

New Empirics of Transnational Terrorism and Its Impact on Economic Growth*

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Abstract

This paper applies principal components analysis to decompose transnational terrorism during 1970-2007 into common and idiosyncratic factors. A single common factor is related to individual countries' transnational terrorist events. Three countries' transnational terrorist incidents explain 90% of the variation in the common driver of transnational terrorism, with Lebanon accounting for 67%. A correlation coefficient approach shows that neither the growth rate of real GDP, nor the growth rates of its expenditure components are significantly correlated with terrorism. Separate panel regressions of these growth rates on the overall and common factors of transnational terrorism also indicate no significant relationships.

Keywords: Transnational terrorism; Economic growth; Approximate common factor representation; Cross-sectional dependence

JEL codes: O40, H56

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1. Introduction

Ever since the skyjackings of four wide-bodied planes on September 11, 2001 (henceforth 9/11), economists have shown an enhanced research interest in terrorism. Theoretical and empirical papers have investigated myriad aspects of terrorism – e.g., identification of microeconomic and macroeconomic consequences of terrorism. A portion of this research has focused on the impact of terrorism on economic growth. This research has derived some guiding principles (Sandler and Enders 2008). First, the macroeconomic consequences of terrorism are generally quite small and of a short-term nature for most economies. Like crime, terrorism is anticipated to have a local influence because property damage is typically limited and few people die – on average, 420 people lost their lives annually from transnational terrorist attacks since 1968 (Sandler, Arce, and Enders 2009). Second, large diversified economies are particularly able to endure terrorism with minimal repercussions as economic activities transfer from terrorism-prone to safer sectors. Third, small developing countries are more inclined to suffer adverse economic effects from terrorism (Keefer and Loayza 2008). Fourth, in cross-sectional and panel regressions, transnational terrorism has had a small but significant impact on economic growth (Blomberg, Hess, and Orphanides 2004; Gaibullov and Sandler 2008, 2009; Tavares 2004). This impact has been traced to augmented government expenditures and reduced investment (e.g., Abadie and Gardeazabal 2008). Fifth, a reverse causality has been uncovered where reduced economic growth encourages terrorism (Blomberg, Hess and Weerapana 2004; Li 2005). Finally, macroeconomic consequences can be especially pronounced in small terrorism-ridden countries, where GDP can be reduced by as much as 10% and growth eliminated (Abadie and Gardeazabal 2003; Eckstein and Tsiddon 2004).

The primary purpose of this paper is to re-evaluate the relationship between transnational

terrorism and economic growth using some new insights and methods from dynamic panel analysis. We take an agnostic view of past cross-sectional and panel studies of transnational terrorism and economic growth that provide an average picture for a large number of countries. However, we have no complaints with country-specific studies of terrorism and economic growth (e.g., Abadie and Gardeazabal 2003). For cross-sectional and panel investigations, we apply a variety of methods to ascertain whether transnational terrorism really hampers economic growth. A secondary purpose is to apply principal components analysis to identify common (worldwide) and idiosyncratic (country-specific) factors that influence transnational terrorism. A single common driver is shown to affect transnational terrorism in some regions and countries plagued by terrorism. This common driver is then related to countries' transnational terrorist events. A mere six nations' transnational terrorism explains 99% of the variation in the common driver of transnational terrorism, with Lebanon alone accounting for 67%.

The paper first identifies some pitfalls in previous empirical studies of transnational terrorism and economic growth (Section 2). We next introduce the procedure for decomposing transnational terrorism into common and idiosyncratic components (Section 3). The data are then introduced (Section 4). The empirical results begin with the principal components analysis (Section 5.1). We then investigate the dynamic relationship between transnational terrorism and economic growth through a correlation coefficient approach that shows that neither the growth rate of real GDP nor the growth rates of its expenditure components are significantly correlated with terrorism. This finding casts doubts on some previous terrorism and growth studies. Even when we perform separate panel regressions of the growth of each macroeconomic variable on transnational terrorist incidents, based on their overall and common factor, there are no significant relationships (Section 5.2). Static cross-sectional analysis also finds no negative influence of transnational terrorism on the level of income (Section 5.3). Concluding remarks

end the paper (Section 6).

2. Pitfalls of Previous Empirical Studies

Previous empirical studies on the relationship between terrorism and economic growth suffer from a number of econometric pitfalls (e.g., Blomberg, Hess, Orphanides 2004; Gaibullov and Sandler 2008, 2009; Tavares 2004). Broadly speaking, these previous studies can be categorized into cross-sectional and panel regression exercises. Both types of empirical studies argue that terrorism negatively affects economic growth; however, such empirical results raise concerns, given econometric issues associated with growth studies.

Past cross-sectional papers on terrorism and growth have adopted empirics, where the economic growth rate is the dependent variable, while initial income, terrorism, and other control variables are the independent variables. However, similar cross-sectional studies of economic growth in other contexts have revealed a number of potential drawbacks and pitfalls. Levine and Renelt (1992) showed that any social, macroeconomic, or political variable is not significant and robust in cross-sectional estimates of growth. Thus, it is surprising to see somewhat strong empirical evidence of the negative relation between terrorism and economic growth in the recent terrorism literature. Moreover, Phillips and Sul (2007) proved that the cross-country growth regressions suffer from misspecification, which leads to inconsistent estimators and invalid statistical inference. Therefore, it is difficult to have much confidence in the results from the cross-sectional studies on terrorism and economic growth.

Next, consider the econometric issues and problems in the previous panel studies on terrorism and economic growth. Dynamic panel regressions of the impact of terrorism on economic growth are a basic extension of cross-country growth regressions to panel estimations. Typically, the initial income variable in the cross-country regression changes to lagged income.

