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DOUBLE TROUBLE IN TUNISIA: TESTING TWIN DEFICITS AND FELDSTEIN-HORIOKA UNDER ARDL FRAMEWORK

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Abstract

This study examines Tunisia's fiscal and external imbalances from 1980 to 2022, testing the Twin Deficit Hypothesis using the ARDL Bounds Testing Approach. Three empirical models are applied: Saeed and Khan (2008) for direct causality between budget and current account deficits; Kalou and Paleologou (2012) for indirect causality via real interest and exchange rates; and Fidrmuc (2003) to assess capital mobility through the Feldstein-Horioka framework. Short-run results reveal a unidirectional causal link from budget deficits to current account deficits, both directly and indirectly, validating the Twin Deficit Hypothesis and rejecting Ricardian Equivalence. Tunisia thus behaves as a non-Ricardian economy in the short term. In the long run, cointegration results support Ricardian Equivalence, suggesting fiscal discipline eventually aligns with external balances. The Feldstein-Horioka coefficient is negative and below unity, indicating limited capital mobility. Tunisia was not fully integrated into global financial markets, with over half of its investments financed by foreign savings. These findings highlight the importance of identifying causal dire ction and magnitude for effective fiscal and external policy design.

Keywords: Twin Deficit Hypothesis, Feldstein-Horioka Hypothesis, Bounds Testing, Tunisia

INTRODUCTION

Tunisia is characterized as a little open developing country with scarce natural resources facing pressures on its external and internal balances with an unprecedented levels of inflation exceeding 9%[1], and public debt exceeding 70% in last years. The main causes of the budget deficit upgrade lie on the resource side in tax evasion, the inability of the tax system to ensure adequate collection and the increase in subsidies and remunerations.[2] Due to the 2011 revolution, the 2019 coronavirus pandemic, and more recently, the conflicts of Russia-Ukraine and in the Middle East, Tunisia has witnesed a growth decline, while the investment and savings have seen a downward in their trend reflecting the wait-and-see attitude and signaling a long term crowding out effect. Tunisia has risen new challenges to manage the sustainability of public finances. More specifically, over the past decades, as a result of the economic policies implemented in Tunisia since its independence in 1956 (See Ayadi and Mattoussi, 2015), the current account deficit has been both chronic and volatile, with a clear worsening after 2011 revolution[3] due to political and social instability. As reported in Jlassi (2015), a disaggregated look to the current account components shows that trade balance[4] accounts for the major part of the deficit and is the major driver of the current account deficit, while the service balance records continuous and increasing surpluses. However, Tunisian's trade remains geographically concentrated in Europe exposing it to the risk of negative events in those regions. This essay seeks to remedy these problems by investigating the persistence of current-account deficit in Tunisia. Such a persistent deficit poses serious implications for the national economy and its future prospects for sustainable growth.

A common policy for addressing current account deficit adjustment is through local currency devaluation. As pointed in Thissen and Lensink (2001), such devaluation will have a modest long-term impact on adjusting the current account deficit. As reported in Zoghlami and Ghanmi (2020), based on a bivariate copula model for Tunisia between 1980-2018, the real effective exchange rate misalignment has negative and asymmetric impact on the current account. It should be recalled that while the depreciation of the national currency could promote the export competitiveness of national products, it also has adverse effects on the level of

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[1] The origins of the current inflation are not attributed only to external factors (increasing prices commodities) but as well to the fiscal situation and fiscal policy. (See Ben Romdhane and Bellalouna (2021) Tunisian Central Bank Report).

[2] Amaira and Mensi (2017) consider that with an investment rate that does not fall below 25%, an inflation rate below 5%, the budget deficit remains sustainable up to an optimal rate of 3.92% of real GDP. In other words, beyond this rate, the Tunisian economy enters a prohibited zone characterized by a considerable drop in growth.

[3] With a pic of 10% of GDP between 2017 and 2018 and standard deviation of 3 points in GDP percent between 1980 and 2022.

[4] Especially, due to the deficit of the energy trade balance linked to energy flows with the outside. The deficit appears in 2001 and worsens since 2014. Rapport Sur l'Energie Durable en Tunisie (2018).

external debt expressed in local currency as well as on imports and inflation. While overvaluation of the dinar deteriorates the current account, undervaluation does not improve it.

On the other hand, numerous studies have examined the relationship between the current account deficit adjustment and the surplus of financial account and found that, for many developing countries, debt component plays a more significant role in the process of adjusting external imbalances compared to foreign direct investments and portfolio investments (See Farhoud and Taleb, 2020 for the Tunisian case). However, as pointed in Alfaro et al. (2004), external borrowing can directly increase the burden of public debt, heighten the risk of debt crises, and lead to excessive dependence on foreign lenders.

Along the same lines, this study is motivated by the observation dating back to the 1980s that the current account deficit and the budget deficit have been growing simultaneously and substantially in the United States, and consequently, researchers have increasingly focused on investigating whether actions on the budget deficit could lead to an improvement in the current account deficit, and vice versa. This mutual connection between the two deficits is later referred to as the "Twin Deficits Hypothesis". Recent theoretical and empirical analysis suggest that this hypothesis is subject to structural shifts, the identification of which is very important for policymakers in order to take the correct decisions to overcome situations of economic turmoil. This study is also motivated by the findings in Farhoud and Taleb (2021), showing that for Tunisia, the national trade policy does not contribute to current account deficit adjustment, while there is evidence of significant short run effect of fiscal policy on current account deficit adjustment among other factors.

Three theoretical perspectives are discussed in the literature: A first group of economists maintain the view that no link exists between the current account deficit and the budget deficit, either in the short or long term, and that any apparent correlation is merely a statistical coincidence. This neutral stance is known in economic literature as the "Ricardian Equivalence". A second group of economists argue that there is sufficient evidence to suggest that the worsening of the budget deficit plays a significant role in the deterioration of the external balance, and vice versa. This mutual connection between the two deficits is referred to as the "Twin Deficits Hypothesis." Once this hypothesis is validated, researchers use it to guide their economic recommendations and implications, seeking evidence for one of the following three testable macroeconomic hypotheses : (i) Bidirectional causality, namely, the Feedback Effect, which implies that the processes correspond to the conjecture of the vicious or virtuous circle phenomena since a feedback relationship exists between the twin deficits. Policymakers need to adopt an integrated solution rather than a dual approach, where fiscal and trade policies are independently determined with separate objectives. (ii) Unidirectional causality running from budget deficit to current account deficit Known as *Keynesian causality*, which suggests that government policy should focus on reducing aggregate demand and consequently, reducing imports. (iii) Reverse causality running from current account deficit to budget deficit referred to as the *Targeted Current Account Hypothesis*, this implies that the government sets the elimination of the current account deficit as a primary goal and uses the budget deficit as a tool to achieve this objective.

Empirical studies examining the causal relationship between the current account deficit and the budget deficit yield mixed conclusions. Some researchers explore the direct link between the two deficits (Mukhtar et al., (2007), Pahlavani and Saleh, (2009), Saeed and Khan (2012)), while others investigate an indirect relationship by incorporating variables such as exchange rates and interest rates (See Kalou and Paleologou, 2012).

A third group of researchers extend this analysis by linking the twin deficits phenomenon to the degree of international capital mobility and the Feldstein-Horioka puzzle, since with the liberalization of capital movements worldwide, domestic investments are no longer limited to the amount of domestic savings. Feldstein and Horioka (1980) examine the saving-investment relationship, based on a cross-section regression over the 1960-1974 period in a sample of 16 OECD countries and claim that there is no significant relationship between domestic savings and investment in an economy that has a high degree of capital mobility. Marinheiro (2006) argues that if savings and investment are not strongly correlated indicating a high degree of capital mobility, then there is substantial evidence that the current account deficit and the budget deficit are likely to exhibit a common trajectory. Marinheiro (2006) posits that a high degree of capital mobility, as indicated by a low correlation between savings and investment, is associated with a tendency for the twin deficits (current account and budget deficits) to move together. This relationship is rooted in the idea that high capital mobility allows for external imbalances to reflect domestic fiscal policies more directly.

In the same lines, more recently, Akbas et al., (2014) argue that as capital mobility allows financing savings-investment gap from abroad, changes in current account balance should be linked to either savings-investment and budget balance changes, respectively. Akbas et al., (2014) test the validity of the Triple Deficit Hypothesis as an extension of the Twin Deficit Hypothesis with inclusion of private saving gap.[5]

Generally speaking, and based on the discussion above, empirical studies report mitigated results. As reported in Furceri and Zdzienicka (2018), in developping countries, the validation of such hypotheses points to heterogeneity across countries and over time. The effect

[5] See also the work of Bolat et al. (2014), Sen and Kaya (2016) and Shastri et al., (2017). Since the components of domestic savings are not systematically reported, Shastri et al., (2017) estimate the domestic private savings by deducting gross domestic public savings from gross domestic savings. Gross domestic public savings is calculated as total government revenue less current government expenditure.

tends to be larger during recessions, in countries that are more open to trade; that have less flexible exchange rate regimes; and with lower initial public debt-to-GDP ratios.

