“Causal relationships among fiscal deficit, saving-investment gap, and external imbalances in Jordan: Evidence from the Toda–Yamamoto approach”

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CAUSAL RELATIONSHIPS AMONG FISCAL DEFICIT, SAVING-INVESTMENT GAP, AND EXTERNAL IMBALANCES IN JORDAN: EVIDENCE FROM THE TODA–YAMAMOTO APPROACH

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Abstract

This study aims to identify the direction of Granger predictability between fiscal deficit, saving-investment gap, and external account imbalances in Jordan over the period 1976–2024. It seeks to better understand the interaction between internal macroeconomic imbalances and external sector disequilibria and their implications for long-term economic stability. To achieve this objective, the study first applied the Augmented Dickey–Fuller (ADF) unit root test, which revealed that the variables were not integrated of the same order. This finding limited the applicability of the traditional Granger causality approach. Accordingly, the study employed the Toda–Yamamoto Modified Wald (MWald) causality test, which does not require all variables to be integrated of the same order.

The empirical findings indicate significant predictive linkages between internal and external macroeconomic imbalances in Jordan. Specifically, the fiscal deficit Granger-predicts the current account, while the saving–investment gap Granger-predicts external debt. In addition, the current account, external debt, and foreign exchange reserves jointly Granger-predict the saving–investment gap, highlighting the interconnectedness between domestic and external macroeconomic conditions. The findings suggest that the relationship between internal and external imbalances in Jordan is more complex than implied by the conventional twin-deficit hypothesis and underscore the importance of the saving–investment gap as an important link between domestic and external macroeconomic conditions. Accordingly, the findings highlight the importance of coordinated macroeconomic policies for strengthening fiscal discipline, promoting domestic saving, and improving investment.

Keywords fiscal deficit, saving gap, external imbalances, causality, Toda-Yamamoto, Jordan

JEL Classification E62, H62, E21, F32

INTRODUCTION

Many economists, especially after the 1980s, showed interest in studying the relationship between budget deficit and the current account deficit. After the acceleration of globalization in developed economies, its spread into emerging economies, and the increasing degrees of interdependence between local and external economies, the relationship is no longer limited to the budget deficit and the current account deficit only, but there are now many interdependencies between economic imbalances, both internal and external. Therefore, this topic has received considerable attention, and many applied studies have investigated the nature of this relationship in various economies, taking into account the peculiarities of each economy.

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External economic imbalances are an important indicator for economic policymakers. They reflect the degree of competitiveness of the economy, external financial liquidity, the economy's resilience to global shocks, the structure of domestic saving, the economy's ability to finance domestic investments, the attractiveness of the domestic economy to foreign capital, and also the balance between fiscal policy, monetary policy, and the external position of the economy.

In an era of increasing economic interdependence and interconnectedness between countries, concerns about the consequences of fiscal deficits are no longer confined to analyzing individual economies but also include side effects among various economies. Concerns about the persistent fiscal deficit, the widening saving gap, the chronic current account deficit, and the high volume of external flows – collectively referred to as a dual deficit (internal and external) – in a small and open economy like Jordan stem from viewing these imbalances as significant contributors to macroeconomic instability. Moreover, such instability may hinder long-term economic progress due to the lack of a clear consensus on the direction of causality between them. It remains uncertain whether fiscal deficits and the saving–investment gap are primary drivers of external account imbalances or whether the causal relationship operates in the reverse direction. This unresolved issue complicates the formulation and implementation of effective economic policies aimed at both internal and external macroeconomic stability in Jordan.

1. LITERATURE REVIEW

External imbalances have long been a crucial aspect of macroeconomic analysis, as they significantly influence the stability, sustainability, and policy effectiveness of an economy. These imbalances represent discrepancies in economic and financial transactions between a domestic economy and the global market, typically measured by current account deficits, trade gaps, external indebtedness, net foreign asset positions, and the adequacy of foreign reserves. Due to their close ties with fiscal performance and domestic saving behavior, a considerable body of theoretical and empirical literature has attempted to elucidate the causal relationships among fiscal deficits, saving–investment gaps, and external imbalances. Nonetheless, a consensus on the direction of causality among these variables remains elusive. Various competing perspectives have emerged, including the traditional twin deficits hypothesis and the Ricardian Equivalence proposition, as well as reverse-causality and bidirectional-causality approaches (Islam, 1998).

