The "twin deficits", are-they really twins? An empirical investigation in the case of a small developing economy

(Preliminary version)

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Abstract

This paper explores the empirical relationship between budget and current account deficits in the case of a small developing country, Tunisia. The main objective of the investigation is to test the empirical validity of the Ricardian Equivalence Proposition (REP) compared to the Conventional View in the case of a developing country.

The absence of a significant positive causal link between budget and current account deficits means the validation of the REP. While, a long-run relationship between the two aggregates does demonstrate their dependence and consequently validate the Conventional View. The causality direction predictable, in consistence with the traditional theory, is from the internal deficit to the external one. However, the opposite direction is also tested.

The econometric method used is based on Error-Correction Modelling in a bivariate than a trivariate setting. The data are annual from 1972 to 2000.

However, the theoretical foundations of the "*twin deficits phenomenon*" are first exposed. The main results of the empirical literature in this area are also reviewed. Several issues related to the data and to the econometrical methodology, are discussed. Finally, the results of the different econometrical estimations and their policies implications are summarized.

Results are more consistent with the REP than with the Conventional View. No positive causal link between the two deficits is demonstrated. Yet, by using a residual analysis, we demonstrate that the budget and the current account deficits are co-integrated. In fact, we validate in this second case two significant long-run relationships in which the budget deficit variation is explained by the current account one and vice versa.

Key words: Ricardian Equivalence Proposition, Error-Correction Modelling, Budget Deficit, Current Account Deficit.

JEL Classification: E62, F40, H62.

Les deux déficits, budgétaire et du compte courant, sont-ils jumeaux ? Une étude empirique dans le cas d'une petite économie en développement

(Version préliminaire)

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Résumé

Ce papier examine le lien empirique entre déficit budgétaire et déficit du compte courant dans le cas d'une petite économie en développement, la Tunisie. Il s'inscrit dans la continuité d'une série de tests économétriques ayant pour objectif la validation empirique de la Proposition de l'Equivalence de Ricardo (PER) par rapport à la vision conventionnelle, dans le cadre des économies en développement, la Tunisie comme exemple.

En effet, l'absence d'un lien de causalité entre le déficit budgétaire et du compte courant signifie la validation de la PER au détriment de la vision conventionnelle. Par contre, l'existence d'une relation significative de long terme entre les deux déficits met en évidence leur dépendance et valide, par conséquence, la vision conventionnelle. Par ailleurs, bien que le sens de causalité prédictible est plutôt du déficit intérieur vers le déficit extérieur, le sens inverse est également testé.

La méthode économétrique utilisée se base sur la Modélisation à Correction d'Erreur (*Error –Correction Modeling)* et l'examen de la causalité dans un cadre à deux puis à trois variables. Des tests de robustesse des résultats sont également appliqués.

Toutefois, sont au préalable exposés les fondements théoriques de la problématique des « *déficits jumeaux* ». Une revue des principaux résultats empiriques en la matière est également établie. Différentes issues relatives aux données et à la méthodologie sont par ailleurs discutées. Enfin, sont synthétisés, les résultats des différentes estimations économétriques ainsi que leurs implications en matière de politique économique.

Les données utilisées sont annuelles et couvrent la période de 1972 à 2000. Les résultats sont plutôt en faveur de la PER. Aucun effet de retour positif entre les deux déficits n'a pu être démontré. Toutefois, en adoptant une analyse par les résidus, nous démontrons que les deux déficits sont co-intégrés. En effet, selon cette seconde approche, deux relations de long terme ont été validées. La variation du déficit courant est expliquée par celle du déficit budgétaire et vice versa.

Mots clés : Proposition de l'Equivalence de Ricardo, Modélisation à Correction d'Erreur, Déficit budgétaire, Déficit courant, déficits jumeaux.

Classification JEL: E62, F40, H62.

Introduction

The aim of this paper is to revisit the "*twin deficits*" concept in the case of a small developing economy, Tunisia. In fact, although that many studies were interested in the examination of the relationship between budget and current account deficits, no consensus does nowadays exist about the exact nature of the link between the two aggregates.

Many questions are asked by both economists and policies makers: Are the two deficits independent or correlated? And if they are closely linked-up, in which direction, does the Granger-causality play? In other words, does the budget deficit Granger-cause the current account deficit or is it in the opposite direction that the causality does exist? To these interrogations, the answers are multiple and in some cases contradictory[1].

So that, the objective of this paper is to know whether the two deficits are really co-integrated or their correlation is simply a statistical coincidence.

The policies implications of the problem studied are far from being interest-less. In fact, when a long-run relationship between the two deficits is validated, both budgetary and trade policies have to be reviewed because of their interdependence. Moreover, when the causality's direction between the two aggregates is identified, the prior order between the two deficits must inevitably be reconsidered. Which one of the two deficits has to be the instrument and which one has to be the objective?

In this context, Kasibhatla and al. [2001] remark that the validation of a causal relationship between the two deficits means that the policy makers must design an integrated solution geared towards reducing the budget deficit problem. This integrated approach would be probably more effective than a dualist one in which budget and trade policies are defined separately with independent targets.

Ahmed and Ansari [1994] argue that if the "*twin deficits*" hypothesis is closed to the real world, then the government could not reduce the current account deficit as soon as the budget deficit does persist. If, however, the "*twin deficits*" hypothesis is far from the reality, a persistent current account could be justified not by fiscal deficits but by other factors such as international competitiveness, international mobility of factors and demand for domestic investment goods.

To answer some of these interrogations, we are interested in studying the empirical relationship between the two deficits in the case of a small developing country, Tunisia. The investigation is one of a series of econometric tests[2] developed to examine the empirical validity of the Ricardian Equivalence Proposition (REP) by opposition to the Conventional View in the case of Tunisia. The data are annual from 1972 to 2000.

The methodology adopted is based on *Error-Correction Modelling* in a bivariate than a trivariate setting. The unit root tests and the co-integration tests are firstly performed. Secondly, the causal links between the two aggregates, in both directions, from budget to current account deficits and vice versa, are

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[1] See table 1 included in this paper and in which we summarise the main results of some empirical investigations interested in the relationship between the two deficits.

[2] The examination of the empirical relationship between budget deficit and current account deficits is the second test of a series of econometrical tests having as aim the empirical validation of the REP in the case of Tunisia. The first test investigates the empirical relationship between budget deficit and economic growth.

examined. Finally, tests of results robustness are used. The aim of this last step of the analysis is twice. On the one hand, the robustness tests help to divert the difficulty of the time series relatively short. And on the other hand, they lead to test the hypothesis of time stability of the long-run relationships.

The paper is divided into three sections. In the first section, we both, expose the theoretical foundations of the "*twin deficits*" problem and review the main results of the empirical literature in this area. In section two, we discuss several issues related to the data and to the econometrical methodology. Finally, we summarise in section three results of different econometrical estimations and their policies implications.

Section I: Theoretical foundations and empirical studies

Since the Barro [1974] seminal paper, the "*twin deficits phenomenon*" has been one of the most controversial subject in modern macro economy. In fact, during the last three decades, the relationship between the budget and the current account deficits has been more and more contentious. In fact, between the Conventional View and the Ricardian Approach, there is a huge gap. While, the first approach argues in favour of a direct link between the two deficits, the Ricardian Equivalence Proposition (REP) stipulates that an increase in the budget deficit does not affect the current account balance and vice versa.

1. The Conventional View

The theoretical foundations of the relationship between the two deficits as underlined by the traditional[3] macroeconomic analysis, is derived from the following equation.

$$CC = S^p - I - (G - T) \quad \text{[I]}$$

With CC is the current account; S^p is the private saving; I is the private investment; G are the government purchases; and T are the direct taxes collected from households and firms.

Equation [I] stipulates that the current account CC is directly linked-up to the budget deficit $(G - T)$ defined as the difference between public purchases and fiscal receipts collected from households and firms.

If the difference between private saving and investment $(S^p - I)$ is constant, an increase of budget deficit (an increase in public purchases when fiscal receipts remain unchanged) will influence positively the current account deficit.

However, the theoretical literature related to the "*twin deficits phenomenon*" ads to this direct relationship resulting from equation [I], the interest rate's effect to predict the evolution of the current account balance due to the variation of the budget deficit. In fact, an increase in budget deficit induces an increase of interest rates in the economy. In the context of an open economy, this increase of the capital return will affect positively the attractiveness of the economy to foreign investments. When foreign capital flows increase, this would lead to the appreciation of the local currency and consequently to

[3] The theoretical foundations of the relationship between the two deficits are Keynesian. See Vamvoukas [1997; 1999] and Winner [1993].

cheaper imports and more expensive exports. And so, when the interest rate effect is integrated in the analysis, the impact of the budget deficit on the current account deficit is negative.

To sum up, under the Conventional View, direct and indirect links between the two deficits are demonstrated. The sign of each effect is also predictable. Yet, The total effect of the budget deficit increase on the current account remains indeterminate. Its depends upon the relative weight of the positive and the negative impacts.

2. The Ricardian Equivalence Proposition

By opposition to the Conventional View, the Ricardian Equivalence Proposition (REP) stipulates that budget and current account deficits are independent. Under some restrictive assumptions, and when public purchases remain unchanged, the budget deficit does not affect the current account. The explanation of this neutrality is based on the following idea: If we admit that a cut in current taxes is necessarily associated to an equivalent increase in future taxes, a fiscal policy does not affect private consumption or national saving. Consequently, it does not affect the national production, the interest rates, the trade balance and the current account deficit.

However, for many economists, the REP is a hypothetic situation, an ideal that can not be reached. In fact, the validity of the Equivalence hypothesis depends on some powerful assumptions. Consequently, the budget deficit does not matter if and only if these assumptions are respected. These assumptions such are summarized in the related literature[4] are:

[1] Capital markets are perfect (i.e. without any liquidity constraints) and if not, they fail in specific ways;

[2] Economic agents mainly consumers are rational and well informed. Moreover, they are farsighted which means that they satisfy the infinite horizon condition;

[3] Altruistically motivated transfers do exist between successive generations;

[4] The postponement of taxes does not exercise any redistributive effect across families with systematically different marginal propensities to consume;

[5] Taxes are not distortionary and they are lump-sum per capita;

[6] Deficits are not value-creating even through bubbles;

And [7] the manner in which deficits are financed does not alter the political process (i.e. the electoral process and of the choice of government).

