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## Is there a relationship between inequality and terrorism? Evidence from a semi-parametric approach

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### ABSTRACT

Understanding links between income inequality and terrorism is crucially important for social scientists. The current empirical literature suggests that this relationship is positive but inconclusive. In this paper we use a semi-parametric approach to model the relationship between inequality and terrorism, in order to identify nonlinearities in the relationship. We use top income percentile shares as our measure of inequality in response to the inequality measurement literature identifying problems with the Gini. We find that after controlling for explanations of terrorism other than inequality, the positive relationship between inequality and terrorism discussed in the existing empirical literature is very weakly evident. We also find that the semi-parametric model crucially exposes the nonlinear nature of the relationship between inequality and terrorism. The results are different for developed and developing countries. We find that the relationship between inequality and terrorism is nonlinear and at most weakly positive for developed countries, with a slightly stronger positive relationship for developing and middle-income countries.

### KEYWORDS

Terrorism; inequality; top income percentile shares; semi-parametric methods

### JEL CLASSIFICATION

C14; D31; D63; D74; O15

## I. Introduction

In this paper we investigate the relationship between income inequality and terrorism using several inequality measures. Current empirical evidence of the effects of income inequality on terrorism is inconclusive, albeit mostly positive (Enders, Hoover, and Sandler 2016; Gaibulloev and Sandler 2019; Piazza 2011). To uncover this relationship, we employ inequality measures defined by distributional patterns at the top end of the income distribution, following the inequality measurement literature (Atkinson and Brandolini 2010; Bandyopadhyay 2018). We also employ semi-parametric methods (Robinson 1988) to identify possible nonlinearities in the relationship.

With a sample of 139 countries, including 104 developing and middle-income group countries, we use top income percentile shares to provide robust evidence that inequality is weakly positively associated with terrorism. In addition, we observe that inequality has different nonlinear associations with terrorism for developed, middle-income and developing countries. This finding accords with evidence from Enders, Hoover, and Sandler (2016).

## II. Current empirical literature on inequality and terrorism

The empirical evidence on the relationship between income inequality and terrorism has been difficult to pin down, though the literature suggests that the relationship exists in different ways (Enders, Hoover, and Sandler 2016). There is more empirical evidence suggesting associations of income inequality with domestic terrorism than with transnational terrorism (Piazza 2011; Krieger and Meierrieks 2019), even if in specific periods of international instability (prior to 1993, Enders et al. 2011). Empirical studies that control for inequality provide very little evidence that income inequality systematically matters to terrorism (e.g. Abadie 2006). However, using survey responses on income inequality and preferences for domestic revolt, MacCulloch (2005) finds a negative association of preferences for revolt in the face of inequality-reducing policies. The evidence thus far has given us reason to believe income inequality should be significantly associated with dissent, possible revolt and also terrorism, but has eluded full empirical

validation. The possible lack of conclusive evidence could be due to the need for novel modelling techniques or due to the specific inequality measures used for the analyses.

Thus, in our analysis we undertake a thorough investigation using distribution-specific inequality measures, and adopt a semi-parametric approach which allows for nonlinearities in the relationship.

### III. Data and empirical estimations

Our dataset includes 139 countries for years 2001–2018, of which 104 are developing and middle-income countries (Table A1 in Appendix). The dataset includes countries and years for which complete terrorism and inequality data is available. We use several definitions of terrorism for our analysis:

- Total Terrorism: Total number of terrorism incidents
- Total Killed: Number of people killed in terrorist incidents
- Total Terrorism Victims: Number of people killed, and number of people wounded in terrorist incidents
- Domestic Terrorism: Number of domestic terrorist incidents
- Domestic Killed: Number of people killed in domestic terrorist incidents
- Transnational Terrorism: Number of transnational terrorist incidents
- Transnational Killed: Number of people killed in transnational terrorist incidents

These variables have 1612, 1114, 1114, 1041, 700, 651 and 381 observations respectively. ‘Total Terrorism’ and ‘Total Killed’ have been obtained from the Global Terrorism Database (GTD), an open-source database on terrorist events (1970 to 2018).<sup>1</sup> We use Enders et al.’s (2011) definition of domestic and transnational attacks.