The term "external imbalances" refers to the state of imbalance in economic and financial transactions between one country and the rest of the world. It is usually measured using a set of indicators, most notably the current account deficit, or the gap between imports and exports of goods and services; the increase in the ratio of external borrowing to exports; the deterioration of net foreign assets (Net Foreign Assets, NFA), or the low levels of foreign reserves relative to imports, as variables that reflect the external financing capacity of the country (Obstfeld & Rogoff, 2005; Chinn & Prasad, 2003). Previous studies identified four key pillars to explaining the emergence of external imbalances:

1) macroeconomic determinants such as the saving–investment gap, which is the most discussed in the literature (Feldstein & Horioka, 1980);

2) competitiveness and real exchange rate, where an overvalued real currency undermines exports and boosts imports, thus increasing external imbalances (Freund, 2005);

3) financial and institutional structures, where the level of development and efficiency of financial markets and economic institutions affect the economy's ability to absorb or amplify external shocks (Caballero et al., 2008); and

4) demographic and cyclical factors such as aging of population, expansion of credit cycles, aggregate demand dynamics, loan size and turnover velocity, and risk levels (Higgins, 1998).

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External imbalances are linked with economic sustainability, as prolonged deficits may lead to the accumulation of external debt and a deterioration in financial sustainability toward the rest of the world, which may end up requiring sharp adjustments in the exchange rate, economic growth, or interest rates. Hence, the importance of developing dynamic equilibrium models and analyzing capital flows in assessing external risks becomes apparent. Economists did not reach a consensus on adopting a single theoretical approach, nor have previous empirical studies agreed on the same results; several trends have emerged. The first trend is the traditional (Keynesian) perspective, which assumes a positive relationship between the government's fiscal deficit and external imbalance, where an increased budget deficit leads to an increased current account deficit. This relationship is known in economic literature as the twin deficits hypothesis. According to this trend, if taxes collected are less than public spending, then the economy experiences a budget deficit, and the country's total saving decreases (the public sector draws from national saving rather than contributing to its accumulation, thus decreasing loanable funds). This leads to higher domestic interest rates that exceed the global interest rate, and foreign capital begins to flow into the country in large quantities. If the country adopts a flexible exchange rate regime, its local currency would appreciate, leading to an increase in export prices relative to imports, thus reducing net exports, which translates into a deficit in the current account (Froyen, 1999). If the country adopts a pegged exchange rate regime, the central bank intervenes to preserve the exchange rate by increasing the money supply, which boosts domestic demand and thus increases the volume of imports, which also leads to a deterioration in the current account (Dornbusch et al., 2014). The role of the saving gap according to the Keynesian trend can be explained as follows. When domestic savings are insufficient to finance investment, the government resorts to borrowing. If this is accompanied by an expansionary policy, in the form of increased government spending, to promote investment, which depends on aggregate demand, then a budget deficit might rise. In an open economy, a shortage of saving might increase demand for external financing, which may cause an external imbalance.

The second trend relies on the Ricardian Equivalence Hypothesis, which rules out the existence of a causal relationship between budget deficit and the current account deficit. According to the hypothesis, the budget deficit resulting from increased borrowing or reduced taxation used to finance increased public expenditure will not have an increasing impact on private consumption behavior (assuming constant public spending) because individuals expect that the government will increase taxation in the future to finance expenditures and to pay off debts. Therefore, they will increase their saving now, which compensates for the decrease in public sector saving (Vamvoukas, 1999; Barro, 1989). In this case, total domestic saving will maintain its level, eliminating the need for external capital inflows and preventing a current account deficit (Kumhof & Laxton, 2013).

As for the saving gap, it often has no effect on external imbalances, whether on the side of external debt, foreign reserves, or the current account, due to the high volume of private saving resulting from the expectations of higher taxes later. Consequently, there is no shortage in domestic financing, no need to borrow from abroad, no decline in foreign reserves, and no increase in the volume of imports. The third trend stresses the existence of a unidirectional causal relationship from external imbalances to internal fiscal deficits and saving gaps, where a deterioration in the current account, a rise in the debt-to-exports ratio, or a decrease in foreign reserves to exports leads to a slowdown in economic growth. This is reflected in an increase in the general budget deficit or a widening of the saving gap. This effect is more evident in small-open economies of developing countries that rely heavily on foreign capital inflows, particularly foreign direct investment, to finance economic development projects. In this case, the government's financial position is affected either by large capital inflows or by the accumulation of external debt. This ultimately leads to fiscal deficits.

This reverse causality, extending from external imbalances to the budget deficit and saving gap, is called "Current Account Targeting", a concept coined by Summers (1988), who indicated that external adjustment may be achieved through the adoption of appropriate fiscal policies to achieve external balance. This trend is reflected in the ex-

periences of Latin American countries, as well as some East Asian countries (Reisen, 1998). Finally, there is a trend that sees a two-way causal relationship between internal deficit and external imbalance, such that each exacerbates the other. An expansion of the fiscal deficit can contribute to deepening the current account deficit, while a deterioration in the current account may, in turn, weaken economic performance and lead to a decline in tax revenues, which exacerbates pressures on public finances and leads to a widening budget deficit and increased pressures on public finances (Blanchard, 2021).

