ERF Working Papers Series

Estimating the Causal Relationship between External Debt and Inflation in Jordan: Evidence from an ARDL and Toda-Yamamoto Approaches

Mesbah Fathy Sharaf, Abdelhalem Mahmoud Shahen and Badr Abdulaziz Binzaid

ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

Working Paper No. 1641
July 2023

ESTIMATING THE CAUSAL RELATIONSHIP BETWEEN EXTERNAL DEBT AND INFLATION IN JORDAN: EVIDENCE FROM AN ARDL AND TODA-YAMAMOTO APPROACHES

Mesbah Fathy Sharaf, Abdelhalem Mahmoud Shahen and Badr Abdulaziz Binzaid

Working Paper No. 1641

July 2023

Send correspondence to:
Mesbah Fathy Sharaf
Department of Economics, Faculty of Arts, University of Alberta, Canada
Email: sharaf@ualberta.ca

First published in 2023 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This study investigates the causal relationship, if any exists, between external debt and inflation in Jordan over the period 1970 to 2020 within a multivariate framework by including other determinants of inflation. The study uses an ARDL bounds testing approach to cointegration to test the existence of a long-run relationship between the inflation and its drivers. An error correction model is estimated to reveal the short-run dynamics between the series. The direction of causality is examined using Toda-Yamamoto Granger non-causality test. The results suggest a statistically significant long-term relationship between inflation and its drivers. The Toda-Yamamoto Granger noncausality test reveals a bi-directional causality between inflation and external debt, between the nominal effective exchange rate and inflation, and between money supply and inflation. Proper management of the exchange rate policy, money supply and external debt levels is crucial to control inflation rates in Jordan.

JEL classification: E31; E52; F34; O24

Keywords: External Debt; Exchange rate; Money supply; Inflation; Jordan; Causality; ARDL.

ملخص

تهدف هذه الدراسة إلى اختبار مدى تحقق العلاقة السببية بين الدين الخارجي والتضخم في الأردن خلال الفترة (2020 1970). وقد تم فحص العلاقة بين تضخم الديون الخارجية في إطار نموذج متعدد المتغيرات، ذلك من خلال تضمين محددات التضخم الأخرى، بما في ذلك عرض النقود والدين الخارجي وسعر الصرف الاسمي الفعال. ولتحقيق ذلك الهدف استخدمت الدراسة المنهج التحليلي القياسي الذي يعتمد على اختبارات الحدود كمدخل للتكامل المشترك، والمصاحب لنموذج الانحدار لاختبار وجود علاقة طويلة المدى بين ، (ARDL)الذاتي ذي الفجوات الزمنية الموزعة الخطية لتقدير معلمات الأجلين (ECM) معدل التضخم ومحركاتهـ. كما تم استخدام نموذج تصحيح الخطأ القصير والطويل لديناميكيات التوازن بين متغيرات الدراسة. وللتحقق من وجود علاقة سببية في (Toda & Yamamoto) الأجل الطويل بين الدين الخارجي والتضخم، استخدمت الدراسة اختبار للسببية .وقد توصلت نتائج الدراسة إلى وجود علاقة تكامل مشترك في الأجل الطويل بين التضخم ومحركاتهـ، كما أوضحت النتائج أن انخفاض القيمة الاسمية للدينار الأردني يؤدي إلى ارتفاع معدلات التضخم في الأجلين القصير والطويل. كما أظهرت النتائج أن الدين الخارجي وعرض النقود لا يؤثران على التضخم في الأجل القصير. وتكشف نتائج اختبار السببية إلى أن هناك علاقة سببية ثنائية الاتجاه ذات معنوية إحصائية بين التضخم والدين الخارجي، وبين سعر الصرف الاسمي الفعال والتضخم، وبين عرض النقود والتضخم .وتعد الإدارة السليمة لسياسة سعر الصرف وعرض النقود ومستويات الدين الخارجي أمرًا بالغ الأهمية للتحكم في معدلات التضخم في الأردن.

1. Introduction

The relationship between external debt and inflation attracted the attention of academics and policymakers due to its implications for the design of macroeconomic policies in light of mounting debt levels in many developing economies. One of the primary concerns associated with external debt is the risk of default, which can result in macroeconomic instability and potentially lead to higher inflation. Countries that accumulate external debt may face pressure to service their debt obligations by printing more money or implementing austerity measures, which can contribute to higher inflation. In addition, countries with high levels of external debt may have limited capacity to pursue monetary or fiscal measures to counter inflationary pressures.

There is a concern that the external debt of Jordan has reached a level that may be hindering economic stability, as various indicators suggest that the foreign debt has become excessive and problematic for the economy.

The literature is abundant with studies examining the relationship between external debt and economic growth in Jordan (see, for instance: Al-Qudah & Jaradat, 2018; AL-Tamimi & Jaradat, 2019). However, to date, we are unaware of any empirical study that has assessed the impact of external debt on inflation in Jordan. We contribute to the extant literature on the macroeconomic effects of external debt by investigating the causal relationship between external debt and inflation in Jordan from 1970 to 2020. The external debt-inflation nexus is examined within a multivariate framework by including the money supply and the nominal effective exchange rate as additional drivers of inflation. An ARDL bounds testing approach to cointegration is used to examine the short-run and long-run relationships, and causality among the variables is tested using a modified version of the Granger causality test due to Toda & Yamamoto (1995).

