



Testing the validity of the twin deficit hypothesis in the Algerian economy during the period (2000-2022)

Granger causal test developed for: Toda and Yamamoto

اختبار صحة فرضية عجز التوأم في الاقتصاد الجزائري خلال الفترة (2000-2022)

اختبار سببية جرانجر المطورة لـ: Toda and Yamamoto

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Abstract

The study focused on testing the twin deficit hypothesis and its applicability in the Algerian economy during the period (2000-2022), that is, studying the causal relationship between the public budget deficit and the trade balance deficit using the developed Granger methodology Toda and Yamamoto during the period under study, where the results indicated a one-way negative relationship in the short and long term from the budget deficit to the trade balance deficit, as stipulated by The twin deficit hypothesis based on the Keynesian analysis and model, which confirms the validity and realization of this hypothesis in the Algerian economy during the study period.

JEL Classification Codes : E12; E62; F32; H62; C12

Keywords

Trade deficit;
Budget deficit;
Twin deficit hypothesis;
Algerian economy;
Granger's causality test;

الكلمات المفتاحية

عجز الميزان التجاري؛
عجز الموازنة العامة؛
فرضية عجز التوأم؛
الاقتصاد الجزائري؛
اختبار سببية جرانجر.

المخلص

تمحورت الدراسة حول اختبار فرضية عجز التوأم ومدى انطباقها في الاقتصاد الجزائري خلال الفترة (2000 - 2022)، أي دراسة العلاقة السببية بين عجز الموازنة العامة وعجز الميزان التجاري باستخدام منهجية جرانجر المطورة Toda and Yamamoto خلال الفترة قيد الدراسة، حيث أشارت النتائج المتوصل إليها إلى وجود علاقة سببية على المدى القصير والطويل أحادية الاتجاه من عجز الميزانية إلى عجز الميزان التجاري، كما تنص عليه فرضية عجز التوأم المستندة من التحليل والنموذج الكينزي، مما يؤكد على صحة وتحقيق هذه الفرضية في الاقتصاد الجزائري خلال فترة الدراسة.

تصنيف JEL : E12 ؛ E62 ؛ F32 ؛ H62 ؛ C12

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I. INTRODUCTION:

Macroeconomic theory posits two trends, one of which pertains to the correlation between the deficits of the two balances as articulated in the twin deficit hypothesis. This concept, rooted in the Keynesian framework of macroanalysis, emerged in the 1980s when the US economy experienced deficits in both the general budget. The second trend indicates a lack of correlation between the two balances, grounded in the Ricardian equivalence hypothesis, which contradicts the Keynesian perspective on the twin deficit hypothesis, positing that in an open economy, there is no association between the public budget deficit and the trade balance deficit.

Investigating the causal relationship between the budget deficit and the trade balance deficit through economic theory and econometric methods is crucial for analysing their interrelation. Comprehending the quantitative and causal dynamics between these deficits is essential for formulating and guiding economic policies to achieve economic objectives. The relationship between these two variables, and the degree to which each influences the other, is grounded in a logical theoretical framework that elucidates this interaction. Without comprehending the dynamics of these forces, it is impossible to implement an effective policy that addresses this situation.

From this perspective, the Algerian economy has been experiencing prolonged distress due to a public budget deficit stemming from elevated expenditures surpassing public revenues, alongside a trade balance deficit caused by imports of goods and services exceeding exports, particularly during declines in international oil prices, where this deficit is pronounced in both accounts. Algeria's fiscal policy, akin to other macroeconomic factors, is contingent upon a singular economic variable: the price of oil, dictated by the dynamics of global demand and supply.

The main problem:

The primary issue of this study was articulated as follows:

"What is the validity of the twin deficits hypothesis in the Algerian economy ?"

Research hypothesis:

The study hypothesis was formulated in accordance with the subsequent research objectives:

- There exists a direct link between the public budget deficit and the trade deficit in the Algerian economy.

This study is significant as it examines the causal link between the budget deficit and the trade balance deficit via methodologies grounded in economic theory and econometric techniques, aiming to analyse the interplay between these two deficits within the Algerian economy.

Previous research:

The study subject encompassed several prior investigations, including the following:

- An article titled "Testing for Twin Deficits and Ricardian Equivalence Hypotheses: Evidence from Iran," authored by Farzane Bagheri, aims to examine the correlation between the public budget deficit and the trade balance in Iran from 1971 to 2007 by validating the twin deficit hypothesis and the Ricardian equivalence hypothesis, utilising joint integration tests. Johansen and Granger's causal tests for the examined period revealed a long-term equilibrium relationship between the budget deficit and the trade balance deficit in the Iranian economy, indicating a

unidirectional causal relationship from the budget deficit to the trade balance deficit. (Farzane, 2012)

➤ Article titled: "The Twin Deficits Hypothesis and Reverse Causality: A Short-Run Analysis of Peru," authored by César R. Sobrino, investigates the causal relationship between the general budget and the trade balance utilising quarterly data from Peru's open economy. The primary conclusion indicates the rejection of the deficit hypothesis in the Peruvian economy, suggesting that it does not influence the public budget balance. The trade balance deficit, conversely, is the cause of the public budget deficit. (Sobrino, 2013)

