404]	[0.96650]	[-0.56874]	[-1.25680]
D(LFDI(-1))	-0.039996	0.006303	0.017966	-0.011881	0.001379	-0.310614	0.038644
	(0.02237)	(0.01671)	(0.01954)	(0.01102)	(0.02710)	(0.20994)	(0.02231)
	[-1.78792]	[0.37710]	[0.91946]	[-1.07826]	[0.05087]	[-1.47953]	[1.73238]
D(LGDPC(-1))	0.415323	-0.139907	0.367134	0.039602	-0.562135	3.174483	-0.061496
	(0.32444)	(0.24239)	(0.28338)	(0.15981)	(0.39307)	(3.04485)	(0.32352)
	[1.28012]	[-0.57719]	[1.29554]	[0.24781]	[-1.43011]	[1.04257]	[-0.19008]
C	0.003056	0.006873	-0.037617	0.002702	0.034355	-0.174467	0.031640
	(0.02169)	(0.01620)	(0.01894)	(0.01068)	(0.02627)	(0.20353)	(0.02163)
	[0.14093]	[0.42418]	[-1.98589]	[0.25294]	[1.30755]	[-0.85721]	[1.46311]

APPENDIX 4: OLS estimation of long-term relation between MIS and GPCR

Dependent Variable: GPCR
Method: Least Squares
Date: 02/11/20 Time: 06:07
Sample (adjusted): 1980 2017
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	40.12347	14.69981	2.729524	0.0110
MIS	-1.405341	0.726169	-1.935281	0.0635
TER	0.002036	0.052318	0.038916	0.9692
TPR	-0.095852	0.033514	-2.860026	0.0081
DIR	0.146099	0.043960	3.323484	0.0026
PER	-0.647388	0.076691	-8.441462	0.0000
INF	0.066389	0.214409	0.309638	0.7592
PG	-3.163014	1.209132	-2.615937	0.0144
EN	0.007857	0.053401	0.147138	0.8841
LEX	-0.447720	0.193992	-2.307932	0.0289
FDI	-0.142707	0.180075	-0.792486	0.4350

R-squared	0.795317	Mean dependent var	2.178571
Adjusted R-squared	0.719509	S.D. dependent var	2.509939
S.E. of regression	1.329299	Akaike info criterion	3.644379
Sum squared resid	47.70999	Schwarz criterion	4.118417
Log likelihood	-58.24320	Hannan-Quinn criter.	3.813038
F-statistic	10.49115	Durbin-Watson stat	2.330479
Prob(F-statistic)	0.000001		