Our principal dependent variable is the total number of terrorist incidents per country-year observation. We also present results with domestic terrorism, due to it being more frequently observed than transnational terrorism and being associated

with income inequality (Piazza 2011). Summary statistics of the variables are available at the following link *here*. Finally, we separate our dataset into two samples – developed, and developing and middle-income countries.<sup>2</sup> We combine the latter two groups of countries into one and have labelled them as ‘developing’ for brevity in figures and tables below. We use several top income percentile shares as our principal inequality measure, obtained from the World Inequality Database, and present our results using the top 1% and top 10% income shares. We also use the Gini measure for robustness, obtained from the World Income Inequality Database (United Nations University 2019).

In order to observe the nature of the relationship between terrorism and inequality, and to include other explanatory factors of terrorism, we estimate a semi-parametric model. We assume a nonlinear relationship between inequality and terrorism, where inequality enters the equation nonlinearly according to a non-binding function  $f$ . It then includes the rest of the determinants of terrorism linearly. We use Robinson’s (1988) double residual semi-parametric regression estimator, where the non-parametric estimator for  $f$  used is a Gaussian kernel-weighted local polynomial fit.<sup>3</sup> Bootstrapped 95% confidence intervals are presented in the figures. The model estimated is:

$$Terr_{it} = f(Inequality)_{it} + \mathbf{Z}_{it}\gamma + \alpha_i + e_{it} \quad (1)$$

where  $Terr_{it}$  is the incidence of terrorism for country  $i$  and time  $t$ ,  $\mathbf{Z}_{it}$  is a vector of control variables,  $\alpha_i$  is a country fixed effect and  $e_{it}$  is an error term assumed to have 0 mean and constant variance  $\sigma_{e_{it}}^2$ . As other explanatory variables that explain terrorism, we include GDP per capita, foreign direct investment (FDI), corruption, military expenditure, unemployment, consumption expenditure, rural population, armed forces personnel and the Polity Index.

Table 1 presents the parametric estimates of coefficients of the controls that enter the model linearly. We obtain significant negative coefficients for rural population, which indicates that countries with large

<sup>1</sup>We are grateful to Todd Sandler for providing us with domestic and transnational terrorism variables (1970 to 2016)

<sup>2</sup>We group the developing and middle-income countries together because their results were found to be greatly similar.

<sup>3</sup>We use the Stata command ‘xtsemipar’ for our estimations, which includes fixed effects. We also cluster the standard errors at the country level.

**Table 1.** Parametric component estimates of semi-parametric model of terrorism on other explanatory variables.

	All Countries				Developing Countries	
	Terrorism Incidents		Total Killed		Terrorism Incidents	
	Total	Domestic	Total	Domestic	Total	Domestic
	Top 1%	Top 1%	Top 1%	Top 1%	Top 1%	Top 10%
GDP Per Capita	0.971 (1.06)	0.125 (0.125)	-0.991 (1.63)	-0.009 (0.214)	0.850 (0.828)	0.772 (0.754)
Foreign Direct Investment	-0.001 (0.003)	-0.003 (0.002)	0.051* (0.03)	-0.060 (0.040)	0.022 (0.022)	-0.021 (0.020)
Corruption	-0.045 (0.324)	0.236 (0.368)	-0.509 (0.764)	0.022 (0.214)	-0.177 (0.160)	0.326 (0.285)
Military Expenditure	0.024 (0.027)	-0.016 (0.013)	-0.067 (0.050)	-0.004 (0.074)	-0.025 (0.022)	-0.018 (0.018)
Unemployment	-0.030 (0.03)	0.003 (0.013)	0.081 (0.058)	-0.084 (0.081)	0.048 (0.039)	-0.064 (0.062)
Consumption Expenditure	-0.020*** (0.006)	-0.018*** (0.012)	-0.028*** (0.14)	-0.015* (0.007)	-0.019*** (0.008)	-0.016*** (0.006)
Rural Population	-0.111 (0.014)	-0.191*** (0.071)	-0.131 (0.121)	-0.048 (0.138)	-0.147** (0.007)	-0.048*** (0.019)
Armed Forces Personnel	0.135 (0.213)	0.748 (0.495)	-0.185 (0.667)	-1.27 (0.863)	0.188 (0.479)	-0.490 (0.512)
Economic Freedom Index	-0.005 (0.019)	0.024 (0.034)	-0.020 (0.036)	0.040 (0.059)	-0.001 (0.002)	0.012 (0.013)
Polity Score	0.029 (0.012)	-0.048* (0.029)	0.043 (0.03)	-0.046 (0.033)	-0.026 (0.026)	0.045 (0.041)
Within R <sup>2</sup>	0.05	0.06	0.06	0.08	0.07	0.09
N	647	440	410	288	488	277