To be specific, we express the typical dynamic panel regressions as:

$$\Delta \ln Y_{it} = a_i + \beta_1 \ln Y_{it-1} + \beta_2 \tau_{it} + \mathbf{z}'_{it} \boldsymbol{\gamma} + u_{it}, \quad (1)$$

where Y_{it} is the i th country's per capita real GDP at time t , τ_{it} is the i th country's transnational terrorist events at time t , \mathbf{z}_{it} is a vector of control variables at time t for country i , and u_{it} is an error term (e.g., Blomberg, Hess, and Orphanides 2004; Gaibullov and Sandler 2009; Tavares 2004). In (1), a_i is a country-specific intercept, β_1 and β_2 are coefficients for income and terrorism, and $\boldsymbol{\gamma}$ is a vector of parameters for control variables. Eq. (1) can be re-written as:

$$\ln Y_{it} = a_i + \rho \ln Y_{it-1} + \beta_2 \tau_{it} + \mathbf{z}'_{it} \boldsymbol{\gamma} + u_{it}, \quad (2)$$

where $\rho = 1 + \beta_1$.

To isolate the specification issue from the estimation issue, we first assume that (1) is correctly specified and that the terrorism and control variables are exogenous. Under this last assumption, the within group (WG) estimators in (1) with fixed effects are inconsistent as $N \rightarrow \infty$ for any fixed T . To see this inconsistency, we rewrite (2) in the following matrix form:

$$\mathbf{y} = \mathbf{a} + \rho \mathbf{y}_{-1} + \mathbf{X} \mathbf{b} + \mathbf{u}, \quad (3)$$

where $\mathbf{X} = (\boldsymbol{\tau}, \mathbf{z})'$, $\mathbf{y} = (\mathbf{y}_1, \mathbf{y}_2, \dots, \mathbf{y}_N)'$, and $\mathbf{y}_i = (y_{i1}, y_{i2}, \dots, y_{iT})'$. Other variables are defined similarly. Nickell (1981) indicated that the exact bias for the WG estimator of \mathbf{b} is given by

$$\text{plim}_{N \rightarrow \infty} (\hat{\mathbf{b}} - \mathbf{b}) = -\text{plim}_{N \rightarrow \infty} \left[(\mathbf{X}' \mathbf{X})^{-1} \mathbf{X}' \mathbf{y}_{-1} \right] \text{plim}_{N \rightarrow \infty} (\hat{\rho} - \rho), \quad (4)$$

where $\text{plim}_{N \rightarrow \infty} (\hat{\rho} - \rho) < 0$. If, therefore, current terrorism is negatively correlated with past income (in other words, bad economic conditions in past years cause terrorist attacks in the current year), then the WG estimate for β_2 becomes negative even when the true β_2 is zero.

This so-called ‘‘Nickell’’ bias continues even with a large T as long as $T/N \rightarrow 0$ as $N, T \rightarrow \infty$.

In this case, Alvarez and Arellano (2003) showed that the limiting distribution of $\hat{\mathbf{b}}$ is given by

$$\sqrt{NT}(\hat{\mathbf{b}} - \mathbf{b}) \rightarrow^d N(\mathbf{c}, \Sigma_{\mathbf{b}}^2), \quad (5)$$

where \mathbf{c} is a function of many nuisance parameters, including the N/T ratio. In other words, a typical t -statistic becomes either positive or negative infinity as $N, T \rightarrow \infty$.

At this point, readers may think that if $T > N$, then all of these issues can be avoided. However, in this case, eq. (2) becomes like a covariate unit root test regression, studied by Hansen (1995). The limiting distribution then becomes a mixture of normal and Brownian motion, so that the standard t -statistic becomes invalid.

Second, one may consider more general specification like panel Vector Autoregression (VAR) with fixed effects, but, in this case, Nickell bias continues to hamper the statistical inference [see Lee (2007) for more detailed discussion]. To avoid such complicated concerns, we take a rather crude but robust panel correlation coefficient approach. Initially, we decompose the terrorism data into a worldwide or common component and a purely country-idiosyncratic component.

3. New Empirics on Transnational Terrorism

There are many reasons to anticipate that transnational terrorist activities are cross-sectionally correlated. Since the start of the modern era of transnational terrorism in 1968, terrorists have shared ideologies – the leftists sought to overthrow capitalist governments, while the fundamentalists have followed a fatwa issued against the “enemies” of Islam. These common ideologies and calls to action motivated terrorists to strike in concert against target countries. Some political events have simultaneously resulted in attacks in many countries – e.g., a spate of terrorist attacks followed the Israeli-Arab conflicts, the US retaliatory raid against Libya in April

1986, the Gulf War in January 1991, and the Abu Ghraib prison revelations in April 2004 (Brandt and Sandler 2009; Enders and Sandler 1993). Moreover, countries' attacks are correlated owing to diverse terrorist groups receiving training in just a few countries – camps in Jordan, Lebanon, Afghanistan, and Yemen trained terrorists since the 1970s (Alexander and Pluchinsky 1992; Hoffman 2006, 77-78). In the 1990s, al-Qaida established terrorist training camps in Afghanistan with the intent to strike the interests of a set of enemy countries at home and abroad. With concentrated training facilities, terrorists grew to share common modes of attack and distain for similar countries.

As targeted countries responded to attacks through defensive or protective measures, the terrorists reacted by seeking out softer targets where they could hit the protected countries' interests. Thus, terrorist attacks in one country led to attacks in other countries (Enders and Sandler 2006a). Cross-country correlations also arose because terrorists have cells in multiple countries – e.g., al-Qaida affiliates circle the globe. Hezbollah and other Middle Eastern groups engaged in attacks outside of the region – e.g., Hezbollah blew up the Israeli embassy in Buenos Aires on March 17, 1992 (US Department of State 1993). The same was true for many of the European leftist terrorists, such as the Red Army Faction (RAF), which operated within and outside of Germany. Throughout the 1970s and 1980s, Middle Eastern terrorism spilled over to Europe, where terrorists tried to capture the world stage through greater media exposure for their cause (US Department of State various years).