Given all this background, this study aims to analyze twin deficit and Feldstein-Horioka hypotheses in Tunisia using the annual data during the period 1980-2022. Our motivation is to provide comprehensive evidence on the potential direct and indirect[6] causal links between current account deficit and budget deficit in Tunisia and then, to provide an empirical investigation to test the direction, sign, and magnitude of the relationship between the two aggregates. Our enquiry is to answer if the budget balance drives the financing of the current account deficit in Tunisia from 1980 to 2022[7]. The selected period, 1980 to 2022 is motivated by both analytical depth and data reliability. Starting from 1980 allows to capture Tunisia's economic evolution across multiple political and economic regimes. It includes key structural reforms, such as the shift toward liberalization in the mid-1980s and the structural adjustment programs of the 1990s. The dataset spans critical events like the 1986 balance of payments crisis, the 2011 revolution and its economic aftermath, the COVID-19 pandemic's fiscal and external shocks. These events are essential for understanding fluctuations in both fiscal and current account balances. Moreover, a 42-year span enhances the reliability of econometric models, especially for time series analysis. It allows for testing long-run relationships between fiscal and current account deficits, which is central to the twin deficit hypothesis. The period includes multiple fiscal policy regimes and external trade strategies, offering rich insights for policy recommendations. It helps assess whether the twin deficit phenomenon is persistent or episodic in Tunisia's case. Together, these dimensions render Tunisia an empirically and theoretically relevant case for assessing the dynamic interplay between internal and external imbalances in the context of a structurally segmented developing economy.

The ultimate goal remains to enlighten policy-makers in their decision-making process and to ensure the current account's deficit sustainability in Tunisia. We follow in this study, a bound testing cointegration approach using an autoregressive distributed lag (ARDL). This kind of procedure is applied to capture the essence of estimation in the short and the long-run between series with a different order of integration (See Pesaran, et al., 2001)) and can help in identifying the cointegrating vectors. Furthermore, this approach is applicable even if the series are I (0), I (1) or a mix of I (0) /I (1). Unlike the Johansen and Juselius (1990) cointegration test,

[6] The inclusion of interest rate and exchange rate as intermitting variables in the model can be motivated by the fact that budget deficit alone would not be strong enough to stimulate current account deficit. Indeed, controlling for interest and exchange rates as transmission channels in the analysis enhances the influence of budget deficit on current account deficit. Farhoud and Taleb (2021) show evidence of short and long term impact of monetary policy in current account deficit adjustment in Tunisia.

[7] The choice of Tunisia is motivated by the fact that the relationship between budget deficit and current account deficit has been poorly investigated in the literature for this country, and that the current account deficit is persistant for the last four decades.

the ARDL model allows indicating both the short and the long-run relationship between the variables.

In line with earlier studies, our paper takes a close look at how robust is the relationship between current account deficit and budget deficit in Tunisia, but with some differences. Empirical research has predominantly concentrated on developed countries, often overlooking developing economies. As demonstrated by Chinn and Prasad (2003), evidence indicates that the factors influencing the current account can vary significantly between developed and developing nations. Previous studies generally considered MENA and South Mediterranean Countries, including Tunisia (See Khedhiri and Hebiri, 2005, Furceri and Zdzienicka, 2018, and El-Khishin and El-Saeed, 2021). With respect to the case of Tunisia, studies that tried to investigate the causal links between current account deficit and budget deficit are very few, this means that the question remains unresolved. We have studied particularly the Twin Deficits for the Tunisian economy, considered as a developing country, that remains quite poorly explored in the literature. Furthermore, the present study is not limited to investigate the direct relationship between current account and budget deficit, but investigate potential indirect links through interest rate and exchange rate channels. We extend our analysis by investigating the link between the twin deficits phenomenon and the degree of international capital mobility and the Feldstein-Horioka puzzle. We assess if the degree of capital mobility in Tunisia allows for external imbalances to reflect domestic fiscal policies more directly.

The investigation of such links in Tunisia is thus interesting because budget balance should constitute an important source of current account deficit financing. This allows us to examine, in addition, the link between twin deficits since the good understanding of this relationship is essential given the massive empirical research works focusing on the economic growth enhancing. Relevant findings from the analysis also help the Tunisian government to make deep decisions and judicious economic policies when it has to understand how fiscal policy impact external imbalance and vice versa. Second, we set ourselves apart from the previous literature on the causal links between current account deficit and budget deficit in the econometric method. Indeed, we put in advance the powerful ARDL approach correcting for the endogeneity. Consequently, the obtained estimates possess desirable properties and allow making final conclusions.

The remainder of the paper is organized as follows. Section 2 presents the literature review. The paper further presents the methodology used to investigate the causality links between the variables, provides a preliminary analysis of the data, and discusses the empirical results in sections 3 and 4. Our findings reveal that in the short run, there is significant evidence that the causal relationship between budget and current account deficits works through two channels : directly between budget deficit and current account deficit, and indirectly, through interest and exchange rates. While, in the long run, the results support the validation of the Ricardian Equivalence Hypothesis. Results also suggest that although the fixed capital investment coefficient is, as expected, negative but lower than 1 shows the validity of Feldstein-Horioka Hypothesis, Tunisia was not fully integrated to international markets. Given the obtained results, policy implications and concluding remarks are provided in Section 5.

LITERATURE REVIEW

The imbalance in the current account of the balance of payments and the causal links between the current account deficit and the budget deficit in developed and developing countries are of great importance and are also of analytical interest politically. In this section, we present the main theoretical explanatory perspectives on the relationship between the budget deficit and the current account deficit, as well as empirical evidence. In the context of an open economy, the theoretical foundation of the relationship between the budget deficit and the current account deficit can be analyzed using the following national accounting identity:

$$Y = C + I + G + [X - M], \qquad (1.1)$$

where, Y is the national income and is equal to the sum of consumption C, investment I, government spending G, and net exports (X−M). On the other hand, national income Y is allocated to various uses, including consumption C, savings S, taxes T, and transfer payments R, as follows:

$$Y = C + S + T + R \qquad (1.2)$$

By rearranging the two previous equations and neglecting transfer payments, we obtain:

$$[S - T] + [T - G] = [X - M] \longrightarrow [I - S] + [G - T] = [M - X] \qquad (1.3)$$

The term on the left side represents the gap between domestic savings and investment (I - S) and the budget deficit (G - T). The sum of these two components determines the current account deficit (M - X). Any observed imbalance in the current account can be attributed either to a gap between investment and savings or to the fiscal balance. This relationship implies that the current account balance is directly linked to the gap between savings and investment as well as the gap between taxes and public spending. Furthermore, national savings is divided into private savings (Sp) and public savings (Sg) as follows:

$$S = S_p + S_g \qquad (1.4)$$

By substitution, Eq. (1.4) can be rewritten as follows:

$$[X - M] = [S_p - I] + S_g \quad \text{and} \quad CAD = S_p - I + BD_g \qquad (1.5)$$

From this macroeconomic identity, two perspectives are advanced:

No causal relationship between current account deficit and budget deficit

The first perspective posits no causal relationship between the two deficits, if the government budget deficit worsens, households increase their private savings, thereby neutralizing any effect on the current account balance. This perspective supports the absence of a causal relationship between the current account deficit and the budget deficit. This viewpoint is known as the "Ricardian Equivalence Hypothesis." Ricardo (1817) argued that the budget deficit does not affect capital formation, economic growth, or the level of aggregate demand, including import demand. This is because forward-looking individuals fully account for future taxes associated with budget deficits. In other words, the theory implies that there is no apparent correlation between the two deficits. Although controversial, Ricardo's hypothesis suggests that the public sector views the budget deficit as public investment and treats public and private investments as perfect substitutes. However, fiscal measures designed to influence aggregate demand will have no effect as long as individuals reduce consumption in anticipation of future tax liabilities. Buchanan (1976) builds on Barro's (1974) work, which states that "the government deficit is neutral, and a twin deficits situation can occur merely by coincidence." Barro (1974; 1989) further supports Ricardo's Equivalence Hypothesis, indicating the absence of a causal relationship between the two deficits. Buchanan's (1976) results also show that intertemporal changes in taxes and budget deficits do not affect interest rates, investment levels, or the current account balance. Studies by Miller and Russek (1989), Dewald and Ulan (1990), Enders and Lee (1990), Alse and Bahmani-Oskooee (1992), Kim and Roubini (2008), and Kaufmann et al. (2002) validate the Ricardian Equivalence Hypothesis, concluding that there is no systematic relationship between current and budget deficits. Based on Unated States data, Enders and Lee (1990) suggest that an increase in taxes aimed at reducing government debt will not affect either private spending or the current account balance and investigate if an increase in government spending (regardless of its financing methods) lead to a current account deficit? Based on a VAR unrestricted model, results do not reject the independence between both deficits, thereby supporting the Ricardian Equivalence hypothesis in the United States.