Note: Standard errors in parentheses are clustered by country

rural populations have a lower incidence of terrorism. This highlights the importance of developing and middle income countries in the sample being associated with low levels of terrorism. We also find consumption expenditure to be significant and negatively associated with all definitions of terrorism, again indicating that terrorism is characteristic of low income/consumption expenditure countries (rather than high income countries). The signs and magnitudes of the coefficients for most other variables broadly accord with those obtained in the literature, though they are not significant for many (i.e. positive and significant for FDI once, negative and significant for the Polity score once). Corruption and unemployment are not significantly associated with terrorism.

The following Figure 1–4 present the non-parametric component of the models estimated above using total and domestic terrorism.<sup>4</sup> The figures highlight two salient features. First, they highlight that after controlling for explanations of terrorism other than inequality, the positive relationship between inequality and terrorism discussed in the existing empirical literature is very

weakly evident for both total and domestic terrorism. For Figure 1–3, which use the top 1% income percentile share inequality measures the relationship is barely positive.

For the sample of developing countries, the relationship observed in Figure 3 using both top 1% and top 10% shares reveals more promising evidence of a weak positive relationship, even if it is still not pronounced.

Second, the non-parametric components in Figure 1–3 crucially expose the nonlinear nature of the relationship between inequality and terrorism. When we use the Gini as the inequality measure (in Figure 4) we obtain a barely positive relationship for both ‘all countries’ and ‘developing countries’ samples. The recent literature on the time dependent properties of inequality measures (Atkinson and Brandolini 2010; Bandyopadhyay 2018), however, has highlighted that mean-dependent measures of inequality, such as the Gini (as ‘relative’ inequality measures), are less reliable representations of inequality over time. Thus, ‘absolute’ inequality measures, such as the top income percentile shares are more reliable compared with the Gini in

<sup>4</sup>A ‘rule-of-thumb’ bandwidth estimator is calculated by Stata for specifying the bandwidth for the non-parametric component. All non-parametric plots have been estimated by trimming the inequality measure, with the plot of the estimates within the 15th to 85th percentile of the inequality measure. This is because non-parametric functions can be outlier-driven near the edges of the sample domain. We thank a referee for this suggestion. Results using other terrorism indicators are available with authors.

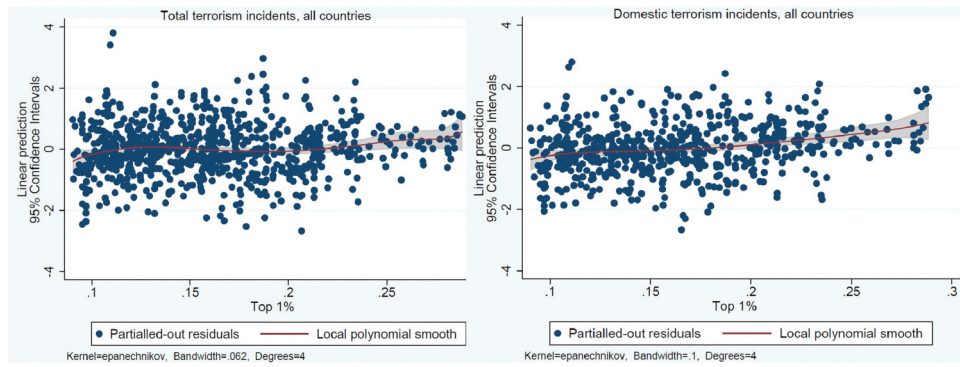


Figure 1. Non-parametric component of the effect of top 1% income shares on total and domestic terrorism incidents for all countries.