The empirical results suggest a bi-directional causal relationship between external debt, money supply, and exchange rate and the rate of inflation in Jordan. We expect the current study's findings to be timely and germane as a warning alarm concerning the inflationary impact of external debt.

The remainder of the paper is organized as follows: Section 2 provides a snapshot of the trends of inflation and external debt in Jordan from 1970 to 2020. Section 3 briefly reviews the related literature. Section 4 presents the data and the empirical methods. The results are presented in Section 5, and Section 6 concludes the paper.

2. An overview of inflation and external debt evolution over the period 1970 to 2020

To finance its development needs, the Jordanian economy has been heavily dependent on external sources of funds, including external debt, remittances, and foreign aid, due to its limited natural resource base. Most of Jordan's external debt is acquired from official sources, such as multilateral institutions, bilateral loans, and export credit guarantees (Maghyereh & Omet, 2002).

Since gaining independence, Jordan has been struggling with a chronic balance of payment deficit and has relied on external borrowing to finance it. The first external debt, worth one million Jordanian dinars, was obtained from the British government in 1949-1950 (Abdelhadi, 2013).

As depicted in Figure 1, which shows the external debt stocks in billions and inflation rate (%) in Jordan from 1970 to 2020, there has been a consistent rise in Jordan's external debt over the past five decades, with fluctuations in inflation rates between increasing and decreasing, accompanied by persistent challenges related to external debt and inflation during the study period.

Insert Figure 1 here

The external debt remained relatively stable in Jordan until the early 1970s. However, from the late 1970s onwards, Jordan faced a period of high inflation caused by a combination of external factors, such as the 1979 oil crisis, and internal factors, such as the rapid rise in government spending and deficits for financing development projects. Consequently, since then, Jordan's external debt has started to increase significantly.

Jordan's external debt and inflation rates reached unprecedented highs by the end of the 1980s and early 1991. External debt stood at 9.7 billion in 1991 due to the need for

external financing to restructure the economy. The inflation rate peaked during the study period, hitting approximately 26% in 1989.

In 1989, Jordan introduced an economic reform program incorporating economic and political reform measures. However, the Gulf conflict interrupted its implementation and was not resumed until 1992. The reform program has three key components: economic reform to modernize and liberalize the economy, political reform to increase popular political participation, and external relations/regional reform to promote regional cooperation for mutual gains—additionally, the reform program aimed to decrease debt and inflation levels (Rossman, 1996).

As shown in figure (1), since the beginning of the new millennium, there has been a rapid rise in both external debt and inflation in Jordan. This was primarily due to the challenges associated with the global financial crisis and Jordan's dependence on external aid and loans from international organizations to finance its budget and current account deficits. Consequently, the inflation rate soared to 14% in 2008, marking one of the highest inflation rates during the study period. Furthermore, the external debt reached 14 billion dollars in the same year.

Jordan faced new challenges, notably the Arab Spring, the Syrian refugee crisis, and the slow economic growth in the 2010s, which led to a rise in external debt levels. By 2020, the external debt had increased to approximately $38 billion, while the inflation rate fluctuated throughout this period. The COVID-19 pandemic further exacerbated the country's fiscal and debt challenges, as the government had to increase its healthcare and social protection spending while experiencing a decline in revenue and tourism.

3. Theoretical Background and Empirical Literature

Economists from various theoretical perspectives have extensively analyzed the interrelationship between debt and inflation. Traditionally, inflation is considered a monetary phenomenon primarily caused by changes in the relative supply of money versus that of goods and services (Kwon et al., 2006). This theory is based on the quantity theory of money, which suggests that inflation is mainly caused by an increase in the money supply relative to the demand for money. Central banks can control inflation by managing the money supply. At the same time, excessive government

borrowing could lead to inflation if it is financed through money creation rather than taxation or borrowing from the private sector. Debt is also considered a potential source of inflationary pressure since it can increase the demand for money (Friedman, 1969).

The Fiscal Theory of the Price Level (FTPL) proposes a different perspective from the monetarist view on the drivers of inflation. The FTPL proposes that the price level is determined by debt, with monetary policy having an indirect role. The FTPL also identifies the wealth effect of government debt as an additional channel of fiscal influence on inflation. While debt-financed government spending can stimulate macroeconomic demand in the short term, it could also increase inflationary pressure in the medium to long term. Extensive academic debate and empirical research have explored these perspectives, with research conducted by Sargent & Wallace (1981) and Kwon et al. (2006) supporting the FTPL's theory of the wealth effect of public debt as an additional mechanism through which fiscal policy influences inflation. Furthermore, the FTPL suggests that increased government debt can contribute to household wealth and demand for goods and services, which may result in price pressures.

According to Sims (2016), a persistent and expanding budget deficit can lead to inflationary pressures, regardless of the policies implemented by the central bank. This view suggests that fiscal policy is a critical determinant of inflation and that the central bank's ability to manage inflation effectively may be limited if the fiscal policy is not sound.

