Tariq *et al. Journal of Economic Structures* (2024) 13:14
https://doi.org/10.1186/s40008-024-00336-z

Journal of Economic Structures

RESEARCH

Open Access

Deciphering the non-linear nexus between government size and inflation in MENA countries: an application of dynamic-panel threshold model

Asif Tariq[1,2*], Aadil Amin[1] and Masroor Ahmad[1]

*Correspondence: asiftariq@outlook.com

[1] Department of Economics, Central University of Kashmir, Ganderbal 191201, India
[2] Department of Data Science, Christ University, Bengaluru, India

Abstract

Contradictory to conventional economic theory, which foresees any increase in the size of government as inflationary, this article provides evidence that the reaction of price levels to changes in the size of government is nonlinear. The price levels do not necessarily increase in response to a rise in the size of the government but only up to a certain threshold or optimal level. Accordingly, this paper utilizes the dynamic panel threshold model to examine the threshold effects of government size (measured as government final consumption expenditure as a proportion of GDP) on inflation using a sample of 10 selected MENA countries from 1980 to 2019. The findings of this study stand out in several ways. First, the results support the nonlinear relationship between government size and inflation in the study area. Second, the government size's estimated threshold level is equivalent to 12.46%. Third, government size negatively impacts inflation in the regime of small governments up to the threshold level. The impact turns positive once the government size goes beyond the threshold level in a regime of large size of government. These findings have ramifications for the conduct of fiscal policy. Policymakers in the MENA region can increase the size of government till it reaches the threshold level without exerting any upward pressure on price levels.

Keywords: Government size, Inflation rate, Nonlinear relationship, MENA, Dynamic panel threshold

1 Introduction

Conventional wisdom holds that an increase in government size through heightened public spending is inherently inflationary (Jørgensen and Ravn 2022). Putting differently, it would imply that the price levels in an economy will rise if the size of government is "too large".Yet, how large is too large? Following the global financial crisis of 2008, to stimulate and stabilize the economies, fiscal stimulus via government spending has become an increasingly prominent policy by governments worldwide (Nguyen 2019). Simultaneously, academic and public discussions have often highlighted the correlation between government size and inflation (Han and Mulligan 2008). Despite this, rising price levels (inflation) and their drivers in contemporary macroeconomics have received considerable attention due to their far-reaching economic, social, and welfare implications (Saad et al. 2006).

Yet, amidst these discussions, the effects of government size on inflation and how inflation responds to government size changes have garnered relatively less attention from researchers, policymakers, and practitioners, both in theory and practice (Jørgensen and Ravn 2022). This knowledge gap poses significant challenges, as a limited understanding of the impacts of government size on inflation can affect fiscal and broader macroeconomic policy decisions. It is also widely acknowledged that 'high and volatile' inflation impedes economic growth and inflicts severe welfare costs (Baharumshah et al. 2016). Undoubtedly, this idea of transmitting fiscal policy shocks via government size is the essence of several theoretical models, including the standard textbook New Keynesian Model. According to Keynesian theory, governments of all nations, irrespective of their development levels, must spend to bring stability to the economy by augmenting productivity and investment (Mehrara et al. 2016).

Nevertheless, the size of the government, measured in terms of public expenditure, impacts not only production but also exerts a significant influence on the inflation rate within an economy (Georgauntopoulos and Tsamis 2012). Indeed, inhibiting inflation within the permissible band can improve the growth potential in any economy. Concurrently, a low inflation rate can have counter-productive effects (Vinayagathasan 2014). Countries usually face the tradeoff of restricting price levels within manageable limits and increasing the size of government simultaneously to fend off any recessionary tendencies and to boost their economies (Tariq et al. 2022). Besides, Armey (1995) suggests that the relationship between government size and economic growth is non-linear. This implies that upto a certain optimal/threshold level, increments in government size will improve the growth rates in an economy.In turn increased economic growth enhances the aggregate supply of the economy, potentially leading to a decrease in the price level. However, if government size expands beyond a certain threshold, economic growth diminishes, which may positively impact the price level. Thus, in situations where the government is already large, further expansion does not boost aggregate supply but instead contributes to inflation. Conversely, when the government size is small, increasing it can enhance aggregate supply without causing inflationary pressures(Nademi and Winker 2022). Even though we have little to add to the existing literature, we believe that the association between government size and inflation is critical. Although much light has been shed on the theory of inflation and its drivers, few questions about the government size and inflation nexus arise and warrant answers. First, whether the relationship between government size and inflation is non-linear? Second, does the size of the government matter for inflation? Finally, at what level does government size positively and negatively influence price levels?

This article focuses on the threshold effects of government size on inflation in a sample of ten Middle East and North African (MENA) countries, namely Algeria, Egypt, Iran, Iraq, Jordan, Morocco, Oman, Saudi Arabia, Syria and Tunisia. The MENA region consists of countries with diverse economic structures, including oil-exporting nations, resource-poor countries, and economies at various stages of development. The impact of government size on inflation may differ across these diverse economies. Some may be more susceptible to inflationary pressures from government spending, making it vital to understand the nuances. While the importance of various economic conditions, such as external deficits and economic structures cannot be overlooked, our focus on fiscal imbalances captured via variations in the size of the government is driven by their significant impact on macroeconomic stability and saving rates, particularly in MENA countries (Eken et al. 1996). Fiscal imbalances have been consistently identified as a major source of macroeconomic instability in this region (Eken et al.1996). Therefore, despite the influence of other economic factors, our analysis prioritizes fiscal imbalances to better understand their role in potential non-linearity between government size and inflation. We believe that this focus is crucial given their prominent role in affecting economic stability and performance in MENA countries. Furthermore, government size in MENA countries have been notably high by international standards, as have their revenue levels. Historically, the region has experienced substantial fiscal imbalances, which have significantly contributed to low savings rates and macroeconomic instability (Eken et al. 1996). In most of the MENA countries that comprise our sample, budget financing predominantly relies on oil revenues, a situation that contrasts with that of developed nations. Moreover, these countries typically possess less developed tax systems. According to Han and Mulligan (2008), countries with underdeveloped tax systems may exemplify Sargent's (1982) assertion that inflation can be viewed as a fiscal phenomenon (Nademi and Winker 2022). Despite sizeable economic and financial variations that can be seen among MENA countries, most of them share identical structural economic attributes. The public sector's dominance in economic activities is one of those attributes which many MENA countries have in common (Eken et al. 1996). During the 1970s and 1980s, the MENA countries achieved high growth rates due to the encouraging external environment, including severe spikes in oil prices (Eken et al. 1997). Not only were the oil-exporting countries beneficiaries of the oil prices boom, but many non-oil-exporting nations also indirectly reaped the benefits. During the same period, the governments of the MENA countries played a predominant role in the MENA economies through expenditure and public enterprises (Eken et al. 1997). Following the dwindling oil prices in the early 1980s, the availability of finances also declined, with its corresponding effects on government size, activities, and the external sector (Eken et al. 1997). The average government size (measured as general government final consumption expenditure as a percentage of GDP) over the study period for the sample MENA countries is 18.30 %, with Saudi Arabia having the largest government size, followed by Oman and Jordan, and Egypt have the smallest government size, followed by Iran and Tunisia.

The studies on inflation in these countries are not only scanty, but some of these MENA countries have witnessed a wide range of inflationary experiences (Saad et al. 2006). The average inflation rate for the sample MENA countries over the study period (1970–2019) is 13.52 %. At the same time, the average inflation rate for Saudi Arabia, Algeria, Jordan, Morocco, Oman and Tunisia for the said period remained below 5 % annually. In contrast, Egypt, Iran, Iraq and Syria were infested with a double-digit inflation rate, particularly Iraq, where the inflation rate climbed to triple-digit during the early 1990s. However, one cannot simply look at these figures and pick out policy suggestions. Instead, a careful empirical analysis considering all possible associations (linear and non-linear) involved in the government size-inflation nexus is required.