➤ A scientific article titled: "The Extent of Twin Disability in Egypt from 1977 to 2015," authored by Sherine Adel Nosseir, aimed to evaluate the applicability of the double disability hypothesis to Egypt and to ascertain the relationship between the two disabilities utilising annual time series data from 1977 to 2015. To attain the research objective, the cointegration approach and the error correction model were employed within the Autoregressive Distributed Lag (ARDL) framework to estimate the quantitative and causal long- and short-term relationships between the budget deficit and the trade deficit. The results indicated a co-integration link between the two deficiencies, characterised by a significant adjustment rate from short-term imbalance to long-term equilibrium. The findings demonstrated that the commercial deficit exerts a positive influence on the budget deficit. According to the error correction model, a short-term relationship exists between the two deficits; however, this relationship is reciprocal, indicating that each deficit adversely impacts the other. Consequently, this leads to the rejection of the twin deficit hypothesis and supports the reverse causal hypothesis in Egypt throughout the study period. (Nosier, 2019)

An article titled: "Government Spending Asymmetric Shocks in Algeria: Are the Budget and Current Account Deficits Twins," authored by Mariam Jadiri and Mohamed Mekedich, was published in the North African magazine. The research aimed to ascertain the relationship between the budget deficit and the trade balance in Algeria from 1990 to 2020, utilising time series data. The study concluded that a relationship exists between the two deficits, confirming the validity of the twin deficits hypothesis in the Algerian economy. (Gadiri & Mekidich, 2022)

II. THEORETICAL ASPECT OF THE STUDY:

2.1. Theoretical rooting of the twin deficit hypothesis:

The term "twin deficit," also referred to as "double deficit," emerged in the 1980s when the US economy experienced simultaneous deficits in both the public budget and the trade balance. The interplay between these two deficits constitutes a significant form of imbalance that adversely influences macroeconomic performance. This relationship is a critical economic subject, as it illustrates the reciprocal effects of fiscal policy and monetary policy. (Nosier, 2019, p. 52) To analyse the link between the two deficits, several interpretations have arisen across different economic schools, with some asserting a relationship exists while others deny its existence.

2.1.1. The Keynesian perspective on the examination of the hypothesis: The Keynesian approach posits a direct correlation between the public budget deficit and the trade balance deficit, establishing a directional influence from the public budget deficit to the trade balance deficit, referred to as the twin deficit. This framework elucidates that the expansion of the public budget

deficit results from increased public expenditures, consequently diminishing government savings, which in turn leads to elevated interest rates and their subsequent rise. The demand for the local currency by foreigners escalates, resulting in an appreciation of the local currency against foreign currencies. This appreciation renders imports more appealing and less costly for citizens, consequently augmenting imports and diminishing exports, thereby creating a trade balance deficit. This trade balance deficit subsequently contributes to a public budget deficit. Rahali and Boultif (2023, p. 184)

To understand this relationship, Keynesian analysis was based on the following equations:

$$Y = C + I + G + (X - M).....(01)$$

$$Y = C + S + T.....(02)$$

Where each of the representatives of:

Y: National income, C: total consumption, I: private investment, G: government spending, X: exports, M: Imports, S: savings, T: taxes

Equating the two equations above, we find

$$(X - M) = (S - I) + (T - G).....(03)$$

$$TD = SD + BD.....(04)$$

SD: Savings deficit, BD: Public .Budget Deficit, TD: Trade Balance Deficit

We conclude from .the previous two equations that increasing. the public budget deficit leads to an increase in the trade balance deficit, in other words, the budget deficit causes the trade deficit.

2.1.2. Ricardian equivalence hypothesis: The Ricardian equivalence hypothesis diverges from Keynesian analysis regarding the twin deficit hypothesis, positing that in an open economy, there is no correlation between the public budget deficit and the trade balance deficit. Consequently, the former does not influence the latter; thus, alterations in the government's tax structure will not affect the real interest rate or investment. The premise is that consumer spending patterns will be influenced by the life cycle model established by Modigliani and Ando in 1957, which posits that present consumption is determined by anticipated lifetime income rather than current income, as suggested by the Keynesian model. Furthermore, Milton Friedman's permanent income theory, proposed in 1957, asserts that private consumption will rise alone with a sustained growth in income. This indicates that the transient increase in income is driven by tax reductions or governmental expenditure funded by private savings rather than by consumption. The Ricardian equivalence theory posits that budget deficits do not affect capital formation, economic growth, or aggregate demand, including import demand, as forward-looking individuals account for the future taxes implied by budget deficits. (Gadiri & Mekidich, 2022, p. 46)

2.2 Projecting the hypothesis on the oil states:

The following are some of the most significant traits of the oil-producing nations in relation to the double deficit:(Page 179, Saidi, 2023)

- The budget deficit in oil-producing nations is attributable to excessive government expenditure and the State's inability to curtail it, rather than tax reductions. Oil revenues represent the predominant share of public revenue components in these countries, influenced by external factors;

- An increase in public spending inevitably results in a public budget deficit, given the stability of public revenues. This scenario leads to a rise in non-oil income through the multiplier effect, consequently elevating import values and exacerbating the trade balance deficit. The efficacy of this mechanism is contingent upon the multiplier's value and the flexibility of the productive apparatus, which is notably weak in most oil-producing nations.

In oil-rich nations, taxes are not regarded as a primary source of public revenue, rendering the Ricardian equivalence theory concerning tax reductions inapplicable. Furthermore, most oil-exporting countries possess economies insulated from external influences, characterised by fixed exchange rates, regulated interest rates, and trade restrictions. Consequently, the Keynesian framework, which relies on the correlation between public budget deficits and exchange rates affecting the trade balance, proves ineffective, as exchange rates are administratively determined.