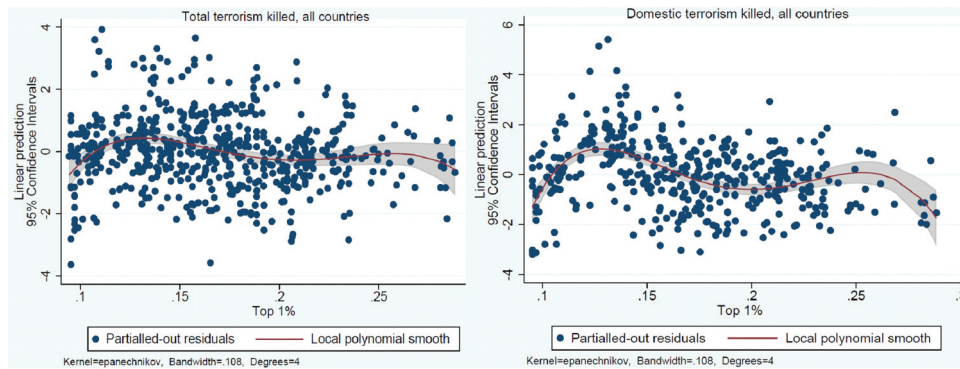


Figure 2. Non-parametric component of the effect of top 1% income shares on total and domestic terrorism fatalities (killed) for all countries.

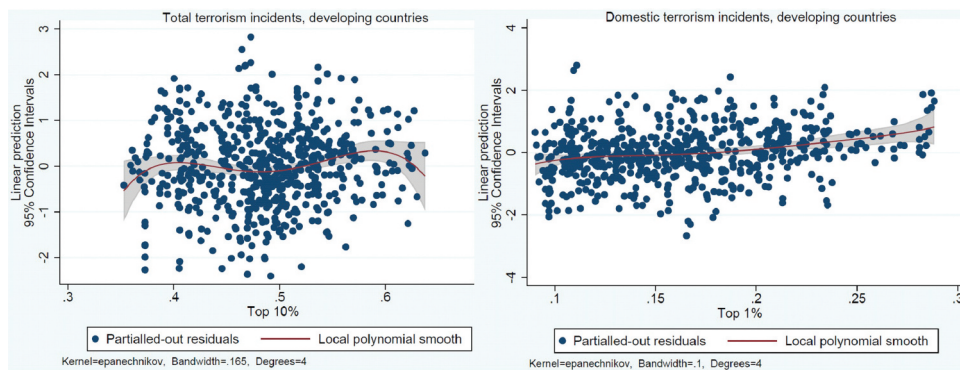
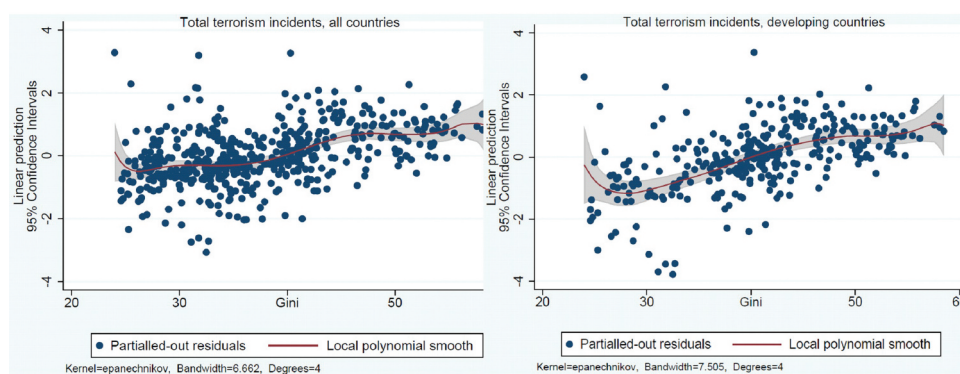


