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## **An empirical analysis of terrorism impact on public debt: A dynamic heterogeneous panel approach**

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### **Abstract**

The increase in the frequency of terrorist attacks and the availability of data has enhanced the interest of economists in analysing this phenomenon and studying its impact on the economy. Besides the loss of lives, terrorism can seriously strain public finance. Indeed, these events promote the increase of national security expenditures which leads either to the reallocation of public resources with a fall in productive investment or to an increase in the sovereign debt. Furthermore, terrorist attacks affect financial markets and lead risk premium escalation, thus increasing government borrowing cost. This paper tries to examine the causal relationship between terrorism and public debt for 19 developed and developing economies, frequently affected by terrorism attacks, for the period of 2002–2017. Due to the presence of cross-sectional dependence in the panel, we employ the Pesaran's Cross-sectionally augmented Im-Pesaran-Shin test to ascertain unit root properties. The Westerlund cointegration test indicates the presence of a long-run association between terrorism and public debt estimated through the augmented mean group method. We show that an increase in the Global Terrorism Index can impact public debt more in MENA than in Western countries.

**Keywords:** Terrorism, public debt, cross-section dependence, heterogeneity panel cointegration.

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## 1. Introduction

In recent years, terrorist acts, which are becoming more frequent and increasingly violent, have continued to disrupt the economies of several countries. However, until now, there is no universal agreement on its definition. It is the multidimensional nature which has made it difficult to define. The most economic literature often uses the definition of the Institute for Economics and Peace (IEP) that considers terrorism as 'the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious or social goal through fear, coercion or intimidation'.

In fact, there is a long tradition amongst the economists to try to understand the economic repercussions of the conflicts and peace. Following the First World War, renowned economists such as Keynes (1920) and Pigou (1940) affirmed the existence of a strong relationship between the war, peace and economic situation. However, terrorism and, in particular, its repercussions received less importance in the economic literature until 11 September when it drew the attention due to its considerable economic consequences. Beyond the loss of lives, terrorism can seriously strain the whole of the economy. Since 2000s, this impact has steadily increased to reach a peak of US\$ 108 billion in 2014 to experience some decline (IEP, 2018). In 2017, deaths from terrorism accounted for 72% of its global economic impact. Indirect GDP losses are the second largest category at 25% of the total impact.

These significant economic consequences have led economists to focus more on this phenomenon. On the one hand, many researchers have tried to identify the main economic conditions that can explain terrorist behaviour. On the other hand, several analyses have focused more on the consequences of terrorist attacks on the economy, in general, or on particular sectors. In this research, we try to investigate if terrorism attacks deter public finance, especially public debt.

This study contributes to the existing literature in three dimensions. First, as far as we know, it is to focus on the direct relationship between terrorism and debt. Second, it employs alternative panel data estimation techniques addressing econometric issues, such as heterogeneity and cross-section dependence between countries. Finally, it uses recent data with new terrorism indicator for, as well full or divided, samples.

We will overview the studies on the nexus between public debt and terrorism in Section 2. Section 3 introduces data and method. Section 4 gives major findings. Finally, the study is concluded with a summary of the main results and policy implications.

## 2. Terrorism and public debt: literature review

Several economists show that terrorism can affect economic growth negatively by harming the determinants of it, such as physical and human capital, public infrastructure and political stability (Abadie & Gardeazabal, 2007; Bayar & Gavriletea, 2018; Bloomberg, Hess & Orphanides, 2004). This effect is more pronounced with a large number of victims (Tavares, 2004) if the target country is characterised by less development and less diversified economy (Choi, 2015) and finally when the actors are member of transnational and known terrorist organisations (Sandler and Gaibullov, 2008; Tavares, 2004).

These macroeconomic influences of terrorism can be distinguished from sector-specific effects. Since 1990s, Enders, Sandler and Gerald, (1992) demonstrated that terrorism deters tourism not only on the target country but also in neighbouring nations. More recently, Samitas, Asteriou, Polyzos and Kenourgios (2018) showed that terrorism has a negative and persistent effect in the long run, in the case of Greece. Enders and Sandler (1996) revealed that violent attacks in Spain have reduced FDI by an average of 13.5% per annum from 1975 to 1991. Nitsch and Schumacher (2004) showed that terrorism impacts directly trade by increasing transaction costs and indirectly by affecting economic growth and production capacity. For Mirza and Verdier (2008), openness makes transnational terrorism more likely.