III. ANALYTICAL ASPECT OF THE STUDY:

3.1. The economic system underwent a transformation at the close of the 1980s and the onset of the 1990s, transitioning the Algerian economy from a centrally planned model to a liberal framework grounded in market economy principles. In response to this shift, Algeria initiated a series of economic reforms, with fiscal policy serving a crucial role in attaining various internal and external economic equilibria. This transformation has led to the evolution of fiscal policy in Algeria, which can be categorised into two fundamental phases.

3.1.1. The overarching budget concerning the transition to a market economy: This period was marked by the decline and intensification of Algeria's economic and political conditions, prompting the initiation of various structural reforms and engagement with international entities, such as the International Monetary Fund, for external debt management to initiate and execute a series of economic programs, specifically the economic stabilisation program (1989-1995) and the structural adjustment program (1995-1998). During this period of structural economic reforms initiated by Algeria, the financial and monetary policy played a significant role. The key characteristics of fiscal policy during this stage are illustrated in the following table:

Table (01): Evolution of expenditures, revenues and the general budget in Algeria during the period (1990-2000)

Unit: Million Algerian dinars

Years	Public revenues	Growth rate %	Overhead	Growth rate %	Budget balance
1990	152500	31,01	136500	9,64	16000
1991	248900	63,21	212100	55,39	36800
1992	311864	25,30	420131	98,08	-108267
1993	313949	0,67	476627	13,45	-162678
1994	477181	51,99	566329	18,82	-89148
1995	611731	28,20	759617	34,13	-147886
1996	825157	34,89	724609	-4,61	100548
1997	926668	12,30	845196	16,64	81472
1998	774511	-16,42	875739	3,61	-101228
1999	950496	22,72	961682	9,81	-11186

2000	1578161	66,04	1178122	22,51	400039
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Source: (Minister of Finance, 2022) ; (National Office of Statistics, 2022, p. 246)

The aforementioned table indicates that the general budget experienced a deficit in the majority of years during this period. This deficit was mitigated through a corrective policy of dinar devaluation. The primary cause of the deficit was the escalation of public expenditures, attributed to increased wages and salaries, social network expenses, and heightened military expenditures due to prevailing security conditions. Additionally, the decline in fuel prices to \$17 per barrel adversely affected petroleum revenue, resulting in a reduction of the state's overall revenues during this timeframe. (National Office of Statistics, 2022, p. 211)

3.1.2. The overarching budget allocated for investment initiatives aimed at facilitating economic recovery: The significant increase in international fuel prices at the onset of 2000, rising from 17.97 US dollars in 1999 to 38.27 dollars in 2004, enabled Algeria to adopt and execute various expansionary policies and extensive investment programs grounded in an expansionary fiscal policy through increased public expenditure. The state allocated an estimated sum of 1216 billion dinars to support the economic recovery from 2001 to 2004. Masai (2012, p. 147) The supplemental program for growth (2005-2009) allocated around 4202.7 billion dinars, whereas the growth consolidation program (2010-2014) allocated roughly 21.214 billion dinars. The following table illustrates the key characteristics of fiscal policy throughout this period:

Table (02): Evolution of expenditures, revenues and the general budget in Algeria during the period (2000-2022)

Unit: Million Algerian dinars

Years	Public revenues	growth rate %	public expenditures	growth rate %	Budget balance
2000	1578161	66,04	1178122	22,51	400039
2001	1505526	-4,60	1321028	12,13	184498
2002	1603188	6,49	1550646	17,38	52542
2003	1974466	23,16	1639265	5,71	335201
2004	2229899	12,94	1888930	15,23	340969
2005	3082828	38,25	2052037	8,63	1030791
2006	3639925	18,07	2453014	19,54	1186911
2007	3687900	1,32	3108669	26,73	579231
2008	2902448	-21,30	4191053	34,82	-1288605
2009	3275362	12,85	4246334	1,32	-970972
2010	3074644	-6,13	4466940	5,20	-1392296
2011	3489810	13,50	5853569	31,04	-2363759
2012	3804030	9,00	7058173	20,58	-3254143
2013	3895315	2,40	6024131	-14,65	-2128816
2014	3927748	0,83	6995769	16,13	-3068021
2015	4552542	15,91	7656331	9,44	-3103789
2016	5011581	10,08	7297494	-4,69	-2285913
2017	6047885	20,68	7282630	-0,20	-1234745

2018	6389469	5,65	7732070	6,17	-1342601
2019	6601576	3,32	7741345	0,12	-1139769
2020	5114087	-22,53	6902887	-10,83	-1788800
2021	5915434	15,67	7436084	7,72	-1520650
2022	7171567	21,23	9660004	29,91	-2488437

Source: (Minister of Finance, 2022) ; (National Office of Statistics, 2022, p. 246)

The aforementioned table indicates that the general budget experienced a surplus from 2001 to 2007, attributable to the resurgence of oil prices, which consequently enhanced public revenues through increased petroleum collections. However, commencing in 2008, the general budget faced a persistent deficit due to a rise in public expenditures on one hand and a decline in oil prices on the other. This deficit was financed through the Resources Control Fund, but starting in 2014, The general budget exhibited a substantial and acute deficit due to a decrease in petroleum revenues, stemming from a significant drop in oil prices, which reached approximately \$53 per barrel at the end of this year, down from about \$30 in 2015, and further declined to around \$27 in 2016. This decline was attributed to reduced global demand and increased oil supply. In response to these conditions, Algeria implemented a contractionary fiscal policy (austerity measures) to rationalise government expenditures, resulting in a reduction of the state budget deficit in 2017 and 2018. Minister of Finance, 2022 Nonetheless, despite the contractionary fiscal strategy, this gap persisted until 2022, even with the resurgence in oil prices in recent years.