Causal relationship between current account deficit and budget deficit

The second perspective posits a causal relationship between the two deficits, namely Twin Deficits Hypothesis occurs if the difference between private savings and investment remains stable over time, fluctuations in the public sector balance will be fully reflected in the current account balance, and vice versa. Assuming that private savings equals investment (at the marginal value), several authors conclude that the external current balance and the public budget are directly interrelated. This implies that both variables will move in the same direction and in the same proportions. The assumption that one of the deficits can be used to explain the other seems unreasonable given the possibility of bidirectional causality between the two deficits. If the twin deficits hypothesis is confirmed, an appropriate recommendation would be to reduce the budget deficit through tax increases. This would result in a reduction of the current account deficit due to decreased consumption of imported goods caused by the decrease in disposable income. Therefore, it is more reasonable to focus on analyzing the relationship between these two deficits, known as the twin deficits hypothesis. However, in the empirical literature, a log-linear function is generally used to describe this relationship as follows:

$$CAD_t = \alpha_0 + \alpha_1 BD_t + \varepsilon_t, \tag{1.6}$$

with ε_t representing the error term. We expect that the coefficient α_1 will be positive and lie between zero and one. The latest perspective can be disagregated into three scenarios : specifically, (i) Causality can run directly from the budget deficit to the current account deficit. This hypothesis is grounded in Keynesian absorption theory and the Mundell-Fleming framework (See Mundell, 1960 and Fleming, 1962), which suggests that an increase in the budget deficit will put upward pressure on interest rates, leading to an appreciation of capital inflows and exchange rates. In a flexible exchange rate system, the appreciation of the exchange rate makes exports less attractive and imports more attractive, thereby worsening the current account deficit. In summary, according to this hypothesis, a budget deficit leads to a current account deficit or exacerbates an existing current account deficit. Thus, the appropriate government policy measure would be to reduce aggregate demand and corresponding imports. Studies by Darrat (1988), Abell (1990), Bahmani-Oskooee (1992, 1995), Rosenweig and Tallman (1993), Leachman and Francis (2002), Salvatore (2006b), and Baharumshah and Lau (2007) show that the two deficits are closely linked and support the Keynesian hypothesis. Vanvoukas (1997) uses annual data from Greece and demonstrate a unidirectional causal relationship from the budget deficit to the current account deficit in both the short and long term. By specifying an ARDL model to test the Keynesian and Ricardian Equivalence hypotheses in India from 1971 to 2010, Sahoo (2012) finds empirical support for the Keynesian hypothesis. The results indicate that a high budget deficit exacerbates the current account deficit, implying that government measures aimed directly at reducing the budget deficit will indirectly contribute to reducing the current account deficit in India. (ii) Reverse Causality can run directly from the current account deficit to the budget deficit, the Targeted Current Account Hypothesis proposed by Summers (1988), asserts that a deterioration in the current account leads to an increase in the budget deficit. This hypothesis is particularly relevant for a small open economy that relies heavily on foreign capital inflows to boost economic growth. In other words, a country's budgetary position will be negatively affected by large capital inflows or the accumulation of debt. Studies by Abell (1990), Kearney and Monadjemi (1990), Khalid and Guan (1999), Fountas and Tsoukis (2000), Kouassi et al. (2004), and Marinheiro (2008) support the Targeted Current Account Hypothesis, indicating a positive dependence and a causal direction from the current account deficit to the budget deficit. However, the results of the Toda and Yamamoto (1995) causality test align with Summers (1988), showing a unidirectional causality from the current account deficit to the budget deficit. This suggests that an increase in the current account deficit leads to a worsening of the budget deficit in Malaysia. Saeed and Khan (2012) analyze the dynamics between the current account deficit and the budget deficit in Pakistan from 1972 to 2008 and confirm a unidirectional causality from the current account deficit to the budget deficit. Merza et al. (2012) study the twin deficits hypothesis in Kuwait using quarterly data from 1993 to 2010 and applying Johansen's (1995) cointegration test and VAR model. They test the direction of causality between the two deficits and find that causality runs from the current account deficit to the budget deficit. (iii) Causality can be direct and bidirectional (Feedback Effect) between the two deficits. Studies by Biswas et al. (1992) and Kouassi et al. (2004) also suggest a bidirectional causal relationship between the two deficits. Darrat (1988) employs the multivariate Granger causality test and the Akaike Criterion using U.S. data from 1960 to 1984. His analysis concludes that there is bidirectional causality between the budget deficit and the current account deficit. Islam (1998) examines the validity of the twin deficits hypothesis for Brazil between 1973 and 1991 and finds evidence of bidirectional causality between the two deficits in this country. Additionally, Islam (1998) investigates Morocco and confirms a bidirectional causality between the two deficits using cointegration tests and an error correction model. Similarly, Normandin (1999) validates this type of relationship for the Canadian economy. Mukhtar et al. (2007) analyze the persistence dynamics of the current account and budget deficits, investigating the validity of the twin deficits hypothesis in Pakistan using quarterly data from 1975 to 2005. The cointegration test reveals a long-term relationship between the two deficits. The causality test shows bidirectional causality between the deficits during the study period. Mukhtar et al. (2007) suggest further exploration of this result by applying simultaneous equations models to the same data for future research. Pahlavani and Saleh (2009) assess the validity of the Keynesian or Ricardian Equivalence hypothesis in the Philippines from 1970 to 2005. Their empirical results indicate a long-term cointegration relationship between the two deficits. However, the causality test results reveal a bidirectional relationship between the deficits. According to Pahlavani and Saleh (2009), this finding seems plausible and is linked to the external debt crisis of the 1980s under Marcos. The results also suggest that policies aimed at reducing the current account deficit will, in turn, reduce the budget deficit, and vice versa. If the twin deficits hypothesis is validated, an appropriate policy recommendation would be to reduce the budget deficit through increased taxation. This budgetary consolidation would directly reduce the budget deficit and, consequently, indirectly reduce the current account deficit, as consumption of imported goods decreases due to a reduction in private disposable income after taxes (See Normandin, 1999).

The role of interest rate and exhange rate

Causality can be indirect through interest rate and exchange rate channels between the two deficits. Given that in Eq. (1.5), both private savings and investment depend on the interest rate and the exchange rate, and following the work of Kalou and Paleologou (2012), this equation can be rewritten as:

$$CAD = I(IR, ER) - S_p(IR, ER) + BD \quad (1.7)$$

Abell (1990) highlights the mediating role of interest rate between the two deficits. In a small open economy, interest rates are exogenous, suggesting a long-term causal relationship from interest rates to the current account, while in a large economy, interest rates are determined by the deficit. The exchange rate is also a crucial variable. In this case, the government aims to eliminate the current account deficit and uses the budget deficit as a tool to achieve this objective. Hakro (2009) investigates the causal links between the current account deficit, the budget deficit, in Pakistan between 1948 and 2005 and showed evidence of causality from the budget deficit to prices, interest rates, capital flows, exchange rates, and ultimately to the trade deficit. These findings suggest that reducing the budget deficit would help control price levels. Consequently, minimal government intervention and a balanced budget could restore the trade deficit and improve Pakistan's international trade climate. It then seems pertinent to test whether the interest rate and the exchange rate act as mediators or moderators that indirectly link the current account deficit to the budget deficit. If the variables of interest are cointegrated, their potential causal relationship will be examined using an error correction model. Otherwise, a more appropriate specification would be an unrestricted VAR model (See Eq. (1.8) below):

$$\Delta BD_t = a_0 + a_1 ECT_{t-1} + \sum_{i=1}^{n} a_{2i}[1-L]\Delta BD_{t-i} + \sum_{i=1}^{n} a_{3i}[1-L]\Delta IR_{t-i} + \sum_{i=1}^{n} a_{4i}[1-L]\Delta ER_{t-i} + \sum_{i=1}^{n} a_{5i}[1-L]\Delta CA_{t-i} + \mu_t \quad \text{(Eq.1.8.1)}$$

$$\Delta IR_t = b_0 + b_1 ECT_{t-1} + \sum_{i=1}^{n} b_{2i}[1-L]\Delta IR_{t-i} + \sum_{i=1}^{n} b_{3i}[1-L]\Delta BD_{t-i} + \sum_{i=1}^{n} b_{4i}[1-L]\Delta ER_{t-i} + \sum_{i=1}^{n} b_{5i}[1-L]\Delta CA_{t-i} + \varepsilon_t$$