Against this background, the significance of studying the non-linear nexus between government size and inflation in MENA countries cannot be overstated. Given the diversity of economic structures and each nation's unique challenges, economic stability and sustainable growth are paramount in the Middle East and North Africa region. Comprehending the nuanced relationship between government size and inflation is crucial for crafting effective fiscal and monetary policies that can mitigate the adverse impacts of inflation while promoting economic development. With many MENA countries relying heavily on revenues from natural resources, such as oil and gas, the risks associated with excessive government spending and inflation are heightened (O'Sullivan et al. 2011). Furthermore, the dominance of the public sector in many MENA economies (Eken et al. 1996) and the structural economic characteristics shared by these nations underscore the need for an in-depth analysis of the government size-inflation nexus. The findings of this study could provide valuable insights for policymakers in MENA countries to strike the right balance between fiscal expansion and inflation control, ultimately contributing to economic stability, welfare enhancement, and sustainable growth in the region.

The rest of this paper has the following structure: Section 2 outlays the literature review. Section 3 discusses the data and the methodology employed in the empirical application. Section 4 presents the empirical results. Finally, in Section 5, we conclude and offer some policy suggestions.

2 Literature review

2.1 Theoretical review

Understanding the intricate relationship between government size and inflation involves comprehensively exploring various economic theories. Neoclassical economics, firmly anchored in the quantity theory of money, proposes that government size can influence inflation by manipulating the money supply (Curwen 1976). An upsurge in government spending, often funded through deficits, can potentially expand the money supply, setting the stage for potential inflationary pressures (Ball 1964). In contrast, Keynesian economics strongly emphasises the role of government spending in invigorating economic activity and doesn't categorically label government size as intrinsically inflationary (Bhat and Sharma 2020; Afonso et al. 2021; Vishal and Ashok 2021). The effect of government size on inflation varies with the economic context, with full employment potentially sparking demand-pull inflation.

The Fiscal Theory of the Price Level introduces a novel perspective challenging conventional wisdom. According to this theory, fiscal policies, notably government spending, are pivotal in shaping an economy's price levels (Afosno et al. 2021). It contends that government size, rather than monetary policy, stands as the principal driver of inflation (Woodford 1994, 1995; Leeper 1991; Sims 1994). The theory suggests that when the fiscal authority generates revenue to finance increased government spending independently of the monetary authority, the gap between tax revenue and government outlays diminishes. This reduction in government savings, in turn, leads to an escalation in the general price level. In simple terms, this theory asserts that domestic fiscal policies have a significant impact on a nation's price levels, potentially reducing the role of monetary policy in determining prices.

On the other hand, the Ricardian Equivalence Theory (RET) offers a different viewpoint on the relationship between government size and inflation. According to RET, the potential for government size to induce inflation is balanced by increased private savings and reduced consumption as individuals anticipate higher future taxes (Barro 1979). This expectation of future tax burdens neutralizes the immediate stimulative effect on demand, rendering government size's immediate impact on inflation relatively neutral (Thornton 1990). In essence, RET suggests that government size is less likely to lead to demand-pull inflation, where increased demand drives prices higher.

These diverse economic theories provide nuanced perspectives on the dynamic interaction between government size and inflation, enriching our comprehension of this multifaceted relationship and its implications for economic policy and stability.

2.2 Empirical review

Undeniably, the literature on government size-inflation nexus in general and MENA countries, in particular, is scant and indeterminate. In reality, inflation is a critical variable for researchers and policymakers worldwide. Studies, for instance (Grilli et al. 1991; Edelberg et al. 1999; Caldara and Kamps 2008; Ezirim et al. 2008; Christiano et al. 2011; Ben Zeev and Pappa 2017; Wang and Wen 2019; Ferrara et al. 2021) provide evidence of rising prices in response to increases in government size (public expenditures). Similarly, there are others, for example, Fatas and Mihov 2001; Canzoneri et al. 2002; Muhammad et al. 2009; Mountford and Uhlig 2009; Mehrara et al. 2016; Ricco et al. 2016; D'Alessandro et al. 2019 whose results provide evidence against a positive association between government size and inflation. Some studies, like Cukierman (1992) and Becker and Mulligan (2003), argued that the size of government in an economy responds to the efficiency of taxes. Their primary argument was that inflation and government size might be negatively related. In their opinion, the reason for this negative relationship was that countries without access to efficient taxes would probably rely mainly on inefficient taxes for revenues and consequently would have smaller governments. Likewise, Alesina and Tabellini (1987) and Barro and Gordan (1983) viewed inflation as a shred of evidence against a government failing to fulfil its credible promises. They believed that such governments tend to inflate their economies optimally to reap the short-run benefits of rising price levels.

Moreover, studies like those of Mankiw (1987); Veigh (1989); and Poterba and Rotemberg (1990) suggest that as the size of the government increases, so does the optimal inflation tax. In contrast, few studies like Kimbrough (1986), Woodford (1990), and Correia and Teles (1996) argued that it is not always feasible for bigger governments to inflate more when money is considered a particular sort of "intermediate good". Apart from such studies at extreme ends, few studies, for example, Campillo and Mirron (1997), Perotti (2005), Canova and Pappa (2007), Han and Mulligan (2008) and Nguyen (2019) provide conflicting or mixed results about the association between government size and inflation. The probable reasons for these contradictory results can be ascribed to the assumption of a linear association between the size of government and inflation and, thereby, the adoption of linear analytical methods. Holding on to the assumption of linearity while ignoring the possibility of a non-linear nexus between the size of government and inflation can generate biased estimation results if the relationship is non-linear. Two recent studies, Nademi and Winker (2022) and Tariq et al. (2022) have addressed the nonlinearity between government size and inflation using different threshold models. Therefore, in this article, the dynamic panel threshold model by Kremer et al. 2013 is used to unravel the non-linear nexus between government size and inflation in MENA countries. More specifically, this study empirically investigates the existence of the threshold level of government size and how the threshold level of government size affects inflation unequally. The present study is unique and differs from the prevailing ones in several ways. First, to the best of the author's knowledge, hardly any study in the literature addresses the nonlinearity issue between inflation and government size in the MENA region. Second, we investigate the likelihood that a non-linear model can appropriately portray the government size-inflation nexus with a markedly different response of inflation to the government size changes. Third, we precisely estimate the threshold level of government size in MENA countries and how it influences inflation differently.

3 Data and empirical strategies

3.1 The data

Our empirical analysis using the dynamic panel threshold model to unravel the government size-inflation nexus is grounded on a balanced panel dataset for ten MENA countries from 1970 to 2019. Since the dataset covers a period long enough, the sample holds more detailed information about the inflation-depressing and inflation-stimulating effects of government size. Table 1 presents the variable definitions, their sources and descriptive statistics.

The descriptive statistics for the variables indicate substantial variations over 40 years. The inflation rate (inf_{it}) displays an average of 15.89%, with a maximum of 448.5% and a minimum of − 16.11%, reflecting considerable volatility (Std. Dev = 42.99). This reveals a substantial degree of price level volatility within the MENA economies. The semi-log transformation of the Consumer Price Index (CPI), π_{it}, yields a mean of 1.07, with a maximum of 6.10 and a minimum of − 17.11, demonstrating its impact on inflation.

Similarly, the descriptive statistics for government size (Gsize_{it}) reveal that, on average, general government final consumption expenditure constitutes approximately 18.30% of the Gross Domestic Product (GDP) over 40 years. These data reflect the financial footprint of the government within the economy. The variable exhibits substantial variability, with the highest proportion being 43.38% and the lowest at 2.33%.

In our sample of MENA countries, the highest recorded government size (Gsize_{it}) for a single year occurred in Iraq in 1995, with general government final consumption expenditure constituting a substantial 43.38% of the GDP. Conversely, in 1983, the lowest government size for a single year was observed, accounting for only 2.33% of the GDP.