Although, in recent years, there are several economic researches on terrorism, the analysis of its impact on public fiscal is much rare. The objective of this study is to make progress towards an examination of the Fiscal Consequences of Terrorism. We assume that violent attack can weaken fiscal position of country through three channels: First of all by increasing the cost of government borrowing. In fact, the increase of sovereign risk and the decrease of credit rating enhance the sovereign spread and consequently raise the cost of debt. On another side, terrorism can erode a tax base because insecurity discourages both the consumption and investment, slowing down economic activity and reducing tax revenues. Finally, terrorism increases public order and safety spending which raise the volatility of the discretionary component of fiscal policy and change the composition of public spending.

Many authors have tried to study the relationship between terrorism and one of these channels of transmission. Haddad and Hakim (2008) and Procasky and Ujah (2015) have sought to analyse the impact of terrorist acts on the sovereign rating in a panel of several countries, and their research shows that terrorism decreases the sovereign rate mostly in developing countries. The study of Yogo (2015) using both cross-country and panel data analysis for 66 countries revealed that the fiscal policy volatility is higher in countries of small size and lower in more democratic countries. By conducting research on the European countries, Drakos and Konstantiniou (2014) showed that terrorist attacks significantly increase public spending on public order. However, the magnitude of this effect is small and lasts only 1 year. Unlike many studies, the analysis of FMI, conducted by Cevik and Ricco (2015), found that terrorism has only a marginal negative effect on tax revenue. This effect is also not robust to alternative specifications and empirical strategies.

This article aims to contribute in this debate by exploring the direct impact of terrorism on public debt and investigating whether this relationship is specific for a given group of countries and whether it becomes more widespread in the short or long term.

### 3. Data and method

#### 3.1. Data description

The panel data set used in this study consisted of 19 developed and developing economies, frequently affected by terrorism attacks, covering 18 consecutive years, i.e. the period from 2002 to 2017. The data set was obtained from different sources (Table 1).

**Table 1. Description of the variables**

Variables	Role	Definition	Source
DTG	Dependent variable	Debt-to-GDP ratio	IMF
GTI	Main independent variable	Global Terrorism Index	IEP
INF	Control variables	Inflation, GDP deflator (annual %)	WDI
LNGDP		Log of GDP per capita (current US\$)	WDI
LNTOTR		Log of total reserves minus gold (current US\$)	WDI
TB		Trade balance	WDI

*IMF: International Monetary Fund; IEP: Institute for Economics and Peace; WDI: World Development Indicator*

The choices of country set and data period were shaped by data availability concerns. In particular, we focused on countries having no missing values for any of our selected variables over time. Countries subjected to our research are divided into 9 MENA countries: Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Saudi Arabia, Tunisia and Turkey and 10 Western countries: France, Spain, Ireland, the USA, the United Kingdom, Sweden, Greece, Germany, Italy and Norway.

The choice of the MENA region is particularly justified by the high frequency of terrorist attacks and the extent of their damage in this geographical area. As shown in Figure 1, this region accounts for the highest number of the most lethal terrorist attacks.

The MENA region, with over 90,000 deaths from terrorism since 2002.

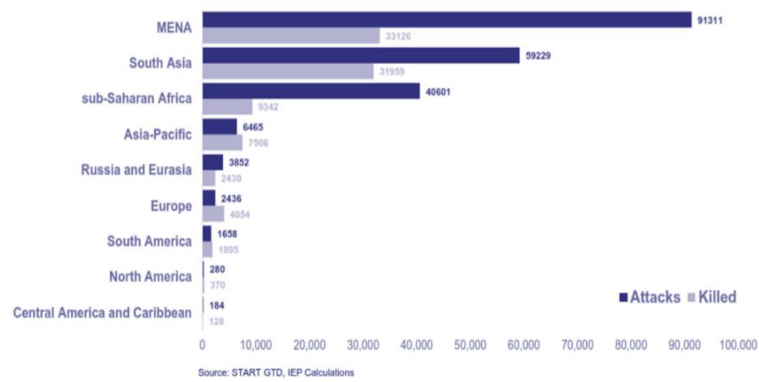


Figure 1. Attacks and deaths from terrorism by region, 2002–2017

Although the Western countries are generally less targeted by terrorist attacks, some of them, those on our sample, count for a high number of deaths from terrorism attacks mainly carried out by ISIL (Fig. 2).