Cross-country correlations of transnational terrorist attacks may also stem from terrorists copying successful attack innovations – e.g., suicide car bombings, first used in Lebanon in 1983, were later used elsewhere (Pedahzur 2005). Similarly, counterterrorism innovations can reduce terrorist incidents worldwide – e.g., the introduction of metal detectors in airports reduced greatly the number of skyjackings worldwide (Enders and Sander 1993, 2006b). Finally, state

sponsorship of terrorism, beginning in the late 1970s, meant that terrorist acts in one country could be correlated with acts in other countries – e.g., the Abu Nidal Organization served as a terrorist group for hire for state sponsors and, as such, operated in many countries (Hoffman 2006).

Such co-movement of terrorism across countries may be due to a few common or worldwide factors. We decompose annual transnational terrorist events in country i (τ_{it}) into common (G_{it}) and idiosyncratic (τ_{it}^o) components:

$$\tau_{it} = G_{it} + \tau_{it}^o. \quad (6)$$

The common component is allowed to vary across countries since the same common or worldwide component may affect terrorist activity for each country differently. Suppose that transnational terrorist activities in a country are correlated with economic growth, $\Delta \ln Y_{it}$. Then, it would be interesting to know whether or not such correlation is due to the correlation between worldwide transnational terrorist activities and economic growth or that between idiosyncratic (or country-own) transnational terrorist activities and economic growth. A decomposed analysis is informative even when no correlation is found between transnational terrorism and economic growth. It is conceivable to have a zero correlation if the correlations between terrorism components and economic growth are in opposing directions that offset each other.

Consider the following equation:

$$\text{cov}(\tau_{it} \Delta \ln Y_{it}) = \text{cov}(G_{it} \Delta \ln Y_{it}) + \text{cov}(\tau_{it}^o \Delta \ln Y_{it}). \quad (7)$$

Thus, such zero correlation between τ_{it} and $\Delta \ln Y_{it}$ may arise when $\text{cov}(G_{it} \Delta \ln Y_{it}) < 0$ but $\text{cov}(\tau_{it}^o \Delta \ln Y_{it}) > 0$, or vice versa, with offsetting magnitudes. Similar reasoning justifies decomposing GDP into its components and investigating the relationship between transnational

terrorism and the growth rate of each component of GDP. For example, a zero correlation between GDP and transnational terrorist events may arise due to a positive correlation between the growth rate of government spending and terrorist events offsetting a negative correlation between the growth rate of investment and terrorist events.

The decomposition of transnational terrorism into common and idiosyncratic components is novel to this literature. Hence, we now present an approximate common factor representation, which has been recently developed in econometrics. We decompose the transnational terrorism data into the k -common factors and idiosyncratic components:

$$\tau_{it} = \lambda_i' \mathbf{F}_t + \tau_{it}^o, \quad (8)$$

where τ_{it} denotes transnational terrorist events for the i th country at time t . \mathbf{F}_t is a $K \times 1$ vector of common factors that represents the worldwide terrorism activities. λ_i is a $K \times 1$ vector of factor loading coefficients that indicates the distance between the common factors and transnational terrorism, τ_{it} . The idiosyncratic term represents locally independent transnational terrorism, which is typically assumed to be cross-sectionally independent. In the approximate common factor literature, the number of common factors is usually assumed to be small.

Typically, factor loadings, common factors, and idiosyncratic components are assumed to be independent of one another.¹ Such independence enables us to decompose the whole variation of an individual country's transnational terrorism into the two components. To be specific, we have

$$\text{var}(\tau_{it}) = \text{var}(\lambda_i' \mathbf{F}_t) + \text{var}(\tau_{it}^o), \quad (9)$$

because the covariance between the common factors, $\lambda_i' \mathbf{F}_t$, and the idiosyncratic term becomes zero. In (9), $\text{var}(\bullet)$ denotes the variance.

We use Bai and Ng (2002)'s panel information criteria (IC_{p2} criteria) to estimate the

factor number. As Greenaway-McGrevy, Han, and Sul (2010) pointed out, the standardized series should be used for the estimation of the factor number and factors. Otherwise, the most volatile idiosyncratic terms might be estimated as a common factor.

4. Data

Given our interest in identifying common and idiosyncratic determinants of countries' transnational terrorist attacks, we must rely on transnational terrorist event data. This reliance is further justified because of our concern about the impact of terrorism on economic growth. Past studies of this impact (e.g., Blomberg, Hess, and Orphanides 2004; Gaibullov and Sandler 2009) used transnational terrorist data. As with previous studies, we draw our transnational terrorist data from *International Terrorism: Attributes of Terrorist Events* (ITERATE) dataset that records the incident date, country location, and other relevant observations. ITERATE was originally devised by Mickolus (1982) and recently updated by Mickolus et al. (2009). We use transnational terrorist events throughout the world for 1970-2007, which includes most of the relevant era of transnational terrorism.

Terrorism is the premeditated use or threat to use violence by individuals or subnational groups against noncombatants to obtain political or social objectives through the intimidation of a large audience, beyond that of the immediate victims. Terrorist acts are violence with political or social motives; violent acts without such motives are criminal acts and do not count as terrorism. An attack used to finance a terrorist group's campaign to induce political or social change is counted as a terrorist event. Terrorists utilize various modes of attacks – bombings, hostage taking, assassinations, suicide operations, arson, and armed assaults – to cajole a government into giving in to their political/social demands in response to public (audience) pressure.

Terrorism is further subdivided into two categories: domestic and transnational events. Domestic events involve perpetrators, victims, and audience from just the host or venue country. In contrast, transnational terrorism concerns perpetrators, victims, or audience from two or more countries. A terrorist incident that ensues in one country and concludes in another – e.g., an international skyjacking or letter bombings – is a transnational incident. If the perpetrators plan the attack in one country and execute it in another, then the attack is a transnational terrorist incident. When the victims or perpetrators include nationalities other than that of the venue country, the incident is a transnational terrorist event. In short, transnational terrorist incidents impact the interests from at least two countries – e.g., the 9/11 skyjackings affected the world stock exchanges for 30 to 40 days (Chen and Siems 2004).