In a similar vein, the highest inflation rate (inf_{it}) in a single year was recorded in Iraq in 1994, reaching a substantial 448.5%. Conversely, in 1996, the same member nation of the MENA region experienced the lowest inflation rate, at a negative − 16.11%. These extreme fluctuations in inflation rates during these years could have been influenced by a variety of economic factors, including government size (Gsize_{it}). High

Table 1 Definitions and descriptive statistics and source of variables

Variables	Definition, description and source	Years	Mean	Max	Min	Std.Dev
Inflation rate (inf_t)	Annual percentage change of Consumer Price Index (CPI), from WDI	40	15.89	448.5	− 16.11	42.99
Semi-log transformation of CPI (π_{it})	$\pi_{t=}\ \pi_t - 1$, if $\pi_t < 1$ and $\pi_t = \log(\pi_t)$ if $\pi_t \geq 1$	40	1.07	6.10	− 17.11	2.94
Government size($Gsize_{it}$)	General government final consumption expenditure as a percentage of GDP, from WDI	40	18.30	43.38	2.33	5.91
Growth rate of GDP (gr_{it})	Annual percentage growth of GDP, from WDI	40	3.82	57.81	− 64.04	8.24
Broad money growth ($bmgr_{it}$)	Annual percentage growth rate of broad money, WDI	40	14.02	54.04	− 9.09	9.33
Output gap (og_{it})	log of output gap calculated using Hordrick-Prescott filter	40	21.61	24.85	16.61	1.82
Population growth rate (pop_{it})	Annual growth rate of population, from WDI	40	2.46	7.34	− 4.53	1.49
NEER ($neer_{it}$)	unadjusted weighted average of bilateral nominal exchange rate, from Darvas and Solt (2021)	40	845.72	36,563.06	1.31	477.25
Openess ($open_{it}$)	trade as percentage of GDP, from WDI	40	71.02	154.23	0.020	28.03

Table 2 Average inflation rates and government size in select MENA countries (1980–2019)

Country	Avg. inflation	Country	Avg. Gsize
Iraq	66.49	Saudi arabia	25.63
Syria	38.85	Oman	23.38
Iran	19.72	Jordan	22.65
Egypt	11.97	Iraq	18.9
Algeria	8.86	Morrocco	17.77
Tunisia	5.62	Tunisia	16.77
Jordan	4.65	Algeria	16.65
Morrocco	3.77	Syria	15.48
Saudi arabia	1.42	Iran	13.61
Oman	− 2.45	Egypt	12.13

inflation in 1994 might have been associated with substantial government expenditure or other macroeconomic factors contributing to price increases, while deflation in 1996 could have resulted from fiscal austerity measures or other factors impacting the government's size and spending, underscoring the interplay between government policies and economic stability during these periods.

Table 2 presents the average inflation rate and government size for selected MENA countries over a 40-year study period arranged from largest to smallest values.

Notably, Iraq and Syria exhibit the highest average inflation rates at 66.49% and 38.85%, respectively, highlighting the economic challenges faced by these nations over the years. These elevated inflation rates could be attributed to factors such as geopolitical instability and conflicts, which often lead to disruptions in economic activities and currency devaluation. In contrast, countries like Saudi Arabia and Oman display relatively low average inflation rates, with Saudi Arabia even recording a positive value (1.43%) and Oman experiencing deflation (− 2.46%). These lower inflation rates suggest greater economic stability and effective monetary policies, possibly influenced by factors like oil revenues and prudent fiscal management in these MENA countries. The varying inflation rates across these countries underscore the diverse economic landscapes in the region and provide valuable insights for policymakers and researchers examining inflation dynamics in the Middle East and North Africa.

Likewise, Saudi Arabia emerges with the highest average government size at 25.64%, followed closely by Oman at 23.39%, indicating that these countries have relatively larger public sectors compared to the other sampled MENA nations. This could be attributed to the government's dominant role in these member MENA countries, particularly in managing and controlling oil-related revenues. Conversely, Egypt and Iran report the smallest average government sizes at 12.13 and 13.61%, respectively. This suggests that these countries have a relatively smaller share of government expenditure compared to their GDP. The varying government sizes across these countries reflect distinct economic and political structures and offer valuable insights for researchers and policymakers studying the dynamics of government spending in the Middle East and North Africa region. It is important to consider the implications of these differences in government size when evaluating economic policies, fiscal strategies, and public sector contributions to the respective economies.

3.2 Variables included

Numerous determinants of inflation can be traced from various strands in the literature. These variables can be related to business cycles, structural, monetary, and external and openness-related variables. This paper has attempted to cover as many variables as possible. Since this article addresses the threshold effects of government size on inflation, we have used annual percentage change in the consumer price index as a dependent variable. The data for the inflation rate in our sample comprise negative values; we, therefore, by following Khan and Senhadji (2001), Drukker et al. (2005), and Ibara and Trupkin (2016), have employed a semi-log transformation of the inflation rate π_{it}, where for the sake of continuity, we re-scaled the inflation rates below 1.[1] Then we included in our model government size mimicked by the general government's final consumption expenditure as a proportion of GDP, which is our primary variable of interest next behind inflation. Economic growth is yet another variable which can affect inflation in any economy, and for the same reasons, we have incorporated it in our specification. Our model also includes the output gap as a determinant of inflation because it encompasses valuable information required to forecast short-run inflation in an economy. To control for the influence of monetary determinants on inflation, we plugged into our model the broad money growth rate as a percentage of GDP. We also use trade as a percentage of GDP as a proxy for openness to investigate the

[1] $\widetilde{\pi}_{it} = \begin{cases} \pi_{it} - 1, & \text{if } \pi_{it} \leq 1\% \\ ln(\pi_{it}), & \text{if } \pi_{it} > 1\% \end{cases}$

impact of openness on inflation. Moreover, we used nominal effective exchange rates to account for the impact generated by the exchange rate movements. Finally, to consider the effects of population dynamics on inflation, we have included the growth rate of the population in our model specification.

3.3 The econometric model

In this article, we apply Kremer et al.'s (2013) dynamic panel threshold model, which augments Hansen's (1999) static model with endogenous regressors to analyze the effect of the government size threshold on inflation. The extension of the Kremer et al. (2013) model is based on the cross-sectional threshold model of Caner and Hansen (2004), where they allow for endogeneity using a Generalised method of moments (GMM) type estimator. Towards this purpose, we consider the general form of the panel threshold model with the following specification

$$y_{it} = \varphi_i + \alpha_1^* X_{it} I\left(q_{it} \leq \gamma\right) + \alpha_2^* X_{it} I(q_{it} > \gamma) + \mu_{it}, \tag{1}$$

where the subscript $i=1, 2, 3, \ldots N$ denotes the individual countries in the panel and $t=1, 2, 3, \ldots T$ represents the time dimension of the panel. φ_i denotes the country-specific fixed effect, μ_{it} is the idiosyncratic error term iid $\sim(0, \sigma^2)$. *I(.)* is the indicator function denoting the regime specified by the threshold variable q_{it}, and the value of threshold parameterγ. Also X_{it} is a k-dimensional vector of explanatory variables, which may also include the lagged values of the dependent variable y_{it} and some other endogenous variables. X_{it} which is the vector of explanatory regressors is comprised of two subsets; X_{1it} of exogenous regressors uncorrelated with the error term μ_{it} and X_{2it} of endogenous variables correlated with the error term μ_{it}. In addition to the threshold Eq. (1), the model requires a suitable set of $k \geq m$ instrumental variables Z_{it} including X_{it}.