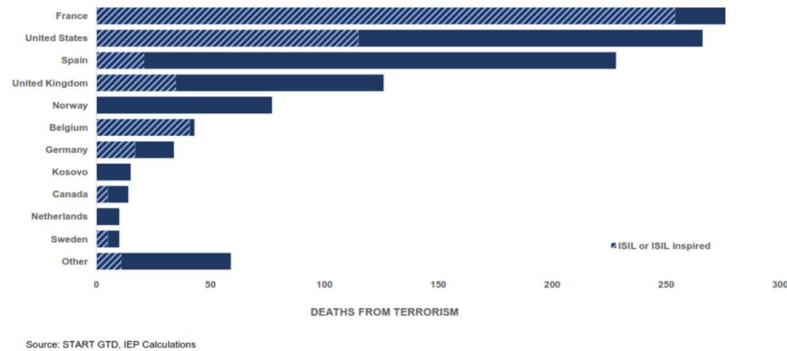


Figure 2. ISIL activity in Western Europe and North America, 2003–2017

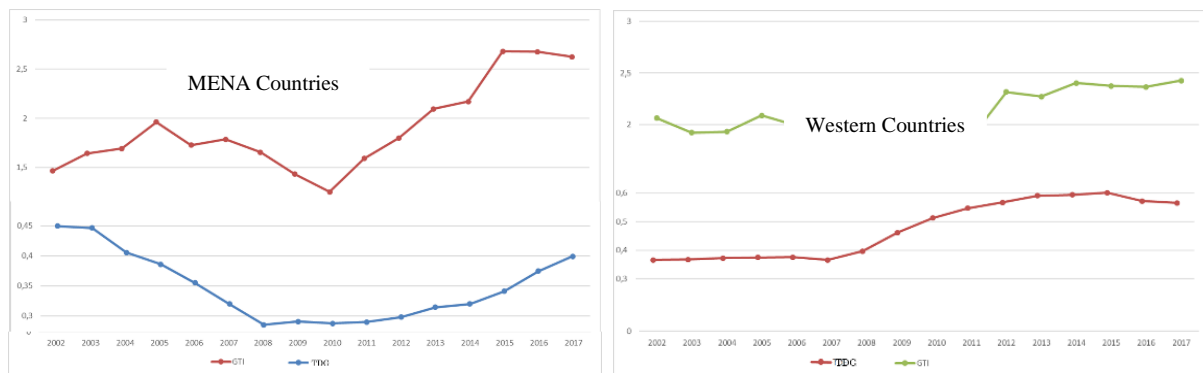


Figure 3. Evolution of the terrorism index and public debt, 2002–2017

Figure 3 shows the data on average on both the Global Terrorism Index and ratio of public debt, for the MENA and Western countries over the period of 2002–2017. A relationship between the two indicators can be expected.

### 3.2. Econometric methodology

Two major research questions are analysed in this study: first, if national debt and terrorism are cointegrated and the magnitude of the impact of terrorism on national debt if the long-run equilibrium relationship is identified, and second, what is the causal relationship between terrorism and national debt by region?

To answer all these questions and since there is no distinct theory to study the direct debt-terrorism relationship, we include GDP per capita, foreign exchange reserves, trade balance and inflation, along with the Global Terrorism Index to explain public debt, in line with Dunne (2003) model.