However, during the last two decades, the theoretical and empirical literature interested in the REP's hypothesis, has been extended to the developing economies context. The key idea in which this literature is based could be summarized as follows: The rejection of the Equivalence hypothesis is probably more recurrent in developing than in developed economies. In fact, on the one hand, the conditions required to validate the Ricardian proposition in developed countries remain necessary in developing economies. However, the likelihood to satisfy them is less in the second case than in the first.

In this context, Haque and Montiel [1987]; Rossi [1988] and Lopez and al. [2000] argue that as in the case of developed countries, the assumption of perfect capital markets could not be respected in

[4] Papers interested in the discussion of the conditions of the REP's validity are multiple. See Berheim [1989] and Ricciuti [2003], among others.

developing countries. Yet, liquidity constraint and credit rationing are more significant in developing than in developed countries. The financial repression is more pronounced in countries where governments introduce measures to give priority to public debt. So that, in these circumstances, every increase in budget deficit is associated to an increase in capital markets imperfections. Finally, the existence of the parallel credit market and the development of the non-monetary credit activity contribute to the increase of the financial repression in these countries.

Blanchard [1985] and Faruquee and al.[1997] outline that the economic agents in developing as in developed economies, do not satisfy or partially satisfy the hypothesis of infinite horizon of Barro [1974].

On the other hand, sum additional specific conditions have to be joined in developing economies to validate the REP's hypothesis. In fact, Giorgiani and Holden [2003] argue that the weight of the parallel economy in developing countries could influence negatively the rationality of economic agents. In fact, the latter are so reactive to information when available.

3. Empirical studies

Since the theory is oscillating between the Conventional View and the REP, many empirical studies have been interested in the relationship between the two deficits during the last three decades. The question asked by all these investigations is the following: Which approach will prevail over the other and in which circumstances?

The "*twin deficits phenomenon*" is studied in both developed and developing countries. However, the American case has monopolized the majority of these empirical studies (Hatemi and Shukur [2002]; Leachman and Francis [2002]; Kasibhatla and al. [2001]; Rahman and Mishra [1992]; Zietz and Pemberton [1990] and Walter, and Bong-soo [1990]). Yet, no consensus has emerged from all these studies. Results are divergent and in some times inconclusive.

By using quarterly data related to the American economy from 1975 to 1998, Hatemi and Shukur [2002] validate a causal effect between the two deficits. However, by integrating the time stability concept to the analysis, they outline an original result. During the period from, 1975 to 1989, they demonstrate that the Granger-Causality does exist in only one direction, from the budget to the current account deficits. While during the period from 1990 to 1998, the causality validated is in the opposite direction i.e. from the external to the internal deficits.

Leachman and Francis [2002] use also quarterly data of the American economy but with longer time series from 1948 to 1992. They do not succeed in the validation of the "*twin deficits phenomenon*" during all the period studied. The explanation of this result sensitive to the sub-periods examined, as given by the authors, is closed to the exchange regime adopted. In fact, during the *Bretton Woods* agreements period, the "*twin deficits phenomenon*" is not validated. Yet, since 1974, when the fixed exchange regime has been abandoned, the two deficits are co-integrated. The causal relationship is from the internal deficit to the external one.

The empirical studies interested in the "*twin deficits phenomenon*" in the case of developed countries are relatively not many. Kaufmann and al. [2002] study the empirical relationship between the two deficits in the Austrian case. They don't validate any causal effect between the two aggregates. Ahmed and Ansari [1994] demonstrate that in the Canadian case, the two deficits are linked to each other but also to the gap between saving and investment. In fact, the authors show that both the budget deficit and the gap between saving and investment are statistically significant in the explanation of the current account deficit.

Some studies adopt a comparative approach between different countries, developed and developing. The majority of these studies are inconclusive about the nature of the relationship between the two aggregates (Fidrmuc [2003]; and Kouassi and al. [2004]).

The examination of the empirical relationship between the two deficits, in the case of developing countries, does not constitute an exception to the rule of the "*case by case*" and mainly the studies of Kulkarni and Erickson [2001]; d'Anoruo and Ramchander [1998]; and Islam [1998].

The main results of the different empirical studies mentioned in our review of the literature are summarized in table 1.

Table 1: Main results of some empirical studies interested in the relationship between the two deficits

Authors	Sample	Period	Main results
Ahmed and Ansari [1994]	Canada	1973-1991 (AD)	The current account deficit is correlated to both budget deficit and saving-investment gap.
Anoruo and Ramchander [1998]	Five developing economies of Southeast Asia[5]	Periods varying with information availability[6] (AD)	A unidirectional causal relationship is validated. In fact, for four countries of the sample, the causality is from the current account deficit to the budget deficit. And even, in the fifth case (Malaysian case) the "*twin deficits phenomenon*" is not rejected. The causality is yet bidirectional.
Fidrmuc [2003]	A selection of ten developed and in transition economies[7]	1980-2001 (AD)	Validation of the "*twin deficits phenomenon*" in some economies of the sample with fundamental differences between the first and the second decade studied.
Hatemi and Shukur [2002]	United States	1975-1998 (QD)	Validation of the "*twin deficits*" hypothesis. However, during the sub-period from 1975 to 1989, the Granger-causality does exist from budget to current account deficits. While, from 1990 to 1998, the Granger-Causality is validated in the opposite direction i.e. from external to internal deficits.
Islam [1998]	Brasil	1973-1991 (QD)	A bilateral Granger-Causality between the two deficits is validated.
Kasibhatla and al. [2001]	United States	1959-1993 (QD)	The budget deficit does Granger-cause the current account one.
Kaufmann and al. [2002]	Australia	1986-1998 (QD)	The causal relationship between the two deficits is not validated.
Kouassi and al. [2004]	A sample of twenty developed and	Periods varying with information	* Validation of a causal relationship between the two deficits (unidirectional or bidirectional) in the

[5]The sample includes India, Indonesia, Korea, Malaysia and the Philippines.

[6] India and Philippines, from 1957 to 1993 ; Malaysia, from 1960 to 1993 ; Korea, from 1967 to 1993 and Indonesia, from 1970 to 1993.

[7] The ten countries of the sample are : Australia, Austria, Canada, Finland, France, Mexico, The Netherlands, Spain, United Kingdom, and United States of America.

	developing countries[8]	availability and in most of cases between 1969 and 1998 (AD)	case of some developing countries but globally results are mixed. ▪ A unidirectional causal relationship from budget to current account deficits in the case of Israel. ▪ A causal relationship but in the opposite direction i.e. from current account deficit to budget deficit in the Korean case. ▪ A feed back effect i.e. a bidirectional causal relationship for Thailand. * For developed countries, the evidence for any causal link between the two deficits is less convincing. Only in the Italian case, causality is validated in one direction from current account deficit to budget deficit.
Kulkarni and Erickson [2001]	India, Pakistan and Mexico	1969-1996 (AD)	▪ The "*twin deficits phenomenon*" is not validated in the Mexican case. ▪ In the case of India and Pakistan, the two deficits are correlated. However, while in India, the traditional scheme of the budget deficit creating the current account deficit is validated, for Pakistan, the causal relationship in the opposite direction is demonstrated.
Leachman and Francis [2002]	United States	1948-1992 (QD)	The "*twin deficits phenomenon*" is not validated during the post-World War II period under the *Bretton Woods* agreements. Since 1974, when the fixed exchange regime was abandoned, the two deficits had been co-integrated. The uni-directional causal relationship validated is from the internal to the external deficits.
Rahman and Mishra [1992]	United States	1946-1988 (AD)	The two deficits (defined in nominal levels) are not co-integrated. A long-run equilibrium relation between the two deficits is not demonstrated.
Vamvoukas [1997 ; 1999]	Greece	1948-1993 (AD)	Validation of a unidirectional causal effect from budget to current account deficits.
Walter and Bong-soo [1990]	United States	1947-1987 (QD)	The hypothesis of the two deficits independence is not rejected.
Winner [1993]	Australia	1948-1989 (AD)	Rejection of the hypothesis of the dependence of the two deficits. The budget deficit does not exercise a significant effect on the current account deficit and vice versa.
Zietz and Pemberton [1990]	United States	1972-1987 (QD)	▪ The American current account deficit during the 80's could not be entirely explained by macroeconomic fundamentals and a fortiori by budget deficit. ▪ The budget deficit could influence the current account deficit more via revenues and consumption than through interest and exchange rates.

- (AD) Annual Data.
- (QD) Quarterly Data.

[8] Developed countries of the sample are : Australia, Austria, Canada, France, Italy, Netherlands, New Zealand, Sweden, United Kingdom and Unites States. The sub-sample of developing countries includes Columbia, Dominican Republic, India, Israel, Korea, Malaysia, Singapore, South Africa, Thailand and Venezuela.

Section II: Data and methodology

To investigate the empirical relationship between budget and current account deficits, we adopt a three steps approach. Firstly, the unit root tests and of co-integration are applied to different time series. Secondly, the causal links between budget and current account deficits are studied in both bivariate and trivariate settings. Thirdly, and in order to validate empirical models, tests of robustness are used.

1. Data and variables

The empirical tests described in this paper are done in time series. Data are annual from 1972 to 2000[9]. The choice of the period studied is dictated by the availability of statistical data. Two different database are used, the World Bank Database, *(The World Development Indicators Database)* and the database of the "*Centre d'Etudes Prospectives et Informations Internationales* (*CEPII*)" (*CHELEM* or "*Comptes Harmonisés sur les Echanges et l'Economie Mondiale*" database).

Three variables are identified to study the causal links between budget and current account deficits:

- The budget deficit: B_t ;
- The trade deficit or the current account deficit: T_t ;
- And the Gross Domestic Product (GDP): Y_t .

The first variable B_t is calculated through the transformation of the budget deficit at current prices as it is evaluated in the database[10] to a budget deficit at constant prices. The deflator used is that of GDP (referential year is 1990).

The second variable T_t is extracted from the *CEPII* database. The current account deficit evaluated in current local currency is transformed in to current account deficit measured in constant local currency. The deflator used is also that of GDP (referential year is 1990).