In the next step to eliminate the country-specific fixed effects, we follow Kremer et al. (2013) and use forward orthogonal deviations transformation as Arellano and Bover (1995) suggested instead of within transformation and first-differencing transformation, which leads to the error terms to be serially correlated. Apart from getting rid of the serial correlation of the errors, one more advantage of the forward orthogonal deviations transformation is that it retains the distributional assumptions underlying Hansen (1999) and Caner and Hansen (2004). Therefore, instead of within transformation, which includes subtracting the mean from each observation as in Hansen (1999) and ending up with inconsistent estimates and first-differencing transformation which results in the serial correlation of the error terms, the forward orthogonal deviations transformation subtracts the mean of all available future observations of variables. The forward orthogonal deviations transformation of the error term is therefore given by

$$\mu_{it}^* = \sqrt{\frac{T-t}{T-t+1}}\left[\mu_{it} - \frac{1}{T-t}\left(\mu_{i(t+1)} + \cdots + \mu_{iT}\right)\right]. \tag{2}$$

Therefore, the uncorrelatedness of the error terms is maintained using forward orthogonal deviations transformation, that is,

$$\mathrm{Var}(\mu_i) = \sigma^2 I_T \Rightarrow \mathrm{Var}\left(\mu_i^*\right) = \sigma^2 I_{T-1}. \tag{3}$$

As suggested by Hansen (2000), this method guarantees the application of the estimation procedure originated by Caner and Hansen (2004) for the cross-sectional model to the dynamic panel threshold model given in Eq. (1).

The estimation process involves finding and choosing the threshold value γ with the minimum sum of squared residuals. After the $\widehat{\gamma}$ is determined, the generalised method of moments (GMM) can be used to estimate the coefficients of the previously used instruments and previously estimated threshold $\widehat{\gamma}$.

Applying the dynamic panel threshold model to assess the potential nonlinearities and the impact of the threshold between government size and inflation in MENA countries, we specify the threshold model of the government size-inflation nexus as follows:

$$\mathrm{inf}_{\mathrm{it}} = \rho \mathrm{inf}_{\mathrm{it}-1} + \alpha_s \mathrm{Gs}_{\mathrm{it}} I(\mathrm{Gs}_{\mathrm{it}} \leq \gamma) + \lambda_1 I(\mathrm{Gs}_{\mathrm{it}} \leq \gamma) + \alpha_l \mathrm{Gs}_{\mathrm{it}} I(\mathrm{Gs}_{\mathrm{it}} > \gamma) + \beta x_{\mathrm{it}} + \varphi_i + \mu_{\mathrm{it}}. \tag{4}$$

In the above equation, $\mathrm{inf}_{\mathrm{it}}$ is inflation, $\mathrm{Gs}_{\mathrm{it}}$ is both the regime dependant variable and threshold variable. $I(.)$ is the indicator function. γ is the threshold value. The subscripts s and l on α represent small and large phases or regimes of government size. Following Bick (2010) and Kremer et al. (2013), we permit for variations in regime intercepts (λ_1).x_{it} is the vector of regime-independent control variables (partly endogenous), and β's are the parameters associated with control variables. Finally φ_i is the country-fixed effect, which captures the impact of individual country level variations and μ_{it} is the idiosyncratic error term. In addition, following Arellano and Bover (1995), $\rho \mathrm{inf}_{\mathrm{it}-1}$ represents the lagged value of the dependent variable, i.e., inflation which we use as instruments in our model. Our empirical results may rely on instrument number (p) (Kremer et al. 2013). Specifically, a bias/efficiency tradeoff is involved in finite samples in choosing instrument number (p). If, on one hand, we use all the available lags of the instrument variable ($p = t$), we may be able to increase the efficiency while, on the other hand lowering the instrument number to 1 ($p = 1$) may result in biased coefficient estimates due to possible avoidance of an overfit of instrumented variables. Therefore, for the reasons cited above and as depicted in Kremer et al. (2013) we restrict our analysis to one lag of the instrument variable because the choice of instruments does not have any important bearing on their results.

3.4 Panel causality test

In addition to examining the threshold effects of government size on inflation in MENA countries, this paper also investigates the causal nexus between the variables of interest. Checking for the causal nexus becomes imperative because mere association or correlation between the variables does not necessarily entail causation. When the data consist of multiple times series, as in the case of our panel data, Granger causality becomes useful. Various methods for testing Granger causality are cited in the literature. A few notable methods include the GMM approach of Holtz-Eakin et al. (1988), which is feasible for homogenous panels with a small count of time series observations (T). Other prominent examples include the methods of Emirmahmutoglu and Kose (2011) and Dumitrescu and Hurlin (2012), valid for non-homogenous large-T panels.

Lately, Juodis et al. (2021) have come up with a new technique for testing the null hypothesis of no granger causality, which is suitable for models with heterogenous or homogenous coefficients. The freshness of their method is that under the null hypothesis of no granger causality, the parameters are equivalent to zero, indicating that they are homogenous. This approach enables the use of pooled fixed-effects type estimator restricted to these parameters only and safeguards a $\sqrt{NT}$ convergence rate, where N represents the number of cross-sections in the panel and T indicates the time dimension in the panel. To take into account the so-called "Nickel Bias" of the pooled estimator, their method employs the Half Panel Jackknife (HPJ) procedure devised by Dhaene and Jochmans (2015). The consequent process performs aptly under situations of numerous cross-sections, few time dimensions in the panel, immense persistence and non-homogenous nuisance parameters.

In this paper, we specify the linear dynamic panel model to test for bias-corrected granger non-causality as follows:

$$y_{i,t} = \varphi_{0,i} + \sum_{p=1}^{P} \varphi_{p,i} y_{i,t-p} + \sum_{p=1}^{P} \alpha_{p,i} x_{i,t-p} + \mu_{i,t}, \tag{5}$$

where the subscripts $i = 1, 2, 3, \ldots. N$ denote the individual countries in the panel and $t = 1, 2, 3, \ldots T$ represents the time dimension of the panel. For the ease of demonstration and without losing generalisation $x_{i,t}$ is hypothesised to be a scalar. The parameters $\varphi_{0,i}$ represent the individual-specific effects, $\mu_{i,t}$ is the stochastic error term, $\varphi_{p,i}$ are the non-homogenous autoregressive coefficients $p = 1, 2, \ldots., P$ and $\alpha_{p,i}$ are the Granger Causality parameters or the heterogeneous feedback coefficients. In this approach, pertaining to the lag length selection, the computational costs are negligible because of the same number of lags for $y_{i,t}$ and $x_{i,t}$.

The null hypothesis that $x_{i,t}$ does not Granger-cause $y_{i,t}$ can be drafted as a set of linear restrictions on the parameters in Eq. (5);

$$H_0;\, \alpha_{p,i} = 0, \text{ for all } i \text{ and } p.$$

$$H_0;\, \alpha_{p,i} \neq 0, \text{ for some } i \text{ and } p.$$

Failure to turn down the null hypothesis would mean $x_{i,t}$ does not Granger-cause $y_{i,t}$. Same applies when $x_{i,t}$ is a $K \times 1$ vector of regressors.

4 Empirical results

4.1 Unit root (stationarity) properties

To examine the stationarity properties of the data, several tests, namely Levin, Lin and Chu, Im, Pesaran and Shin, Breitung, and HT unit root, were employed in our study. Table 3

shows the results of these unit root tests. It can be observed from the table that for inflation (inf_{it}) and government size (Gsize_{it}), the null of the unit root can be rejected at the level for all the tests except for the Breitung unit root test. In a similar spirit, the null of unit root for growth (gr_{it}), openness (open_{it}) and output gap (og_{it}) can be rejected at the level form for all the tests but Breitung. Also for broad money growth rate (bmgr_{it}), the null hypothesis of unit root can be rejected at the level for only LLC and IPS test, and for Breitung and HT tests, we fail to reject the null of unit root.