It may be inferred that Algeria's fiscal policy, like to other macroeconomic variables, is contingent upon a singular microeconomic variable, specifically the price of oil, which is dictated by the dynamics of demand and supply in global markets.

3.1.3.Sources of public revenue: The budgetary general revenues of Algeria comprise three primary sources: regular collection, non-tax revenue, and petroleum collection, as seen in the subsequent table:

Table (03): Evolution of public revenue sources in Algeria (2000-2022)

Unit: Million Algerian dinars

Years	Regular collection	Petroleum Collection	Non-tax	Petroleum collection rate %	Public revenues
2000	349502	1173237	55422	74,34	1578161
2001	398238	956389	150899	63,53	1505526
2002	482896	942904	177388	58,81	1603188
2003	524925	1284975	164566	65,08	1974466
2004	580411	1485699	163789	66,63	2229899
2005	640472	2267836	174520	73,56	3082828
2006	720884	2714000	205041	74,56	3639925
2007	766750	2711850	209300	73,53	3687900
2008	965289	1715400	221759	59,10	2902448
2009	1146612	1927000	201750	58,83	3275362
2010	1297944	1501700	275000	48,84	3074644

2011	1527093	1529400	433317	43,82	3489810
2012	1908576	1519040	376414	39,93	3804030
2013	2031019	1615900	248396	41,48	3895315
2014	2091456	1577730	258562	40,17	3927748
2015	2354648	1722940	474954	37,85	4552542
2016	2482208	1682550	846823	33,57	5011581
2017	2630003	2126987	1290895	35,17	6047885
2018	2711762	2349694	1328013	36,77	6389469
2019	2843465	2518488	1239623	38,15	6601576
2020	2625168	1394710	1094209	27,27	5114087
2021	2762032	1927051	1226351	32,57	5915434
2022	2943211	3211921	1016435	44,78	7171567

Source: (Minister of Finance, 2022) ; (National Office of Statistics, 2022, p. 246)

The aforementioned table indicates that the primary source of budgetary revenues predominantly comprises petroleum collections, which constituted approximately 74.34% in 2000. This figure is significantly high in comparison to the contribution of regular collections to public revenues, reflecting the earlier assertion that Algeria's fiscal policy, akin to other macroeconomic variables, is constrained by a singular economic variable. The price of oil is dictated by the dynamics of demand and supply in international markets. Nonetheless, the contribution rate of petroleum collection had a persistent reduction until 2022, ultimately reaching 44.78% due to the state's reliance on alternative sources of public income. Despite this decrease, it can be asserted that the public budget remains reliant upon fuel prices in Algeria.

3.1.4. Progression of public spending distribution: Public expenditures are often categorised into administrative costs and operational costs.

Table (04): Evolution of the distribution of public expenditures in Algeria (2000-2022)

Unit: Million Algerian dinars

Years	Management expenses	Processing expenses	Overhead
2000	856193	321929	1178122
2001	963633	357395	1321028
2002	1097716	452930	1550646
2003	1122761	516504	1639265
2004	1250894	638036	1888930
2005	1245132	806905	2052037
2006	1437870	1015144	2453014
2007	1674031	1434638	3108669
2008	2217775	1973278	4191053
2009	2300023	1946311	4246334
2010	2659078	1807862	4466940
2011	3879206	1974363	5853569
2012	4782634	2275539	7058173

2013	4131536	1892595	6024131
2014	4494327	2501442	6995769
2015	4617009	3039322	7656331
2016	4585564	2711930	7297494
2017	4677182	2605448	7282630
2018	4813683	2918387	7732070
2019	4895236	2846109	7741345
2020	5009346	1893541	6902887
2021	5479700	1956384	7436084
2022	7573698	2086306	9660004

Source: (Minister of Finance, 2022) ; (National Office of Statistics, 2022, p. 246)

The aforementioned table indicates a substantial increase in public expenditures within Algeria's budget during the analysed period, rising from 1,178,122 million Algerian dinars in 2000 to approximately 9,660,004 million Algerian dinars in 2022. However, in recent years, expenditures have exhibited relative stability, experiencing a decline of approximately 10% in 2020. In 2022, there was a 29.9% rise compared to 2021, and during this year, management expenditures exceeded equipment expenses.

3.2. Structure of Algeria's trade balance:

The trade balance is a critical element of a country's balance of payments, since it documents the flow of products through exports and imports over a certain period, often one year.

3.2.1. Structure of Algeria's trade balance (2000-2022): The subsequent table illustrates the evolution of Algeria's trade balance from 2000 to 2022, from which the coverage rate can be computed using the following equation:

$$\text{Coverage rate} = (\text{exports} / \text{imports}) \times 100 \%$$

Table (05): Evolution of the trade balance balance 2000-2022

Unit: Million USD

Years	Total exports	Total Imports	Trade balance balance	Coverage rate %
2000	22031	9173	12858	240,17
2001	19132	9940	9192	192,47
2002	18825	12009	6816	156,76
2003	24612	13534	11078	181,85
2004	32083	18308	13775	175,24
2005	46001	20357	25644	225,97
2006	54613	21456	33157	254,53
2007	60163	27631	32532	217,74
2008	79298	39479	39819	200,86
2009	45194	39294	5900	115,02
2010	57053	40473	16580	140,97
2011	73489	47247	26242	155,54