The third variable used as a control's variable is the Gross Domestic Product (GDP), Y_t . This variable is extracted from the World Bank database. It was initially, evaluated in current domestic currency. Consequently, it is transformed in constant prices variable by using the GDP deflator (referential year is 1990).

The three variables are expressed as natural logarithms.

The evolution of the three variables is illustrated by the graphs annexed to this paper (graphs 1 to 4).

[9] Ahmed and Ansari [1994]; Kulkarni and Erickson [2001]; Fidrmuc [2003] and Kouassi and al. [2004] used similar sized time series with the same frequencies. To avoid the critic of time series relatively short, tests of robustness are usually used. They give an idea about the sensitivity of results to the time series size. In our case, the Cusum and the Cusum of squares tests are performed to know whether the models estimated are time stable or not. See time stability tests annexed to this paper.

[10] The variable budget deficit as it is defined in the World Bank Database, is the difference between current revenues, capital revenues and official grants, on the one hand and total expenditures on the other hand. The data concerns the central administration and are evaluated in local currency at current prices. The sources of data used are: (i) The database of the International Monetary Fund and (ii) the database of the Tunisian ministry of finance.

2. Methodology

In a co-integrated system of two time series[11], expressed by an Error Correction Model (ECM) representation, causality must exist, at least, in one way. If B_t and T_t are co-integrated, an ECM representation could have the following form:

$$\Delta B_t = a_0 + a_1 E_{t-1} + \sum_{i=1}^{n} a_{2i}(1-L)\Delta B_{t-i} + \sum_{i=1}^{n} a_{3i}(1-L)\Delta T_{t-i} + u_t [1]$$

And

$$\Delta T_t = b_0 + b_1 C_{t-1} + \sum_{i=1}^{n} b_{2i}(1-L)\Delta B_{t-i} + \sum_{i=1}^{n} b_{3i}(1-L)\Delta T_{t-i} + \varepsilon_t [2]$$

L is the lag operator; Δ is the difference operator; E_{t-1} and C_{t-1} are error correction terms and u_t and ε_t are white noise disturbance terms.

The error correction term E_{t-1} represents the lagged value of the residuals from the Ordinary Least Squares (OLS) regression of B_t on T_t.

While the error correction term C_{t-1} represents the lagged value of the residuals from the Ordinary Least Squares (OLS) regression of T_t on B_t.

In the equations [1] and [2], ΔB_{t-i}, ΔT_{t-i}, u_t and ε_t are stationary. This means that their right hand side have to be stationary also.

Consequently, the formulation of the ECM in the equations [1] and [2] implies that:

ΔB_t does not Granger-cause ΔT_t if the parameters $a_1 = 0$ and $a_{3i} = 0$; and,

ΔT_t does not Granger-cause ΔB_t if the parameters $b_1 = 0$ and $b_{3i} = 0$.

However, the causal link between the two variables B_t and T_t could be due to a third variable. Such a possibility could be investigated in a trivariate framework by using a control's variable. In our case, the third variable introduced to study the causal relationship between budget and current account deficits, is the Gross Domestic Product. In the trivariate setting, the co-integration regressions could be specified as follow:

$$B_t = k_0 + k_1 T_t + k_2 Y_t + E_t [3]$$

and

$$T_t = \lambda_0 + \lambda_1 B_t + \lambda_2 Y_t + C_t [4].$$

[11] The theoretical foundations of the approach used are developed by Engle and Granger [1987]. Many other studies used the same methodology. See Vamvoukas [1997; 1999 and 2000].

With $k_0, k_1, k_2, \lambda_0, \lambda_1 et \lambda_2$ are regression coefficients, Y_t is the real GDP; E_t and C_t are error correction terms.

However, before studying the co-integration between variables, every time series have to be subject of a stationarity examination since one prior condition of co-integration is that the variables have to be integrated of the same order. And if linear combinations $B_t - k_0 - k_1 T_t - k_2 Y_t = E_t$ and $T_t - \lambda_0 - \lambda_1 B_t - \lambda_2 Y_t = C_t$ are co-integrated of order zero I (0) so B_t and T_t could be generated by the following ECM representations:

$$\Delta B_t = a_0 + a_1 E_{t-1} + \sum_{i=1}^{n} a_{2i}(1-L)\Delta B_{t-i} + \sum_{i=1}^{n} a_{3i}(1-L)\Delta T_{t-i} + \sum_{i=1}^{n} a_{4i}(1-L)\Delta Y_{t-i} + u_t [5]$$

And

$$\Delta T_t = b_0 + b_1 C_{t-1} + \sum_{i=1}^{n} b_{2i}(1-L)\Delta B_{t-i} + \sum_{i=1}^{n} b_{3i}(1-L)\Delta T_{t-i} + \sum_{i=1}^{n} b_{4i}(1-L)\Delta Y_{t-i} + \varepsilon_t [6]$$

With E_{t-1} and C_{t-1} the lagged values of the residuals of equations [3] and [4]. Consequently, equations [5] and [6] indicate that the ECM representation and co-integration are equivalent since they form a trivariate vector auto regression in first differences augmented by the error correction terms E_{t-1} and C_{t-1}.

With the [5] and [6] formulations, ΔB_t does not Granger-cause ΔT_t if the parameters $a_1 = 0$ and $a_{3i} = 0$ and $a_{4i} = 0$;

And equivalently, ΔT_t does not Granger-cause ΔB_t if the parameters $b_1 = 0$, $b_{2i} = 0$ and $b_{4i} = 0$.

Section III: econometric results

1. Unit root tests

The first step of the analysis is to examine the stationnarity of the time series. The Dickey Fuller tests[12] are applied to series in both levels and first differences.

For the variables in levels, the ADF tests are applied since the examination of the correlogramms (auto correlation (AC) and partial correlation (PAC)) shows the existence of some lags significantly different from zero.

While, for variables defined in first differences, the simple DF tests are applied. In fact, the correlogramms diagnostics demonstrate that no lag is significantly different from zero.

[12] The Dickey Fuller tests [1979] and the Augmented Dickey fuller tests [1981] are respectively noted AD and ADF.

The Augmented Dickey-Fuller tests [1981] are based on the estimation by the Ordinary Least Squares method of the following three different models, with the alternative hypothesis $|\phi_1| \prec 1$:

$$\Delta x_t = \varphi x_{t-1} - \sum_{j=2}^{p} \phi_j \Delta x_{t-j+1} + \varepsilon_t \,(1)$$

$$\Delta x_t = \varphi x_{t-1} - \sum_{j=2}^{p} \phi_j \Delta x_{t-j+1} + c + \varepsilon_t \,(2)$$

$$\Delta x_t = \varphi x_{t-1} - \sum_{j=2}^{p} \phi_j \Delta x_{t-j+1} + c + bt + \varepsilon_t \,(3)$$

With $\varepsilon_t \rightarrow i.i.d.$

For the variables in first differences, if the Hypothesis $H_0 : \phi_1 = 1$ is validated in one of the three models using in DF tests, the process is not stationary. The three models are the following:

$$x_t = \phi_1 x_{t-1} + \varepsilon_t \,(1)$$

$$x_t = \phi_1 x_{t-1} + \beta + \varepsilon_t \,(2)$$

$$x_t = \phi_1 x_{t-1} + bt + c + \varepsilon_t \,(3)$$

The unit root tests are conducted with the three possible specifications of the model, with constant, with constant and time trend and without neither constant nor time trend.

The results of the ADF tests indicate that the three time series are not stationary in levels. However, the DF tests applied to the first differences reject the null hypothesis of the unit root at 1% level of significance in the majority of cases (and at 5% in the other cases). Since the first differences are stationary, the three variables are integrated of order 1, (I(1)).

Moreover, the Phillips and Perron tests[13] [1988] are applied for a Newey-West truncation value of 3. Results are in conformity with those of the DF and ADF tests. All the time series are non stationary in levels but stationary in first differences.

The details of the unit root tests are summarized in tables 2 to 4.

Table 2: Determination of the lag order for applying the DF and ADF tests

Series	The lag order significantly different from zero (correlogramms analysis : Autocorrelation function)	
	levels	First differences
Yt	p = 5(C simple), p = 1(C partiel)	p = 0
Bt	p = 1	p = 0
Tt	p = 2(C simple), p = 1(C partiel)	p = 0

- Total lags included : 15.

[13] The Phillips and Perron tests [1988] are noted the PP tests.

Table 3: Results of the unit roots tests (DF and ADF tests)

a. Tests in Levels

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
Yt	-1,292(n.s)	-2,789(n.s)	5,510(n.s)
Bt	-2,740 (10%)	-2,566(n.s)	0,646(n.s)
Tt	-1,993(n.s)	-2,679(n.s)	1,132(n.s)

- (n.s) non significant.
- Mac Kinnon [1991] critical values for rejection of hypothesis of unit root are applied.

b. Tests in first differences

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
Yt	-6,310 (1%)	-6,366 (1%)	-2,000 (5%)
Bt	-7,267 (1%)	-7,265 (1%)	-7,295 (1%)
Tt	-7,011 (1%)	-6,928 (1%)	-6,859 (1%)

- (n.s) non significant.
- Mac Kinnon [1991] critical values for rejection of the hypothesis of unit root are applied.

Table 4: Results of the unit root tests (PP Tests)

a. Tests in levels

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
Yt	-0,491(n.s)	-2,011(n.s)	10,271(n.s)
Bt	-3,280 (5%)	-3,163(n.s)	0,979(n.s)
Tt	-2,168(n.s)	-3,186(n.s)	1,390(n.s)

- (n.s) non significant.
- Mac Kinnon [1991] critical values for rejection of the hypothesis of unit root are applied.

b. Tests in first differences

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
Yt	-6,235 (1%)	-6,336 (1%)	-1,811 (10%)
Bt	-8,365 (1%)	-9,245 (1%)	-8,239 (1%)
Tt	-7,538 (1%)	-7,616 (1%)	-7,059(1%)

- Mac Kinnon [1991] critical values for rejection of the hypothesis of unit root are applied.
- The Newey-West truncature is $l \approx 4(N/100)^{2/9} \approx 3$ with N is the number of total observations.