Given the above discussion, the basic regression model that we aimed to estimate can be expressed as follows:

$$DTG_{i,t} = \beta_0 + \beta_1 GTI_{i,t} + \beta_2' [X_{i,t}] + v_{i,t} \quad (1)$$

$$v_{i,t} = \delta_i f_t + \varepsilon_{i,t} \quad (2)$$

The term  $i$  in (Eq. 1) refers to countries with cross-sectional units; time dimension is  $t$ .  $DTG_{i,t}$  represents the national debt measure;  $GTI_{i,t}$  represents the Global Terrorism Index;  $X_{i,t}$  is the vector of control variables that include inflation  $INF_{i,t}$ ,  $\ln(TOTR_{i,t})$ ,  $\ln(GDPI_{i,t})$  and  $TBI_{i,t}$ ;  $f_t$  is the unobserved common factor with heterogeneous factor loadings  $\delta_i$  and  $\varepsilon_{i,t}$  is the error term.

Our main parameter of interest is  $\beta_1$ , which approximately describes the percentage point change in public debt measure as a response to one percentage point increase, alternatively, in the index of terrorism.

Since terrorism is considered as a form of political instability, we assume that it can also be a determinant of public debt, as Ozler and Tabellini (1991) have already shown. An increase of Global Terrorism Index is expected to raise the ratio of debt. Moreover, trade balance surplus which creates the supply of foreign exchange can wildly lead to fall in external borrowing. Likewise, countries that enjoy high GDP per capita and large stock of foreign reserves tend to pay off the debt and also reduce the need to borrow externally. The variable of inflation is included as a substitute of borrowing if countries choose the monetisation of their debt. We expect a negative correlation between inflation and external debt ratio.

Before employing main estimation method, it is appropriate to test the time series and cross-sectional property of longitudinal data, and it is necessary to apply some pre-tests to the series to be used in the analysis and to determine appropriate methods according to these test results. The choice or decision to opt estimation technique is crucial to decide on further econometric tests used in the case of panel data such as unit root test and cointegration test. Therefore, before testing for stationary property, we tested cross-sectional dependence (CD) using Pesaran's (2004) CD test. If the null hypothesis of no cross-section dependence is rejected, we employed the second-generation Pesaran's (2007) Cross-sectionally augmented Im-Pesaran-Shin (CIPS) unit root test that regards cross-sectional dependency. Then, we investigated long-run relationship amongst public debt, terrorism and control variables with Westerlund-Durbin-Hausman (2008) cointegration test. The finding of cointegration between variables indicates the possibility existence of causality, and a test must be conducted to specify the direction of this causality. For this, we analysed the causal relationship between variables with Dumitrescu and Hurlin (2012) causality test. Finally, to tackle this peculiar situation, augmented mean group (AMG) estimator (Eberhardt and Bond, 2009) is employed to estimate all three panels of longitudinal data.

## 4. Empirical results

### 4.1. Cross-sectional dependence analysis

The first step of the empirical analysis was the CD tests to analyse the contemporaneous correlation across countries in the panel. This test is necessary to decide on the estimation method which must be used.

A huge body of literature claims that panel data sets tend to show CD, which may arise from economic integration of countries, common shocks (such as financial, political and social shocks) and sometimes unobserved factors that eventually become part of the error (disturbance) term (Pesaran, 2004).

There are various tests that analyse CD in panel data. In this study, tests developed by Pesaran (2004), CDLM, were used. Pesaran proposed a simple alternative test which is based on the pairwise correlation coefficients when N is large, calculated by the following formula:

$$CD_{LM} = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \rightarrow N(0,1)$$

CD statistic of Pesaran has mean zero for the fixed values of T and N, where N indicates cross-section dimension, T is time dimension of panel and  $\hat{\rho}$  represents the sample estimate of the cross-sectional correlations amongst residuals. This test, which is asymptotically standard normal distribution, is used when  $T > N$  and  $N > T$ .

**Table 2. CD test results**

Pesaran's CD test	Country panel	MENA countries	Western countries
DTG	5.060***	0.352	4.354***
GTI	8.413***	3.332***	2.960***
INF	2.764***	3.557***	11.480***
LNTOTR	7.986***	1.603*	7.770***
LNGDP	31.188***	3.540**	17.474***
TB	1.894*	0.006	18.311***

The results obtained as recorded in Table 1 showed that the null hypothesis, in which there is cross-sectional independency, was rejected at 1% significance level because p value was found to be 0.0000. Hence, we revealed a cross-section dependence amongst the series.