As for the empirical evidence that supports the traditional approach based on the idea of a positive correlation between internal deficit and external imbalance, or what is called the "twin deficit hypothesis," it appeared during the "Reagan financial experiment" or what is popularly known "Reaganomics" in the 1980s. This experiment represented a period of sharp rise in the value of the dollar and an unusual shift in the current account, which was not in favor of the United States. Germany and Sweden faced similar challenges in the early 1990s when their rising budget deficits were accompanied by a real rise in the value of their national currencies, which in turn negatively affected the current accounts of these countries (Ibrahim & Kumah, 1996).

Other empirical studies, including Summers (1988), Bahmani-Oskooee (1995), Cavallo (2007), Epaphra (2017), Darrat (1988), Zietz and Pemberton (1990), Baharumshah et al. (2006), Erceg et al. (2005), and Bahmani-Oskooee (1992), provide empirical evidence of a relationship between internal fiscal deficits and external imbalances, thereby lending support to the twin deficit hypothesis, although the direction and strength of causality vary across studies.

Abell (1990), however, showed that the relationship between the two deficits is indirect, and that the causal chain runs from the budget deficit to rising interest rates, then to inflows of foreign capital, then to a rise in the exchange rate, and finally to the trade deficit.

In contrast, the results of another group of studies support the Ricardian equivalence hypothesis, which denies the existence of a causal relationship from internal fiscal deficits to external imbalances, such as Barro (1989), Bernheim (1989), Khalid (1996), Forte and Magazzino (2015), Miller and Russek (1989), Enders and Lee (1990), Bluedorn and Leigh (2011), and Dewald and Ulan (1990).

The evidence that supports the third trend is embodied in the experiences of Latin American countries, as well as some East Asian countries. This is shown in the studies of Reisen (1998) and Baharumshah et al. (2006), whose results support this approach and confirm that this relationship is achieved when the government uses its fiscal policy to target the current account balance. For example, if the government notices that the deficit in the current account is large, it may reduce government spending or encourage saving to reduce dependence on external financing.

Finally, several applied studies support a mutual causal relationship between the two deficits, such as Islam (1998), Vamvoukas (1999), and Leachman and Francis (2002). Hatemi and Shukur (2002) adopted a co-integration approach, assuming that internal and external deficits share a long-term equilibrium path that reflects the interdependence of fiscal policies and the economy's external circumstances. Along with the previous approaches, another strand of literature has emerged questioning their validity in explaining external account deficits. The new literature attributes current account deficits to the saving–investment gap, considering it the most fundamental determinant of external deficits. This literature argues that the current account is determined by the dynamics of aggregate saving and investment spending rather than by the direct impact of fiscal deficits, whether positive or negative. Several studies support this view, including Feldstein and Horioka (1980), Obstfeld and Rogoff (1995), Chinn and Prasad (2003), and Alfaro et al. (2008). This argument has gained further support with the emergence of evidence from some developed countries that have fiscal surpluses while simultaneously experiencing current account deficits, raising doubts about the validity of the twin deficit hypothesis in explaining recent developments in external accounts (Mukhtar et al., 2007).

In summary, theoretical and empirical literature do not provide a unified consensus regarding the

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relationship among fiscal deficits, saving gaps, and external imbalances. The traditional Keynesian perspective argues that fiscal deficits contribute to external imbalances through their effects on national savings, interest rates, and capital flows. In contrast, the Ricardian Equivalence Hypothesis suggests that increases in private savings may offset fiscal imbalances, thereby weakening their impact on the external sector. Furthermore, some empirical studies report a reverse causal relationship, whereby external imbalances influence domestic fiscal outcomes and saving behavior, particularly in small open economies that rely heavily on external financing. Other studies find evidence of bidirectional causality, implying that fiscal and external imbalances may reinforce each other over time. Overall, these conflicting theoretical perspectives and empirical findings highlight the need for further investigation into the direction of causality among these macroeconomic imbalances. This study addresses this gap by examining the Jordanian economy using the Toda-Yamamoto Granger causality approach.

Accordingly, this study aims to examine the causal relationships among fiscal deficit (FD), the saving–investment gap (SG), the ratio of external debt to export (EXD), the ratio of foreign exchange reserves to import (RES), and the current account balance (CA) in Jordan using the Toda–Yamamoto Granger causality approach. Specifically, it seeks to determine the direction of causality among these macroeconomic imbalances. By providing empirical evidence from Jordan, this study contributes to the literature on macroeconomic imbalances and offers policy-relevant insights for achieving both internal and external macroeconomic stability. The hypotheses are formulated based on Model (1) as shown below, which is specified using the Toda and Yamamoto causality test within a Vector Autoregression (VAR) framework, as follows.