A growing number of studies have investigated the relationship between debt and inflation. For example, Taghavi (2000) tested whether debt adversely affects investment, inflation, and growth in large European economies. Using hybrid cointegration and vector autoregressive models, the study found that debt has significant adverse effects on investment but does not clearly impact growth. The study also found that debt is inflationary in most cases in the long run, but there is no clear pattern in the short run. These findings suggest that debt management is crucial to control inflation and to maintain investment in large European economies. Janssen et al. (2002) investigate the relationship between debts, deficits, the monetary base, and the price level in the UK and finds that the price level is closely linked to the evolution of the base money supply. However, there is little evidence to suggest that fiscal policies have significantly

impacted the course of the price level or exchange rate under the Gold Standard. The study highlights the importance of monetary policy in influencing the price level. In another study, Castro et al. (2003) examine the relationship between debt and inflation in OECD countries by analyzing the interdependence between fiscal and monetary policies and their joint role in determining the price level. The study found that debt plays only a minor role in determining the price level in these economies.

High levels of debt have been found to be positively associated with higher inflation rates, according to the findings of several recent studies. For instance, Arisa (2020) found that external debt has a rising inflationary effect in Kenya. Sunder-Plassmann (2020) explored the relationship between sovereign debt, default, and inflation in emerging market economies and found that a shift away from external debt contributed to disinflation in the Mexican economy.

In general, empirical evidence on the causal relationship between debt and inflation in the extant literature is inconclusive, with mixed findings, and differs across countries, periods, and the used empirical methods. For a recent review of the literature on the debt-inflation nexus, see Aimola & Odhiambo, (2020).

Existing studies that examined the macroeconomic effects of external debt in Jordan have assessed its impact on economic growth (see for instance: Abdelhadi, 2013; Al-Qudah & Jaradat, 2018; AL-Tamimi & Jaradat, 2019; Maghyereh & Omet, 2002). For example, Maghyereh & Omet (2002) assessed the impact of external debt on the Jordanian economy and determined the optimum level of debt. Al-Qudah & Jaradat's (2018) investigated the impact of economic growth and external debt on budget deficits in Jordan for the period from 1993 to 2017. Although these previous studies provide valuable insights about the relationship between external debt and economic performance in Jordan, none has investigated the link between external debt and inflation and the current study aims to fill this gap in the literature.

4. Data and methods

To examine the nexus between external debt and the rate of inflation, we draw data on the consumer price index (P), the nominal effective exchange rate (ER), the total external debt stock (debt), and the broad money (M) over the period 1970 to 2021. The consumer price index, external debt, and broad money data are obtained from the World

Development Indicators. The nominal effective exchange rate data is obtained from Bruegel's database Darvas (2021). All the variables are expressed in natural logarithmic form.

The empirical analysis will consider three factors, widely identified in the literature, as main drivers for the inflation rate, as shown in Equation 1.

$$P_t = \gamma_0 + \gamma_1 \, Debt_t + \gamma_2 M_t + \gamma_4 ER_t + \varepsilon_t \qquad (1)$$

Before estimating the ARDL model, it is essential to check the stationarity property of the variables under investigation. The validity of the ARDL bounds test for cointegration requires that none of the variables is integrated of an order greater than one. We use the Augmented Dickey-Fuller (ADF) and Phillips- Perron (PP) tests. Two versions of both tests are used; one version allows for a constant, and the second allows for a constant and a deterministic trend.

After determining the order of integration of the variables, cointegration is tested using the bounds test for cointegration within an ARDL unrestricted error correction model.

The model in Equation (1) can be presented in an ARDL framework as in Equation (2).

$$\Delta P_t = \nu_1 + \sum_{i=1}^{a} \pi_{1i} \Delta P_{t-i} + \sum_{i=1}^{b} \pi_{2i} \Delta Debt_{t-i} + \sum_{i=1}^{c} \pi_{3i} \Delta M_{t-i} + \sum_{i=1}^{d} \pi_{4i} \Delta ER_{t-1} + \upsilon_1 P_{t-1} + \upsilon_2 \, Debt_{t-1} + \upsilon_3 \, M_{t-1} + \upsilon_4 ER_{t-1} + \varepsilon_t \qquad (2)$$

Where Δ is a first difference operator, and the rest of the variables are as defined before. a, b, c, d are the optimal lag order determined based on the SIC information criterion.

The bounds testing approach to cointegration uses an F-test for the joint significance of the coefficients of the lagged level variables (H0: $\upsilon_1 = \upsilon_2 = \upsilon_3 = 0$) and a t-test for the statistical significance of the coefficient on the lagged level of the dependent variable (H0: $\upsilon_1 = 0$). Both the F- and t- statistics do not follow the standard F- and t-distributions, and Pesaran et al. (2001) provided their lower and upper bound critical values. The lower bound critical values assume all variables are I(0), while the upper bound assumes that they are I(1). Cointegration between the variables of interest is established if the F- and t- statistics exceed the upper bound critical values.