Table 3 Results of unit root tests

Variables	Test	LLC	IPS	Breitung	HT	Order of integration
inf_{it}	At level	− 2.89*** (0.001)	− 4.98*** (0.000)	− 0.25 (0.599)	0.57*** (0.000)	*I(0)*
$Gsize_{it}$	At level	− 2.71*** (0.0033)	− 2.01** (0.0300)	− 0.47 (0.3177)	0.81*** (0.000)	*I(0)*
gr_{it}	At level	− 12.40*** (0.000)	− 5.90*** (0.000)	− 5.56*** (0.000)	− 0.12*** (0.000)	*I(0)*
$open_{it}$	At level	− 6.25** (0.037)	− 1.79** (0.036)	− 2.34*** (0.009)	0.85*** (0.001)	*I(0)*
$neer_{it}$	At first difference	− 5.22*** (0.009)	− 1.46 (0.590)	1.76 (0.96)	0.92 (0.508)	*I(1)*
pop_{it}	At level	− 13.53*** (0.000)	− 14.62*** (0.000)	− 2.73*** (0.003)	0.95 (0.863)	*I(0)*
$bmgr_{it}$	At level	− 2.73* (0.092)	− 3.33*** (0.000)	2.83 (0.997)	0.96 (0.911)	*I(0)*
og_{it}	At level	− 7.22*** (0.000)	− 3.37*** (0.000)	− 2.35*** (0.009)	0.58*** (0.000)	*I(0)*

Figures in parentheses are *p*-values; ***, **, and * indicate statistical significance at 1%, %% and 10% level

Table 4 Results of panel causality test (JKS-2021)

Null hypothesis (H_0)	HPJ Wald test	*p*-value	Results for the half-panel Jackknife estimator	
			Coefficient	*p*-value
$Gsize_{it}$ does not Granger cause inf_{it}	25.45	0.000***	− 0.10131	0.000***
gr_{it} does not Granger cause inf_{it}	0.2191	0.6397	0.0046	0.640
$open_{it}$ does not Granger cause inf_{it}	14.886	0.0001***	− 0.1882	0.000***
$neer_{it}$ does not Granger cause inf_{it}	1.4e+05	0.0000***	0.0007	0.000***
pop_{it} does not Granger cause inf_{it}	1.9965	0.1577	− 0.09654	0.158
$bmgr_{it}$ does not Granger cause inf_{it}	2.4682	0.1162	− 0.00152	0.116
og_{it} does not Granger cause inf_{it}	0.3223	0.5702	5.37e−12	0.570

***Denote statistical significance at 1% level

Moreover, for population growth (pop_{it}), the unit root null can be rejected at the level form for all the tests but HT test. The nominal effective exchange rate ($neer_{it}$) is the only variable for which the evidence to reject the null of unit root is provided by LLC test only at level form. Based on these results, we can conclude that most tests provided evidence to reject the null of unit root for all the variables except the nominal effective exchange rate. In other words, all the variables are stationary at their level form, i.e., integrated of order zero *I(0)*. For $neer_{it}$ the null of unit root can be rejected after taking its first differences implying that it is integrated of order one *I*(*1*).

4.2 Results of JKS (2021) panel granger non-causality test

The results of the JKS-2021 panel Granger non-causality test are presented in Table 4. We begin by testing the pairwise/univariate causal relationship between inflation and other variables. It can be seen from the table that the null hypothesis that $Gsize_{it}$ does not Granger cause inf_{it} is violated and can be rejected at 1 percent significance level. Likewise, the null hypothesis that $open_{it}$ does not Granger cause inf_{it} can also be rejected at 1 percent significance level. In the same spirit, we could also reject the null hypothesis that $neer_{it}$ does not Granger cause inf_{it} at 1 percent significance levels. Also, it is evident

Table 5 Government size threshold and inflation in MENA countries

Dependant variable inflation	Coefficients	*z*-statistic	*p*-value
Threshold ($\widehat{\gamma}$)	12.46***	5.08	0.00
95% confidence interval	[7.72, 17.44]		
Government size			
$\widehat{\alpha}_s(\text{Gsize} < \gamma)$	− 0.12***	− 2.38	0.01
$\widehat{\alpha}_l(\text{Gsize} > \gamma)$	0.017	0.47	0.63
Impact of regime-independent covariates			
gr_{it}	0.0011	0.06	0.951
$\text{inf}_{\text{it}-1}$	0.516***	7.80	0.000
open_{it}	0.024***	2.63	0.009
neer_{it}	0.0002*	1.95	0.051
pop_{it}	0.0137	0.13	0.900
og_{it}	0.047	0.52	0.601
bmgr_{it}	− 0.002	− 0.23	0.817
$\widehat{\lambda}_1$	− 2.491	− 1.09	0.277
Linearity test (*p*-value)	0.000		
SupWStar	12.58***	5.08	0.00
m_2	− 0.495 (0.62)		
J(*p*-value)	1.000		
Countries	10		
Time	40		
Total Obs	400		

The null of the linearity test is $H_0 : \hat{\alpha}_s = \hat{\alpha}_1$. m_2 tests for the absence of second-order serial correlation in the residuals. *J* is a specification test for overidentifying restrictions. Rejection of the null hypothesis of *J* means either the orthogonality conditions or assumption or both are false.***,**, and * denote statistical significance at 1%, 5% and 10% level

from the results that we fail to reject the null hypothesis for other covariates implying that they do not Granger cause inf_{it}.

Therefore, the results of the JKS test confirm that the lagged values of the selected covariates provide information which aids in determining the past values of inf_{it} apart from the information contained in the lagged values of inf_{it} itself. It is to be noted that the results provided in Table 4 included the lagged values of the selected covariates and the dependent variable. The optimal lag length is determined by the BIC criterion and equals one.

4.3 Results of the dynamic panel threshold model

In the next step of our analysis and to pursue our main objective, which is to investigate the threshold effects of government size on inflation in MENA countries (1980–2019), we applied the dynamic panel threshold model of Kemer et al. (2013). The results from the threshold model are presented in Table 5. To avoid any spurious relation, as in Hansen (1999) and Kremeret al. (2013), all the variables used are stationary at level except one, which is integrated of order one $I(0)$.[2] The threshold level of government size is precisely estimated to be 12.46%, with the value contained in the confidence interval of [7.72–17.44]. The government size is our threshold, as well as the regime-dependent variable. Its coefficients, the marginal effects of government size on inflation, provide evidence of a non-linear nexus between government size and inflation.

[2] See Table 3 for the unit root estimation results.

Moreover, the 95% confidence interval ([7.72–17.44]) contains the estimated threshold value for the MENA countries. The probable reasons for the negative association between the two in the small phase of government size might be that an increase in the size of government in terms of expenditure might not unavoidably result in running any budget deficits. Since the size of the government is small, any required increase in public spending can be financed from revenues generated through taxes from the private sector and other sources like revenues from oil exports. Armey (1995) also suggested that economies with small governments are likely to have more effective and efficient public expenditure systems than those with large governments. Small-sized governments' efficiency in providing public utilities to the private sector enhances the aggregate supply in an economy and, thus, the decline in price levels.

Moreover, aggregate demand is enhanced through an increase in private consumption and investment following a rise in the size of government via public spending in an economy. The possible inability of aggregate supply to match the increase in aggregate demand due to its inelastic or fixed nature in the short run might drive up the price level, hence the positive correlation in the phase of large government size. Besides, these findings comply with the results of Nademi and Winker (2022) and Tariq et al. (2022).

It is also evident from the results presented in Table 5 that the past values of the inflation rate in MENA countries are also a positive determining factor of the present inflation rate. The coefficient of the lagged dependent variable, inflation, is 0.516 with a p-value equal to 0.000, implying statistical significance at 1% level.

In addition, for brevity and more comprehension, the pictorial representation of the nexus between the size of government and inflation in MENA countries is in Fig. 1. It can be inferred from the graph that when the size of the government lies below the threshold level, it would inversely impact inflation until it reaches a minimum or threshold level. Inflation rates will start picking up following any further increase in the size of the government beyond the threshold level (Fig. 1). Figures 2 and 3 given below demonstrate the distribution of government size and inflation rate in select MENA countries.