First, to examine whether there is unidirectional causality from the current account to the general fiscal deficit, we test the following hypotheses:

H0a: The current account does not Granger cause fiscal deficit, which means

$$\sum_{i=1}^{k} \beta_{13,i} = 0 .$$

H1a: The current account Granger-causes fiscal deficit, which means

$$\sum_{i=1}^{k} \beta_{13,i} \neq 0 .$$

Next, to examine whether there is bidirectional causality between the current account and the fiscal deficit, the hypotheses are formulated as follows:

H0b: The current account does not Granger-cause the fiscal deficit, and the fiscal deficit does not Granger-cause the current account, which means

$$\sum_{i=1}^{k} \beta_{13,i} = 0 \ \textit{and} \ \sum_{i=1}^{k} \beta_{11,i} = 0 .$$

H1b: The current account Granger-causes the fiscal deficit, and the fiscal deficit Granger-causes the current account, which means

$$\sum_{i=1}^{k} \beta_{13,i} \neq 0 \ \textit{and} \ \sum_{i=1}^{k} \beta_{11,i} \neq 0 .$$

Finally, to examine whether there is joint causality from the external variables to the fiscal deficit, the hypotheses are formulated as follows:

H0c: The current account, external debt, and reserves do not jointly Granger-cause the fiscal deficit, which means

$$\left(\sum_{i=1}^{k} \beta_{13,i} = \sum_{i=1}^{k} \beta_{14,i} = \sum_{i=1}^{k} \beta_{15,i} = 0 \right).$$

H1c: The current account, external debt, and reserves jointly Granger-cause the fiscal deficit, which means

$$\sum_{i=1}^{k} \beta_{13,i} \neq \sum_{i=1}^{k} \beta_{14,i} \neq \sum_{i=1}^{k} \beta_{15,i} \neq 0 .$$

2. METHOD

Using econometric models to estimate the parameters of time series data involves several concerns. First, misleading results may arise since most time series data are non-stationary at levels. Second, the estimates obtained from these models may be sensitive either to the omission of relevant variables or the inclusion of irrelevant variables. To avoid these concerns and to reach a decision with a high degree of certainty about the nature of the causal

relationship between internal deficits and saving gaps on the one hand and external imbalances on the other hand, this study decided to adopt a causality test. It identifies the direction of the relationship between the study variables without assuming a prior direction of causality, especially given their mutual dynamic relationships and the theoretical uncertainty about the nature of the effect between them.

The traditional Granger test of causality, which was first employed by Granger (1986), followed by Engle and Granger (1987), and then by Johansen and Juselius (1990), faces limitations related to the choice of lag length, which is crucial in determining the direction of causality. Choosing fewer lag periods than the appropriate number leads to bias in the results, while choosing excess lag periods reduces the efficiency of the estimates. In addition, this test assumes the stationarity of the time series or the equality of their integration orders. This makes its results sensitive and fragile in case one of these assumptions is violated, which often happens due to the non-stationarity of most time series at level, or non-stationarity at the same order. To overcome these limitations, Toda and Yamamoto (1995) developed a causality test based on the modified Wald (MWald) statistic, which is characterized by the possibility of applying it to time series with different orders of integration, whether it is I(0), I(1), or I(2). The first step in this methodology is testing the stationarity of the time series using any of the unit root tests such as (ADF) and determining the highest order of integration of the variables, which is often denoted as (d_{max}). Second, the optimal lag periods for the VAR model are determined based on the most famous statistical testing criteria such as (AIC), (SIC), (HQ), which are often denoted as (k). Third, the VAR model is estimated in levels, with the lag length set to ($k + d_{max}$). Fourth, the causality test is conducted based on the augmented VAR model. Finally, the MWald test is applied to the coefficients of the first k lagged terms only, while the additional d_{max} lags are excluded from the causality test. These additional lags are included solely to correct the asymptotic statistical properties of the model in the presence of non-stationary variables and to ensure that the MWald statistic asymptotically follows a chi-square distribution (Toda & Yamamoto, 1995; Dolado & Lutkepohl, 1996).

To examine the causality between internal sector and external sector variables, our structural model can be formulated based on the Toda and Yamamoto (1995) causality test and VAR as shown in Model (1).

2.1. The study variables in the Jordanian economy

We classified the variables into two groups: (1) the internal sector group, which includes the general budget deficit and the saving–investment gap; and (2) the external sector group (representing external imbalances), which includes the ratio of external debt to exports, the current account balance, and the ratio of foreign reserves to imports. The data-