2012	71866	50376	21490	142,66
2013	65917	54852	11065	120,17
2014	62886	58580	4306	107,35
2015	34668	51702	17034-	67,05
2016	28883	46115	-17232	62,63
2017	34569	48980	-14411	70,58
2018	41115	48573	-7458	84,65
2019	35312	44632	-9320	79,12
2020	21925	35547	-13622	61,68
2021	35040	37739	-2699	92,85
2022	63153	39007	24146	161,90

Source: (National Center for Information and Statistics of Customs, 2022)

The table illustrates that the trade balance during the analysed period exhibited a peak surplus of 39,819 million dollars in 2008, contrasted by a minimal surplus of 4,306 million dollars in 2014. The overall outcomes for Algeria's foreign exchange achievements in 2015 reveal a trade balance deficit of 17,034 million dollars, which persisted until 2021, primarily attributed to the decline in global oil prices commencing mid-2014. However, in 2022, the trade balance experienced a surplus due to the resurgence of oil prices in international markets.

3.2.2. Commodity Composition of Algerian Imports and Exports:

3.2.2.1. Composition of Algerian Imports by Commodity: To elucidate the nature and content of Algerian imports, we present the classification of this group, the commodity categories it encompasses, and the contribution of each category to the overall total of these imports, as seen in the following table:

Table (06): Commodity composition of Algerian imports 2020-2022

Unit: Million USD

Material range	2020		2021		2022	
	Value	%	Value	%	Value	%
Foodstuffs	7723	22.73	9268	24.55	10862	27.84
Energy	890	2.5	570	01.51	605	01.55
Raw materials	2199	6.19	2299	06.09	2954	07.57
Semi-finished materials	7614	21.42	7661	20.29	10036	25.72
Agricultural equipment	198	0.56	258	00.68	210	00.53
Industrial Equipment	8697	24.47	10071	26.68	8025	20.57
Consumer Goods	5577	15.69	6347	16.81	5032	12.90
Other Imports	2649	7.45	1264	03.34	1283	03.28
Grand Total Imports	35549	100	37739	100	39007	100

Source: (National Center for Information and Statistics of Customs, 2022)

The overall structure of Algerian imports may vary from specific categories, with the most significant include foodstuffs, energy, raw materials, semi-finished items, agricultural and industrial equipment, and consumer products. The predominant category of these products is foodstuffs, at

27.84% in 2022, the highest proportion during this time, indicating Algeria's reliance on external sources for its food security.

3.2.2.2. Composition of Algerian Export Commodities: Algerian exports are categorised into two primary groups: oil exports and non-oil exports. Oil exports constitute the predominant segment of total exports, despite Algeria's ongoing efforts to enhance non-oil exports. The subsequent table illustrates the progression of Algeria's total exports.

Table (07): Evolution of hydrocarbon and non-hydrocarbon exports to Algeria 2000 - 2022

Unit: Million USD

Years	Hydrocarbon Exports		Non-hydrocarbon exports		Total exports
	Value	%	Value	%	
2000	21419	97.23	612	2.77	22031
2001	18484	96.62	648	3.38	19132
2002	18091	96.11	734	3.89	18825
2003	23939	97.27	673	2.73	24612
2004	31302	97.57	781	2.43	32083
2005	45094	98.03	907	1.97	46001
2006	53429	97.84	1184	2.16	54613
2007	58891	97.89	1272	2.11	60163
2008	77361	97.56	1937	2.44	79298
2009	44128	97.65	1066	2.35	45194
2010	55527	97.33	1526	2.67	57053
2011	71427	97.20	2062	2.80	73489
2012	69804	97.14	2062	2.86	71866
2013	63752	96.72	2165	3.28	65917
2014	60304	95.90	2582	4.10	62886
2015	32699	94.33	1969	5.67	34668
2016	27102	93.83	1781	6.16	28883
2017	32639	93.39	1930	6.61	34569
2018	38285	93.11	2830	6.89	41115
2019	32732	92.69	2580	7.31	35312
2020	19670	89.71	2255	10.29	21925
2021	29991	85.60	5049	14.40	35040
2022	56581	89.60	6572	10.40	63153

Source: (National Center for Information and Statistics of Customs, 2022)

The table data indicates the overwhelming prevalence of energy exports, while the proportion of non-hydrocarbon exports remains minimal, not exceeding 8% of total exports at its highest. However, this percentage has experienced a notable increase in recent years, reaching approximately 14.40% in 2021. Due to Algeria's strategy of promoting non-oil exports, these data suggest that Algeria is integrated into the international division of labour, primarily specialising in the

production and export of various hydrocarbons, which serve as the principal source of funding for development expenditures in Algeria due to the substantial oil revenues generated.

3.2.2.3. Composition of exports excluding the hydrocarbon sector: Exports outside the hydrocarbon industry from 2021 to 2022 exhibited modest growth relative to prior years, although they remain negligible compared to oil exports. The distribution of Algerian exports, excluding hydrocarbons, comprises the following categories:

Table (08): Composite goods for non-hydrocarbon exports 2021 - 2022

Unit: Million USD

Years	Foodstuffs	Raw materials	Raw material	Semi-finished products	Agricultural equipment	Industrial Equipment	Non-food consumer goods	Total non-hydrocarbon exports
2021	556	74	113	4051	1	191	63	5049
2022	270	53	211	5878	2	50	108	6572

Source: (National Center for Information and Statistics of Customs, 2022)

The table data reveals that the commodity distribution of Algerian exports, excluding hydrocarbons, is predominantly comprised of semi-finished products. This suggests that Algerian exports outside the hydrocarbon sector are primarily characterised by non-competitive exporters, as they largely consist of raw materials and semi-finished products.