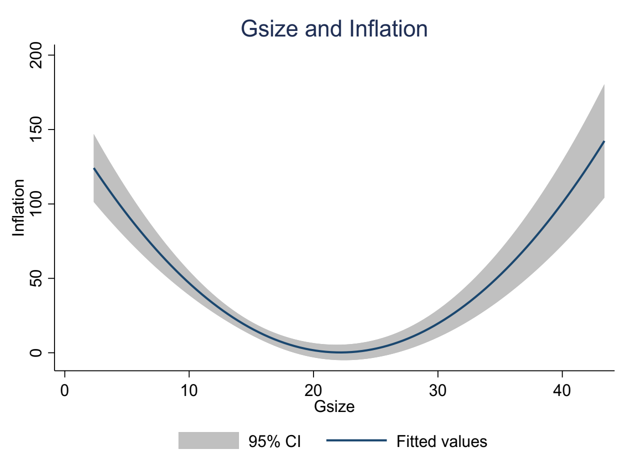

Fig. 1 Government size and inflation in MENA countries

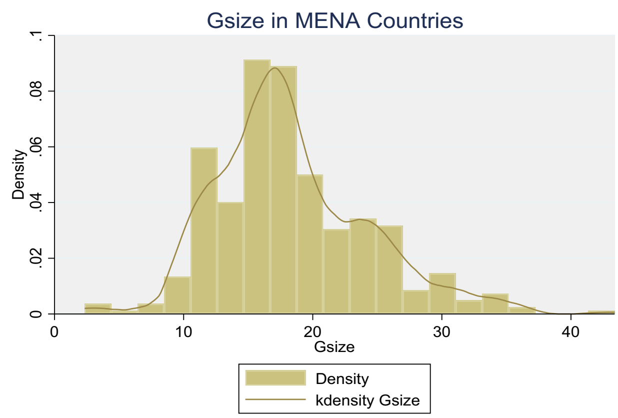

Fig. 2 Government size in MENA countries

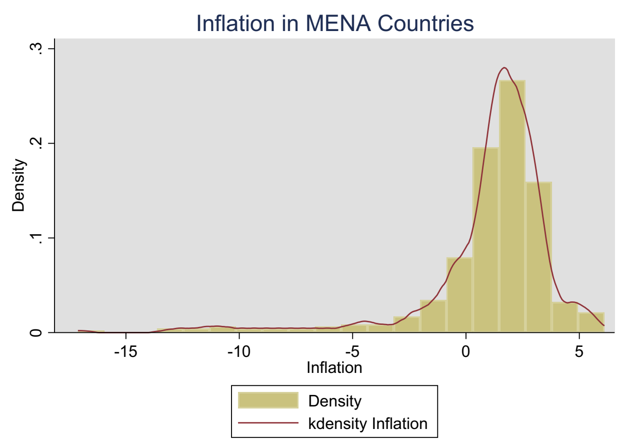

Fig. 3 Inflation in MENA countries

Notably, Saudi Arabia, Jordan, Oman and Iraq, among these sampled MENA nations, have government sizes above the average government size of 18.30. Furthermore, all member nations except Egypt have a government size above the threshold of 12.46. The average government size for Egypt over the study period is 12.13. This would indicate a comparatively more prominent role of government in all sampled MENA economies except Egypt. The results also suggest a diversity of government sizes across the countries studied, highlighting variations in fiscal policies and government expenditure priorities. The number of countries with government sizes below and above the specified threshold can be a crucial factor in policy assessments and international comparisons, and it emphasises the need for tailoring economic policies to individual country contexts.

Besides the regime-dependant/threshold variable, that is, government size, several other covariates or regime-independent control variables have been incorporated into the model to avoid bias stemming from omitting other relevant variables. It is evident from Table 5 that the coefficient of economic growth, although positive, is far from statistically significant. Openness is positively correlated with inflation, with its coefficient equal to 0.024 with p-value $= 0.009$ and thus statistically different from zero.

Empirical studies suggest that more open economies tend to have low inflation levels (Ali and Mim 2011). However, the proponents of the cost-push hypothesis of trade openness propose that openness does not necessarily imply a reduced inflation rate. The fact that monetary authority has some degree of monopoly in international markets and demand for goods produced in the home country is somewhat inelastic among foreign consumers is what causes the positive effect of openness on inflation (Evans 2007).

Furthermore, due to openness, foreign intermediate goods replace domestic capital (labour) in the production process; as a result, the economy's aggregate supply flattens and drives up the price levels (Hardouvelis 1992). Besides, our results conform with Ali and Mim (2011) and Lotfalipour et al. (2013). Concerning the effect of the nominal effective exchange rate, it was expected to correlate positively with inflation. The coefficient of the nominal effective exchange rate equals 0.0002 with a *p*-value equal to 0.051, implying statistical significance at 10 percent level. Conceptually an increase in the exchange rate results in a rise in inflation. An increase in the exchange rate would mean the depreciation of the home currency. This depreciation of the home currency would lead to a surge in domestic production costs as imported inputs and intermediate goods become dearer. Nevertheless, due to rising prices of finished imported goods and substitutes consequent of home currency depreciation, a spiral of inflationary pressures will be observed in the economy (Dornbusch 1976). Also, this finding aligns with the result of Ali and Mim (2011).

Regarding other covariates, the broad money growth rate coefficient surprisingly turned out to be negatively associated with inflation but was far from significant. Similarly, the output gap coefficient contrasted theory and apriori expectations. It turned out to be positively correlated with inflation but was found statistically insignificant. Finally, as expected, the population growth rate coefficient was positively associated with inflation but was far from significant.

We also provide additional diagnostic checks to ensure robust and valid results. We performed m_2 test to check for autocorrelation in the first-differenced errors. The results indicate we can reject the null hypothesis of no autocorrelation in the first-differenced errors. Therefore, we conclude that our model is free from the autocorrelation problem. Also, we have employed the Sargan-Hansen J test of overidentifying restrictions. This test works with the null hypothesis of overidentifying restrictions are valid. The results of this test also indicate that we can reject the null and conclude that the model is correctly specified. Finally, we test if there is a threshold effect in our model or not. The statistic *SupWStar* permits us to test the null hypothesis that there is no threshold effect in Eq. (4) with an alternative hypothesis that there is a threshold. The results indicate that the SupWStar is statistically different from zero at the 1% level. Therefore, we conclude that there is a threshold effect in our model.

Finally, in Table 6, we present the estimation results of the dynamic panel threshold model as a measure of robustness check. Iraq is dropped from the sample because it exhibits large variations in government size and inflation rates. Our results are still reliable and remain robust even after altering the sample size. It can be seen that in comparing the results between the two tables, it is evident that there are similarities and robustness in the findings even after dropping one country from the sample in Table 6, as compared to the initial Table 5.