$$\begin{bmatrix} FD_t \\ SG_t \\ CA_t \\ EXD_t \\ RES_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \beta_{11,i} & \beta_{12,i} & \beta_{13,i} & \beta_{14,i} & \beta_{15,i} \\ \beta_{21,i} & \beta_{22,i} & \beta_{23,i} & \beta_{24,i} & \beta_{25,i} \\ \beta_{31,i} & \beta_{32,i} & \beta_{33,i} & \beta_{34,i} & \beta_{35,i} \\ \beta_{41,i} & \beta_{42,i} & \beta_{43,i} & \beta_{44,i} & \beta_{45,i} \\ \beta_{51,i} & \beta_{52,i} & \beta_{53,i} & \beta_{54,i} & \beta_{55,i} \end{bmatrix} \begin{bmatrix} FD_{t-i} \\ SG_{t-i} \\ CA_{t-1} \\ EXD_{t-1} \\ RES_{t-1} \end{bmatrix} + \sum_{j=i}^{dmax} \begin{bmatrix} \beta_{11,k+j} & \beta_{12,k+j} & \beta_{13,k+j} & \beta_{14,k+j} & \beta_{15,k+j} \\ \beta_{21,k+j} & \beta_{22,k+j} & \beta_{23,k+j} & \beta_{24,k+j} & \beta_{25,k+j} \\ \beta_{31,k+j} & \beta_{32,k+j} & \beta_{33,k+j} & \beta_{34,k+j} & \beta_{35,k+j} \\ \beta_{41,k+j} & \beta_{42,k+j} & \beta_{43,k+j} & \beta_{44,k+j} & \beta_{45,k+j} \\ \beta_{51,k+j} & \beta_{52,k+j} & \beta_{53,k+j} & \beta_{54,k+j} & \beta_{55,k+j} \end{bmatrix} \begin{bmatrix} FD_{t-k-i} \\ SG_{t-k-i} \\ CA_{t-k-i} \\ EXD_{t-k-i} \\ RES_{t-k-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \end{bmatrix} \quad (1)$$

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set covers the period 1976–2024 and was obtained from the Central Bank of Jordan, the World Bank, and the International Monetary Fund (IMF). The data are available on Zenodo (Ghazo, 2026). The variables are specified as follows.

Fiscal deficit (FD), measured by the general budget deficit, refers to a situation in which total public expenditures exceed total public revenues over a specific period. The deficit is often financed through domestic and external borrowing, withdrawals from reserves, or other financing methods (IMF, 2014). In this study, the fiscal deficit is measured as the difference between total government revenues and total government expenditures relative to gross domestic product (GDP). Jordan recorded a persistent fiscal deficit throughout the study period, averaging approximately 10% of GDP. Although the deficit fluctuated over time, it stood at approximately 7% of GDP in 2023. This persistent deficit was accompanied by an accumulation of public debt and continued reliance on external financing.

The saving–investment gap (SG), is defined as the difference between domestic saving and domestic investment. It indicates the extent to which the economy can finance its investment from domestic resources. In this study, the saving–investment gap is measured as the difference between saving and investment relative to gross domestic product (GDP). The gap averaged approximately 6% of GDP over the study period, reflecting relatively low saving rates compared with investment rates. Consequently, the Jordanian economy has relied considerably on external financing to bridge this gap, reflecting the limited availability of domestic saving. The gap has widened in recent years, reaching approximately 7% of GDP in 2023.

External debt (EXD), measured in this study by the ratio of total external debt to total exports, refers to the outstanding liabilities of residents in Jordan to non-residents that require repayment of principal and/or interest in the future. This indicator is used to assess the country's capacity to service its external debt using foreign currency earnings generated by exports (World Bank, 2023). According to World Bank (2023) data, the ratio of external debt to exports increased from approximately 118% at the beginning of the study period to around 300% in some years before following a downward trend while remaining relatively high. By the end of the study period, the ratio stood at approximately 200%. These relatively high levels indicate a substantial external debt burden in relation to export earnings, which may place pressure on the country's capacity to service its external debt, particularly when export growth does not keep pace with the growth of external debt.

Current account (CA), measured in this study as a percentage of gross domestic product (GDP), refers to one of the main components of the balance of payments and measures the net flow of goods, services, primary income, and secondary income between the domestic economy and the rest of the world over a specific period (IMF, 2009). Jordan recorded a persistent current account deficit throughout the study period, averaging approximately 5% of GDP, largely reflecting the dominance of imports over exports. The largest deficit, approximately 18% of GDP, was recorded in 2005. This relatively large deficit was associated with higher oil prices, increased imports relative to exports, lower external transfers, and increased investment and domestic economic activity.

Foreign exchange reserves (RES), measured in this study by the ratio of foreign exchange reserves to imports, refer to the number of months for which a country can cover its imports of goods and services using its foreign exchange reserves in the event of a disruption in foreign currency inflows (IMF, 2023). In Jordan, although foreign exchange reserves exceeded USD 19 billion in 2023, imports remained relatively high. Consequently, import coverage by foreign exchange reserves remained at approximately 7–10 months during the study period.

3. RESULTS

The Augmented Dickey–Fuller (ADF) test was employed to examine the stationarity properties of the study variables. As shown in Table 1, FD, SG, CA, and RES are stationary at levels, I(0), whereas EXD is stationary after first differencing, I(1). Accordingly, the maximum order of integration was identified as (d_{max} = 1). Given that the variables are integrated of mixed orders, the

Table 1. ADF unit root test

Variables	Calculated value	Critical value	Lag Length	Degree of stationarity	Level of significance
FD	–3.01	–2.92	0	I(0)*	5%
SG	–4.13	–3.57	0	I(0)*	1%
CA	–4.04	–3.57	0	I(0)*	1%
EXD	–6.49	–3.58	0	I(1)**	1%
RES	–3.89	–3.52	1	I(0)**	5%

Note: * – with Intercept; ** – no intercept or trend. FD = Fiscal deficit; SG = The saving–investment gap; EXD = External debt; CA = The current account; RES = Foreign exchange reserves.