The error correction representation of the ARDL model presented in Equation (2) is shown in Equation (3) to estimate the short-run impact of external debt, M, and ER on the inflation rate.

$$\Delta P_t = \varphi_1 + \sum_{i=1}^{a} \vartheta_{1i} \Delta P_{t-i} + \sum_{i=1}^{b} \vartheta_{2i} \Delta Debt_{t-i} + \sum_{i=1}^{c} \vartheta_{3i} \Delta M_{t-i} + \sum_{i=1}^{d} \vartheta_{4i} \Delta ER_{t-1} + \psi ECT_{t-1} + \varepsilon_t \quad (3)$$

The error correction term coefficient, ψ, in Equation (3) measures the adjustment speed of the variables to their long-run equilibrium path. Dynamic stability requires ψ to have a negative sign and be less than one.

Using the Toda & Yamamoto (T-Y) (1995) Grander causality test, we test the causal relationship between external debt and inflation rate. To conduct the text, we first check the order of integration of all the variables using the ADF and PP unit root tests. Let the maximum order of integration of the variables be k. We then estimate an unrestricted Vector Auto-Regressive (VAR) model of the variables in their levels with optimal lag length q determined according to the Schwarz Information Criterion (SIC). As a last step, we add r extra lags of the variables into the system of VAR equations to correct for any 'nuisance parameters' in the asymptotic distribution of the Wald test statistic in case any of the variables are non-stationary.

The T-Y Granger causality test is applied to the following VAR model, estimated using the Seemingly Unrelated Regression model.

$$P_t = \rho_0 + \sum_{i=1}^{k} \beta_{1i} P_{t-i} + \sum_{i=k+1}^{k+r} \beta_{2i} P_{t-i} + \sum_{i=1}^{k} \gamma_{1i} Debt_{t-i} + \sum_{i=k+1}^{k+r} \gamma_{2i} Debt_{t-i} + \sum_{i=1}^{k} \tau_{1i} M_{t-i} + \sum_{i=k+1}^{k+r} \tau_{2i} M_{t-i} + \sum_{i=1}^{k} \theta_{1i} ER_{t-i} + \sum_{i=k+1}^{k+r} \theta_{2i} ER_{t-i} + \varepsilon_{1t} \quad (4)$$

$$Debt_t = \rho_1 + \sum_{i=1}^{k} \beta_{3i} P_{t-i} + \sum_{i=k+1}^{k+r} \beta_{4i} P_{t-i} + \sum_{i=1}^{k} \gamma_{3i} Debt_{t-i} + \sum_{i=k+1}^{k+r} \gamma_{4i} Debt_{t-i} + \sum_{i=1}^{k} \tau_{3i} M_{t-i} + \sum_{i=k+1}^{k+r} \tau_{4i} M_{t-i} + \sum_{i=1}^{k} \theta_{3i} ER_{t-i} + \sum_{i=k+1}^{k+r} \theta_{4i} ER_{t-i} + \varepsilon_{2t} \quad (5)$$

$$ER_t = \rho_2 + \sum_{i=1}^{k} \beta_{5i} P_{t-i} + \sum_{i=k+1}^{k+r} \beta_{6i} P_{t-i} + \sum_{i=1}^{k} \gamma_{5i} Debt_{t-i} + \sum_{i=k+1}^{k+r} \gamma_{6i} Debt_{t-i} + \sum_{i=1}^{k} \tau_{5i} M_{t-i} + \sum_{i=k+1}^{k+r} \tau_{6i} M_{t-i} + \sum_{i=1}^{k} \theta_{5i} ER_{t-i} + \sum_{i=k+1}^{k+r} \theta_{6i} ER_{t-i} + \varepsilon_{3t} \quad (6)$$

$$M_t = \rho_3 + \sum_{i=1}^{k} \beta_{7i} P_{t-i} + \sum_{i=k+1}^{k+r} \beta_{8i} P_{t-i} + \sum_{i=1}^{k} \gamma_{7i} Debt_{t-i} + \sum_{i=k+1}^{k+r} \gamma_{8i} Debt_{t-i} + \sum_{i=1}^{k} \tau_{7i} M_{t-i} + \sum_{i=k+1}^{k+r} \tau_{8i} M_{t-i} + \sum_{i=1}^{k} \theta_{7i} ER_{t-i} + \sum_{i=k+1}^{k+r} \theta_{8i} ER_{t-i} + \varepsilon_{4t} \quad (7)$$

Where P, Debt, M, and ER are as defined before. ε_{it} for i=1,2,3,4 are white noise error terms.

K is the optimum lag length, and r is the maximum order of integration of the variables.

A unidirectional causality from external debt to inflation is confirmed if $\gamma_{1i} \neq 0 \ \forall i$ in Equation (4) while a unidirectional causality from inflation to external debt is confirmed if $\beta_{3i} \neq 0 \ \forall i$ in Equation (5). A two-way causality between external debt and inflation is confirmed if both $\gamma_{1i} \neq 0 \ \forall i$ and $\beta_{3i} \neq 0 \ \forall i$ in Equations (4) and (5). Causality between any two other variables can be tested in a similar fashion as shown for testing causality between external debt and inflation.