ITERATE gathered its data on transnational terrorist incidents using a host of sources, including the Associated Press, United Press International, Reuters tickers, *New York Times*, *Washington Post*, the *Foreign Broadcast Information Services (FBIS) Daily Reports*, ABC, NBC, and CBS evening news. Through 1996, the *FBIS Daily Reports* was an invaluable source for ITERATE; these reports drew from hundreds of world print and electronic media services in many languages.

Data on macroeconomic variables, real GDP per capita in constant dollars, government spending as a share of real GDP, consumption as a share of real GDP, trade openness (sum of exports and imports as a share of real GDP), and investment as a share of real GDP are obtained from the *Penn World Table Version 6.3* (Heston, Summers and Aten 2009).

5. Empirical Results

5.1 Common Factor Analysis of Terrorism Data

We begin by estimating the number of common factors. Many countries have experienced few or zero transnational terrorist attacks over the sample period – generally, transnational terrorism affects just over half of the world’s countries. Therefore, we investigate whether or not the frequency of terrorist incidents affects the estimation of the factor number. In particular, we apply the following criteria to estimate the number of common factors:

$$C_i \in G \text{ if } \sum_{t=1}^T \tau_{it} \geq \delta, \quad (10)$$

where C_i denotes country i , and δ represents a lower bound on the sum of the terrorist events in a country from 1970 to 2007. We select subpanels based on this threshold value. Initially, we assign zero to the threshold value and, consequently, include all of our sample countries when estimating the factor number. For the inclusive sample, the estimated number of common factors is found to be just one. Obviously, the number of countries included in the model changes with the threshold value; as we increase the value of δ , we end up with a smaller set of countries to estimate the factor number. We consider various values for δ and, regardless of the threshold value, we always find only a single common factor. Hence, the transnational terrorist activities across countries are commonly correlated due to a single source. Based on our analysis, we subsequently identify this single source of worldwide terrorist activity.

Having estimated the common factor, we are able to decompose the variance of terrorist events into common and idiosyncratic components. Table 1 displays the results of the variance decompositions of the common components. We report the variances by regions (using the standard World Bank classification), and we also present the results for the countries with the five largest and five smallest variances. Because τ_{it} is standardized over time, its variance for each country is always equal to one. The larger values in Table 1 are, thus, indicative of the larger dependence of a country’s (region’s) transnational terrorism on a worldwide or common

source of transnational terrorism. The estimate of the variance of the common component for Middle East and North Africa (MENA) is 0.154, which suggests that around 15% of transnational terrorist activities in this region are explained by a single worldwide driver of terrorism. This also implies that about 85% of transnational terrorist events are explained by idiosyncratic considerations, specific to this region. Similarly, 21% of the variation in transnational terrorist activities in Europe and Central Asia (ECA) and 16% of these terrorist activities in North America (NA) are attributed to a single worldwide driver of terrorism. In our sample, North America includes only Canada and the United States, so that the results are being driven by the United States. The shares of the common component in explaining transnational terrorism in Latin America and Caribbean (LAC), South Asia (SA), sub-Saharan Africa (SSA), and East Asia and Pacific (EAP) are less than 10%. A single worldwide driver of transnational terrorism explains around 71%, 53%, and 51% of transnational terrorist activities in Lebanon, France, and Greece, respectively. Thus, only 29% of terrorism activity in Lebanon is country specific or idiosyncratic and not related to the worldwide driver or common factor. Meanwhile, transnational terrorist activities in Colombia, Liberia, Nicaragua, Guyana, and Gabon are not at all related to the worldwide common factor of transnational terrorism and are, thus, influenced by country-specific considerations.

[Table 1 near here]

This is a fascinating result that has, heretofore, not been shown empirically. Thus, three regions respond more to a common driver of transnational terrorism than other regions. Given that European capitals have been the favored venue for transnational terrorist attacks for much of the sample period, it makes sense that Europe is most influenced as a region by a common driver of transnational terrorism. Middle Eastern terrorism has spilled over to Europe throughout the period (US Department of State various years). The top five countries affected by a common

driver include Lebanon, which has been the training ground for terrorist groups from around the world, including the Red Army Faction (RAF), Hezbollah, HAMAS, Abu Nidal Organization (ANO), Popular Front for the Liberation of Palestine–General Command (PFLP-GC), Palestine Liberation Front (PLF), Fatah, PFLP, Japanese Red Army (JRA), Armenian Secret Army for the Liberation of Armenia (ASALA), al-Qaida, and many others (Hoffman 2006; Mickolus, Sandler, and Murdock 1989; US Department of State various years). France, Greece, Spain, and Austria have been the venue for many transnational terrorist incidents during the sample period. It is, however, quite interesting that a terrorism-ridden country like Colombia is not affected by a worldwide driver. This result agrees with Latin America being less influenced than some other regions by a common driver. Thus, Colombia is not reflecting what has motivated transnational terrorism in other hot spots – its brand of narco-terrorism apparently sets it apart.

Next, we identify the common factor of transnational terrorism. The common factor can be treated as an exogenous variable. For instance, worldwide income fluctuations and oil prices may be the common factor of transnational terrorism. Here, we do not view the common factor as an exogenous variable; instead, we model the common factor endogenously. When, for example, a price leader sets the market price, the prices for the rest of the firms would be highly correlated with the leader's price. Similarly, we ask whether we can find a few core countries whose transnational terrorist incidents determine the common factor for worldwide transnational terrorism. To be more specific, let the linear combination, $a\tau_{1t} + b\tau_{2t}$, be a common factor to τ_{it} .

We then rewrite (8) as:

$$\tau_{it} = \lambda_i (a\tau_{1t} + b\tau_{2t}) + \tau_{it}^o = \lambda_{ai}\tau_{1t} + \lambda_{bi}\tau_{2t} + \tau_{it}^o, \quad (11)$$

where $\lambda_{ai} = \lambda_i a$ and $\lambda_{bi} = \lambda_i b$. These latter coefficients vary across countries.