### 4.2. Panel CIPS unit root test

The presence of CD between countries leads to reject the first-generation unit root test. For this, we use the second-generation panel unit root tests; notably the CIPS unit root test (Pesaran, 2007). Extending from the panel unit root test by Im, Pesaran and Shin (2003) (referred as IPS unit root test), Pesaran (2007) developed an augmented IPS (CIPS) unit root test for heterogeneous panels incorporated with cross-section dependence. The CIPS test statistics are the sample averages of the individual cross-sectionally augmented ADF statistics: The test exhibits an asymptotically normal distribution and is calculated as follows:

$$CIPS = N^{-1} \sum_{i=1}^N CADF_i$$

The results of the CIPS test for the panel are presented in Table 3. The CIPS test results indicated the failure to reject the null hypothesis of the presence of unit root for notably public debt and the

index of terrorism. However, no evidence of a unit root is found after both data series are taken the first differences, indicating that both variables are integrated of order 1.

**Table 3. CIPS panel unit root test results**

Panel	Variable	CIPS (level)	CIPS (first difference)	Integration
Country Panel	DTG	-1.208	-2.530***	I(1)
	GTI	-1.910	-3.509***	I(1)
	INF	-2.860***	-3.515***	I(0)
	LNTOTR	-1.889	-2.731***	I(1)
	LNGDP	-2.088	-2.903***	I(1)
	TB	-1.579	-3.233***	I(1)
MENA countries	DTG	-1.807	-2.371***	I(1)
	GTI	-1.954	-3.509***	I(1)
	INF	-2.651***	-3.671***	I(0)
	LTOTR	-2.457**	-3.802***	I(0)
	LNGDP	-2.862***	-2.575**	I(0)
	TB	-1.620	-2.946***	I(1)
Western countries	DTG	-1.887	-3.548***	I(1)
	GTI	-1.880	-3.599***	I(1)
	INF	-2.3*	-3.626***	I(0)
	LTOTR	-1.903	-2.702***	I(1)
	LNGDP	-0.658	-2.570***	I(1)
	TB	-1.940	-3.550***	I(1)

#### 4.3. Cointegration test

After we confirmed the non-stationarity of the variables for the panel, the subsequent step was to test for cointegration amongst the dependent variable and regressors. The main idea is that if two or more time-series variables are individually integrated of order  $d$ , then there is a possibility of at least one linear combination of them to be integrated of a lower order. In fact, cointegration analysis can evaluate whether the panel variables follow each other, but it does not provide any information about the cause and effect, or the direction of causality between the variables (Khefacha and Belkacem, 2016).

In our study, based on heterogeneous panel, then we investigated long-run relationship amongst public debt and terrorism with Westerlund (2008) which proposed a cointegration test taking into account the presence of cross-section dependence, heteroscedasticity and serial correlation. The main objective is to test for the absence of cointegration by determining whether error correction exists for individual panel members or for the panel as a whole.

**Table 4. Westerlund (2008) panel cointegration test results**

		Gt	Ga	Pt	Pa
Country panel	Statistics	-0.865	-1.119	-7.183	-2.471
	$p$ -value	1.000	1.000	0.798	0.999
	Robust $p$ -value*	0.000	0.000	0.000	0.000
MENA zone	Statistics	-1.098	-0.567	-4.579	-1.684
	$p$ -value	0.999	1.000	0.766	0.992
	Robust $p$ -value*	0.000	0.000	0.000	0.000
WESTERN zone	Statistics	-0.392	-0.774	-3.231	-1.702
	$p$ -value	0.999	1.000	0.766	0.992
	Robust $p$ -value*	0.000	0.000	0.000	0.000

\*The robust  $p$ -values are based on the bootstrapped distribution.



Two statistics are calculated: Durbin–Hausman group statistic based on panel heterogeneity and Durbin–Hausman panel statistic based on panel homogeneity. According to this method, the rejection of the null hypothesis and the deduction of the existence of the cointegration relation specified in the alternative hypothesis require that the group and panel statistic values are larger than the critical table value (Westerlund, 2008).

The results of panel cointegration test show that the four statistics document that DTG and GTI are cointegrated in all three samples, providing evidence of a long-run relationship between public debt and terrorism (Table 4).