2. Co-integration tests

Since the unit root tests demonstrate that the three variables are stationary in first differences, the Johansen tests [1988] are to be performed in the second step of the analysis. The null hypoyhsis tested is that of the existence of r vectors of co-integration in the variables system (Bt, Tt) on the one hand and in the variables system (Bt, Tt, Yt) on the other hand.

The consequences of the identification of more than one co-integration relationship in the long-run between a system of variables is far from being worthless, mainly in economic policies. In fact, when variables are co-integrated, policies deciders have to identify one variable target and try to stabilize the long-runs levels of all the others (Vamvoukas [1997]).

However, since the co-integration is so sensitive to the lag order chosen, the information criteria of Akaike (AIC) and Schwarz (SC), must be calculated firstly. In our case, calculating the information criteria is limited to lag orders varying between 1 and 3.

We choose a maximum lag order equals to three for many reasons. Firstly, the option of the political cycle duration as an indicator of the maximum lag order (Giorgioni and Holden [2003]) is not applied because of its inapplicability to the Tunisian context. Secondly, we admit that in our case, a maximum lag order to be applied is probably 5 because of the five-years economic plans adopted since the mid sixties. However, because of the reduced total number of observations, the choice of a maximum lag order equals to 5 is rejected.

a. Calculating AIC and SC criteria

To determine the lag length to be used in applying the Johansen tests, two information criteria[14] are calculated:

[1] The Akaike criterion (AIC): is the information criterion in which the lag length h to be selected is the lag length that minimises the Akaike function:

$AIC(h) = Ln(\frac{SCR_h}{n}) + \frac{2h}{n}$ With SCR_h is the sum-of-squared residuals of the model at h lagged length, n the number of available observations and ln the natural Logarithm.

[2] The Schwarz criterion (SC): is the information criterion in which the lag length h to be selected is the lag length that minimises the Schwartz function:

$SC(h) = Ln(\frac{SCR_h}{n}) + \frac{hLn(n)}{n}$ With SCR_h are the sum-of-squared residuals the model at h lagged length, n the number of available observations and ln the natural Logarithm.

Details of identifying optimal lag order by using information criteria are summarized in table 5.

Table 5: Calculating AIC and SC criteria

	p =1		p =2		p =3	
	AIC	SC	AIC	SC	AIC	SC
Yt	-4,265	-4,177	-4,384*	-4,240*	-4,272	-4,078
Bt	1,865	1,960*	1,910	2,054	1,850*	2,044
Tt	0,760	0,855	0,766	0,940	-0,178*	0,015*

- (*) Minimum values of the information criteria.

In our case, the optimising information criteria process is inconclusive. Results of minimising the AIC and SC criteria are not coherent. So that, to decide of the optimal lag order to be chosen, we use the critical probability associated to the coefficient of the variable X (-p) with $X = Yt, Bt, Tt$ and $p = 1,2,3$. In fact, for each exogenous variable X, three different VAR models are estimated with an increasing lag order from 1 to 3. In each case, we are interested only in the null hypothesis of the coefficient of the variable associated to the highest lag order. In table 6, we report the critical probabilities of the variables with the highest lag order. The comparison between the probabilities and the level of

[14] The information criteria are often used as a guide in model selection. See Grasa [1989].

significance chosen which is of 5% in our case, allow us to conclude of the optimal lag order to be used for every variable.

Table 6: Critical probabilities associated to the variables coefficient of X (-p)

	p =1	p =2	p =3
Yt	0.000*	0.385	0.854
Bt	0.000*	0.319	0.498
Tt	0.000*	0.228	0.820

- (*) probabilities inferiors to the level of significance.

Results of the critical probabilities associated to variables with the highest lag order conclude in favour of models with only one lag order. However, in order to do an exhaustive analysis, we opt for two different lag orders for all models. In fact, we choose both p equals to 1 and to 3.

b. Johansens[15] tests

The co-integration tests of Johansen are applied in both the bivariate and the trivariate settings. To be exhaustive, the analysis is firstly done under the five specifications mentioned by Johansen. Table 7 summarizes the results of the Johansen's tests under the five specifications and when p is equal to 1.

(1) Case 1 : p=1

Table 7: Results of the Johansen's tests

		(Bt, Tt)	(Bt, Tt, Yt)
No deterministic trend in data.	***H1*** :	No relation of co-integration	Three relations of co-integration
	H2	No relation of co-integration	One relation of co-integration.
Linear deterministic trend in data.	***H3***	No relation of co-integration	No relation of co-integration
	H4	No relation of co-integration	No relation of co-integration
Quadratic deterministic trend in data.	***H5***	Two relations of co-integration.	No relation of co-integration

- Results summarised in this table are those of the LR test (Likelihood Ratio Test) at 5% level of significance.
- Lag intervals (1,1)
- H1: No intercept or trend in co-integration equation or in VAR.
- H2: Intercept (no trend) in co-integration equation-no intercept in VAR.
- H3: Intercept (no trend) in co-integration equation and in VAR.
- H4: Intercept and trend in co-integration equation-no trend in VAR.
- H5: Intercept and trend in co-integration equation-linear trend in VAR.

When the lag order is equal to one, the Johansen's tests reject any co-integration in the bivariate setting in both with and without linear deterministic trend in data (under the hypothesis from H1 to H4).

While, in the trivariate setting, the co-integration hypothesis is validated only in the absence of a deterministic trend in data. Especially, under H1, the only hypothesis used subsequently, three co-integration relations are validated. Table 8 details the results of the co-integration tests under H1 specification in both the bi and trivariate settings.

[15] The Johansen tests are detailed in Bourbonnais [2003], pp.292-94.

Table 8: Results of the Johansen's tests

(Under H1 specification)

a. Bivariate setting

Eignevalue	Likelihood Ratio	5%critical value	1% critical value	Number of co-integration relations
0.275031	10.082223	12.53	16.31	None
0.050471	1.398320	3.84	6.51	At most 1

- *(**) denotes rejection of the hypothesis at 5 %(10%) significance level.
- Lag intervals (1,1).
- LR rejects any co-integration relation at 5% significance level.

b. Trivariate setting

Eignevalue	Likelihood Ratio	5%critical value	1% critical value	Number of co-integration relations
0.606526	43.96613	24.31	29.75	None **
0.341440	18.78216	12.53	16.31	At most 1**
0.242655	7.504272	3.84	6.51	At most 2**

- *(**) denotes rejection of the hypothesis at 5 %(10%) significance level.
- Lag intervals (1,1).
- LR indicates three co-integration relations at 5% significance level

(2) Case 2: p=3

The Johansen's tests with a lag order equal to three do not validate the co-integration hypothesis in all cases. In fact, in the bivariate setting, the co-integration is not validated in the absence of a deterministic trend in data. However, in the trivariate setting, the variables are co-integrated under all the five specifications.

Table 9: Results of the Johansen's tests

		(Bt, Tt)	(Bt, Tt, Yt)
No deterministic trend in data.	***H1*** :	No relation of co-integration	Two relations of co-integration
	H2	No relation of co-integration	Three relations of co-integration
Linear deterministic trend in data.	***H3***	One relation of co-integration	Two relations of co-integration Deux relations de co-intégration
	H4	One relation of co-integration	Two relations of co-integration Deux relations de co-intégration
Quadratic deterministic trend in data.	***H5***	One relation of co-integration	Three relations of co-integration

- Results summarised in this table are those of the LR test (Likelihood Ratio Test) at 5% level of significance.
- Lag intervals (1,3)

Only under the H1[16] specification, the Correction Errors Models will be estimated. Consequently, the Johansen's tests under this specification are detailed in table 10. In the bivariate setting, the LR tests reject any co-integration relationship at 5% level of significance. While, in the trivariate setting, the hypothesis of two co-integration relations is validated at the same level of significance.

[16] The choice of H1 specification is dictated by the analysis of the graphs of the three time series. See graph n° 5 annexed to this paper.

Table 10: Results of the Johansen's tests
(Under H1 specification)

a. Bivariate setting

Eignevalue	Likelihood Ratio	5%critical value	1% critical value	Number of co-integration relations
0.150065	5.070254	12.53	16.31	None
0.039416	1.005355	3.84	6.51	At most 1

- *(**) denotes rejection of the hypothesis at 5 %(10%) significance level.
- Lag intervals (1,3).
- LR rejects any co-integration relation at 5% significance level

b. Trivariate setting

Eignevalue	Likelihood Ratio	5%critical value	1% critical value	Number of co-integration relations
0.621587	38.07991	24.31	29.75	None**
0.390162	13.78567	12.53	16.31	At most 1*
0.552781	1.421611	3.84	6.51	At most 2

- *(**) denotes rejection of the hypothesis at 5 %(10%) significance level.
- Lag intervals (1,3).
- LR indicates two co-integration relations at 5% significance level

c. Causal analysis

The next step of the analysis is to investigate the causal links between the two variables Bt and Tt through the error correction modelling.

When the lag order is equal to one, the Johansen's tests had rejected any co-integration relationship in the bivariate setting and under the H1 specification. Consequently, only the unrestricted approach is validated in this particular case. While, in the trivariate setting, the co-integration's tests had validated three co-integration relations under H1. So that, models will be estimated with both the restricted and the unrestricted approaches.

Similarly, when the lag order is equal to three, the co-integration hypothesis was not validated in the bivariate setting but it was in the trivariate one. Consequently, the two approaches restricted and unrestricted are both possible only in the trivariate setting. In the bivariate setting, only the unrestricted approach could be studied.

The error terms E_{t-1} and C_{t-1} with the models specifications indicated in ([1], [2], [5] and [6]) reflect the long-run effects. They give an idea about the adjustment of the dependant variable to disequilibrium. So that, $a_1 ; b_1$ the coefficients associated to these errors terms in respectively equations [1] and [2] (in the bivariate setting) and [5] and [6] (in the trivariate setting), must be significantly negatives.

The coefficients associated to variables (ΔBt, ΔTt et ΔYt) with a lag order equals to one or varying from 1 to 3 represent the short-run parameters giving an idea about the immediate impact of the independent variables on the dependent ones (ΔBt and ΔTt).