5. Results

The PP and ADF unit root test results, displayed in Table 1, indicate that P, debt, and M are stationary at levels at the 5% significance level in the version with an intercept. Notably, all the series become stationary at their first difference across the two versions of the two tests, the version with a constant and the second with a constant and a deterministic trend. This means that all the series are a mix of I(0) and I(1), and none of them are integrated of an order greater than one, which is a necessary condition for the validity of the cointegration bounds test.

Table 2 presents the estimated F-statistic and t-statistic of the ARDL cointegration bounds test along with their 95% critical bounds. The results suggest the existence of a long-term relationship, cointegration, between P, M, ER, and Debt since the calculated values of both the F-statistic and t-statistic are greater than the upper bound of their critical value at the 5% significance level.

The Schwarz Information Criterion automatically selected an ARDL (1,0,1,0) model. Table 3 presents the short-run and long-run coefficients of the estimated ARDL (1,0,1,0) model. The estimated short-run coefficients show that the nominal effective exchange rate has a statistically significant negative impact on the inflation rate. This means that a nominal depreciation in the Jordanian Dinar is associated with a rise in inflation rates in Jordan. The results also show that none of the other two drivers of inflation; external debt and money supply, affect inflation in the short run.

The estimated coefficient of the error-correction term coefficient has a negative sign and is statistically significant at the 1% significance level. However, the low magnitude of the estimated coefficient,-0.18, indicates a slow convergence of the variables into their long-run equilibrium following a shock. In particular, 18% of the previous period's disequilibrium is corrected in the current period. This implies that following a shock; it takes about 5.56 years for P, M, Debt and ER to restore their long-run equilibrium relationship.

The results show that all the estimated long-run coefficients, which measure the long-run elasticity of the dependent variable with respect to the independent variables, are statistically significant at the 5% significance level. This indicates that the independent variables included in the analysis are key drivers of inflation in Jordan in the long run. In particular, the money supply has a statistically significant positive impact on inflation. A one percent increase in money supply raises the inflation rate by 0.3 percent in the long run. The nominal effective exchange has a statistically significant negative impact on inflation, where its rise by 1 percent lowers the inflation rate by 0.8 percent in the long run. As for the long-run effect of external debt, the estimated long-run coefficients reveal that external debt has a statistically significant positive impact on the inflation rate. A rise in external debt by 1 percent raises the inflation rate by 0.15 percent in the long run.

Results of the diagnostic checks presented in the lower section of Table 3 indicate that the estimated ARDL model does not suffer from any econometric problem. In particular, the Lagrange multiplier (LM) test reveals that the residuals are free from serial correlation and are normally distributed, as shown by Jarque-Bera's normality test at the 5% significance level. Also, Ramsey's RESET test result shows that the estimated ARDL model doesn't suffer from a misspecification error. Further, the estimated model does not suffer from heteroscedasticity according to the results of the Breusch-Pagan-Godfrey test.

To check the stability of the estimated parameters of the ARDL model, we conducted the cumulative sum of recursive residuals (CUSUM) test and the cumulative sum of squares of recursive residuals (CUSUM of squares) test. The results of these two tests, displayed in Figure (2), reveal that the estimated parameters of the ARDL model are stable since the test plots remain within the 5% critical bound levels.

Insert Figure 2 here

The Toda-Yamamoto Granger non-causality test results, presented in Table 4, show no statistically significant causal relationship between money supply and external debt since the modified Wald statistics are not statistically significant. Likewise, no causal relationship exists between external debt and the nominal effective exchange rate. Also, the results suggest no statistically significant causal relationship between money supply and the nominal effective exchange rate. The results reveal a two-way causal relationship between money supply and inflation, as the modified Wald statistics are statistically significant at the 5% significance level. As for the causal relationship between inflation and external debt, the Toda-Yamamoto Granger non-causality test results reveal a bi-directional causality between the two series at the 10% significance level. Similarly, a statistically significant bi-directional causal relationship is found between the nominal effective exchange rate and the inflation rate.

6. Discussion and Conclusion

We expect the current study to offer valuable insights into the relationship between external debt and inflation in Jordan from 1970 to 2020 while highlighting the significance of a multivariate analysis to examine other factors that might affect inflation, such as the nominal effective exchange rate and the money supply. Identifying and understanding the role of these factors that could drive inflation can help develop effective inflation management policies.

To investigate the existence of a long-term relationship between inflation and its drivers, the study adopts the ARDL bounds testing approach to cointegration. It uses an error correction model to analyze the short-term dynamics between the variables. Furthermore, a modified version of the Toda-Yamamoto Granger causality test is utilized to examine the direction of causality among the variables.

According to our results, a nominal appreciation of the Jordanian Dinar lowers short- and long-term inflation rates. This finding was contrary to several earlier studies, including Zhang (2009) who found a positive correlation between currency appreciation

and inflation in China. Zhang argues that as the yuan strengthens against the dollar, it creates inflationary pressures in China. In another study, Baharumshah et al. (2017) found that currency appreciations do not have a significant impact on inflation in Sudan.