IV. THE STANDARD ASPECT OF THE STUDY:

This segment of the research will examine the causal relationship between the public budget deficit and the trade balance deficit to evaluate the twin deficit hypothesis in the Algerian economy from 2000 to 2022. Utilising the previously presented descriptive data, we will investigate the causality between these two variables within the specified timeframe to identify the linear relationship.

4.1. Conditions for causality testing: To perform this test, various methods exist, with the Granger method being the most prominent. However, its application necessitates the stationarity of both series (the general budget and the trade balance); failure to meet this condition precludes the use of this methodology and its capacity to identify the causality between these two variables. Given that the variables in these two series assume substantial negative values, it is imperative to transform them into standard values in accordance with the following relationship:

$$Z_i = \frac{(X_i - \bar{X})}{S}$$

Where each of the representatives of:

Z_i : new standard value, X_i : original value, $\bar{X}$: the arithmetic mean of the series, S : Standard deviation.

4.1.1. Evaluating the stationarity of the two series concerning both the general budget balance and the trade balance: The time series stationarity test is essential for examining causality between two series or a group of time series. It is necessary to ascertain the stationarity of model variables through unit root tests, specifically the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests, which validate the nature and characteristics of the time series variables under investigation. (Borbonais and Terraza 2004, pp. 150-152)

In our investigation, we will utilise the stationary tests of prior time series, namely the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test, to validate the findings of the initial test, as seen in the subsequent two tables:

Table (09): Unit root test ADF

UNIT ROOT TEST RESULTS TABLE (ADF)			
Null Hypothesis: the variable has a unit root			
	<u>At Level</u>		
		BC	BG
With Constant	t-Statistic	-1.5991	-1.2972
	Prob.	0.4662	0.6119
With Constant & Trend	t-Statistic	-1.5337	-3.5871
	Prob.	0.7859	0.1 600
Without Constant & Trend	t-Statistic	-1.6515	-1.3482
	Prob.	0.1 921	0.1594
	<u>At First Difference</u>		
		d(BC)	d(BG)
With Constant	t-Statistic	-3.6752	-4.3980
	Prob.	0.0127	0.0026
		**	***
With Constant & Trend	t-Statistic	-3.5671	-4.2566
	Prob.	0.0578	0.0153
		*	**
Without Constant & Trend	t-Statistic	-3.7910	-4.3816
	Prob.	0.0006	0.0001
		***	***

Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

Table (10): Unit root test PP

UNIT ROOT TEST RESULTS TABLE (PP)			
Null Hypothesis: the variable has a unit root			
	<u>At Level</u>		
		BC	BG
With Constant	t-Statistic	-1.5991	-1.2972
	Prob.	0.4662	0.6119
With Constant & Trend	t-Statistic	-1.5337	-1.8097
	Prob.	0.7859	0.6653

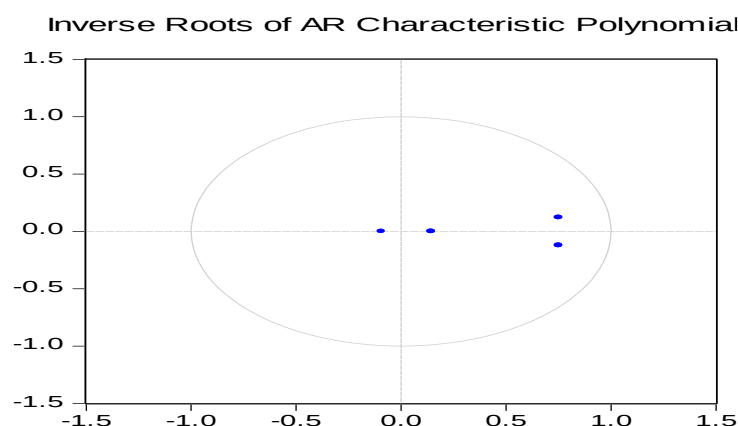
Without Constant & Trend	t-Statistic	-1.6515	-1.3690
	Prob.	0.1 921	0.1538
At First Difference			
		d(BC)	d(BG)
With Constant	t-Statistic	-3.6745	-4.3980
	Prob.	0.0128	0.0026
		**	***
With Constant & Trend	t-Statistic	-3.5691	-4.2566
	Prob.	0.0576	0.0153
		*	**
Without Constant & Trend	t-Statistic	-3.7914	-4.3816
	Prob.	0.0006	0.0001
		***	***

Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

From the above two tables, we note that both series (BC) and (BG) are not stable at grade (0)I, according to the (ADF) test, but both are stable at the first difference (1)I, where these results also confirmed the stationary test according to (PP). as shown in the table above.

In order to ensure the stationary of the model within the single circuit according to the figure below, which shows that all the roots lie within the single circuit, this explains that the model is stable, that is, the model is free from the problem of correlation of errors or instability of variance.

Figure (01): Test of the stationary of the model (single circuit)



Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

4.1.2. Optimal Time Delays for the VAR Model: Prior to model estimation, it is essential to ascertain the appropriate lag period for the study variables, which is derived from a collection of criteria, namely the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC), as seen in the subsequent table:

Table (11): Number of optimal time delays for the VAR model

Endogenous variables: BC BG

Exogenous variables: C

Date: 04/11/24 Time: 06:15
Sample: 2000 2022
Included observations: 21

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-50.71835	ME	1.199698	5.857595	5.956525	5.871236
1	-30.04250	34.45975*	0.189237*	4.004722	4.301513*	4.045646*
2	-29.52298	0.750414	0.285266	4.391443	4.886094	4.459648

* Indicates lag order selected by the criterion

Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

The table indicates that the ideal number of decelerations, as per the VAR model for these two series, is one deceleration.