3. Econometric results

3.1. For p=1

As we have noted previously, when the lag order is equal to one, only the unrestricted approach is studied in the bivariate setting since the two variables Bt and Tt are not co-integrated. While, in the trivariate level, both restricted and unrestricted approaches are used to investigate the causal links between the two deficits because the variables Bt, Tt and Yt are co-integrated under H1.

a. Bivariate approach

The causal analysis within the bivariate setting and for a lag order equals to one, reject any causal relationship between the two deficits in both directions. In fact, on the one hand, the ΔBt (-1) variable is not significantly different from zero in the ΔTt regression. This result means the rejection of the causality effect from the budget deficit to the current account deficit. On the other hand, the nullity of the coefficient of the variable ΔTt (-1) in equation ΔBt implies that the hypothesis of a causal relationship from the external to the internal deficits could not be validated.

Consequently, in the bivariate setting, the Ricardian Equivalence Proposition is prevailing over the Conventional View. The two deficits seem to be independent in the Tunisian case.

However, while the rejection of the causal link from the current account deficit to the budget deficit is affirmative, the hypothesis of the causality in the opposite direction, could not be definitively rejected only by reference to results summarized in table 11. This result is justified as following:

(i) The R^2 of ΔTt regression (19%) is relatively low compared to that of ΔBt equation (37%).

(ii) Only the global significance of ΔBt regression measured by the *F-statistic* is relatively good. While, the later is validated at 5% level of significance, the ΔTt does not do so.

(iii) As mentioned previously, the validation of the different representations is subordinated to a fundamental condition related to the errors terms. In fact, the errors terms must be significantly negative. Since only the errors term E_{t-1} satisfies this condition at 5% level of significance, the ΔTt regression could not be validated.

So that, with reference to ΔBt regression in the bivariate setting and for a log order equals to one, the causality playing from the current account deficit to the budget one is definitively rejected in the Tunisian case. The existence of a causal relationship playing in the opposite direction is neither definitively validated nor rejected. The causal link may exist in this second case but through a third variable.

Table 11: Regressions results in the bivariate setting

Variables	Unrestricted approach	
	ΔBt	ΔTt
ΔBt (-1)	-0.081 (-0.403)	-0.114 (-1.017)
ΔTt (-1)	-0.095 (-0.267)	-0.146 (-0.668)
C	0.104 (0.898)	0.078 (1.120)
Et-1	**-0.692**** **(-2.778)**	- -
Ct-1	- -	-0.316 (-1.546)
R^2	0.370	0.194
Sum Sq. Resids	8.068	2.947
S.E. Equation	0.592	0.358
D-W statistic	1.952	1.641
F- statistic	4.521	1.854
P(F-statistic)	0.012	0.165

- Values in parentheses are the t-statistics. In our case, for a total number of observations equals to n=28, the t-statistics are around 2.048 (1.701) at 5% (10%) level of significance.
- ** (*) coefficients significantly different from zero at 5% (10%) level of significance.
- When variables are not co-integrated only the unrestricted approach could be used to examine the causal relationship between aggregates.

b. Trivariate approach

Table 12 summarizes results of different regressions in the trivariate setting. The lag order chosen is equal to one period.

Results of the causal analysis in the trivariate setting join those of the bivariate one. The "*twin deficits phenomenon*" is not validated in the Tunisian case. No causal relationship between the budget and the current account deficits is demonstrated. However, some differences between the trivariate and the bivariate settings have to be outlined:

(1)With the unrestricted approach

(i) Firstly, the introduction of a third variable to analyse the causal links between the two deficits, allows remedying to some limits of the bivariate approach and mainly with ΔTt regression. While, the bivariate setting was inconclusive whether to accept or reject the hypothesis of a causal relationship from budget to current account deficits, the analysis with a control's variable concludes in favour of the rejection of such causal link. In fact, the introduction of ΔYt (-1) variable in ΔTt regression had improved both the R^2 and the *F-statistic* of the regression. It had also validated the VAR representation since the error terms C_{t-1} became significantly negative at 5% level of significance.

(ii) Secondly, the trivariate setting analysis demonstrates a significant positive causal relationship between economic growth and current account deficit with a lag order equals to one. In fact, the coefficient associated to ΔYt (-1) is different from zero in ΔTt regression at 5% level of significance. The result could be interpreted as follow: The addition of wealth created in the economy in period (t) affects positively the current account deficit of period (t+1). In other words, it does widen the gap between exports and imports. This phenomenon could be justified in the Tunisian case in two different ways. On the one hand, a positive variation of economic activity, even it increases exports, it increases also imports but more proportionally. So that the global effect, in current account deficit is positive. On the other hand, if we take into account the structure of the Tunisian imports, it is evident that the added wealth created in the economy is allocated to imports of investments goods more than of consumption goods. Consequently, the increase of wealth had contributed to the consolidation of the productive machine during the last decades.

(iii) Finally, the results of the trivariate approach converge to those of the bivariate setting. The hypothesis of the "*twin deficits*" is rejected in the Tunisian case.

(2)With the restricted approach

In the trivariate setting, results of the restricted approach do not diverge from those of the unrestricted one. In fact, no significant causal link between budget and current account deficits is validated. However, we note that:

(i) With the restricted approach, the ΔBt regression is not very satisfying. In fact, in spite of being negative, the errors term E_{t-1} is not significant at 5% level of significance under H1 specification. So that, concerning the ΔBt regression, the unrestricted approach seems to prevail over the restricted one.

(ii) With the unrestricted approach, the unidirectional causal relationship from economic growth to current account deficit noted earlier with the unrestricted approach, is also validated (See the regression ΔTt).

(iii) Results of both the restricted and unrestricted approaches are much closed in the case of ΔTt regression. The two representations of ΔTt are validated.

Table 12: Regressions results in the trivariate setting

Variables	Unrestricted approach		Restricted approach (Under H1)	
	ΔBt	ΔTt	ΔBt	ΔTt
ΔBt (-1)	-0.069 (-0.338)	-0.068 (-0.806)	-0.076 (-0.368)	-0.025 (-0.268)
ΔTt (-1)	-0.154 (-0.416)	0.112 (0.547)	-0.100 (-0.228)	0.072 (0.344)
ΔYt (-1)	1.600 (0.372)	**5.683**** **(2.781)**	0.705 (0.163)	**5.396**** **(2.621)**
C (Constante)	0.034 (0.151)	**-0.191*** **(-1.766)**	- -	- -
Et-1	**-0.713**** **(-2.771)**	- -	-0.904 (-0.722)	- -
C1t-1	- -	**-0.799**** **(-3.033)**	0.193 (0.164)	**-0.751**** **(-2.248)**
Co-integration Equation	- -	- -	-0.345 (-0.305)	-0.015 (-0.087)
Co-integration Equation	- -	- -	- -	-0.090 (-1.553)
R^2	0.384	0.509	0.390	0.527
Sum Sq. Resids	7.901	1.795	7.821	1.728
S.E. Equation	0.599	0.285	0.610	0.286

D-W statistic	1.925	1.840	-	-
F-Statistic	3.428	5.716	2.688	4.697
P(F-Statistic)	0.025	0.002	-	-

- Values in parentheses are t-statistics. In our case, for a total number of observations equals to n=28, the t-statistics are around 2.048 (1.701) at 5 %(10%) level of significance.
- ** (*) coefficients significantly different from zero at 5% (10%) level of significance.

3.2. For p=3

In this section, we study the case when the lag order is equal to three. This option could be justified by the incoherent results of the optimizing information criteria process. This case seems to be interesting since it allows making comparison with similar studies and with the referential case (identified as p equals to 1).

a. bivariate approach

Table 13 summarizes the different regressions results in the bivariate setting.

Results of the analysis in the bivariate setting (ΔBt, ΔTt) reject any causal relationship between budget and current account deficits. As no causal link between the two deficits is validated, we conclude against the "*twin deficits phenomenon"* in the Tunisian case. The two deficits are independent and consequently, the Ricardian Equivalence Proposition (REP) is prevailing over the Conventional View.

With the unrestricted approach, the only approach admitted in the bivariate setting, the regression ΔBt is generally more significant than the regression ΔTt. The *F-statistic* associated to ΔBt model is superior than that associated to ΔTt model. Moreover, only the R^2 related to ΔBt is near to R^2 tolerated in similar studies. Finally, the risk of errors correlation given by the *Durbin Watson statistic* is higher in ΔTt regression than in ΔBt.

This result joins that of the analysis with one lag order. In fact, the regression ΔTt is not very satisfying in the bivariate setting. With the introduction of the control's variable, the global significance of the regression ΔTt could be better. This is means that via the revenue canal that the budget deficit could influence the current account one and not in direct way.

Moreover, the errors terms E_{t-1} and C_{t-1} are both not significant at 5% level of significance. These terms reflecting the long-run effects of the variation of one of the two deficits are however negative. However, on one side, concerning, the regression ΔBt, the VAR representation with its unrestricted form could be validated since the error term E_{t-1} is significantly negative (at 20 % level of significance). On the other side, the fact that C_{t-1} is not significantly negative means the rejection of the unrestricted representation of ΔTt. Yet, we outline again that the trivariate approach is the more appropriate in the case of the regression ΔTt.

Table13: Regressions results in the bivariate setting

Variables	Unrestricted approach	
	ΔBt	ΔTt
ΔBt (-1)	-0.259 (-0.673)	-0.023 (-0.173)
ΔBt (-2)	-0.172 (-0.482)	0.003 (0.024)
ΔBt (-3)	**-0.608*** **(-1.877)**	-0.011 (-0.088)
ΔTt (-1)	0.457 (0.717)	0.068 (0.326)
ΔTt (-2)	0.197 (0.379)	-0.076 (-0.375)
ΔTt (-3)	0.183 (0.430)	-0.135 (-0.794)
C	0.105 (0.705)	0.065 (1.232)
Et-1	-0.511 (-1.243)	- -
Ct-1	- -	-0.121 (-0.494)
R^2	0.516	0.111
Sum Sq. Resids	6.054	0.945
S.E. Equation	0.596	0.235
D-W statistic	1.897	2.567
F-Statistic	2.599	0.303
P(F-Statistic)	0.051	0.942

- Values in parentheses are t-statistics. In our case, for a total number of observations equals to n=28, the t-statistics are around 2.048 (1.701) at 5% (10%) level of significance.
- ** (*) coefficients significantly different from zero at 5% (10%) level of significance.
- When variables are not co-integrated only the unrestricted approach could be used to examine the causal relationship between aggregates.

b. Trivariate approach

Table 14 summarizes the different regressions results in the trivariate setting and with a lag order equals to three.