Toda–Yamamoto Granger causality approach was adopted. This approach does not require all variables to be integrated of the same order or the existence of cointegration; instead, it requires identifying the appropriate lag length and estimating an augmented VAR model with $(k + d_{max})$ lags.

Following the unit root analysis, the optimal lag length for the VAR model was determined using several lag-selection criteria, including the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Hannan–Quinn Criterion (HQ), Final Prediction Error (FPE), the log-likelihood (LogL), and the Likelihood Ratio (LR) test. As reported in Table 2, although the AIC suggested a longer lag structure, the SC, HQ, FPE, and LR criteria supported a lag length of three ($k = 3$). To avoid overparameterization and preserve degrees of freedom, $k = 3$ was adopted as the optimal lag length. Since the maximum order of integration was $d_{max} = 1$, the Toda–Yamamoto causality analysis was conducted by estimating an augmented VAR(4) model, corresponding to $k + d_{max} = 4$, following the procedure proposed by Enders (2008).

To further validate the selected lag structure, Table 3 reports the results of the lag exclusion Wald test for the augmented VAR(4) model. The results show that the third lag is statistically significant in all equations ($p < 0.05$), whereas the fourth lag is not statistically significant in any individual equation ($p > 0.05$), supporting the selection of an optimal lag length of three ($k = 3$). The fourth lag was retained solely as the augmentation term required by the Toda–Yamamoto procedure ($k + d_{max}$) to ensure the validity of the asymptotic distribution of the Modified Wald (MWald) test statistic.

Table 2. Optimal lag length selection

Lag Length	LogL	LR	FPE	AIC	SC	HQ
0	–292.5725	NA	0.515138	13.52602	13.72877	13.60121
1	–147.9008	33.91947	0.025838	10.35913	13.60311	11.56215
2	–174.5518	34.41266	0.024697	10.43417	12.66441	11.26125
3	–197.4936	164.2272*	0.021489*	10.34062	11.55711*	10.79175*
4	–119.2653	29.93714	0.028050	10.19388	14.45160	11.77285
5	–87.17489	26.25580	0.032184	9.871586*	15.14306	11.82650

Note: * indicates the lag order selected by each criterion.

Table 3. Lag exclusion Wald test results for the augmented VAR(4) model

Equation	Lag (3) p-value	Lag (4) p-value	Interpretation
FD	0.0167	0.2557	Lag 3 significant; Lag 4 not significant
SG	0.0066	0.3248	Lag 3 significant; Lag 4 not significant
CA	0.0012	0.2150	Lag 3 significant; Lag 4 not significant
EXD	0.0003	0.8471	Lag 3 significant; Lag 4 not significant
RES	0.0000	0.7754	Lag 3 significant; Lag 4 not significant
Joint	0.0000	0.0006	Joint significance across the system

Note: FD = General budget deficit; SG = The saving–investment gap; EXD = The ratio of external debt to exports; CA = The current account; RES = The ratio of foreign reserves to imports.

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Table 4. Diagnostic tests for the augmented VAR (4) model

Diagnostic Test	Null Hypothesis	Test Statistic	p-value	Decision	Conclusion
LM Serial Correlation Test	No serial correlation in the residuals	1.339	0.1073	Fail to reject H_0	No evidence of serial correlation
White Heteroskedasticity Test	Residuals are homoscedastic	315.51	0.2592	Fail to reject H_0	No evidence of heteroskedasticity
VAR Stability Test	All inverse roots lie inside the unit circle	All inverse roots inside the unit circle	–	Stability condition satisfied	The augmented VAR model is stable

Note: VAR(4) denotes the augmented vector autoregressive model estimated with $k + d_{max} = 4$ lags.

After determining the maximum order of integration of the variables ($d_{max} = 1$) and selecting the optimal lag length ($k = 3$), an augmented VAR(4) model was estimated to perform the Toda–Yamamoto modified Wald (MWald) causality test. As shown in Table 4, the results of the LM serial correlation and the White heteroskedasticity tests indicate that there is no evidence of serial correlation or heteroskedasticity. In addition, the VAR Stability Test confirms that all inverse roots of the characteristic polynomial lie inside the unit circle, indicating that the augmented VAR model is stable.

For the LM serial correlation and White heteroskedasticity tests, a *p*-value greater than 0.05 indicates failure to reject the null hypothesis of no serial correlation and no heteroskedasticity, respectively. Moreover, the stability condition is satisfied when all inverse roots of the characteristic polynomial lie inside the unit circle.