To identify the set of core countries, we run

$$\hat{F}_t = a + \sum_{j=1}^k b_j \tau_{jt} + \varepsilon_{it}, \quad (12)$$

where k is the unknown number of core countries, which are identified by minimizing the sum of squared errors. In particular, we apply the following estimation strategy. We begin with $k = 1$ and run (12) for each country. We run N individual regressions and choose the country that gives the highest \bar{R}^2 . Let τ_{st} denote transnational terrorism in country s that gives the greatest \bar{R}^2 . For $k = 2$, we include τ_{st} along with other countries' transnational terrorist events, one country at a time. This involves $N - 1$ individual regressions. Again, we choose the second core country that provides the highest \bar{R}^2 . We repeat this procedure for each k until \bar{R}^2 reaches a threshold value. If the estimated i th factor loading coefficient is significantly different from zero, then the inclusion of τ_{it} always becomes significant, so that \bar{R}^2 increases. When the common factor is known, the core countries can be chosen by maximizing \bar{R}^2 . Since we are using the estimates of the common factor, we must choose a threshold value for \bar{R}^2 , which is set to around 0.99.

Table 2 presents the results for common factor identification. Given our stopping rule, six countries' transnational terrorism serves as a determinant of the common factor, with Lebanon, the United States, and Germany having the greatest combined influence. The principal component estimates are always normalized to identify the factor loadings and common factors; hence, the regression coefficients can always be rescaled. In other words, we do not say that a 1% increase in transnational terrorist events in Lebanon augments the worldwide terrorism by 0.03%. A more appropriate interpretation is as follows: for $k = 2$, around 80% of the global transnational terrorism can be explained by transnational terrorism in Lebanon and the United States. Furthermore, Lebanon's transnational terrorism affects worldwide terrorism by 20% more than that of the United States, because $0.03/(0.03 + 0.02) = 0.6$ for Lebanon, whereas

$0.02/0.05 = 0.4$ for the United States – see Table 2. The other important countries in terms of explaining global transnational terrorism are Germany, Iraq, the United Kingdom, and Italy. Iraq becomes an important driver after the US invasion in 2001.

[Table 2 near here]

An understanding of the large pivotal place that Lebanon has assumed in the modern era of transnational terrorism is reflected by its 67% role as the common driver of global transnational terrorism. This Lebanese factor has previously gone unrecognized. There are many considerations behind this ignominious distinction. Since the start of the Lebanese civil war in 1975, Lebanon has not had a strong government. Consequently, terrorist groups have trained and taken safe haven in Lebanon up to the present day (Alexander and Pluchinsky 1992; Hoffman 2006; US Department of State various years). As mentioned earlier, these groups included major terrorist organizations from the Middle East, Europe, and elsewhere. Many of the main state sponsors of transnational terrorism – Syria, Libya, Iran, and Iraq – have funded transnational terrorist groups in Lebanon that engaged in attacks inside and outside of Lebanon (Hoffman 2006; US Department of State various years). In Lebanon, Iran supported Hezbollah; Syria and Libya supported PFLP-GC; and Iraq supported ANO.

Hezbollah's use of large-scale suicide car bombings in 1983 against the US embassy, the US Marine barracks, and the French Paratroopers sleeping quarters influenced similar attacks in Sri Lanka, Turkey, Russia, Saudi Arabia, Yemen, and elsewhere (Bloom 2005; Pape 2005; Pedahzur 2005). Israeli short-term deportation of HAMAS activists to southern Lebanon in December 1992 resulted in HAMAS learning the art of suicide attacks from Hezbollah. These activists then returned to Israel where suicide attacks later ensued (Hoffman 2006). Another terrorist tactic in Lebanon that influenced transnational terrorism globally was the kidnapping of foreign aid workers, peacekeepers, academics, and diplomats for ransoms in the 1980s and

1990s. Reagan's administration "arms-for-hostage deal" for the release of Rev. Benjamin Weir, Rev. Lawrence Jenco, and David Jacobsen resulted in the "Irangate" scandal that almost brought down the Reagan presidency and demonstrated to the rest of the world that even staunch supporters of the no-negotiation policy might renege. This resulted in increased hostage taking worldwide (Brandt and Sandler 2009; Enders and Sandler 2006b; Mickolus, Sandler, and Murdock 1989).

Lebanon also served as the launching point for transnational terrorist attacks against Israel, which led to Israeli invasions in 1978, 1982, and 2006. These invasions subsequently sparked terrorist incidents worldwide (see, e.g., Brophy-Baermann and Conybeare 1994; Enders and Sandler 2006b). Israeli terrorism does not have a large role as a common driver of global transnational terrorism, insofar as, unlike Lebanon, most incidents in Israel are classified as domestic terrorism. Lebanon has also been the location of internecine conflict among terrorist factions – e.g., Fatah and ANO – that resulted in inter-group assassinations and attacks in Lebanon and other parts of the world – e.g., Tunisia.

US transnational terrorism is also a common driver because the Vietnam War fueled terrorist attacks in the United States and in Europe, where many left-wing groups (e.g., RAF, 17 November, and the Italian Red Brigades) operated. These groups not only protested the Vietnam War, but also alleged US imperialism and capitalism. Moreover, US support of Israel angered many terrorist groups, leading to attacks on US soil (especially before 1990) and abroad. The German RAF served as a driver for transnational terrorism in Europe for almost 25 years. The RAF forged alliances with other groups – e.g., Direct Action in France – and cooperated with Palestinian terrorist groups. The RAF operated in Germany, Belgium, Austria, the Netherlands, and Switzerland (Alexander and Pluchinsky 1992). US military bases in Germany gave rise to many transnational terrorist attacks against US military personnel and dependents in Germany

and elsewhere in Europe. Iraq's presence as a common driver of transnational terrorism is more recent, following the US invasion of Iraq. Our findings then suggest that this invasion brought a new common driver. This was clearly not the intention of the Bush administration. Finally, the United Kingdom and Italy also had small influences as common drivers. In the United Kingdom, the Irish Republican Army's tactics of urban warfare influenced terrorists worldwide, as did the methods of the Italian Red Brigades.