The trivariate analysis (ΔBt, ΔTt, ΔYt) concludes, as the bivariate approach does, in favour of the rejection of any causal relationship between the two aggregates ΔBt and ΔTt in both directions. This conclusion is validated with both the restricted and the unrestricted specifications. Consequently, the independence of the two deficits is entirely validated in the Tunisian case. Even with the introduction of the GDP as control's variable, the Ricardian Equivalence Proposition (REP) is prevailing over the Conventional View. However, we note the two main following points:

(i) Firstly, concerning the regression ΔBt, the restricted approach results are better than those of the unrestricted approach. The error term E_{t-1} is significantly different from zero at 5% level of significance under the restricted approach and 30% with the unrestricted one. Even, in terms of global significance measured by R^2 and *F-statistics*, the first approach seems to be more satisfying than the second.

(ii) Secondly, concerning the regression ΔTt, the unrestricted approach is prevailing over the restricted one. In fact, at 5% level of significance, the error term C_{t-1} is significantly negative only with the unrestricted specification. The positive causal link between growth and current account deficit noted previously is also validated with the unrestricted approach at 10% level of significance. However, the global significance of the restricted approach is superior the unrestricted one.

Table 14: Regressions results in the trivariate setting

Variables	Unrestricted approach		Restricted approach (Under H1)	
	ΔBt	ΔTt	ΔBt	ΔTt
ΔBt (-1)	-0.209	-0.088	-0.093	-0.002
	(-0.479)	(-0.972)	(-0.246)	(-0.030)
ΔBt (-2)	-0.185	-0.023	-0.198	-0.001
	(-0.459)	(-0.261)	(-0.578)	(-0.013)
ΔBt (-3)	-0.538	0.014	-0.423	0.073
	(-1.335)	(0.119)	(-1.215)	(0.705)
ΔTt (-1)	0.457	**0.492***	0.0658	0.299
	(0.607)	**(1.953)**	(0.085)	(1.320)
ΔTt (-2)	0.139	0.133	0.324	0.194
	(0.238)	(0.628)	(0.523)	(1.088)
ΔTt (-3)	0.159	0.032	0.194	0.052
	(0.330)	(0.199)	(0.411)	(0.382)
ΔYt (-1)	1.113	2.249	-3.924	0.575
	(0.185)	(1.265)	(-0.771)	(0.348)
ΔYt (-2)	-4.357	1.178	**-9.890***	-0.383
	(-0.740)	(0.625)	**(-1.833)**	(-0.233)
ΔYt (-3)	1.201	**3.578***	-3.957	2.079
	(0.207)	**(1.853)**	(-0.706)	(1.246)
C (Constante)	0.198	-0.278	-	-
	(0.345)	(-1.688)	-	-
E1t-1	-0.582	-	**-8.962****	-
	(-1.131)	-	**(-2.144)**	-
C1t-1	-	**-0.946****	-	0.300
	-	**(-2.517)**	-	(0.596)
CointE 1	-		**7.995****	**-1.526****
	-		**(2.047)**	**(-2.994)**
	-		**-9.593****	**0.103****
CointE 2	-		**(-2.067)**	**(2.932)**
R^2	0.557	0.446	0.664	0.643
Sum Sq. Resids	5.548	0.588	4.208	0.379
S.E. Equation	0.626	0.205	0.568	0.170
D-W statistic	1.810	2.306	-	-
F-Statistic	1.762	1.131	2.338	3.132
P(F-Statistic)	0.161	0.405	-	-

- Values in parentheses are t-statistics. In our case, for a total number of observations equals to n=28, the t-statistics are around 2.048 (1.701) at 5% (10%) level of significance.
- ** (*) coefficients significantly different from zero at 5% (10%) level of significance.

The analysis with both a lag order equals to one or three concludes against the "*twin deficits*" hypothesis in the Tunisian case. This result in favour of a perfect independence between the two deficits corroborates results of some previous studies conducted for other countries and cited in our review of the literature. In fact, Winner [1993] and Kaufmann and al. [2002] rejected the *"twin deficits phenomenon*" in the Australian case. Kulkarni and Erickson's study [2001] concluded in favour of the independence of the two deficits in Mexico. Moreover, Leachman and Francis [2002] argued that with a fixed exchange regime, the two deficits could not be dependent since in the American case and during the *Bretton Woods* agreements, the "*twin deficits phenomenon*" was not validated.

The policies implications of the independence of the two deficits are related to the relationship between budgetary and trade policies. In fact, when the two deficits are totally independent, the budgetary and trade policies have to be defined separately. The coordination of actions and targets could be sufficient. A global integrated policy with both budgetary and trade targets is not necessary in such case.

So that from our econometric analysis, the main recommendation to be outlined is that budgetary and trade policies could be disassociated to each other with out any risk of fail in the Tunisian context.

3.3. Residuals analysis

In this paragraph, we attempt to improve our results by adopting a residuals analysis to investigate the relationship between the two deficits. In fact, with the Granger-causal analysis, our results deny any causal relationship between the budget and the current account deficits.

At this step of the investigation, we are also interested in the co-integration between the two deficits. However, the approach with one or three lag order is abandoned. In fact, with the residuals analysis, each of the two deficits is explained by the other deficit in a static way firstly and in both static and dynamic ways secondly.

So that, we use the Engle and Granger[17] two steps algorithm. In the first step of the analysis, we test the integration order of the two variables (Bt, Tt). We estimate, in the second step, the long-run relationships and examine the residual stationarity.

As we noted previously one condition of co-integration is that the two time series must be integrated in the same order. When we had applied the unit root tests in the causal analysis, we had concluded that the two time series Bt and Tt are both integrated of order 1, (I(1)). Consequently, we can test co-integration, by estimating the two following long-run relations, using the Ordinary Least Squares method:

$$B_t = aT_t + b + \varepsilon_t [i]$$

and;

$$T_t = cB_t + d + \mu_t [ii]$$

To accept the co-integration hypothesis in [*i*] and [*ii*], the calculated residuals ε_t and μ_t must be stationary.

$$\varepsilon_t = B_t - \hat{a}T_t - \hat{b}$$

and;

[17] See Bourbonnais [2003], pp.282-84.

$\mu_t = T_t - \hat{c}B_t - \hat{d}$

In our case, residuals are calculated as follows:

$\varepsilon_t = B_t - 0.966933T_t + 0.564285$

and;

$\mu_t = T_t - 0.476867B_t - 11.42900$

In tables 15 and 16, we summarize the unit root tests results applied to the calculated residuals.

Table 15: Unit root tests results applied to residuals (DF and ADF tests)

Tests in levels

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
ε_t	-4.024 (1%)	-4.022 (5%)	-4.094 (1%)
Critical values	-3.685 (1%)	-3.579 (5%)	-2.648 (1%)
μ_t	-2.1597 (n.s)	-3.5466 (10%)	-2.2264 (5%)
Critical values	-2.6265 (10%)	-3.2279 (10%)	-1.954 (5%)

- Mac Kinnon [1991] critical values for rejection of hypothesis of unit root are applied.
- The DF tests are applied to ε_t .
- The ADF (1) tests are applied to μ_t .

Table 16: Unit root tests results applied to residuals (Tests PP)

Tests in levels

	Models types		
	Intercept	Intercept and trend	Neither intercept nor trend
ε_t	-4.021 (1%)	-3.986 (5%)	-4.087 (1%)
Critical values	-3.685 (1%)	-3.579 (5%)	-2.648 (1%)
μ_t	-3.053 (5%)	-4.565 (1%)	-3.138 (1%)
Critical values	-2.970 (5%)	-4.322 (1%)	-2.648 (1%)

- Mac Kinnon [1991] critical values for rejection of hypothesis of unit root are applied.

Tables 15 and 16 show that the residuals calculated from the static relations [i] and [ii] are stationary since the null hypothesis of the unit root is not accepted by both the ADF and PP tests.

So that, we estimate in the second stage of the analysis, by using the Ordinary Least Squares Method, the dynamic relations (of short-run):

$\Delta B_t = \alpha_1 \Delta T_t + \alpha_2 \varepsilon_{t-1} + \gamma_t [A]$; $\alpha_2 \prec 0$; ε_{t-1} is the lagged value of residuals calculated from regression [i].

$\Delta T_t = \phi_1 \Delta B_t + \phi_2 \mu_{t-1} + \delta_t [B]$; $\phi_2 \prec 0$; μ_{t-1} is the lagged value of residuals calculated from regression [ii].

To validate [A] and [B] specifications, the coefficients α_2 and ϕ_2 must be significantly negative. If this condition is not satisfied, the Error Correction Models specification must be rejected. Using the Ordinary Least Squares method, estimations are the following:

$$\Delta B_t = 0.486 \Delta T_t - 0.722 \varepsilon_{t-1} + \gamma_t$$

(1.757) (-4.143)

(10%) (1%)

- n=28 ; R^2= 0.420; DW= 2.037 ; Probability(F-statistic)= 0.000 ; (.) t-Student.
- (%) level of significance; (n.s) non significant.

$$\Delta T_t = 0.197 \Delta B_t - 0.419 \mu_{t-1} + \delta_t$$

(2.048) (-2.540)

(5%) (5%)

- n=28 ; R^2=0.214; DW= 2.219; Probability(F-statistic)= 0.013; (.) t-Student.
- (%) level of significance; (n.s) non significant.

With this bivariate analysis, where only the two deficits are taking into account, the ECM representation is validated in both [A] and [B] models. In fact, the coefficients α_2 and ϕ_2 are significantly negative at respectively 1 and 5% levels of significance.

So that, in the short-run, the variation of the budget deficit is explained by the variation of the current account deficit and vice versa.