4.2. Causality test:

Causality is meant to find the variable that affects another variable, for example, if we have a variable (X) and another variable (Y) and we do not know which variable affects the other, that is, we do not know who is the independent variable and the dependent variable, in this case we test the direction of the causal relationship between the two variables (X; Y).

4.2.1. According to the Granger methodology (in the short term):

There are various approaches to perform a causal trend test, with the Granger method being the most prominent. However, its application necessitates the stationarity of both time series, as previously noted. The lack of this condition precludes the utilisation of this methodology, thereby hindering its capacity to ascertain the causality between the two variables.

The Granger test for the variables (X) and (Y) is conducted utilising the VAR model on the initial differences of each, as seen in equations (1) and (2):

$$d(Y_t) = c + \sum_{i=1}^n \beta_n \times d(Y_{t-i}) + \sum_{i=0}^n \alpha_n \times d(X_{t-i}) + \varepsilon_t \dots \dots \dots (1)$$

$$d(X_t) = c + \sum_{i=0}^m \beta_{m,2} \times d(Y_{t-i}) + \sum_{i=1}^m \alpha_{m,2} \times d(X_{t-i}) + \varepsilon_t \dots \dots \dots (2)$$

where (n) represents the number of slowdowns in the first equation and (m) its number in the second equation.

It can also be considered that each of the variable (X) represents the balance of the general Maronites (BG), while the variable (Y) represents the balance of the trade balance (BC), i.e.:

$$\begin{cases} (X) = (BG) \\ (Y) = (BC) \end{cases}$$

From the previous two equations (1) and (2), the relationship between (BG) and (BC) can be written according to this methodology as follows:

$$d(BC_t) = c + \sum_{i=1}^n \beta_{n,1} \times d(BC_{t-i}) + \sum_{i=0}^n \alpha_{n,1} \times d(BG_{t-i}) + \varepsilon_t \dots \dots \dots (3)$$

$$d(BG_t) = c + \sum_{i=0}^m \beta_{m,2} \times d(BC_{t-i}) + \sum_{i=1}^m \alpha_{m,2} \times d(BG_{t-i}) + \varepsilon_t \dots \dots \dots (4)$$

Therefore, from the two previous equations, the following null hypotheses can be deduced:

From the first equation: that the balance of the general budget (BG) does not cause the balance of the trade balance (BC), and this is achieved unless the null hypothesis is achieved and the alternative opportunity is rejected as follows:

$$\begin{cases} H_0 : \sum_{i=0}^n \alpha_n = 0 \\ H_1 : \sum_{i=0}^n \alpha_n \neq 0 \end{cases}$$

From the second equation: that the balance of the trade balance (BC) does not cause the balance of the general budget (BG), and this is achieved unless the null hypothesis is achieved and the alternative opportunity is rejected as follows:

$$\begin{cases} H_0 : \sum_{i=0}^m \beta_m = 0 \\ H_1 : \sum_{i=0}^m \beta_m \neq 0 \end{cases}$$

Based on the above, the following table shows the test of Granger's causality in the short term of the two series (BC) and (BG) as follows:

Table.12. Granger causality test

OBS	Number of optimal decelerations	Null hypothesis H ₀	Calculated value (F)	P-value
21	1	(BG (does not cause BC)	4,72687	0,0330
	1	(BC (does not cause (BG)	0,86404	0,5484

Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

The table reveals that the initial probability value was estimated at 0.0330, which is below the 5% threshold. This suggests that the calculated Fisher value exceeds the tabulated Fisher value, leading us to adopt the alternative hypothesis (H1). It asserts that there exists a causal link between the two variables in the short term, namely that the balance of the general budget (BG) influences the balance of the trade balance (BC) in the near term. The second p-value (0.5484) exceeds the thresholds of 1%, 5%, and 10%, indicating that the computed Fisher value is less than the tabulated Fisher value, thereby suggesting the absence of a causal relationship between the two variables in the short term; specifically, (BC) does not cause (BG) in the short term.

4.2.2. Granger causal test developed for: Toda and Yamamoto:

The research conducted by Toda and Yamamoto (1995) employed an enhanced methodology (M. WALD) to evaluate the Wald test concerning the limitations of the VAR(K) model, where K denotes the duration of the decelerations. To this end, the Wald criteria, grounded in Fisher's test (F), is utilised to assess the null hypothesis. Nassour and Dahmani (2015, p. 145)

To implement this test, which is predicated on the VAR model, as previously said, we must adhere to the subsequent stages:

- Learn about the stationary ranks of the time series included in the model;
- determine the number of delays appropriate for the VAR model;
- Add to this all variables slowly are $(K+d_{\max})$, where (K) is the number of delays proposed and $(d_{\max})$ is the highest stationary rank of the time series used in the model estimated by one of the unit root tests;
- Writing the statistical model of this statistical model for this methodology for the two variables (BC and BG) as follows:

$$BC_t = \alpha_0 + \sum_{i=1}^{K+d_{\max}} \alpha_{1,i} \times BC_{t-1} + \sum_{i=1}^{K+d_{\max}} \alpha_{2,i} \times BG_{t-1} + \varepsilon_t \dots \dots \dots (5)$$

$$BG_t = \beta_0 + \sum_{i=1}^{K+d_{\max}} \beta_{1,i} \times BG_{t-1} + \sum_{i=1}^{K+d_{\max}} \beta_{2,i} \times BC_{t-1} + \varepsilon_t \dots \dots \dots (6)$$

where it represents: (α, β) are fixed parameters representing model estimators, either (ε) represents the error limits with a sum and a zero-arithmetic mean.