Based on principal components analysis, Figure 1 displays the estimated common factors for transnational terrorism, and the fitted values for Lebanon ($k = 1$), Lebanon and the United States ($k = 2$), and Lebanon, the United States and Germany ($k = 3$). All displayed series are standardized so that the variance of each series becomes unity; hence standardized values are measured on the Y -axis. From Table 2, Lebanon and the United States explain around 80% of the common factor and, together with Germany, the three countries explain around 92% of worldwide transnational terrorism. Therefore, it is not surprising that, for the most part, the fitted values for three countries transnational terrorism series coincide well with the estimated common factor series in Figure 1. The only noticeable exception is 2003-2004, after the initial phase of the War on Terror when al-Qaida and its affiliated groups were stressed. As shown by the aggregate common factor curve, transnational terrorism first dropped and then started to recover as the fundamentalist terrorists apparently regrouped.

[Figure 1 near here]

5.2 Investigating the Dynamic Relationship between Transnational Terrorism and Economic Growth: Correlation Coefficient Approach

There are several ways to analyze the dynamic relationship between transnational terrorism and economic growth. A general approach for this analysis would be a VAR method with

appropriate variables; however, there are many restrictions in the panel VAR setting. First, as discussed earlier, we may not have all the important macroeconomic and social variables to implement panel VAR. Omitting key variables, such as educational attainment, a measure of technological shocks, etc., results in model misspecification and consequently leads to inconsistent estimation and invalid statistical inference. Second, least squares dummy variables (LSDV) or the within group estimator becomes inconsistent when $N > T$. Such inconsistency can be resolved by using the first-difference maximum likelihood estimation (MLE), but the lag order and the error distribution should be known. Third, the cross-section dependence hampers statistical inference even for the first-difference MLE.

We may overcome the last two issues by utilizing the sieve bootstrap version of the first-difference MLE, but we may not be able to avoid the first thorny issue. In this paper, we choose to investigate the dynamic relationship in a rather crude way; we just calculate the correlation coefficients given by

$$\rho_k = \frac{\text{cov}(\Delta \ln Y_{it+k}, \tau_{it})}{\sqrt{\text{var}(\Delta \ln Y_{it+k}) \text{var}(\tau_{it})}}, \quad (13)$$

where the sample covariance is calculated as

$$\text{cov}(\Delta \ln Y_{it+k}, \tau_{it}) = \frac{1}{T-k} \sum_{t=1}^{T-k} \left(\Delta \ln Y_{it+k} - \frac{1}{T-k} \sum_{t=1}^{T-k} \Delta \ln Y_{it+k} \right) \left(\tau_{it} - \frac{1}{T-k} \sum_{t=1}^{T-k} \tau_{it} \right), \quad (14)$$

and the sample variance is defined similarly. Insofar as we do not know the direction of causation between the two variables, we initially avoid running a simple regression of transnational terrorism on economic growth, or vice versa. The correlation statistic, though crude, provides extremely robust and fundamental information about the dynamic relationship between transnational terrorism and economic growth. If there is any meaningful relationship,

then the correlation coefficient must be significantly different from zero. The typical first asymptotic t -statistic for the standard error ($s.e.$) of the correlation coefficient is given by

$$s.e.(\rho_k) = \frac{(1 - \rho_k^2)^2}{\sqrt{T - k}} + R_m, \quad (15)$$

where R_m is a small remainder term. Hence, for $k = 1$ case, $|\rho_1|$ must be greater than 0.272 in order to be significantly different from zero at the 5% level. Otherwise, the correlation is asymptotically not significant.

The overall correlation can be further decomposed using two approaches. First, the covariance between economic growth rate and transnational terrorism can be divided into two parts: the covariance between the economic growth rate and the worldwide source of transnational terrorism, and the covariance between the economic growth rate and the idiosyncratic (or country-specific) component of transnational terrorism. That is,

$$\rho_k = \frac{\text{cov}(\Delta \ln Y_{it+k}, \tau_{it})}{\sqrt{\text{var}(\Delta \ln Y_{it+k}) \text{var}(\tau_{it})}} = \frac{\text{cov}(\Delta \ln Y_{it+k}, G_t)}{\sqrt{\text{var}(\Delta \ln Y_{it+k}) \text{var}(G_t)}} + \frac{\text{cov}(\Delta \ln Y_{it+k}, \tau_{it}^o)}{\sqrt{\text{var}(\Delta \ln Y_{it+k}) \text{var}(\tau_{it}^o)}}. \quad (16)$$

Alternatively, we may further decompose the rate of economic growth in each term of the above equation into GDP expenditure components: i.e., the growth rates of government spending, consumption, investment and net exports. Here, instead of net exports, we use trade volume, which is the sum of exports and imports as a measure of the degree of openness.

[Table 3 near here]

The correlation between transnational terrorism and economic growth of real GDP (denoted by RGDP) and its components are reported in Table 3 for three alternative thresholds for the sum of terrorist incidents, $\delta = 0, 50$ and 100 , corresponding to increasingly more limited sample sizes. In general, the sign of the coefficients is negative, except for government

spending. This accords with expectations because enhanced transnational terrorism will require more security and, thus, increased government expenditure. However, none of the correlation coefficients are statistically significant – the magnitudes of coefficients are much smaller than 0.272 in absolute terms. Thus, there is no evidence of correlation between transnational terrorism and economic growth. Nor is there any evidence that the components of RGDP are correlated with transnational terrorism.