Conclusion

By studying the "*twin deficits phenomenon*", we empirically test the validity of the Ricardian Equivalence Proposition (REP) in a small developing economy, Tunisia. In fact, the validation of the "*twin deficits*" hypothesis is synonymous of the REP's acceptance. While, the independence of the budget and the current account deficits means the REP's rejection.

To do that, we adopt a causal analysis in both bivariate and trivariate settings. Since, no causal link between the two deficits is demonstrated, results deny the "*twin deficit phenomenon"* in the Tunisian case. Consequently, the REP is prevailing over the Conventional View in Tunisia.

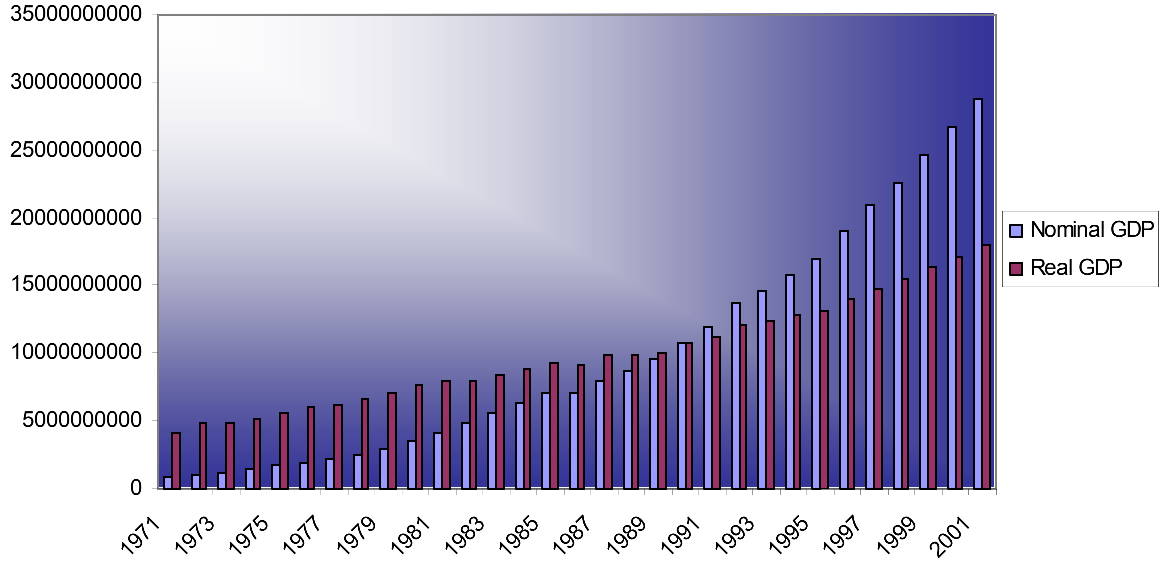
However, by using a residual analysis we demonstrate that the budget and the current account deficits are co-integrated. In fact, we validate in this second case two significant long-run relationships in which the budget deficit variation is explained by the current account one and vice versa.

The main difference between the two approaches is the lag order chosen. In the first case, the lag order is issued from optimising information criteria process. However, this lag order could be biased for two different reasons. Firstly, the time series studied are relatively short; Secondly, the maximal lag order is fixed arbitrarily without any political or economic foundations.

In the second case, the lag order is equal to zero. Consequently, the rationale is relatively simple. The variation of each aggregate is explained by the variation of the other aggregate and a "*feed back*" term. However, the limit of this second approach is the short memory of the associated process. The information related to the previous fluctuations of the two aggregates is ignored.

Annexe: Figures[18]

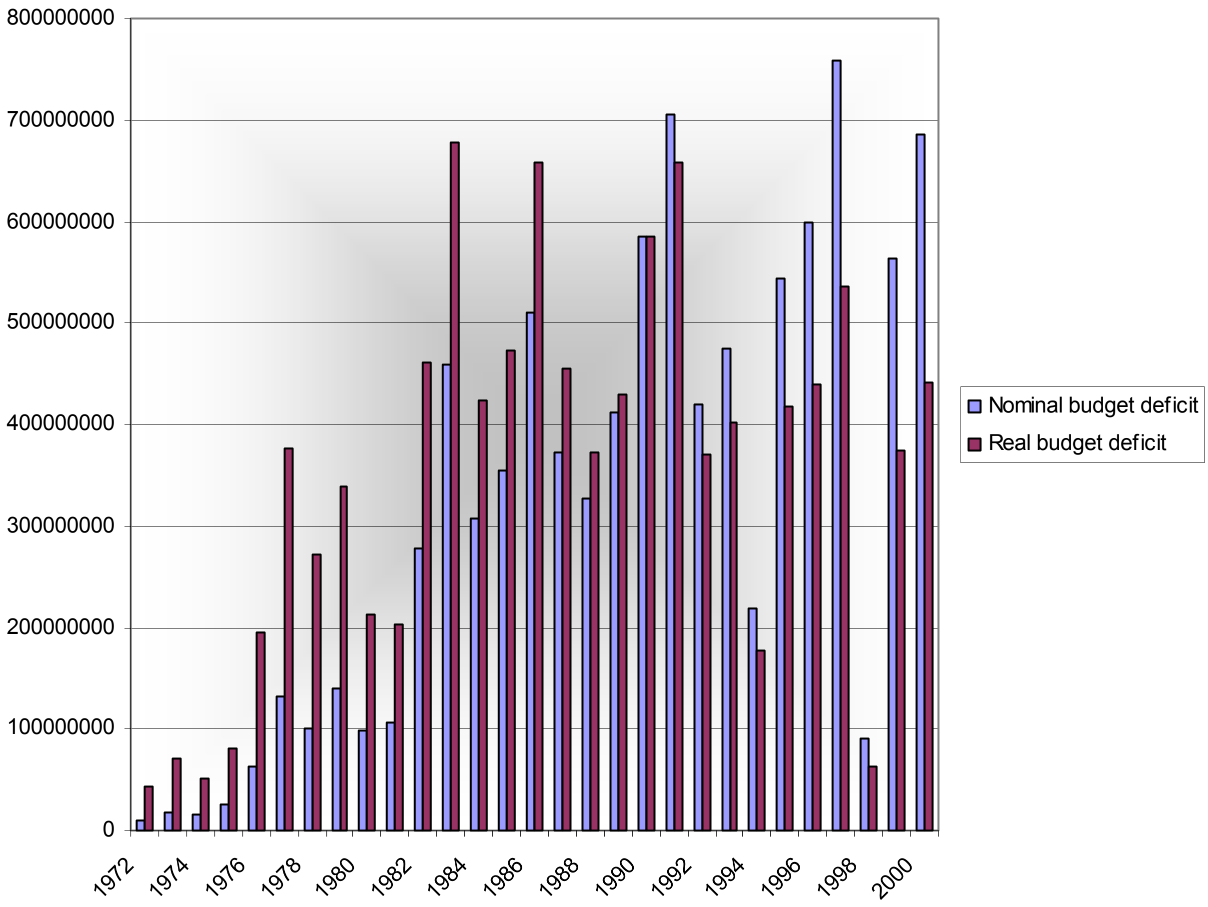
Graph n°1:The Tunisian GDP



Database: *World Development Indicators Database*

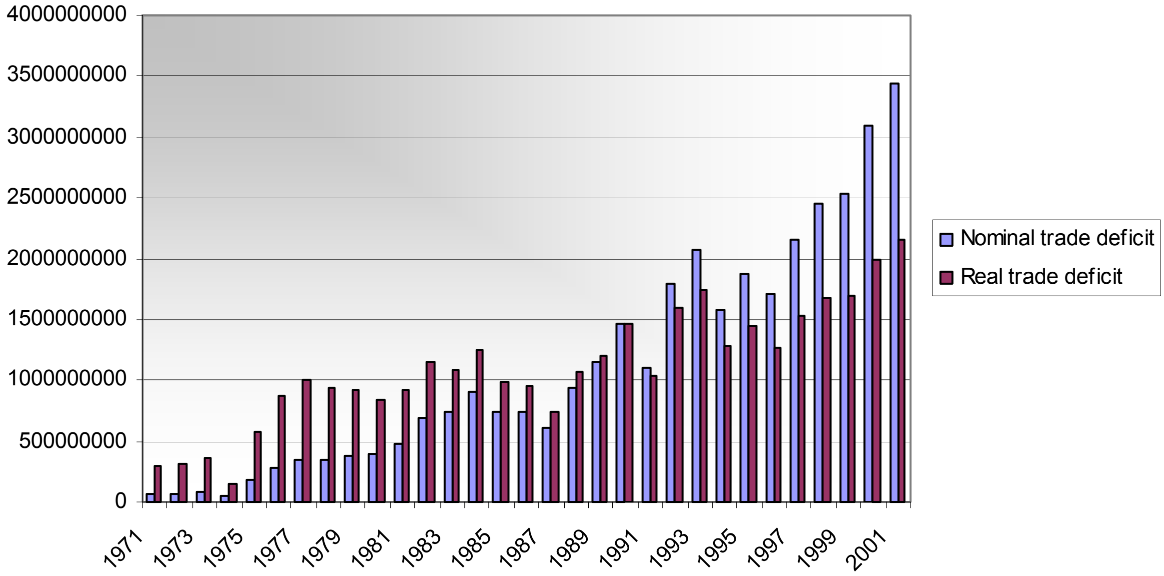
[18] Figures in graphs 1 to 4 are in local currency.