Figure 3. Non-parametric component of the effect of top 10% and top 1% income shares on total and domestic terrorism incidents for developing countries.

identifying underlying relationships between inequality and terrorism. Our results in Figure 1–3 using the top income shares indicate that there is weak evidence of a nonlinear positive relationship between the two entities.

Thus, the non-parametric components reveal weak evidence of a positive relationship between

inequality (measured as top 1% and top 10% income shares), mainly for the developing and middle-income countries, and for domestic terrorism and is far from linear. While this result weakly accords with recent empirical research that the relationship is positive, the key finding is that the relationship is nonlinear and sensitive to the



**Figure 4.** Non-parametric component of the effect of the Gini on total terrorism incidents for all countries and developing countries.

sample in use. This indicates that the mechanisms discussed in the economics and political science literature may yield different effects for different levels of inequality and deserves further research.

#### IV. Conclusion

In this paper we have highlighted two new salient empirical features of the relationship between income inequality and terrorism. Using recently recommended measures of inequality, i.e., top percentile income shares, we fail to confirm previous evidence of a positive relationship between inequality and terrorism. It is, at best, weakly observed, in particular for developing and middle-income group countries. We also find that the relationship is nonlinear, suggesting no particular functional form, and thus deserves future research to identify the mechanisms which govern this relationship. This result of nonlinearity accords with evidence obtained in Enders, Hoover, and Sandler (2016).

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#### Disclosure of potential conflicts of interest

No potential conflict of interest was reported by the author(s).

#### Data availability statement

The data and code that support the findings of this study are available from the authors upon request.

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## Appendix A

**Table A1.** Countries in the dataset

Developed countries		Developing and middle-income group countries			
Australia	Slovak Republic	Afghanistan	Eritrea	Malawi	South Africa
Austria	Slovenia	Albania	Ethiopia	Malaysia	South Sudan
Belgium	Spain	Algeria	Georgia	Maldives	Sri Lanka
Bulgaria	Sweden	Angola	Ghana	Mali	Syria
Canada	Switzerland	Argentina	Guatemala	Mexico	Tajikistan
Croatia	United Kingdom	Armenia	Guinea	Moldova	Tanzania
Cyprus	United States	Azerbaijan	Guinea-Bissau	Montenegro	Thailand
Czech Republic		Bahrain	Guyana	Morocco	Trinidad & Tobago
Denmark		Bangladesh	Haiti	Mozambique	Tunisia
Estonia		Belarus	Honduras	Myanmar	Turkey
Finland		Bhutan	India	Nepal	Uganda
France		Bolivia	Iran	Nicaragua	Ukraine
Germany		Bosnia-Herzegovina	Iraq	Niger	United Arab Emirates
Greece		Brazil	Israel	Nigeria	Uruguay
Hungary		Burkina Faso	Jamaica	Pakistan	Uzbekistan
Iceland		Burundi	Jordan	Panama	Venezuela
Ireland		Cambodia	Kazakhstan	Papua New Guinea	Vietnam
Italy		Cameroon	Kenya	Paraguay	Zambia
Japan		Central African Rep	Kosovo	Peru	Zimbabwe
Latvia		Chad	Kuwait	Philippines	
Lithuania		Chile	Kyrgyzstan	Qatar	
Malta		China	Laos	Russia	
Netherlands		Colombia	Lebanon	Rwanda	
New Zealand		Dem' Re of the Congo	Lesotho	Saudi Arabia	
Norway		Djibouti	Liberia	Senegal	
Poland		Dominican Republic	Libya	Serbia	
Portugal		Ecuador	Macedonia	Sierra Leone	
Romania		Egypt	Madagascar	Somalia	