(Eq.1.8.2)

$$\Delta ER_t = c_0 + c_1 ECT_{t-1} + \sum_{i=1}^{n} c_{2i}[1-L]\Delta ER_{t-i} + \sum_{i=1}^{n} c_{3i}[1-L]\Delta IR_{t-i} + \sum_{i=1}^{n} c_{4i}[1-L]\Delta BD_{t-i} + \sum_{i=1}^{n} c_{5i}[1-L]\Delta CA_{t-i} + \delta_t$$ (Eq.1.8.3)

$$\Delta CA_t = d_0 + d_1 ECT_{t-1} + \sum_{i=1}^{n} d_{2i}[1-L]\Delta CA_{t-i} + \sum_{i=1}^{n} d_{3i}[1-L]\Delta IR_{t-i} + \sum_{i=1}^{n} d_{4i}[1-L]\Delta ER_{t-i} + \sum_{i=1}^{n} d_{5i}[1-L]\Delta BD_{t-i} + \eta_t$$
(Eq.1.8.4)

In Eq. (1.8), ECT represents the error correction term, L is a lag operator, and μ, ε, δ, and η are random error terms that are serially uncorrelated. Empirically, validation of the Ricardian Equivalence hypothesis implies that the parameter d_{2i} in Eq. (1.8.4) and the parameter a_{5i} in Eq. (1.8.1) should not be statistically different from zero. Validation of the Keynesian hypothesis requires that the parameter d_{2i} in Eq. (1.8.4) be statistically different from zero, while the parameter a_{5i} in Eq. (1.8.1) should not be statistically different from zero. Validation of the the Targeted Current Account Hypothesis implies that the parameter a_{5i} in Eq. (1.8.1) should be statistically different from zero, while the parameter d_{2i} in Eq. (1.8.4) should not be statistically different from zero. Validation of the Bidirectional Causality Hypothesis requires that all parameters in Eq. (1.8.1) and Eq. (1.8.4) be statistically different from zero.

Fountas and Tsoukis (2000) examine the interaction between the current account, the budget balance, and the real interest rate, concluding that in the short term, there is evidence supporting the twin deficits hypothesis and targeted current account deficits. Gulcan and Bilman (2005) used cointegration and causality methods on the data of Turkey for the period 1960-2003 and proved a strong influence of budget deficit on the real exchange rate. The study shows that the role of budget deficit in maintaining the real exchange rate is very crucial. Bose and Jha (2011) partially validate the conventional hypothesis of causality running from budget deficit to interest rate to exchange rate and then to the current account deficit in India. Kalou and Paleologou (2012) study the relationship between the current account deficit, budget deficit, short-term interest rates, and the nominal effective exchange rate in Greece from 1960 to 2007. This relationship runs from the current account deficit to the budget deficit through short-term interest rates and the exchange rate. These findings validate the targeted current account deficit hypothesis for Greece.

The role of the degree of international capital mobility

Feldstein and Horioka (1980) point that savings and investment are highly correlated and thus this linkage translates into bi-directional relationship between the fiscal balance and the current account balance, with variables moving together. As the relationship between variables occurs in both directions, this result may support both the Twin Deficit Hypothesis and the Current Account Targeting Hypothesis. At an empirical stage, Fouquau et al. (2007) provide insight into how fiscal and external imbalances interact in the context of global capital mobility. Marinheiro (2006) argues that if savings and investment are not strongly correlated indicating a high degree of capital mobility, then there is substantial evidence that the current account deficit and the budget deficit are likely to exhibit a common trajectory. This is because high capital mobility would typically reduce the correlation between domestic savings and investment, while also influencing the relationship between budgetary and external balances. This relationship is rooted in the idea that high capital mobility allows for external imbalances to reflect domestic fiscal policies more directly. Fidrmuc (2003) was the first to simultaneously examine the twin deficits hypothesis and the Feldstein-Horioka hypothesis using a large sample of industrialized countries, including three newly integrated European Union (EU) members, as well as emerging markets and transition economies from 1970 to 2001. The study's results identify a long-term positive relationship between twin deficits. Additionally, it was shown that investment in several EU countries is financed through international financial markets, indicating that the Feldstein-Horioka hypothesis is less significant for EU countries. Fidrmuc (2003) proposes a regression model that integrates the twin deficits hypothesis with the Feldstein-Horioka puzzle. The starting point is the national accounting identity described in Eq. (1.1). For simplicity, Fidrmuc (2003) identifies net exports with the current account. Rearranging Eq. (1.1), we get:

$$X_t - M_t = Y_t - (C_t + G_t) - I_t = S_t - I_t \qquad (1.8)$$

According to this accounting identity, the trade balance should equal the difference between national savings S_t (defined as output minus total consumption) and investment I_t (proxied by gross fixed capital formation). This suggests a potential link between the external balance and both savings and investment decisions. However, all things being equal, an increase in investment will have a negative effect on the external trade balance. Conversely, policies aimed at reducing public or private consumption are expected to positively impact the external balance by increasing national savings. Fidrmuc (2003) divides savings into public (S^p) and private (S^g) components[8]. This gives the following expressions:

$$X_t - M_t = (Y_t - T_t - C_t) + (T_t - G_t) - I_t = S^p{}_t + S^g{}_t - I_t \qquad (1.9)$$

This identity has motivated the search for a long-term relationship between the current account (X-M), the budget deficit, and total investment. The regression model proposed by Fidrmuc (2003), where the variables are expressed as a percentage of GDP, is formulated as follows:

$$X_t - M_t = \gamma_1 + \gamma_2 (T_t - G_t) - \gamma_3 invt_t + \varepsilon_t \quad , \qquad (1.10)$$

[8] Public savings are assumed to be represented by the budget balance and are defined as the difference between tax revenues (T) and government expenditures (G). Private savings are defined as disposable income minus private consumption.

With, (X-M) representing the current account, (T-G) representing the government budget balance, and (invt) representing the share of investment. As discussed previously regarding the identity in Eq. (1.3), a positive coefficient is expected for the budget balance ($\gamma_2>0$), and a negative coefficient is anticipated for investment ($\gamma_3 < 0$). However, the simultaneous occurrence of a budget deficit coupled with high investment is expected to worsen the current account deficit. Additionally, if the country is perfectly integrated into the global economy, the coefficients of both variables should be unity, meaning that the budget deficit and investment are financed on the international capital market. However, validating the Feldstein-Horioka puzzle hypothesis would be associated with a coefficient γ_3 significantly less than one. Conversely, rejecting the twin deficits hypothesis would be associated with a negative coefficient γ_2.

Marinheiro (2008) builds on Fidrmuc's (2003) work to test the validity of Ricardian Equivalence and the Feldstein-Horioka hypothesis for Egypt from 1971 to 2004. The results do not support Ricardian Equivalence; however, the study indicates a high degree of capital mobility, which leads to the rejection of the Feldstein-Horioka hypothesis. In Turkey, between 1974 and 2010, Altintas and Taban (2011) specify an ARDL cointegration model and use Toda and Yamamoto's (1995) Granger causality test, and validate the twin deficits hypothesis. Additionally, as expected, the investment coefficient is negative and less than 1, validating the Feldstein-Horioka hypothesis. This suggests that Turkey struggles to integrate effectively into the international capital market, with results showing that one-fifth of investments are financed by foreign savings. In Pakistan between 1976 and 2010, Saeed and Khan (2012) empirically examine the validity of the Feldstein-Horioka puzzle in the context of the twin deficits hypothesis, using the ARDL model. Their empirical results reveal a positive relationship between the current account balance and the budget deficit both in the short and long terms. The Toda and Yamamoto (1995) causality test confirms the validity of the twin deficits hypothesis. Additionally, their findings indicate a negative relationship between the current account balance and investment in both the short and long terms, suggesting a high degree of capital mobility and rejecting the Feldstein-Horioka puzzle. However, the short-term investment coefficient is negative and less than one, which validates the Feldstein-Horioka puzzle only in the short term.

As discussed above, Shastri et al., (2017), extend the Twin Deficit Hypothesis and attempt to examine the following model reflecting Triple Deficit Hypothesis including current account balance (CAB), government's fiscal balance (BD) and saving-investment gap (SAV):

$$CAB = \alpha 0 + \beta_1\left(BD_{it}\right) + \beta_2(SAV_{it}) + \varepsilon_{it} \qquad (1.11)$$

The determinants of likelihood and magnitude of twin deficits

This section reviews the major cited factors in the literature that can influence the inferential decision regarding the validation of the existence of a link between current account deficit and budget deficits, and if this link exists, what makes one direction of causality validated, rather than another one. Table 1 summarizes result divergence regarding validation of Twin Deicit Hypothesis for some countries reported in the literature and shows the severity of spurious inference on decision making. This is motivated, on the one hand, by the observation that , obviously, for the same country, and for time intervals that are sometimes similar or slightly offset, the results of the various authors diverge, thus leading users and decision-makers into a situation of uncertainty. For instance, Corsetti and Muller (2006) show that the likelihood and magnitude of twin deficits increase as a function of the degree of openness of the economy, and decrease as a function of the persistence of fiscal shocks. Hashemzadeh et al. (2012) show that the direction of causality between the current account deficit.