Graph n°2: The Tunisian budget deficit



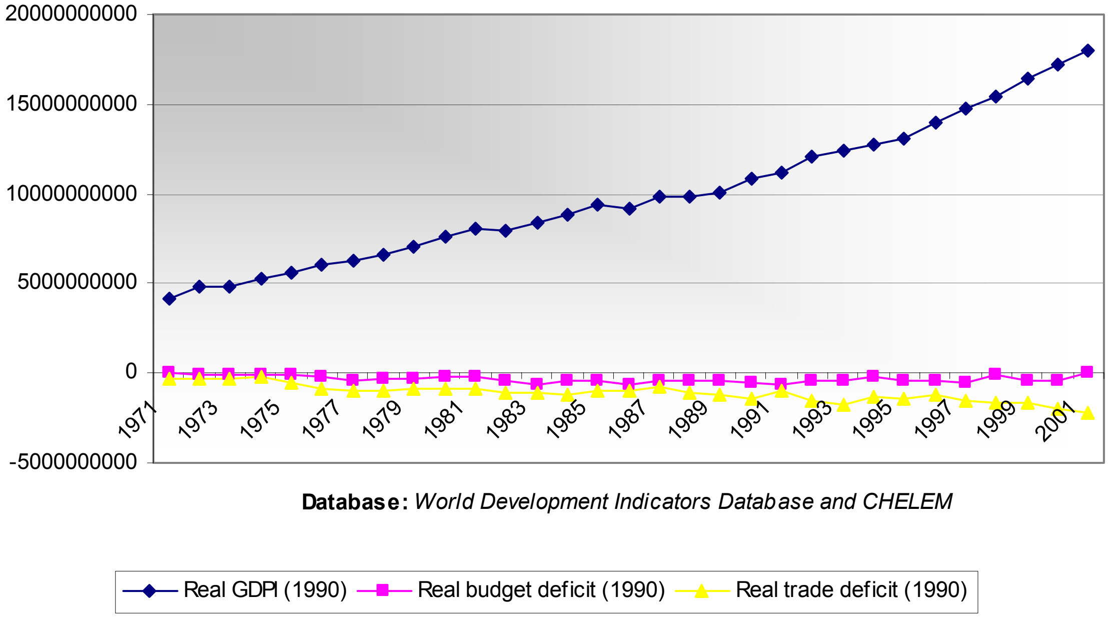
Database: *World Development Indicators Database*

Graph 3: The Tunisian trade deficit



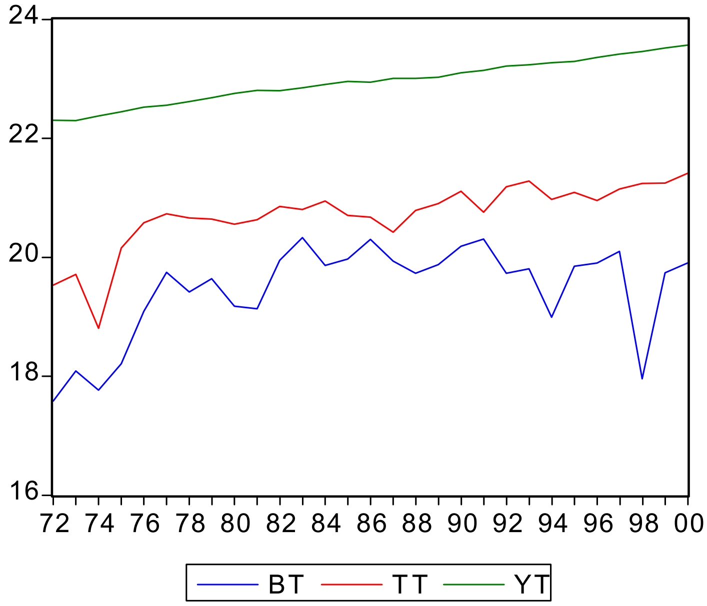
Database: *CHELEM*

Graph n°4: Evolution of the three agregates in Tunisia



Database: *World Development Indicators Database and CHELEM*

Graph n°5: Evolution of the three time series



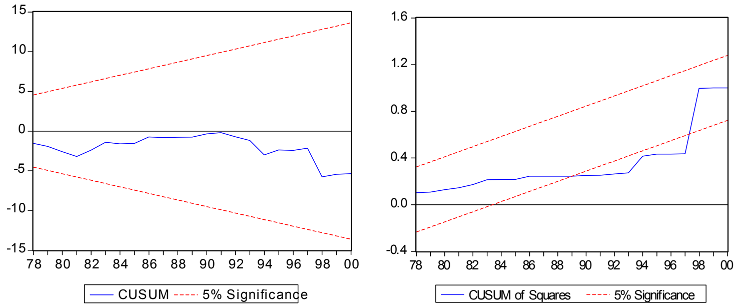
Some descriptive statistics of time series

	Bt	Tt	Yt
Mean	19.45954	20.70861	22.94773
Median	19.74831	20.78903	22.95943
Maximum	20.33459	21.41054	23.56709
Minimum	17.58517	18.80967	22.30039
Ecart type.	0.798236	0.560573	0.370140
Skewness	-1.153676	-1.736764	-0.128830
Kurtosis	3.108286	6.231715	2.031749
Jarque-Bera	6.447183	27.19883	1.213044
Probability	0.039812	0.000001	0.545244
Observations	29	29	29

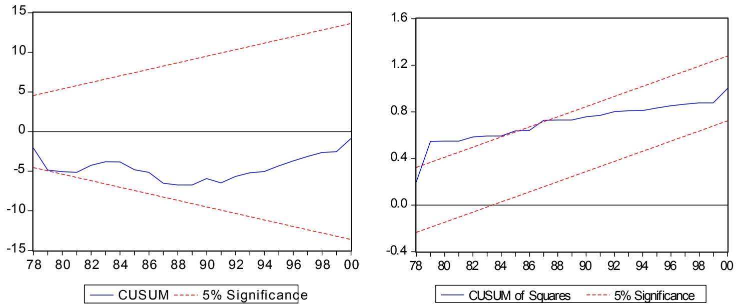
Time stability tests

Case 1: p =1

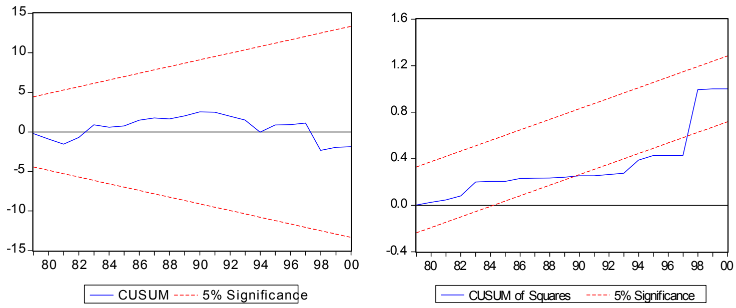
VAR/D(Dt) D(Tt)



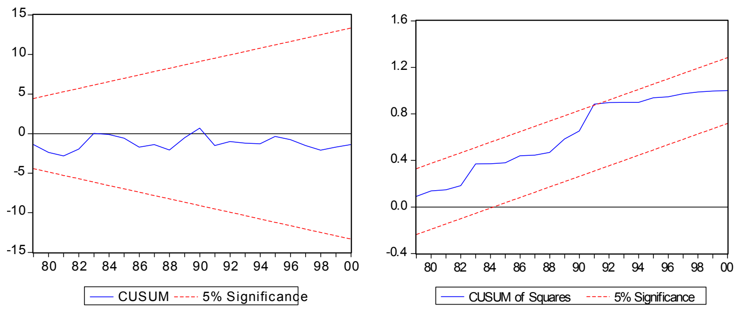
VAR/D(Tt) D(Bt)



VAR/D(Bt) D(Tt) D(Yt)

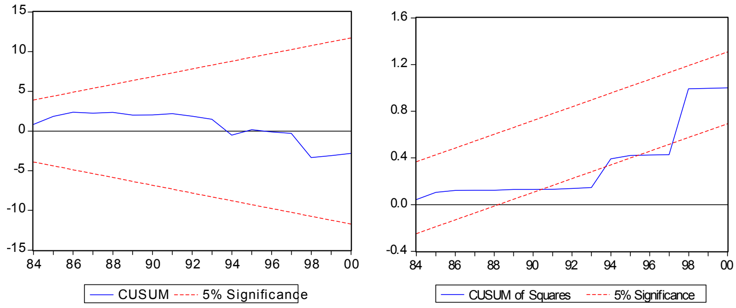


VAR/D(Tt) D(Bt) D(Yt)

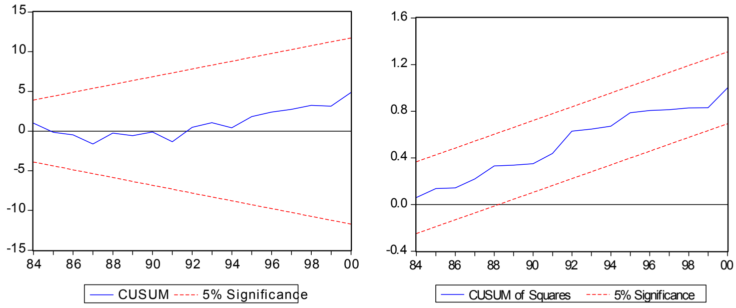


Case 2: p=3

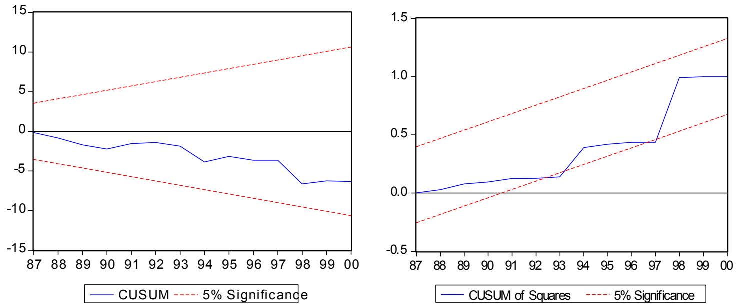
VAR/D(Bt) D(Tt)



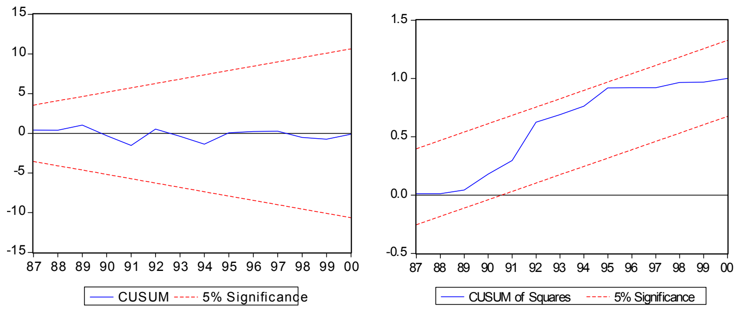
VAR/D(Tt) D(Bt)



D(Bt) D(Tt) D(Yt)



D(Tt) D(Bt) D(Yt)



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