Our findings on the linkage between inflation and exchange rate emphasize the importance of exchange rate management in maintaining price stability in Jordan. Managing currency depreciations could be a valuable tool in controlling inflation by reducing the cost of imports and lowering prices of goods and services. Therefore, efficient exchange rate policies can stabilize inflation and restore economic credibility.

We found no evidence that external debt and money supply significantly determined price levels in Jordan in the short run. However, money supply and external debt have a statistically significant positive impact on inflation in the long run. These findings suggest that while concerns about the potential inflationary effects of external borrowing and money supply are theoretically valid, they may not be significant in practice in the short run. It could take time for these effects to show up. This finding aligns with that of Taghavi (2000), who found that debt in major European economies contributes to inflation over a long period. However, there is no definitive trend in the short term.

The Toda-Yamamoto Granger non-causality test results indicate a two-way causal relationship between inflation and external debt, nominal effective exchange rate, and money supply. These results are consistent with Ghaly's (2023) findings that there is a bidirectional causal relationship between external debt and inflation rates in Egypt. This is also in line with the findings of Choong et al. (2010), who investigated the connection between external debt and inflation in Malaysia and found that external debt can lead to monetization, impacting inflation.

The potential for inflation resulting from external debt arises from several channels. When a country borrows funds in a foreign currency, it must convert its domestic currency into foreign currency to meet its obligations. This may lead to a decline in the domestic currency's value and increased prices for imported goods. Also, borrowing money can increase the money supply, resulting in greater demand and potentially higher prices if supply cannot keep up. Therefore, while external debt can support growth and development, it must be managed carefully to avoid problems such as inflation and

currency depreciation. High levels of external debt can become a constraint and hinder a country's growth potential (Shabbir, 2013; Sharaf, 2021).

The current study's findings underscore the role of external debt management in controlling inflation and ensuring price stability in Jordan. Effective external debt management is essential, as uncontrolled debt levels could have persistent inflationary pressures that could have long-lasting effects on the economy. In light of these findings, we advise the Jordanian government to exercise caution when considering an increase in external debt to minimize potential risks and volatility to the economy in the long term. Overall, the study's findings enhance the understanding of the critical role of external debt management in maintaining price stability in Jordan.

References:

Abdelhadi, D. S. A. (2013). External Debt and Economic Growth: Case of Jordan (1990-2011).

Al-Qudah, A. M., & Jaradat, M. A. (2018). Economic Growth, External Debt and Budget Deficit in Jordan: ARDL Approach. International Journal of Academic Research in Economics and Management Sciences, 7(4), Pages 151-165. https://doi.org/10.6007/IJAREMS/v7-i4/5195

AL-Tamimi, K. A. M., & Jaradat, M. S. (2019). Impact of External Debt on Economic Growth in Jordan for the Period (2010-2017). International Journal of Economics and Finance, 11(4), Article 4. https://doi.org/10.5539/ijef.v11n4p114

Arisa, G. M. (2020). Impact of External Debt on Inflation and Exchange Rate in Kenya [Thesis, Kenyatta University]. https://ir-library.ku.ac.ke/handle/123456789/21755

Baharumshah, A. Z., Sirag, A., & Nor, N. (2017). Asymmetric Exchange Rate Pass□ through in Sudan: Does Inflation React Differently during Periods of Currency Depreciation? African Development Review, 29(3), 446–457.

Castro, R., de Resende, C., & Ruge-Murcia, F. (2003). The Backing of Government Debt and the Price Level [Cahiers de recherche]. Centre interuniversitaire de recherche en Ã©conomie quantitative, CIREQ. https://econpapers.repec.org/paper/mtlmontec/16-2003.htm

Choong, C.-K., Lau, E., Liew, V. K.-S., & Puah, C.-H. (2010). Does debts foster economic growth? The experience of Malaysia. International Scholars Journals, 5(8).

Darvas, Z. (2021). Timely measurement of real effective exchange rates. Bruegel | The Brussels-Based Economic Think Tank. https://www.bruegel.org/working-paper/timely-measurement-real-effective-exchange-rates

Friedman, M. (1968). The Role of Monetary Policy. The American Economic Review, 58(1).

Friedman, M. (1969). The Optimum Quantity of Money. The Economic Journal | Oxford Academic, 80(319), 669–672.

Ghaly, S. B. (2023). External debt in time of inflation in Egypt: A vector error correction model. Science Journal for Studies, Research and Study, 4(1), 661–701. https://doi.org/10.21608/cfdj.2023.258059

Janssen, N., Nolan, C., & Thomas, R. (2002). Money, Debt and Prices in the United Kingdom, 1705-1996. Economica, 69(275), 461–479.

Kwon, G., McFarlane, L., & Robinson, W. (2006). Public Debt, Money Supply, and Inflation: A Cross-Country Study and Its Application to Jamaica.

Maghyereh, A. I., & Omet, G. (2002). External Debt and Economic Growth in Jordan: The Threshold Effect (SSRN Scholarly Paper No. 317541). https://doi.org/10.2139/ssrn.317541

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics, 16(3), 289–326.