Table 6 Government size threshold and inflation in MENA countries—robustness check

Dependant variable inflation	Coefficients	*z*-statistic	*p*-value
Threshold ($\widehat{\gamma}$)	12.40**	2.20	0.02
95% confidence interval	[0.83, 14.66]		
Government size			
$\widehat{\alpha}_s(\text{Gsize} < \gamma)$	− 0.118**	− 2.11	0.035
$\widehat{\alpha}_l(\text{Gsize} > \gamma)$	0.018	0.48	0.633
Impact of regime-independent covariates			
gr_{it}	0.0011	0.06	0.951
inf_{it-1}	0.524***	7.76	0.000
$open_{it}$	0.023***	2.39	0.017
$neer_{it}$	0.0001*	1.81	0.070
pop_{it}	0.016	0.14	0.886
og_{it}	0.659	0.69	0.491
$bmgr_{it}$	− 0.004	− 0.36	0.720
$\widehat{\lambda}_1$	− 2.761	− 1.16	0.246
Linearity test (*p*-value)	0.000		
SupWStar	7.75**	2.20	0.02
m_2	− 0.58 (0.56)		
J(*p*-value)	1.000		
Countries	9		
Time	40		
Total Obs	360		

The null of the linearity test is $H_0 : \hat{\alpha}_s = \hat{\alpha}_1$. m_2 tests for the absence of second-order serial correlation in the residuals. *J* is a specification test for overidentifying restrictions. Rejection of the null hypothesis of *J* means either the orthogonality conditions or assumption or both are false.***,**, and * denote statistical significance at 1%, 5% and 10% level

Firstly, the "$G\text{size}_{it}$ threshold ($\hat{\gamma}$)" remains relatively consistent between the two tables. In Table 5, the threshold was estimated at 12.46, and in Table 6, it is slightly lower at 12.40. This suggests that the threshold is still a statistically significant factor impacting inflation in MENA countries. Secondly, the coefficients for "$G\text{size}_{it}$" ($\widehat{\alpha}_s$ and $\widehat{\alpha}_l$) exhibit a similar pattern in both tables. In Table 5, $\widehat{\alpha}_s$ was − 0.12, and $\widehat{\alpha}_l$ was 0.017. In Table 6, $\widehat{\alpha}_s$ is − 0.118, and $\widehat{\alpha}_l$ is 0.018. Both sets of coefficients are remarkably close. This consistency implies that the relationship between government size and inflation, as divided into "below threshold" and "above threshold," remains stable and robust even with the change in the sample.

The *p*-values for the government size coefficients in both tables remain quite low, indicating statistical significance. This means that the impact of government size on inflation, both below and above the threshold, is supported by the data in both the full and reduced samples.

Additionally, other covariates like gr_{it}, inf_{it-1}, $open_{it}$, "$neer_{it}$, pop_{it}, og_{it}, $bmgr_{it}$, and $\widehat{\lambda}_1$ maintain similar relationships with inflation in both tables. The linearity test in both cases yields *p*-values of 0.000, emphasizing the non-linear nature of the relationship between government size and inflation.

Overall, the findings in Table 6, despite being derived from a reduced sample of nine countries, are strikingly consistent with those in Table 5. This robustness suggests that the observed relationships between government size and inflation, along with the associated covariates, are not heavily influenced by the inclusion or exclusion of one country.

Researchers and policymakers can have confidence in the stability of these results and the generalisability of these findings to the broader context of MENA countries.

5 Conclusion and policy implications

Using the dynamic panel threshold model, this article examined the threshold effects of government size on inflation in ten MENA countries from 1980 to 2019. The study results reveal a U-shaped relationship between government size and inflation, indicating that an increase in government size does not lead to inflation below the threshold or optimum level. However, above the estimated threshold of 12.46%, an increase in government size exerts upward pressure on the price level.

Among the covariates examined, trade openness and nominal effective exchange rate positively correlate with inflation and are statistically significant. Output growth rate, population growth rate, and output gap also positively impact inflation, although they were not statistically significant. On the other hand, the broad money growth rate was found to be negatively associated with inflation, but the relationship was statistically insignificant.

Furthermore, a causality analysis was conducted to test the causal nexus between inflation, government size, and other covariates. The findings indicate that only government size, nominal effective exchange rates, and trade openness have a significant causal association with inflation in MENA countries.

Based on these findings, it is evident that large-sized governments, trade openness, and depreciation of the home currency contribute to higher inflation rates in MENA countries. These findings have important implications for fiscal and macroeconomic policies. Policymakers in the MENA countries can consider increasing the size of the government up to the threshold level to stimulate investment, boost the economy, and enhance productivity while keeping inflation within acceptable limits. Setting the benchmark at 12.46% can serve as a guideline for government expansion. Conversely, if the inflation level exceeds the permissible limits, policymakers can reduce the size of the government and bring it back towards the threshold or benchmark level. Failure to manage inflation effectively may harm growth prospects and result in significant economic and welfare costs.

In conclusion, this study provides valuable insights into the relationship between government size, inflation, and other covariates in MENA countries. The findings highlight the need for policymakers to consider the threshold effects of government size on inflation when formulating fiscal and macroeconomic policies. By adhering to the threshold level and monitoring the impact of trade openness and exchange rate fluctuations, policymakers can foster sustainable growth while maintaining price stability in their economies.

Acknowledgements

The article processing charge was covered by the funds of PAPAIOS and JSPS (KAKENHI Grant No. JP21HP2002), as I was not able to find the check box to ask the payment of APC by your side, PAPAIOS and JSPS.

Author contributions

1. Asif Tariq: Conceptualization, Methodology, Formal Analysis and Writing original Draft. 2. Aadil Amin: Writing, Editing, Data curation and Software. 3. Dr. Masroor Ahmad: Supervision and Visualization, Review and Editing.

Funding

We declare that no funding was received for this study.

Availability of data and materials

The data used in this paper is extracted from the World Development Indicators (WDI) database of the World Bank and Darvas and Solt (2021).

Declarations

Ethics approval and consent to participate

The authors declare that this is an original piece of work, and the work has not been submitted elsewhere nor is it under consideration by any other publication. The paper entirely credits the meaningful contributions of co-authors. Authorship has been agreed before submission and that no one has been 'gifted' authorship or denied credit as an author ("ghost authorship"). The results are appropriately placed in the context of prior and existing research. The work does not include libellous, defamatory or unlawful statements. The authors also declare that this piece of work does not include studies on human subjects, human data or tissue and animals. The authors also declare that our work does not include any image of anyone's face or anything else that might identify them.

Competing interests

The authors declare that they have no competing interests.

Received: 26 June 2023 Revised: 30 August 2024 Accepted: 15 September 2024
Published online: 03 October 2024

References

Afonso A, Sen H, Kaya A (2021) Government size, unemployment and inflation nexus in eight large emerging market economies. Hacienda Publica Espanola 236:133–170
Alesina A, Tabellini G (1987) Rules and discretion with noncoordinated monetary and fiscal policies. Econ Inq 25(4):619–630
Ali MSB, Mim SB (2011) What drives inflation in MENA countries? Int J Econ Financ 3(4):119
Arellano M, Bover O (1995) Another look at the instrumental variable estimation of error-components models. J Econometr 68(1):29–51
Armey RK (1995) The freedom revolution: the new republican house majority leader tells why big government failed, why freedom works, and how we will rebuild America. Regnery Publishing, Washington
Baharumshah AZ, Slesman L, Wohar ME (2016) Inflation, inflation uncertainty, and economic growth in emerging and developing countries: panel data evidence. Econ Syst 40(4):638–657
Ball RJ (1964) Inflation and theory of money. George Allen and Unwin Ltd, London
Barro RJ (1979) On the determination of the public debt. J Polit Econ 87(5 Part 1):940–971
Barro RJ, Gordon DB (1983) A positive theory of monetary policy in a natural rate model. J Polit Econ 91(4):589–610
Becker GS, Mulligan CB (2003) Deadweight costs and the size of government. J Law Econ 46(2):293–340
Ben Zeev N, Pappa E (2017) Chronicle of a war foretold: the macroeconomic effects of anticipated defence spending shocks. Econ J 127(603):1568–1597
Bhat JA, Sharma NK (2020) Identifying fiscal inflation in India: some recent evidence from an asymmetric approach. J Econ Finance Admin Sci 25(50):363–393
Bick A (2010) Threshold effects of inflation on economic growth in developing countries. Econ Lett 108(2):126–129
Caldara D, Kamps C (2008) What are the effects of fiscal policy shocks? A VAR-based comparative analysis. (No. 877). European Central Bank
Campillo M, Miron JA (1997) Why does inflation differ across countries? Reducing inflation. Motivation and strategy. University of Chicago Press, Chicago, pp 335–362
Caner M, Hansen BE (2004) Instrumental variable estimation of a threshold model. Economet Theor 20(5):813–843
Canova F, Pappa E (2007) Price differentials in monetary unions: the role of fiscal shocks. Econ J 117(520):713–737
Canzoneri MB, Cumby RE, Diba B (2002) Should the European Central Bank and the Federal Reserve be concerned about fiscal policy?. Rethinking Stabilisation Policy, pp. 29–31.
Christiano L, Eichenbaum M, Rebelo S (2011) When is the government spending multiplier large? J Polit Econ 119(1):78–121
Correia I, Teles P (1996) Is the Friedman rule optimal when money is an intermediate good? J Monetary Econ 38(2):223–244
Cukierman A (1992) Central bank strategy, credibility, and independence: theory and evidence. J Économistes Études Humaines 3(4):581–590
D'Alessandro A, Fella G, Melosi L (2019) Fiscal stimulus with learning-by-doing. Int Econ Rev 60(3):1413–1432
Dhaene G, Jochmans K (2015) Split-panel jackknife estimation of fixed-effect models. Rev Econ Stud 82(3):991–1030
Dornbusch R (1976) Expectations and exchange rate dynamics. J Polit Econ 84(6):1161–1176
Drukker D, Gomis-Porqueras P, Hernandez-Verme P (2005) Threshold effects in the relationship between inflation and growth: a new panel-data approach. Working Paper, University of Texas
Dumitrescu EI, Hurlin C (2012) Testing for Granger non-causality in heterogeneous panels. Econ Model 29(4):1450–1460
Edelberg W, Eichenbaum M, Fisher JD (1999) Understanding the effects of a shock to government purchases. Rev Econ Dyn 2(1):166–206
Eken MS, El-Erian MMA, Fennell MS, Chauffour MJP (1996) Growth and stability in the Middle East and North Africa. Int Monet Fund
Eken MS, Helbing T, Mazarei A (1997) Fiscal policy and growth in the Middle East and North Africa region. Int Monet Fund