Having confirmed the adequacy of the augmented VAR model through the diagnostic tests, the Toda–Yamamoto Modified Wald (MWald) test was conducted to examine Granger causality[1] among the study variables. The results are presented in Table 5.

Table 5. Toda–Yamamoto individual and joint causality test results

Null Hypothesis (H_0)	Test Type	MWald (χ^2)	df	P-value	Decision	Causality Result
FD does not Granger-cause CA	Single	8.8072	3	0.032	Reject H_0	UC
SG does not Granger-cause CA	Single	4.2685	3	0.2339	DNR H_0	NC
FD and SG do not jointly Granger-cause CA	Joint	11.7571	6	0.0676	DNR H_0	NC
FD does not Granger-cause RES	Single	2.037	3	0.564	DNR H_0	NC
SG does not Granger-cause RES	Single	2.4432	3	0.4856	DNR H_0	NC
FD and SG do not jointly Granger-cause RES	Joint	4.8369	6	0.5649	DNR H_0	NC
FD does not Granger-cause EXD	Single	0.5538	3	0.9069	DNR H_0	NC
SG does not Granger-cause EXD	Single	9.036	3	0.029	Reject H_0	UC
FD and SG do not jointly Granger-cause EXD	Joint	3.3214	6	0.7675	DNR H_0	NC
CA does not Granger-cause SG	Single	10.2309	3	0.0167	Reject H_0	UC
RES does not Granger-cause SG	Single	2.268	3	0.5185	DNR H_0	NC
EXD does not Granger-cause SG	Single	7.58	3	0.0555	DNR H_0	NC
CA, RES, and EXD do not jointly Granger-cause SG	Joint	17.178	9	0.047	Reject H_0	UC
CA does not Granger-cause FD	Single	0.1993	3	0.9777	DNR H_0	NC
RES does not Granger-cause FD	Single	0.6916	3	0.8752	DNR H_0	NC
EXD does not Granger-cause FD	Single	4.9630	3	0.1745	DNR H_0	NC
CA, RES, and EXD do not jointly Granger-cause FD	Joint	11.4565	9	0.2457	DNR H_0	NC

Note: Single refers to an individual MWald test, while Joint refers to a combined MWald test. NC: No Causality; UC: Unidirectional Causality; DNR H0: Do not reject the null hypothesis. The MWald restrictions are imposed only on the first $k = 3$ lags of the augmented VAR($k + d_{max}$) model, while the additional lag ($d_{max} = 1$) is left unrestricted. The reported df corresponds to the number of restrictions imposed on each MWald test.

1 In this study, "Granger causality" refers to predictive precedence within the Toda–Yamamoto framework and should not be interpreted as evidence of structural causality. Accordingly, a finding that X Granger-causes Y implies that past values of X provide statistically significant information for predicting Y, conditional on the other variables included in the VAR model.

4. DISCUSSION

The findings of the Toda–Yamamoto modified Wald (MWald) test reveal several statistically significant Granger predictive relationships between internal and external macroeconomic imbalances in Jordan. For ease of discussion, the results are organized according to the direction of Granger predictability among the study variables.

4.1. Granger predictability from internal economic variables to external sector variables

The Toda–Yamamoto MWald test provides no evidence of joint Granger predictability from the fiscal deficit (FD) and the saving–investment gap (SG) to the current account (CA), external debt (EXD), or foreign exchange reserves (RES). These findings suggest that, when considered jointly, fiscal and saving imbalances do not provide additional predictive information about the evolution of Jordan's external sector indicators, which may reflect the influence of other domestic economic conditions and external developments not explicitly captured in the present model. Consequently, the joint predictive contribution of fiscal and saving imbalances appears limited.

Despite the absence of joint Granger predictability from the fiscal deficit and the saving–investment gap to the current account, the MWald test provides evidence of unidirectional Granger predictability from the fiscal deficit (FD) to the current account (CA). This finding is broadly consistent with the traditional twin deficits hypothesis, suggesting that fiscal imbalances may contain useful predictive information regarding subsequent developments in the current account. This result is consistent with (Summers, 1988; Bahmani-Oskooee, 1995; Cavallo, 2007) implying that internal fiscal deficits exert predictive power over external imbalances.

In the context of Jordan, this predictive relationship may reflect the interaction between fiscal conditions and external sector dynamics, although the specific transmission mechanisms cannot be identified within the Toda–Yamamoto framework. Accordingly, this result should be interpreted as evidence of Granger predictability rather than structural causality, as the Toda–Yamamoto approach identifies temporal predictive relationships without establishing the underlying economic transmission mechanisms. In all events, this result is in contrast to Abell (1990), who identified an indirect causal chain through interest rates, capital inflows, and exchange rate appreciation. In Jordan the linkage between fiscal deficits and current account imbalances is more direct. This might be explained by the fact that Jordan is small and open economy and heavily rely on external financing. This makes fiscal shocks transmit more quickly to external accounts.