Table 1. Severity of result divergence regarding the validation of Twin Deficit Hypothesis in some countries

Country	Authors	Period	Method	Results
U.S.A	Miller and Russek (1989)	1950 – 1980	Deterministic and stochastic procedures Cointegration test	Twin deficits exist only under flexible exchange rates. Ricardian Equivalence
	Enders and Lee (1990), Normandin (1999)	1970 – 1993 During the flexible exchange rate regime period from	Cointegration test	Ricardian Equivalence
	Kim and Roubini (2008)	1973	Cointegration test	BD causes CAD
	Zietz and Pemberton (1990), Bachman (1992), Rosenweigh and Tallman (1993), Bahmani and Oskooee (1992, 1995) and Dibooğlu (1997).	Quarterly 1960 – 1994	Cointegration test Variance decomposition	Twin Deficits

	Hatemi et Shukur (2002)	Quarterly 1975 – 1998	Cointegration test in presence of stuctural breaks	BD causes CAD between 1975 and 1989. CAD causes BD between 1990 and 1998.
Turkey	Zengin (2000) Akbostancı and Tunç (2002)	Quarterly 1987–1999 1987 – 2001	VAR model	Twin Deficits in short and long terms
	Günaydın (2004) Utkulu (2003)	1987 – 2003 1950–2000	Causality test Toda Yamamoto (1995) Cointegration test	Unidirectional causality from BD to CAD
	Aksu et Başar (2005,2009) Çetintaş and Barışık (2005) Kuştepeli (2001)	1989-2003	VAR model	Ricardian Equivalence
Pakistan	Hakro (2009)	Quarterly 1948 - 2005	VAR model	Unidirectional causality from BD to CAD
	Javid et al. (2011)	1960-2009	VAR model	Ricardian Equivalence
	Siddiqui (2010)	1986–2008	Cointegration test in presence of stuctural breaks	CAD causes BD before 1982. BD causes CAD between 1992 and 2008.

Note: CAD, BD, respectively, denote the current account deficit and budget deficit

Furceri and Zdzienicka (2018), in developing countries, the validation of such hypotheses points to heterogeneity across countries and over time. The effect tends to be larger during recessions, in countries that are more open to trade; that have less flexible exchange rate regimes; and with lower initial public debt-to-GDP ratios. For example, Leachman and Francis (2002) rely on quarterly data in the United States between 1948 and 1992 and do not validate the hypothesis of twin deficits over the entire period of the study. Leachman and

Francis (2002) explain this result by the exchange rate regime adopted which changed from one sub-period to another.

METHODOLOGY

As can be seen from the above discussion, little have been investigated in the literature on the causality linkage between current account deficit and budget deficit for the Tunisian case. Our paper then addresses this issue. The objective of this study is to test the short and long run validation of the Twin Deficit Hypothesis in Tunisia over the period 1980-2022, and essentially to chek the severity of result divergence and/or robustness based on three assessing tools largely reported in the literature of empirical investigations. To this end, this study first analyzes the direct causal relationship between the current account deficit and the budget deficit following the model (M1) in Saeed and Khan (2008). Second, this study investigates the potential mediating role of both real interest rate and real effective exchange rate following the model (M2) in Kalou and Paleologou (2012). The integration of the real effective exchange rate variable is motivated by the results in Zoghlami and Ghanmi (2020), based on a bivariate copula model, they suggest that the real exchange rate misalignments affect the current account gap differently, depending on the sign and size of the exchange rate deviation from its equilibrium value. Third, and following the model (M3) in Fidrmuc (2003), this study assesses if the Tunisian degree of international capital mobility allow for external imbalances to reflect domestic fiscal policies more directly. In lights of these facts, some questions arise. (i) do current account balance changes precede, follow or occur at the same time as changes in budget balance in Tunisia? (ii) How does interest and exchange rates influence this relationship? (iii) Does Tunisian degree of international capital mobility allows for external imbalances to reflect domestic fiscal policies more directly. Does the country require recommended policies to deal jointly with fiscal and trade movements to guarantee a sustained current account deficit in Tunisia?

In this study, the sample comprises annual data from 1980 to 2022[9] and investigates the dynamic relationships between budget balance (BD) (measured as the difference between government revenues and expenditures), as share of GDP, and current account balance (CAD) (measured as the difference between the value of exports of goods and services plus current income and transfers and imports of goods and services plus current income and transfers), as share of GDP. We also investigate the role of the real interest rate (RIR) and the real effective exchange rate (REER). Investment (I) is proxied by the ratio of gross fixed capital formation

[9] Data are collected from the International Monetary Fund, the World Bank, the International Financial Statistics, the Tunisian Central Bank Reports, and the National Institute of Statistics.

(GFCF) to GDP and is used to investigate the role of the degree of capital mobility to confirm the initial link between the two deficits through assessing the validation of the Feldstein Horioka Hypothesis**.**

The selected methodology consists in applying the ARDL approach proposed by Pesaran et al. (2001), which is commonly used to investigate the long-run links between variables. In comparison with other known cointegration methods, the ARDL approach allows different optimal lags for the variables, and is a very useful tool since it substantially improves the small-sample properties of the estimates regardless of the nature of the time series, stationary or not. Another feature of substantial importance of the ARDL approach is that it can be applied even for small sample size (see Narayan, 2005), and allows getting simultaneously the short-term and long-term estimates.

First, descriptive statistics of the series are provided in order to clarify the nature of the links between them. Second, the stationarity properties of the series are examined. Third, diagnostic tests are performed to ensure the validity of the regressions used for the implementation of the bounds test approach of cointegration among the variables. Fourth, given the supported cointegrating relationships, we compute the long- and short-run elasticities, assess the causality direction between variables, and check the return to the long-run equilibrium based on the estimated error correction model.

RESULTS AND DISCUSSION

Descriptive statistics and preliminary stylized facts

Figure 1 reports visual inspection of the series in order to better apprehend the joint dynamics of the series and shows evidence of time trending behavior, which could be indicative of long-run links between the variables. Like the majority of developing countries, Tunisia is characterized by structural large and persistent internal and external imbalances, where the magnitude depends on the economic and social circumstances of the country[10] during the study period**.** The current account and the budget imbalances follow a cyclical trend over five-year periods[11], with a clear worsening after 2011 revolution. However, the budget deficit exceeds the current account deficit until 2010, whereas the opposite is true after Revolution since 2011.

Table 2 documents that, in most cases, the two imbalances exhibit similar averages around 5% as a percentage of GDP. The budget deficit has lower risk than the current account deficit 1.98 (3.00), respectively. Tunisia expansionary fiscal policies have led to budget deficit

[10] See Ayadi and Mattoussi (2015).
[11] This observation is well justified in a five-year development framework. The evolution of the gap between tax revenues and public expenditure depends on public commitments in terms of investment and development defined at the level of the five-year development plans.

and public debt growth; the budget has remained focused on increasing current expenditure rather than the investment.

The results of the unconditional correlation test reported in Table 2 initially suggest that the budget deficit and the current account deficit are positively linked at 1 % significance level. As the internal imbalance is the equivalent of an external current account deficit, we can notice easily that the public and external deficits move in the same way giving first insight that they may be twin deficits, through for example, the impact of oil price shock on public subsidies and imports in the same time. But the government deficit may influence the external deficit through expansionary fiscal policy as the rise in wages, during the last years, has created purchasing power that was partially import-oriented, widening in this way the trade deficit.

The persistent current account and budget deficits in Tunisia brought us to study the real exchange rate[12] misalignment and the real interest rate impact on the current account and budget imbalances. Figure 2 and Table 2 show that the real effective exchange rate is in continious decrease with a minimum of 78.34 recorded in 2019 and a maximum of 221.09 recorded in 1981 and a significant volatility measured by standard deviation of 42.28. As reported in Zoghlami and Ghanmi (2020), Tunisia's real effective exchange rate was alternating between over and undervaluation periods with critical episodes of high misalignment (1982-1985, 1988-1990, 2006-2008 and 2015). However, the unconditional correlations reported in Table 2 show that the real effective exchange rate is not linked to the current account deficit, neither to the budget deficit.

Figure 2 and Table 2 show that the real interest rate fluctuates between negative (in ten years over the study period) and positive values, with a minimum of -5.75 recorded in 1982, a maximum of 6.48 recorded in 1993 and a standard deviation of 2.37. However, the interest rate doubly conditions the competitiveness of companies as a cost component and as a determinant of investment. On the one hand, a high interest rate hinders investment due to the high cost of credit, but on the other hand, it helps to contain inflation.