Next, we perform separate regressions of each macroeconomic variable on the transnational terrorism data. These regressions are decomposed further into the overall and common factors of terrorism as follows:

$$\Delta \ln X_{it} = a_i + b_1 \tau_{it} + e_{it}, \quad (17a)$$

$$\Delta \ln X_{it} = a_i + b_2 F_t + u_{it}. \quad (17b)$$

Table 4 shows the regression results. Each dependent variable is expressed in percentage terms. Not surprisingly, there is no significant relationship between any pair of series. Because transnational terrorist events usually injure few people or cause little property damage (transnational terrorist events for the sample period kill on average just over one person – see Enders and Sandler 2006b), such terrorism is like crime having more of a local influence than a countrywide macroeconomic effect. Large-scale terrorist attacks, called spectacular events, are few in number – usually, one or two a year – so that most countries do not experience such events and must contend with small-scale bombings and assassinations. Thus, on average, we should anticipate that transnational terrorism will have little macroeconomic consequence, consistent with our results here. The sole exception would be a country plagued with an intense terrorist campaign, like Israel. But such campaigns are not relevant for our panel analysis where we want to know the average influence of transnational terrorism on macroeconomic variables

for a global sample of countries.

[Table 4 near here]

To be on the safe side, we repeat the exercise reported in Table 4 using just casualty transnational terrorist events. Such terrorist incidents involve either one or more injuries, deaths, or both. This subset of transnational terrorist incidents is more intense and, thus, more apt to have economic repercussions. Nevertheless, there is no significant relationship between these transnational terrorist incidents and the growth rates of GDP or its expenditure components. These panel regression results, available upon request, hold for alternative sample sizes. The most inclusive sample contains 95 countries that had one or more casualty incidents of a transnational nature during 1970-2007.

5.3 Investigating Static Relationship between Transnational Terrorism and Economic Growth

In this section, we concentrate on the cross-sectional part of the sample information. In particular, using a cross-sectional regression approach, we investigate whether countries with higher transnational terrorism have a lower rate of economic growth. We emphasize that a lower growth rate does not necessarily mean that a country is less developed. The average rate of economic growth (over time) for each country is calculated by

$$g_{i,T,1} = \frac{\ln Y_{it} - \ln Y_{i1}}{T - 1}, \quad (18)$$

which provides a consistent estimate for the trend coefficient. This estimate is robust regardless of stationarity conditions of the logged value of real GDP.

First, we investigate if the average growth rate is correlated with transnational terrorism. Because each country has only one average growth rate measured by $g_{i,T,1}$, the sum of transnational terrorism between year 1 and T becomes an independent variable. We note that all

regression coefficients on terrorism (i.e., the sum of transnational terrorist events) are not significantly different from zero; hence, we do not report these regression results here. Instead, we inquire why and how we obtain such insignificant results.

Panel A of Figure 2 is constructed using information on average growth rates from 1970 to 2007 (vertical axis) and the aggregate number of transnational terrorist incidents over this period (horizontal axis) for each sample country. That is, each point corresponds to a sample country for the period. The graph does not reveal any systematic relationship between transnational terrorism and average economic growth across sample countries. To examine if the past transnational terrorist events are cross-sectionally related to future economic growth, we split the sample in half. Panel B depicts the scatter plot of average economic growth rates from 1989 to 2007 against aggregate transnational terrorist events from 1970 to 1988. Again, there is no evidence of a relationship between transnational terrorism and growth rate based on this graph. Finally, we ask if there is any meaningful relationship between past economic growth and future transnational terrorism. To do so, we display the scatter plot between the average economic growth (between 1970 and 1988) and transnational terrorism (between 1989 and 2007) in Panel C. Once again, these two variables appear to be independent of one another.

[Figure 2 near here]

So far, we found no evidence that transnational terrorism results in less economic growth, or vice versa. Next, we study the relationship, if any, between the level of development and aggregate transnational terrorism. That is, we investigate whether or not poor countries have more terrorist attacks. In particular, we regress the logarithm of RGDP (level) for *each* year on aggregate transnational terrorist incidents and find no statistical relationship between the two variables. This is also the case when the average of the logarithm of RGDP for 1970-2007 is regressed on aggregate transnational terrorist events. Figure 3 displays a scatter plot of the

logarithm of RGDP in 2007 and aggregate transnational terrorist events for each of the sample countries. There is no discernible positive or negative relationship between the level of income and aggregate transnational terrorism.² If, in Figure 3, we focus only on countries with aggregate transnational terrorist incidents that number over 100 (28 countries), we see a hint of a positive relationship between aggregate transnational terrorism and the logarithm of RGDP in 2007. Of course, this does not mean that transnational terrorism somehow improves a country's well-being; rather, it implies that more terrorist events occurred in relatively rich countries, which agrees with Blomberg, Hess, and Weerapana (2004). Rich countries attract these attacks because they are "target rich"; thus, efforts to harden some targets leave others unfortified and targets of opportunity. Terrorist attacks in rich countries are likely to gain press coverage that publicizes the terrorist cause (Li 2005). Since press freedoms tend to correlate with countries' income, transnational terrorist attacks are more plentiful in rich countries. Also, rich countries have more active foreign policy that may create grievances and terrorist attacks at home.

[Figure 3 near here]

6. Concluding Remarks

Unlike previous empirical studies of transnational terrorism, we apply principal components analysis to identify common and idiosyncratic drivers of transnational terrorism for 1970-2007. Regardless of the sample size, we find a single common factor or driver for transnational terrorism. Some regions – e.g., Europe and Central Asia, and Middle East and North Africa – are more influenced by this common factor than other regions. Moreover, select countries – Lebanon, France, Greece, Spain, and Austria – are more affected by this common factor than other countries. We then investigate whether a few countries' transnational terrorist incidents are the common drivers of worldwide transnational terrorism. In fact, transnational terrorism in

Lebanon, the United States, and Germany explains about 92% of this common factor, with Lebanon alone accounting for 67%. These results cannot be used for forecasting purposes because common drivers may change owing to political and strategic events. For example, it appears that transnational terrorism in Iraq began exerting a common influence ever since the US-led invasion of Iraq. The principal components findings show how a failed or weak state – Lebanon – that gives sanctuary to transnational terrorist groups – can impact transnational terrorism globally. Thus, failed states can generate negative spillovers of terrorism far beyond their own borders. This suggests that the world community must assume a more proactive role in stabilizing these failed states in the future and assisting them to eliminate any resident terrorist group.