On the other hand, our findings do not lend support to the Ricardian Equivalence proposition (Barro, 1989; Bernheim, 1989; Kumhof & Laxton, 2013), which suggests that private saving offsets fiscal deficits, thereby neutralizing their impact on external imbalances. In Jordan, this result can be explained by the low saving rates and heavy reliance of external inflows of capital.

The results also provide evidence of Granger predictability running from the saving–investment gap (SG) to external debt (EXD). Several studies supported this finding including Feldstein and Horioka (1980), Obstfeld and Rogoff (1995), Chinn and Prasad (2003), and Alfaro et al. (2008). This finding is economically plausible because when domestic investment persistently exceeds national saving, additional financing is required to bridge the resource gap. If non-debt external inflows, such as foreign direct investment and workers' remittances, are insufficient, external borrowing is likely to become a more important source of financing. Under such circumstances, external borrowing may increase, leading to a higher external debt-to-exports ratio. Accordingly, the estimated relationship is consistent with the role of the saving–investment imbalance as an indicator of future external financing requirements.

For the remaining pairwise relationships, the MWald test provides no evidence of Granger predictability from the fiscal deficit (FD) to either external debt (EXD) or foreign exchange reserves (RES), or from the saving–investment gap (SG) to the current account (CA) or foreign exchange reserves (RES). These findings indicate that neither fiscal imbalances nor saving–investment im-

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balances, when considered individually, systematically improve the prediction of these external sector indicators. This may reflect the influence of other domestic and external factors not explicitly captured in the estimated VAR model, thereby limiting the predictive contribution of fiscal and saving imbalances for these variables.

4.2. Granger predictability from external sector variables to internal economic variables

The Toda–Yamamoto MWald test provides evidence of joint Granger predictability from the current account (CA), external debt (EXD), and foreign exchange reserves (RES) to the saving–investment gap (SG). These findings are consistent with the findings of Islam (1998), Vamvoukas (1999), and Hatemi and Shukur (2002).

This finding suggests that, when considered jointly, external sector conditions provide significant predictive information regarding the evolution of domestic saving–investment imbalances in Jordan. A possible explanation is that external imbalances affect domestic saving and investment through multiple interconnected channels rather than through any single external indicator. Current account deficits may increase dependence on external financing, rising external debt may intensify future debt-servicing obligations, and declining reserve adequacy may reduce the economy's capacity to absorb external shocks. These external conditions may also influence domestic financing conditions, including borrowing costs, thereby collectively influencing domestic saving and investment decisions and contributing to changes in the saving–investment gap. Accordingly, the results suggest that the predictive content arises from the combined interaction of external sector variables rather than from the independent effect of any single indicator.

In contrast, the MWald test provides no evidence of Granger predictability from the current account (CA), external debt (EXD), or foreign exchange reserves (RES) to the saving–investment gap (SG) when each variable is considered individually. These findings indicate that no single external sector indicator systematically improves the prediction of domestic saving–investment imbalances. These findings are consistent with the view that the influence of external imbalances on domestic macroeconomic conditions reflects the interaction of multiple external factors rather than the isolated effect of any individual external sector variable.

Similarly, the MWald test provides no evidence of Granger predictability from the current account (CA), external debt (EXD), or foreign exchange reserves (RES) to the fiscal deficit (FD), either individually or jointly. These findings indicate that developments in the external sector do not systematically improve the prediction of fiscal deficit dynamics in Jordan. This may reflect the influence of domestic factors not explicitly captured in the estimated VAR model, thereby limiting the predictive contribution of external sector variables to fiscal deficit dynamics within the study period. These results contrast the results of Reisen (1998) and Baharumshah et al. (2006) who documented reverse causality from external imbalances to fiscal deficits, hence the "Current Account Targeting" is not applicable in the Jordanian case.

CONCLUSION

This study examined the direction of Granger predictability among the fiscal deficit, the saving–investment gap, and external account imbalances in the Jordanian economy using the Toda–Yamamoto Modified Wald (MWald) approach. The findings suggest that the relationship between internal and external macroeconomic imbalances in Jordan is more complex than implied by the conventional twin-deficit hypothesis. Although the fiscal deficit exhibits predictive content for the current account, the saving–investment gap appears to constitute an important link between domestic and external macroeconomic conditions, while external sector variables jointly provide predictive information regarding domestic imbalances. These findings underscore the importance of monitoring both fiscal and external sector developments when assessing macroeconomic vulnerabilities. They also suggest that policies aimed at strengthening fiscal discipline, promoting domestic saving, and improving investment

efficiency may contribute to reducing macroeconomic imbalances. In addition, greater coordination among fiscal, monetary, and external sector policies may enhance the effectiveness of efforts to address internal and external macroeconomic imbalances in an integrated manner.

AUTHOR CONTRIBUTIONS

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