It should be noted that while the policy of lowering interest rates could encourage investment, it could work against the development of savings and encourage consumption;

[12] Indeed, since the collapse of the Bretton Woods International Monetary System, Tunisia has experienced two main exchange rate systems and has undertaken several reforms in monetary and exchange rate policy. These reforms have generated a growing interest in assessing the performance of exchange rate policy and modelling the determinants of the dinar exchange rate. From 1973 to 1986, a fixed regime has been adopted. Since then, the Central bank of Tunisia attempted to stabilize the REER so that the Tunisian economy could maintain its international competitiveness. During the '90s, Tunisia made significant progress in opening its external sector. This strategy aimed toward ensuring a competitive environment for national companies and products. In 1992, the authorities decided to introduce further flexibility to the exchange rate via the REER targeting, regular adjustments in the nominal exchange rate, and establishing the convertibility of the dinar for the non- residents. It is considered as an intermediary step toward a floating exchange rate system. In the early 70's, the authorities chose to peg their currency to the FF, since France was their principal trading partner. During the same decade, an interbank foreign exchange market was established in 1994. In 1997, resident and non-resident licensed brokers were allowed to operate in foreign exchange forward transactions on behalf of their resident customers. Since 2000, following the IMF advice, the CBT has limited its intervention in the foreign exchange market and allowed for a more flexible exchange rate using a managed float policy. Aforementioned regime aimed to improve competitiveness

which would result in an increase in domestic demand and pressure on the trade balance through increased imports. Furthermore, this policy does not allow savings to be channelled further towards the banking system. The interest rate cut aims to support private investment and alleviate the financial burdens of companies that have been hit hard by an unfavorable national and international economic situation. This decline can be explained in real terms by the decline in the nominal rate in addition to remarkably high levels of the inflation rate. The interest rate trend has been more volatile with a general downward trend.

Table 2 shows that the real interest rate is positively related to both the current account deficit and the budget deficit at 5% and 1% significance levels, respectively, indicating that (i) an increase of the real interest rate worsens both the current account and budget deficits, and (ii) the real interest rate is likely to play an active role in the causal chain.

Figure 1. Evolution of current account deficit, budget deficit, real effective exchange rate, real interest rate and investment in Tunisia, 1980-2022

Table 2. Summary statistics and empirical correlations between series

Level	CAB	BB	I	REER	RIR
Mean	-5.10	-4.36	23.89	128.90	1.50
St.Dev	3.00	1.98	3.98	42.28	2.37
Minimum	-10.79	-9.40	15.84	78.39	-5.75
Maximum	2.08	-1.20	34.03	221.09	6.48
Correlations					
CA	1.00	.55**	-.06	.06	.33*
BD		1.00	-.06	-.14	.39**
I			1.00	.82**	-.04
REER				1.00	-.10
RIR					1.00

Note: CAB, BB, I, REER and RIR, respectively, denote the current account balance, budget balance, investment, real effective exchange rate and real interest rate.
**, * The correlation is significant at the 0.01 and 0.05 levels, respectively

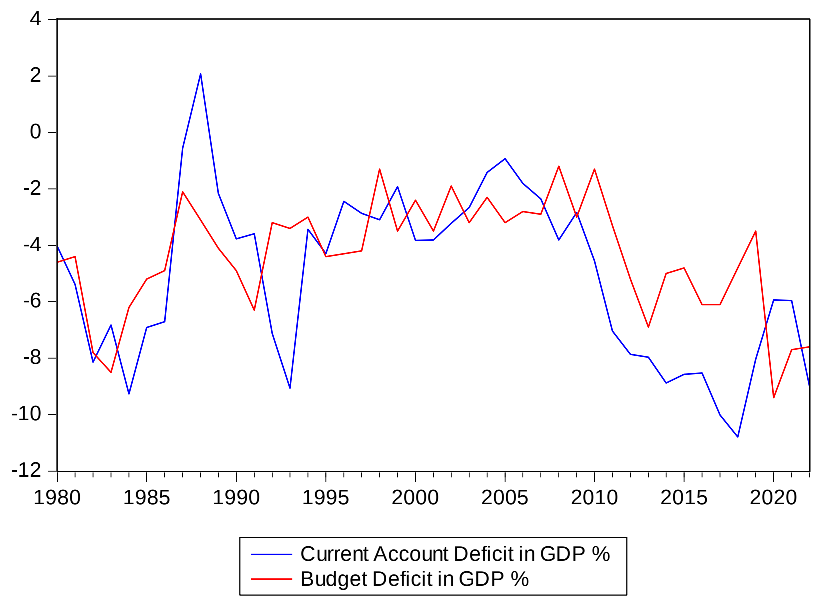

Figure 2. Evolution of current account deficit and budget deficit gap in Tunisia, 1980-2022

In Tunisia, Investment is considered as the driver of growth and is funded either by domestic savings or external borrowing. According to the intertemporal approach, the gap between domestic savings and investment is a key determinant of the current account balance. In Tunisia, foreign direct investment financed 15.7% of gross fixed capital formation during the period from 2000 to 2014, a rate considered low compared to competing countries. It can be argued that an increase in investment worsens the current account in the short run, but as reported in Farhoud and Taleb (2019), if the investment is directed to the most profitable sectors, it may improve current account balance in the long-term. Moreover, as reported earlier in Fidrmuc (2003), the simultaneous occurrence of a budget deficit coupled with high investment is expected to worsen the current account deficit. However, Tunisia has a history of over 50 years of integration into the global economy. Tunisia is adopting an onshore-offshore economic model facilitated by the implementation of the Tunisian Investment Incentives Code (IIC)[13]. While this approach initially contributed to Tunisia's development, it also introduced distortions. By the 1990s, it became apparent that this dual economy model was no longer conducive to achieving a high level of economic growth. Table 2 shows that the investment as a GDP share decreases from 30% between (1980-1985) to 25% between (1986-2019) to 16% between (2020-2022), with a severe gradual drop after 2011 revolution and continued until 2014[14] marked by economic, social, and security instability. Tunisia has actually lower investment rates compared to emerging economies[15] that had similar investment rates in the early 2000s. This difference was attributed to the reforms, development programs, and infrastructure that benefited the private sector in these countries[16]. In terms of the sectorial distribution, after 2000s, market services held the dominant share at 52% of the total, with increased investment in the transport and telecommunications sector. The non-manufacturing industry represented 21.3% of total gross fixed capital formation, while manufacturing and agriculture sectors occupied 12.5% and 8.5%, respectively. The results of the linear regression model (not reported here) suggest that the coefficient of budget deficit γ_2 is positive (.837) (TDH occurs) and the coefficient of the investment is negative and significantly less than unity (FHT) does not occur. The coefficient linking investment to the current account deficit is negative and far from one, suggesting that (i) domestic investment is not financed by external funds and (ii) Tunisia is not relatively integrated into the international capital market. However, these findings should be confirmed by a more detailed analysis both in the long term and short term. This correlation analysis just allows providing a preliminary idea about nature of the relationship among the variables of interest, but cannot be determinative of the presence of causal links between series.

In the next step, we first ensure that the considered series are not integrated of order two or more to apply the approach of Pesaran et al. (2001)[17]. We test for unit root using the ADF (See Said and Dickey, 1984) 1992). Overall, as can be seen from Table 3, we infer that the

[13]The IIC, established by the law 93-120 of December 1993, covers all sectors of activity except mining, energy, domestic commerce, and the financial sector, each of which are governed by specific legislation, and distinguishes between two basic regimes for "fully exporting" firms (or offshore) and for "non-exporting" or "partially exporting" firms (or onshore). The IIC has resulted in an economy segmented between an onshore sector that remains closed to competition and characterized by rents, cronyism, and low productivity, and an offshore sector trapped mainly in low value-added activities—with no competition and limited spillovers of know-how between onshore and offshore sectors. The IIC, established by the law 93-120 of December 1993, covers all sectors of activity except mining, energy, domestic commerce, and the financial sector, each of which are governed by specific legislation, and distinguishes between two basic regimes for "fully exporting" firms (or *offshore*) and for "non-exporting" or "partially exporting" firms (or *onshore*).

[14]From 26% in 2010 to 16% in 2020. Source: Tunisian Ministry of Development, Investment, and International Cooperation.

[15]Morocco (31%), India (31.7%), Indonesia (28.8%) and China (42.9%).