This methodology tests the null hypothesis that there is no causal relationship between (BC) and (BG) in equation No. (5), that is, (BG) does not cause (BC), while the alternative hypothesis expresses the existence of a causal relationship between the two variables, which can be formulated as follows:

$$\begin{cases} H_0 : \sum_{i=1}^{K+d_{\max}} \alpha_{2,i} = 0 \\ H_1 : \sum_{i=1}^{K+d_{\max}} \alpha_{2,i} \neq 0 \end{cases}$$

This methodology also tests the null hypothesis that there is no causal relationship as well between (BC) and (BG) in equation No. (6), that is, (BC) does not cause (BG), while the alternative hypothesis expresses the existence of a causal relationship between the two variables, which can be formulated as follows:

$$\begin{cases} H_0 : \sum_{i=1}^{K+d_{\max}} \beta_{2,i} = 0 \\ H_1 : \sum_{i=1}^{K+d_{\max}} \beta_{2,i} \neq 0 \end{cases}$$

Based on the data of the previous table, which shows the stationary of the two time series, we have seen that both series (BC) and (BG) did not stabilize at level I(0), but at the first difference I(1), both series stabilized at this level, so we conclude that the highest rank of maximum integration

($d_{\max}$) is (1), but from the previous table by which the optimal slowing periods (K) were determined based on the previous criteria, which is represented in: (LR; FPE; AIC; SC; HQ (1). If according to the developed Granger test (Toda and Yamamoto), the optimal deceleration period (K) becomes the VAR rank as follows: ($K + d_{\max}$) i.e. (1 + 1). So, it's 2.

Table (13): Results of the test of the long-term direction of causation for Toda and Yamamoto)

OBS	Number of slowdowns	Null hypothesis H_0	Calculated Wald value	P-value
21	1	(BG (does not cause BC))	7,702443	0,0213
	1	(BC (does not cause (BG)	1,48074	0,4761

Source: Prepared by researchers based on the outputs of the statistical program (Eviews 9)

The table reveals that the initial probability value was estimated at 0.0213, which is below the 5% threshold. This suggests that the calculated Fisher value exceeds the tabulated Fisher value, leading us to adopt the alternative hypothesis (H_1). This indicates a long-term causal link between the two variables, namely that the general budget balance (BG) influences the trade balance (BC) over an extended period. The second p-value (0.4761) exceeds the thresholds of 1%, 5%, and 10%, indicating that the computed Fisher value is less than the tabulated Fisher value, signifying the absence of a causal relationship between the two variables in the long term; specifically, (BC) does not cause (BG) over an extended period. From the results of this table, we deduce that they are identical to those obtained in the brief duration.

V. CONCLUSION:

The theory of twin disability, also known as double disability, has garnered significant attention from economists and has become a prominent subject of academic research across various nations. However, the empirical validation of this hypothesis varies from economy to economy; it has been substantiated in some countries while remaining unproven in others, attributable to the distinct characteristics or equations of each economy. This study article aims to evaluate the validity of the twin deficit theory and its applicability to the Algerian economy from 2000 to 2022. The findings are as follows:

Results:

Based on prior discussions, the investigation yielded the following results:

- Notwithstanding Algeria's economic reform initiatives, a disparity persists in the two principal macroeconomic variables: budget and trade balances. The inadequacy of both fiscal policy and foreign trade policy is evident; the former fails to effectively align public expenditures with public revenues, while the latter continues to seek optimal strategies for enhancing exports, particularly beyond hydrocarbons, to offset imports.
- The general budget balance and the trade balance are contingent upon global fuel prices, indicating that both macroeconomic variables rely on a specific economic variable, namely oil, the price of which is influenced by external forces.
- The vulnerability of the Algerian economy stems from its insufficient economic diversification, as the majority of its non-oil exports are classified as semi-manufactured and lack competitiveness

(primarily in crude form). Furthermore, its predominant focus on the production and export of hydrocarbons renders the latter the principal source of funding for development expenditures in Algeria, due to the substantial oil revenues it generates.

➤ A causal relationship exists both in the short and long term, with a unidirectional influence from the budget deficit to the trade balance deficit; specifically, the trade balance is positively impacted by the public budget deficit in Algeria. This substantiates the validity of our primary hypothesis, affirming the twin deficit hypothesis in the Algerian economy from 2000 to 2022.

Recommendation:

among the most recommendations put forward through the previous results are the following:

- The need to adopt an effective fiscal policy aimed at seeking new revenues independent of petroleum collection and compatible with the public expenditures of the State, in order to alleviate the budget deficit;
- Getting rid of oil dependency by working to activate the productive system based on economic diversification and international competition to penetrate foreign markets, in order to diversify sources of foreign currency;
- Work to provide an appropriate economic environment aimed at attracting foreign capital and encouraging local investments, in order to increase production capacity and improve competitiveness, to replace imports and increase exports outside hydrocarbons, in order to diversify incomes and revenues in local and foreign currency, which reduces the budget and trade deficit together.

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