#### 4.4. Dumitrescu and Hurlin (2012) causality test

The finding of cointegration between variables indicates the existence of causality, and an error correction model must be estimated to test the direction of this causality.

For this, we will use the Granger causality test. This technique tests a short-term causality and validates a long-term relationship. In fact, Granger (1981) developed a methodology for analysing the causal relationships between time series. Suppose  $x_t$  and  $y_t$  are two stationary series, then the following model can be used to test whether  $x$  causes  $y$ . The basic idea is that if past values of  $x$  are significant predictors of the current value of  $y$  even when past values of  $y$  have been included in the model, then  $x$  exerts a causal influence on  $y$ .

Dumitrescu and Hurlin (2012) provided an extended test designed to detect causality in the heterogeneous panel data. Under the null hypothesis of homogeneous non-causality, there is no causal relationship for any of the cross-section units of the panel. The alternative hypothesis implies that the casual relation could be observed in one subgroup of countries but not necessarily in another subgroup given the economic conditions.

**Table 5. Test for panel Granger causality.**

	GTI does not Granger cause DTG		
	Z-statistics	p-value	No. of lags
Country panel	5.2121	0.000	2
Mena zone	9.9149	0.000	1
Western zone	3.4057	0.0007	2

As expected, the results of the Granger causal relationship indicate that terrorism index Granger causes public debt in all three samples as the terrorism accelerates the speed of public debt amongst countries and reciprocally.

#### 4.5. Long-run cointegrating coefficients

As we verified the presence of cointegration in our model, the long-run relationship in the panel regression model can further be estimated. In this context, the AMG estimator was used to obtain individual long-term coefficients (Eberhardt and Bond, 2009; Eberhardt and Teal, 2010). This estimator accounts for cross-section dependence by including a ‘common dynamic process’ in the country regression.

**Table 6. Long-term coefficient estimation with AMG method**

Dependent variable DTG	Country panel	MENA countries	Western countries
	AMG	AMG	AMG
Estimator			
GTI	0.006*	0.008**	0.0076**
INF	-0.002	-0.484	0.362
LNGDP	-0.4***	-0.265	-0.416**
LNTOTR	0.006	0.088	0.035

TB	0.187	-0.318	0.361
constant	0.031	0.316	0.077
N	285	135	150
Wald Test	49.99 (0.000)	12.22 (0.0319)	15.26 0.0093
RMSE	0.0407	0.0336	0.0467

According to these results, in the whole panel, it is understood that terrorism has a statistically significant effect on public debt with positive direction. Furthermore, we find that proxy growth measured by LOGGDP has the expected negative impact on public debt.

## 5. Concluding remarks and policy suggestions

This study examines the cointegration and Granger causal relationship between terrorism and public debt for 19 developed and developing economies. In this context, we researched the interaction between the Global Terrorism Index and debt-to-GDP ratio during the period of 2001–2014 using Westerlund–Durbin–Hausman (2008) cointegration analysis allowing for cross-section dependence. Our results suggest that public debt is cointegrated with economic growth in three regions. A long-run equilibrium relationship between these two variables is identified in all countries. In addition, based on a recently developed panel Granger causality analysis that accounts for cross-section dependence and heterogeneity, our results show the existence of unidirectional causal relationships between terrorism and public debt as well for MENA countries and Western countries.

Thanks to the AMG estimation, our econometric results suggest that terrorist activity can effectively damage public debt and this effect is more pronounced in MENA countries, which are more vulnerable to violent attacks than richer and diversified countries. For control variables, we find that GDP is the significant determinant of debt. This finding is consistent with existing literature, which considered GDP as the most important determinant of debt (Azam & Feng, 2015; Dunne, 2003).

For MENA countries, a close examination of the relationship between the Global Terrorism Index and public debt is worthwhile, not only due to the unexpected results (especially, for inflation and trade balance) obtained but also due to the specificity of the region.

The analysis in this research demonstrates that the political authorities need to take into account the impact of terrorism for budget planning and expenditure allocation purposes, mostly in less developed countries. These economies must be financially supported in their fight against terrorism as they are the most economically vulnerable to these attacks. Indeed, the challenge of countering terrorism is not only concern target countries but also it is a worldwide defiance.

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