[16]Source: Tunisian Ministry of Development, Investment, and International Cooperation

[17] See Ang (2007).

integration degrees of the variables are not the same and that our data are a mix of variables integrated of order 0, I(0), and 1, I(1). This should be considered with caution when choosing appropriate cointegration and causality techniques in the sequel. The cointegration methods based on the works of Engle and Granger (1987), Johansen (1995), and Johansen and Juselius (1990) require all series to be I(1). However, these techniques are not suitable for our case. Therefore, this study employed the ARDL modeling approach developed by Pesaran et al. (2001), which is most appropriate for cases where the series are a combination of I(0) and I(1). Therefore, we are now able to investigate the long-run links between the variables based on level series, and the short-term linkages based on the first-difference series.

Cointegration results

Before testing for cointegration, we conduct diagnostic tests to check the validity of the above-unrestricted regressions. Indeed, we apply the LM test for autocorrelation, the ARCH test, the Jarque-Bera normality test, and the Ramsey RESET test for the correct functional form of the specifications. The results reported in Table 4 conclude, in general, in favor of correctly specified models that can be used to test for cointegration between series. Regarding the cointegration analysis, the results depicted in Table 4 document that the observed F-statistics exceed the upper bounds of the critical values at conventional significance levels. Therefore, long-run relationships are detected between variables in all selected models, which implies that the variables move together over the long-run in each of the three systems of equations.

Table 3. Unit root tests

Level	ADF		
	a	b	c
CAD	-2.298		
BD	-2.120		
REER		-3.419**	
RIR			-1.414
I	-4.590***		
	First Difference		
DCAD	-4.946***		
DBD	-5.722***		
DRIR			-5.388***

Notes: (a) indicates a model with only a constant term;
(b) model with constant and deterministic trend and (c) model with none.
*, ** and *** indicate the rejection of the null hypothesis at the 10%, 5% and 1% levels, respectively.

Table 4. Diagnostic tests and *F*-statistic for cointegration

Test	Model 1		Model 2		Model 3
	CAD	BD	CAD	BD	CAD
LM(3)	0.172	0.377	1.217	0.454	0.299
	[0.843]	[0.689]	[0.315]	[0.642]	[0.743]
ARCH(3)	1.443	0.241	0.534	0.598	0.531
	[0.250]	[0.787]	[0.591]	[0.444]	[0.593]
JB	0.622	7.876**	0.260	4.976*	3.422
	[0.732]	[0.019]	[0.878]	[0.083]	[0.181]
RESET	0.071	0.726	0.841	0.239	1.588
	[0.931]	[0.659]	[0.445]	[0.789]	[0.220]
F-statistic	3.696*	11.173***	8.826***	11.824***	16.842***

Notes: The values in parentheses are the p-values. *, ** and***indicate the rejection of the null hypothesis at the 10%, 5% and 1% levels, respectively. With, LM, ARCH, JB, RESET and F-statistic, respectively, indicate The Breusch–Godfrey serial correlation LM test, the Engle's ARCH test, the Jarque-Bera normality test, the Ramsey RESET test and F-statistic test.

The next step is to estimate the long-term coefficients, short-term coefficients for each system, and to draw conclusions about the different causal relationships, respectively.

Causality relationship between CAD and BD

Given the supported cointegration relationships, we address the question of whether budget deficit causes current account deficit. The methodology pursued is to look for evidence of a relationship between the two aggregates. Once the relationship is established, the second step is to test for the direction and magnitude of causality. To this end, we examine the long-run and short run causality between variables for both the direct and indirect levels through real effective exchange rate and real interest rate channels, by using the ARDL bounds-testing models and the Error Correction Models (ECM). Thereafter, we report the results of the tests using CAD and BD first and then, the CAD and BD with REER and RIR variables. In a third step, and following the same econometric procedure, we test the role of the degree of capital mobility in the validation of the Twin Deficit Hypothesis for the Tunisian Context.

Direct level relationship

As mentioned above, the F-statistic values confirm the presence of long-term relationships between these two variables. The results reported in Table 5 and Table 6 show evidence of positive dependence and reverse causality running from current account deficit to budget deficit referred to as the *Targeted Current Account Hypothesis*. The effect is more pronounced in the short term as reported significance levels are 5 % and 10 % (weak form), for short and long terms, respectively. That is a deterioration in the current account leads to an increase in the budget deficit. Specifically, changes in current account deficit occur before changes in budget deficit, and an increase of one unit in the current account deficit leads to a worsening of the budget deficit by 0.23 units. The error correction term coefficient is significantly negative, pointing to a return to the long-term state. Within this context, the deviation from the long-term current account path has corrected by 78.8% over the following year, which means that the adjustment takes place very quickly.

Table 5. Estimated long run coefficients using the ARDL approach (Direct relationship)

	Dependent Variable	
	CAD [a]	BD [b]
CAD	-	0.231
		(0.085)*
BD	0.157	-
	(0.401)	
Trend		-1.142
		(0.066)

Notes: * denote significance at the 10%. CAD and BD, respectively, denote the current account, and the budget deficits in terms of GDP.
a The selected model is an ARDL (1, 3). b. The selected model is an ARDL (1, 4).
The values in parentheses are the t-statistics.

Table 6. Estimated ECM coefficients using the ARDL approach (Direct relationship).

Dependant variable (Lagged variable)		
Lagged variable	CAD [a]	BD [b]
CAD	-	0.271**
		(0.068)
BD	0.177	-
	(0.390)	
Intercept	-	-1.182***
		(0.002)
ECM	-0.346***	-0.788***
	(0.009)	(0.000)

Notes: ** and ***denote significance at the 5% and 1% levels, respectively. CAD and BD, respectively, denote the current deficit, and the budget deficit in terms of GDP.
a. The selected model is an ARDL (1, 4). b. The selected model is an ARDL (1, 3).
The values in parentheses are the t-statistics.

The role of REER and RIR

This section aims to test whether the causality results detected in the direct level relationship discussed in the previous section between the budget deficit and the current account deficit are modified under the mediating role of the channels of both interest rates and exchange rates when they are augmented to the initial model. As mentioned above, the F-statistic values confirm the presence of long-term relationships between these four variables. The results in Table 7 and Table 8 provide sufficient evidence for the following points:

Table 7. Estimated long run coefficients using the ARDL approach (Indirect relationship)

	Dependent Variable	
	CAD [a]	BD [b]
CAD	-	-0.129
		(0.284)
BD	-0.355	-
	(0.133)	
REER	0.103*	-0.121**
	(0.062)	(0.013)
RIR	-0.470	-0.870***
	(0.208)	(0.000)
Intercept	-21.375***	-
	(0.001)	
Trend	0.233**	-7.090***
	(0.024)	(0.000)

Notes: ** and ***denote significance at the 5% and 1% levels, respectively. CAD and BD, respectively, denote the current account, and the budget deficits in terms of GDP.
a. The selected model is an ARDL (4, 2, 2, 2). b. The selected model is an ARDL (4, 3, 4, 4).
The values in parentheses are the t-statistics.

Table 8. Estimated ECM coefficients using the ARDL approach (Indirect relationship)

	Dependant variable (Lagged variable)	
Lagged variable	CAD [a]	BD [b]
CAD	-	-0.179
		(0.177)
BD	-0.375**	-
	(0.024)	
REER	0.173**	-0.171***
	(0.031)	(0.004)

RIR	-0.760**	-0.870***
	(0.020)	(0.000)
Intercept	-21.375***	-7.090***
	(0.000)	(0.000)
Trend	0.233***	
	(0.000)	
ECM	-0.541***	-1.146***
	(0.000)	(0.000)

Notes: ** and ***denote significance at the 5% and 1% levels, respectively. CAD and BD, respectively, denote the current account, and the budget deficits in terms of GDP.
a. The selected model is an ARDL (4, 2, 2, 2). b. The selected model is an ARDL (4, 3, 4, 4).
The values in parentheses are the t-statistics.

The results reported in Table 7 show evidence of no causal relationship between the two deficits in the long run, as the coefficients in the long-term equation are not significant. The two deficits are independent in the long term. This result rejects the Twin Deficits Hypothesis and supports the Ricardian Equivalence Hypothesis in the long run. This result coincides with the long run weak form causality detected in the previous direct model investigation.

The results reported in Table 8 show evidence at 5 % significance level, in the short term, of negative unidirectional causality running from budget deficit via the real effective exchange rate and the real interest rate to current account deficit, Known as *Keynesian causality*, That means that government short term measures aimed directly at reducing the budget deficit will indirectly contribute to reducing the current account deficit in Tunisia. The error correction term coefficient is significantly negative, pointing to a return to the long-term state. Within this context, the deviation from the long-term current account path has corrected by 54 % over the following year, which means that the adjustment takes place very quickly. The adjustment rate from short-term deviations towards the long-run equilibrium is fast. This specific finding confirms the existence of a significant short term unidirectional causal effect between the two deficits similar to the findings in the initial direct model reported in Table 6. However, both models diverge relative to the direction of causality where REER and RIR are augmented to the initial model.