Rossman. (1996). Jordan: Reform, Subsidies, and the Economics of Peace. The Washington Institute. https://www.washingtoninstitute.org/policy-analysis/jordan-reform-subsidies-and-economics-peace

Sargent, T. J., & Wallace, N. (1981). Some Unpleasant Monetarist Arithmetic. Quarterly Review, Federal Reserve Bank of Minneapolis, 5. https://ideas.repec.org/a/fip/fedmqr/y1981ifallnv.5no.3.html

Shabbir, S. (2013). Does External Debt Affect Economic Growth: Evidence from Developing Countries. SBP Working Paper Series, Article 63. https://ideas.repec.org//p/sbp/wpaper/63.html

Sharaf, M. F. (2021). The asymmetric and threshold impact of external debt on economic growth: New evidence from Egypt. Journal of Business and Socio-Economic Development, 2(1), 1–18. https://doi.org/10.1108/JBSED-06-2021-0084

Sims, C. A. (2016). Fiscal policy, monetary policy, and central bank independence. Fiscal Policy.

Sunder-Plassmann, L. (2020). Inflation, default and sovereign debt: The role of denomination and ownership. Journal of International Economics, 127, 103393. https://doi.org/10.1016/j.jinteco.2020.103393

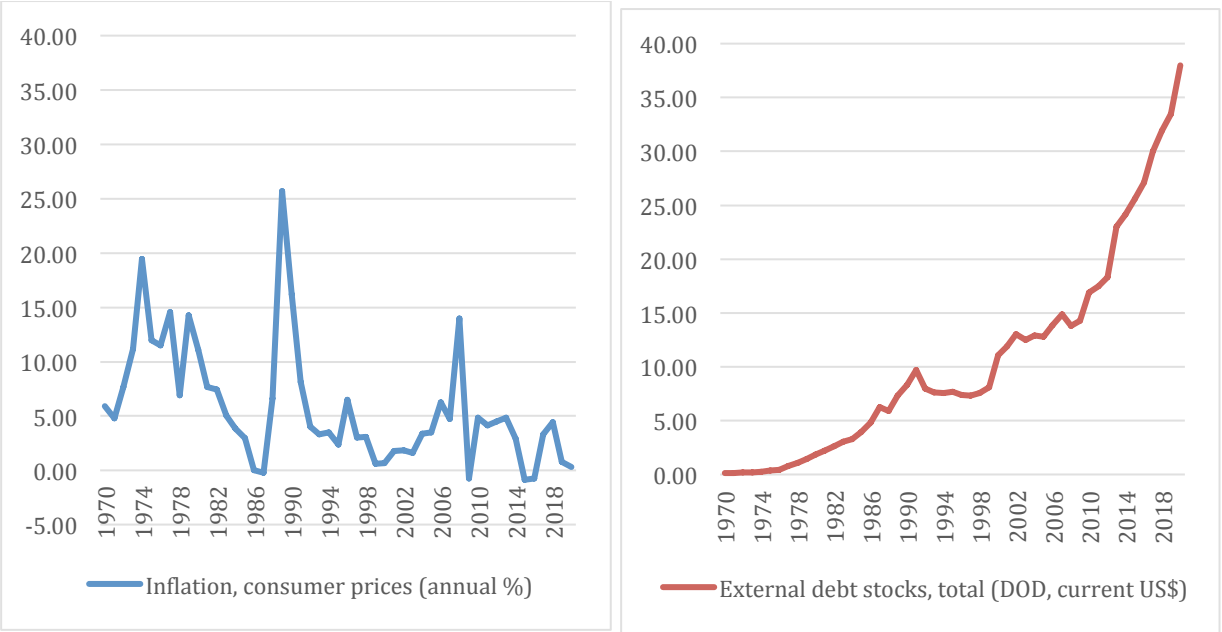
Taghavi, M. (2000). Debt, growth and inflation in large European economies: A vector auto-regression analysis. Journal of Evolutionary Economics, 10(1), 159–173. https://doi.org/10.1007/s001910050010

Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. Journal of Econometrics, 66(1), 225–250. https://doi.org/10.1016/0304-4076(94)01616-8

Zhang, C. (2009). Excess Liquidity, Inflation and the Yuan Appreciation: What Can China Learn from Recent History? The World Economy, 32(7), 998–1018. https://doi.org/10.1111/j.1467-9701.2009.01191.x

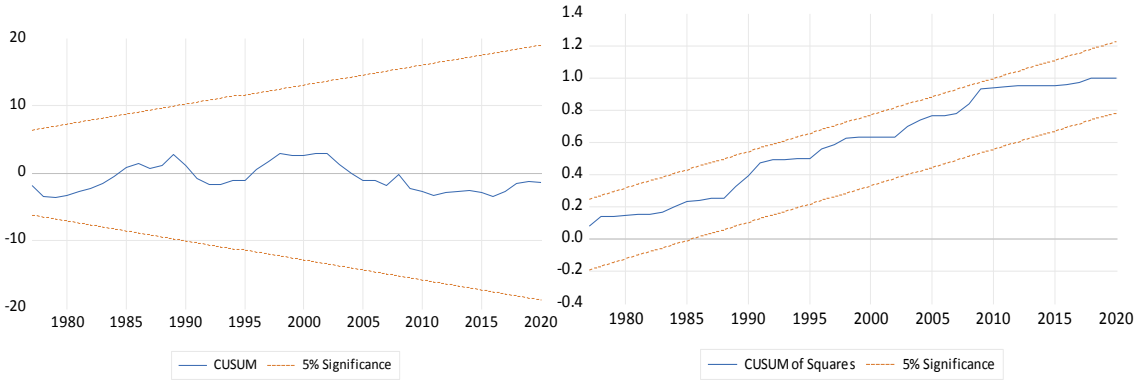
List of Figures

Figure 1: External debt levels and inflation rate in Jordan over the period 1970 to 2020



Source: Authors' compilation based on data from the world development indicators.