Emirmahmutoglu F, Kose N (2011) Testing for Granger causality in heterogeneous mixed panels. Econ Model 28(3):870–876
Evans RW (2007) Is openness inflationary? Imperfect competition and monetary market power. Globalisation and Monetary Policy Institute, Federal Reserve Bank of Dallas, GMPI Working Paper (1)
Ezirim C, Muoghalu M, Elike U (2008) Inflation versus public expenditure growth in the US: an empirical investigation. North Am J Finance Banking Res 2(2)
Fatas A, Mihov I (2001) The Effects of fiscal policy on consumption and employment: theory and evidence. CEPR Discussion paper 2760
Ferrara L, Metelli L, Natoli F, Siena D (2021) Questioning the puzzle: fiscal policy, real exchange rate and inflation. J Int Econ 133:103524
Georgantopoulos AG, Tsamis A (2012) The interrelationship between money supply, prices and government expenditures and economic growth: a causality analysis for the case of Cyprus. Int J Econ Sci Appl Res 5(3):115–128
Grilli V, Masciandaro D, Tabellini G (1991) Political and monetary institutions and public financial policies in the industrial countries. Econ Policy 6(13):341–392
Han S, Mulligan CB (2008) Inflation and the size of government. Rev Fed Reserve Bank St Louis 90(3):245
Hansen BE (1999) Threshold effects in non-dynamic panels: estimation, testing, and inference. J Econometrics 93(2):345–368
Hansen BE (2000) Sample splitting and threshold estimation. Econometrica 68(3):575–603
Hardouvelis GA (1992) Monetary policy games, inflationary bias, and openness. J Econ Dyn Control 16(1):147–164
Holtz-Eakin D, Newey W, Rosen HS (1988) Estimating vector autoregressions with panel data. Econometr J Econometr Soc 1371–1395
Ibarra R, Trupkin DR (2016) Reexamining the relationship between inflation and growth: Do institutions matter in developing countries? Econ Model 52:332–351
Jørgensen PL, Ravn SH (2022) The inflation response to government spending shocks: a fiscal price puzzle? Eur Econ Rev 141:103982
Juodis A, Karavias Y, Sarafidis V (2021) A homogeneous approach to testing for Granger non-causality in heterogeneous panels. Empir Econ 60(1):93–112
Khan MS, Senhadji AS (2001) Threshold effects in the relationship between inflation and growth. IMF Staff Pap 48(1):1–21
Kimbrough KP (1986) The optimum quantity of money rule in the theory of public finance. J Monet Econ 18(3):277–284
Kremer S, Bick A, Nautz D (2013) Inflation and growth: new evidence from a dynamic panel threshold analysis. Empir Econ 44(2):861–878
Leeper EM (1991) Equilibria under 'active' and 'passive' monetary and fiscal policies. J Monet Econ 27(1):129–147
Lotfalipour MR, Montazeri S, Sedighi S (2013) Trade openness and inflation. Evidence from MENA region countries. Pet-Gas Univ Ploiesti Bull Tech Ser 65(2)
Mankiw NG (1987) The optimal collection of seigniorage: theory and evidence. J Monet Econ 20(2):327–341
Mehrara M, Soufiani MB, Rezaei S (2016) The impact of government spending on inflation through the inflationary environment. STR Approach World Sci News 37:153–167
Mountford A, Uhlig H (2009) What are the effects of fiscal policy shocks? J Appl Econometr 24(6):960–992
Muhammad SD, Wasti SKA, Hussain A, Lal I (2009) An empirical investigation between money supply, government expenditure, output, and prices: the Pakistan evidence. Eur J Econ Finance Admin Sci 17:60
Nademi Y, Winker P (2022) Non-linear effects of government size on inflation in OPEC countries: a threshold panel approach. Iran Econ Rev 26(1):199–214
Nguyen TD (2019) Impact of government spending on inflation in Asian emerging economies: evidence from India, China, and Indonesia. Singapore Econ Rev 64(05):1171–1200
Perotti R (2005) Estimating the effects of fiscal policy in OECD countries. CEPR Discussion paper 168. Center for Economic Policy Research, London.
Poterba JM, Rotemberg JJ (1990) Inflation and taxation with optimising governments. J Money Credit Bank 22(1):1–19
Ricco G, Callegari G, Cimadomo J (2016) Signals from the government: policy disagreement and the transmission of fiscal shocks. J Monet Econ 82:107–118
Saad MM, AbuAl-Foul BM, Darrat AF (2006) On the roots of inflation in MENA: recent evidence from the monetarist model. Savings Dev 23–30
Sims CA (1994) A simple model for study of the determination of the price level and the interaction of monetary and fiscal policy. Econ Theory 4(3):381–399. https://doi.org/10.1007/bf01215378
Tariq A, Ahmad M, Amin A (2022) Assessing non-linear effects of government size on inflation in India: recent evidence from smooth transition autoregression model. J Econ Admin Sci (ahead-of-print)
Thornton DL (1990) Do government deficits matter? Fed Reserve Bank St. Louis Rev 72(September/October 1990)
Véigh CA (1989) Government spending and inflationary finance: a public finance approach. IMF Staff Pap 36(3):657–677
Vinayagathasan T (2014) Monetary policy and the real economy: a structural VAR approach for Sri Lanka. Asian J Empir Res 4(1):41–64
Vishal S, Ashok M (2021) Revisiting the dynamics of the fiscal deficit and inflation in India: the non-linear autoregressive distributed lag approach. Ekon Reg 17(1):318–328. https://doi.org/10.17059/ekon.reg.2021-1-24
Wang X, Wen Y (2019) Macroeconomic effects of government spending in China. Pac Econ Rev 24(3):416–446
Woodford M (1990) The optimum quantity of money. Handb Monet Econ 2:1067–1152
Woodford M (1994) Monetary policy and price level determinacy in a cash-in advance economy. Econ Theory 4:345–380
Woodford M (1995) Price-level determinacy without control of a monetary aggregate. Carnegie-Rochester Conf Ser Public Policy 43:1–46. https://doi.org/10.1016/0167-2231(95)90033-0

Publisher's Note