The results reported in Table 7 and Table 8 shows also evidence of significant long and short run positive causality from Reer to CAD and only long run negative relationship from Reer to BD. The results reported in Table 7 and Table 8 show evidence of significant negative long run relationship from RIR to only BD. As for the short run, results show evidence of significant negative causal relationship from RIR to CAD and BD. Note that the RIR effect on CAD is more pronounced. That means changes in Reer occur before changes in both CAD and BD, and changes in Rir occur before changes in BD.

The role of the degree of capital mobility

Between the second model findings, which support Ricardian Equivalence in the long term and Twin Deficit in the short run, and the first model findings, which supports Twin Deficits Hypothesis in the short run and a weak form in the long run, and a divergence in the direction of short run causality, this section is based on the framework of Fidrmuc (2003), which links the Twin Deficits Hypothesis to the Feldstein-Horioka Puzzle Hypothesis and proposes a model to simultaneously test the Twin Deficits and the Feldstein-Horioka Hypotheses. This involves introducing the variable (Domestic Investment) into the causal relationship between the current account deficit and the budget deficit in the initial model.

As discussed previously, regarding the identity in (Eq. 1.10), a positive sign is expected for the budget balance coefficient ($\gamma 2 > 0$) and a negative sign is expected for the investment coefficient ($\gamma 3 < 0$). However, the simultaneous occurrence of a budget deficit combined with high investment is assumed to exacerbate the current account deficit. However, the validation of the Feldstein-Horioka Puzzle Hypothesis would be associated with a coefficient γ3 significantly less than one. Conversely, the rejection of the Twin Deficits Hypothesis would be associated with a non-significant or negative coefficient γ2. The Twin Deficits Hypothesis is confirmed if there is a significant and positive coefficient associated with the budget deficit in Fidrmuc (2003) model.

Table 9. Estimated long run coefficients using the ARDL approach

	CAD [a]
BD	1.321***
	(0.000)
I	-0.681***
	(0.000)
Intercept	22.042***
	(0.000)
Trend	-0.249**
	(0.000)

Notes: ** and ***denote significance at the 5% and 1% levels, respectively. CAD and BD, respectively, denote the current account, and the budget deficits in terms of GDP.
a. The selected model is an ARDL (1, 2, 0).
The values in parentheses are the t-statistics.

Table 10. Estimated ECM coefficients using the ARDL approach

	Dependant variable (Lagged variable)
Lagged variable	CAD [a]
BD	0.272**
	(0.070)
I	-0.512**
	(0.000)
Intercept	16.576***
	(0.000)
Trend	-0.187***
	(0.000)
ECM	-0.752***
	(0.000)

Notes: ** and ***denote significance at the 5% and 1% levels, respectively. CAD and BD, respectively, denote the current account, and the budget deficits in terms of GDP.
a The selected model is an ARDL (1, 2, 0).
The values in parentheses are the t-statistics.

As mentioned above in Table 4, the F-statistic values confirm the presence of long-term relationships between these three variables. As a consequence of the long term estimation of the ARDL model reported in Table 9, BD and I variables are seen as expected to be (BD = 1.321 and I = - 0.681) and statistically significant. Results confirm a positive association running from budget deficit to current account deficit. The positive coefficient of budget deficit in relation with current account deficit leads to acceptance of the Twin Deficits Hypothesis through Keynesian causality. Our results suggest that a rise in budget deficit by one percent of GDP worsens current account balance by 1.321 percent of GDP. The long term ARDL results indicate that although there is an evidence for the existence of the twin deficit problem, Ricardian Equivalence hypothesis is not valid in Tunisian context. Furthermore, results also reveal that investment exerts negative and significant impact on current account balance. An increase in investment by 1 percent of GDP improves current account balance by 0.752 percent. Although the fixed capital investment coefficient is, as expected, negative but lower than 1 shows the validity of Feldstein-Horioka Hypothesis, Tuisia was not fully integrated to international markets in the examined period and more than half of its investments are financed by foreign savings. The reason for this situation is that the capital flows are limited in the included period (1980-2022).

As for the short run, reported in Table 10, the lagged error-correction term (ECM) is derived from the long-run equation. The coefficient *ECM* is expected to be negative and it shows the eliminating of speed of disequlibrium. *ECM* is negative and statistically significant as expected and suggests that deviation from the long-term *CA* path is corrected by around 0.752 percent over the following year. This means that the adjustment takes place very quickly. The same conclusions are reprted in the short run except that a rise in budget deficit by one percent of GDP worsens current account balance by 0.275 percent of GDP. This suggests that Tunisia is fairly integrated into the global economy and that the Feldstein-Horioka Puzzle Hypothesis is not fully verified for Tunisia in either the short term or the long term.

CONCLUSION AND POLICY IMPLICATIONS

Between validating the Twin Deficits Hypothesis, which posits that a tax increase in fiscal policy is an appropriate prescription for adjusting the current account deficit and stabilizing the economic cycle, and validating the Ricardian Equivalence Hypothesis, which suggests that such a policy has no effect because fiscal and commercial policies are determined independently with separate objectives, this study aims to assess the case of a small developing country, Tunisia, using data spanning a relatively long period (1980-2022). An extensive empirical literature review reveals that there is three issues to assess the validity of the Twin Deficit Hypothesis. This study investigates the three issues for the case of Tunisia and demonstrates the severity of mitigated results and complexity of decision making. Since the unit root results of the series are integrated of either $I(0)$ or $I(1)$ processes, the models are estimated by the use of bounds testing approach which is known as ARDL cointegration method proposed by Pesaran et al. (2001), which has the advantage to provide estimates with desirable properties and allow to make reliable conclusions.

Based on a direct causality model that includes both the current account deficit and the budget deficit, the results from the ARDL procedure indicate that both deficits have a long-term relationship, and confirm a positive unidirectional causality from the current account deficit to budget deficit in the short run (while, a weak form is confirmed in the long run). Using a second model of indirect causality that incorporates to the initial causal chain, the real effective exchange rate and the real interest rate channels, the results from the ARDL procedure show that all four variables have a long-term relationship and that the real effective exchange rate affects the two deficits differently. The Ricardian Equivalence can be validated in the long run. In the short run, results confirm a negative unidirectional causality running from budget deficit to exchange rate to interest rate to current account deficit and validate Keynesian Causality. Applying a third model proposed by Fidrmuc (2003), which includes, in addition to the two deficits, the investment variable and tests the Twin Deficits Hypothesis alongside the Feldstein-Horioka Puzzle Hypothesis. In the long and short runs, results confirm a positive association running from budget deficit to current account deficit and confirms Keynesian Causality meaning that fiscal consolidations can help reducing current account imbalances. This reverse sign can be explained by the fact that the real effective exchange rate affects the two deficits differently. In summary, for the Tunisian context, between 1980 and 2022, this study suggests that in the long run, the results support the validation of the Ricardian Equivalence Hypothesis. As there is no systematic relationship between current and budget deficits, fiscal measures designed to influence aggregate demand will have no effect as long as individuals reduce consumption in anticipation of future tax liabilities. As expected in developing countries, our long run results are similar to Hashemzadeh and Wade (2012) results who explore the validation of Twin Deficit Hypothesis in several Middle Eastern and North African countries, including Tunisia, between 1980 and 2002. Our long run results also coincide with Ajili (2007) findings in favor of Ricardian Equivalence Hypothesis for Tunisia from 1980 to 2005.

In the short run, there is evidence of validation of causality between external and internal imbalances in Tunisia that can be attributed to Tunisia's strategic orientations directed towards five-year development plans in the form of economic cycles. The evidence of significant Keynesian Causality running from Budget deficit to current account deficit through real effective exchange rate and interest rate channels suggests that changes in budget balance occur before changes in the current account deficit. As reported in Abell (1990) in a small economy, like Tunisia, interest rates are exogenous, suggesting a long-term causal relationship from interest rates to the current account. The government policy should focus on reducing aggregate demand and consequently, reducing imports. However, the short run mitigated results need further investigation of the short run context.

Furthermore, the findings reveal that although the fixed capital investment coefficient is, as expected, negative but lower than 1 showing the validity of Feldstein-Horioka Hypothesis, Tuisia was not fully integrated to international markets under the scope of the examined period. This can be due to potential barriers to international capital flows or structural factors influencing the country's investment behavior. The results provide insights into the degree of financial integration and capital mobility in Tunisia and highlight the need for further investigation into factors affecting the country's capital market and government efforts should improve capital market integration and enhancing investment efficiency. This result is also confirmed in Khedhiri and Hebiri (2005) based on an empirical investigation into the Feldstein-Horioka puzzle within the context of Middle Eastern and North African (MENA) countries, including Tunisia between 1980 and 2002. The Tunisian weak degree of international capital mobility does not allow for external imbalances to reflect domestic fiscal policies more directly.

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