Figure 2. ARDL (1,0,1,0) CUSUM and CUSUMSQ stability plots



List of Tables

Table 1. Results of the ADF and PP unit root tests

	P		Debt		M		ER	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
	Unit root tests of variables in levels							
Intercept	-3.2652** (*0.0221)*	-4.00*** (0.0029)	-4.9208*** (*0.0002)*	-4.085*** (*0.0023)*	-3.3627** (*0.0173)*	-3.246** (0.0230)	-2.5978 *(0.1003)*	-1.8519 (*0.3518)*
Intercept & Trend	-2.2955 (*0.4283)*	-1.5623 (*0.7937)*	-2.7930 (*0.2066)*	-2.5303 (*0.3129)*	-3.6604** (*0.0350)*	-1.2769 (*0.8823)*	-3.3746* (*0.0667)*	-2.3413 (*0.4048)*
	Unit root tests of variables in first difference							
Intercept	-3.5208** (*0.0114)*	-3.5203** (*0.0115)*	-4.2067*** (*0.0017)*	-4.2154*** (*0.0016)*	-2.0215 (*0.2770)*	-3.0357** (*0.0385)*	-3.7714*** (*0.0058)*	-3.8178*** (*0.0051)*
Intercept & Trend	-4.5732*** (*0.0032)*	-4.5616*** (*0.0033)*	-4.8809*** (*0.0013)*	-4.9077*** (*0.0012)*	-4.2800*** (*0.0072)*	-4.1831*** (*0.0093)*	-3.7344** (*0.0292)*	-3.7807** (*0.0261)*

*, **, *** indicate rejection of the null hypothesis (series is non-stationary) at the 10%, 5%, and 1% significance level, respectively. Lag length is based on SIC. P-values are in parenthesis

Table 2: Results of the Cointegration bounds test

				95% Critical bounds	
Dependent variable	Explanatory variables	Specification	F-statistic	I(0)	I(1)
Δ(P)	$M, ER,$ Debt	**ARDL (1,0,1,0)**	16.01	3.50	4.7
			t-statistic	I(0)	I(1)
			-8.27	-2.86	-3.7

The lower and upper bound critical values are obtained from Pesaran et al.,(2001)

Table 3: The estimated short run and long run coefficients of the ARDL (1,0,1,0) model

Short run coefficients	**Coefficient**	**Standard errors**
Constant	-0.5431***	0.0729
ΔER	-0.2845***	0.0582
Long run coefficients		
M	0.3407***	0.0641
ER	-0.8840***	0.2434
Debt	0.1561**	0.0751
ECT_{t-1}	-0.1882***	0.0227
Diagnostics checks		
Heteroskedasticity	$\chi^2(5) = 12.65$ P value (0.116)	
Serial correlation	$\chi^2(2) = 1.719$ P value (0.423)	
Functional form misspecification	**F (1,43)**= 0.9568 P value (0.33)	
Normality	Jarque-Bera=0.105 P value (0.94)	

*, **, *** indicate statistical significance at the 10%,5%, 1% significance level.

Table 4. Results of the Toda-Yamamoto Granger non-causality test

Null hypothesis	Modified Wald Statistic	P-value	Direction of Causality
External debt does not Granger cause Inflation	2.41*	0.10	$\boldsymbol{D \rightarrow P}$
Money supply does not Granger cause Inflation	6.703***	0.009	$\boldsymbol{M \rightarrow P}$
Nominal effective exchange rate does not Granger cause Inflation	8.570***	0.003	$\boldsymbol{ER \rightarrow P}$
Inflation does not Granger cause External debt	2.506*	0.10	$\boldsymbol{P \rightarrow D}$
Money supply does not Granger cause External debt	1.388	0.238	**None**
Nominal effective exchange rate does not Granger cause External debt	1.218	0.269	**None**
Inflation does not Granger cause Money supply	5.755**	0.016	$\boldsymbol{P \rightarrow M}$
External debt does not Granger cause Money supply	1.432	0.231	**None**
Nominal effective exchange rate does not Granger cause Money supply	0.947	0.330	**None**
Inflation does not Granger cause Nominal effective exchange	3.455*	0.063	$\boldsymbol{P \rightarrow ER}$
External debt does not Granger cause Nominal effective exchange	0.928	0.335	**None**
Money does not Granger cause Nominal effective exchange	2.290	0.130	**None**

*, **, *** indicate statistical significance at the 10%,5%, 1% significance level.