To discern the dynamic relationship between transnational terrorism and economic growth, we take a simple, direct approach and investigate the correlation coefficients. In so doing, we find no significant correlation between transnational terrorism and economic growth, even when we account for the common and idiosyncratic factors of transnational terrorism. Moreover, we do not uncover any evidence that the growth rates of GDP's expenditure components are correlated with transnational terrorism. These findings are supported when the growth of each macroeconomic variable is regressed on the common and idiosyncratic components of transnational terrorism. Finally, we investigate the static long-term relationship between transnational terrorism and economic growth. We identify no systematic relationship in either direction between transnational terrorism and average economic growth for the sample period. This remains the case when we relate income levels and transnational terrorism. These findings indicate that transnational terrorism is not, on average, a significant negative influence on economic growth in most countries. We do not deny that small terrorism-plagued countries experience negative macroeconomic impacts. However, our findings caution against

generalizing from such countries to countries in general. Our conclusions should be taken into account when governments decide how much to spend on homeland security, because savings in potential GDP losses is one of the determinants of the benefits from such expenditures (Sandler, Arce, and Enders 2009). The paper also suggests that some terrorist groups' – e.g., al-Qaida – intent to harm the world's economy has not been very successful.

Footnotes

1. Suppose that the number of common factors is r . Then the largest r eigenvectors of the $N \times N$ covariance matrix of τ_{it} becomes the principal components estimates of common factors.

The factor loading coefficients are estimated by running τ_{it} on the estimated common factors, while the regression residuals become the estimated idiosyncratic terms. Therefore, the estimates for three components are independent.

2. This absence of a discernible relationship is also true for the logarithm of RGDP for any year between 1970 and 2007 that we place on the vertical axis.

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Table 1: Variance Decomposition

Regional						
MENA	ECA	LAC	SA	SSA	EAP	NA
0.154	0.214	0.091	0.048	0.054	0.050	0.161
Top Five						
Lebanon	France	Greece	Spain	Austria		
0.708	0.525	0.506	0.484	0.467		
Low Five						
Colombia	Liberia	Nicaragua	Guyana B.G.	Gabon		
0.002	0.001	0.001	0.000	0.000		

Note: Middle East & North Africa (MENA), Europe & Central Asia (ECA), Latin America & Caribbean (LAC), South Asia (SA), sub-Saharan Africa (SSA), East Asia & Pacific (EAP), and North America (NA)

Table 2: Identification of the Common Factor

k	\bar{R}^2	Lebanon	USA	Germany	Iraq	UK	Italy
1	0.670	0.031 (4.39)					
2	0.806	0.029 (7.56)	0.019 (3.62)				
3	0.916	0.027 (10.7)	0.019 (5.53)	0.012 (4.96)			
4	0.956	0.026 (15.3)	0.016 (6.95)	0.011 (7.07)	-0.009 (-4.53)		
5	0.984	0.026 (34.5)	0.015 (14.5)	0.010 (14.2)	-0.008 (-9.08)	0.009 (8.55)	
6	0.991	0.025 (38.6)	0.012 (11.0)	0.010 (17.4)	-0.008 (-11.3)	0.008 (9.21)	0.010 (5.40)

Note: Numbers in parentheses are t -statistics based on the long run variance by Andrews (1991)

Table 3: Correlation Coefficients between Transnational Terrorism and Economic Growth

	$\delta = 0$: All 114 countries			$\delta \geq 50$: 49 countries			$\delta \geq 100$: 28 countries		
	Total	Common	Idio	Total	Common	Idio	Total	Common	Idio
$\Delta \ln RGDP$	-0.058	-0.100	0.042	-0.062	-0.031	-0.031	-0.073	-0.018	-0.056
$\Delta \ln$ Gov Spending	-0.016	0.022	-0.037	0.010	0.006	0.004	0.029	0.002	0.026
$\Delta \ln$ Consumption	-0.040	-0.105	0.065	-0.041	-0.019	-0.023	-0.054	-0.015	-0.038
$\Delta \ln$ Trade	-0.071	-0.132	0.061	-0.115	-0.048	-0.067	-0.078	-0.027	-0.051
$\Delta \ln$ Investment	-0.054	-0.084	0.030	-0.064	-0.016	-0.047	-0.076	-0.016	-0.060

Note that Idio stands for idiosyncratic factor and $\Delta \ln$ denotes a growth rate of what follows, so that $\Delta \ln RGDP$ is the growth of real GDP.

Table 4: Regression Coefficients Analysis

$\Delta \ln X_{it}$	Total			Common		
	$\delta = 0$	$\delta \geq 50$	$\delta \geq 100$	$\delta = 0$	$\delta \geq 50$	$\delta \geq 100$
$\Delta \ln RGDP$	-0.005 (-0.330)	0.003 (0.180)	0.003 (0.126)	-0.021 (-0.636)	-0.018 (-0.528)	-0.015 (-0.368)
$\Delta \ln$ Gov Spending	0.036 (1.173)	0.046 (1.457)	0.049 (1.608)	-0.001 (-0.012)	0.000 (0.004)	-0.014 (-0.239)
$\Delta \ln$ Consumption	-0.008 (-0.403)	-0.003 (-0.134)	0.002 (0.066)	-0.015 (-0.366)	-0.014 (-0.329)	-0.016 (-0.361)
$\Delta \ln$ Trade	-0.044 (-1.364)	-0.031 (-1.034)	-0.021 (-0.598)	-0.065 (-1.023)	-0.059 (-1.002)	-0.044 (-0.649)
$\Delta \ln$ Investment	-0.016 (-0.309)	-0.001 (-0.028)	0.007 (0.138)	-0.049 (-0.488)	-0.039 (-0.434)	-0.042 (-0.430)

Note: Numbers in parentheses are t -statistics based on panel robust HAC estimation.

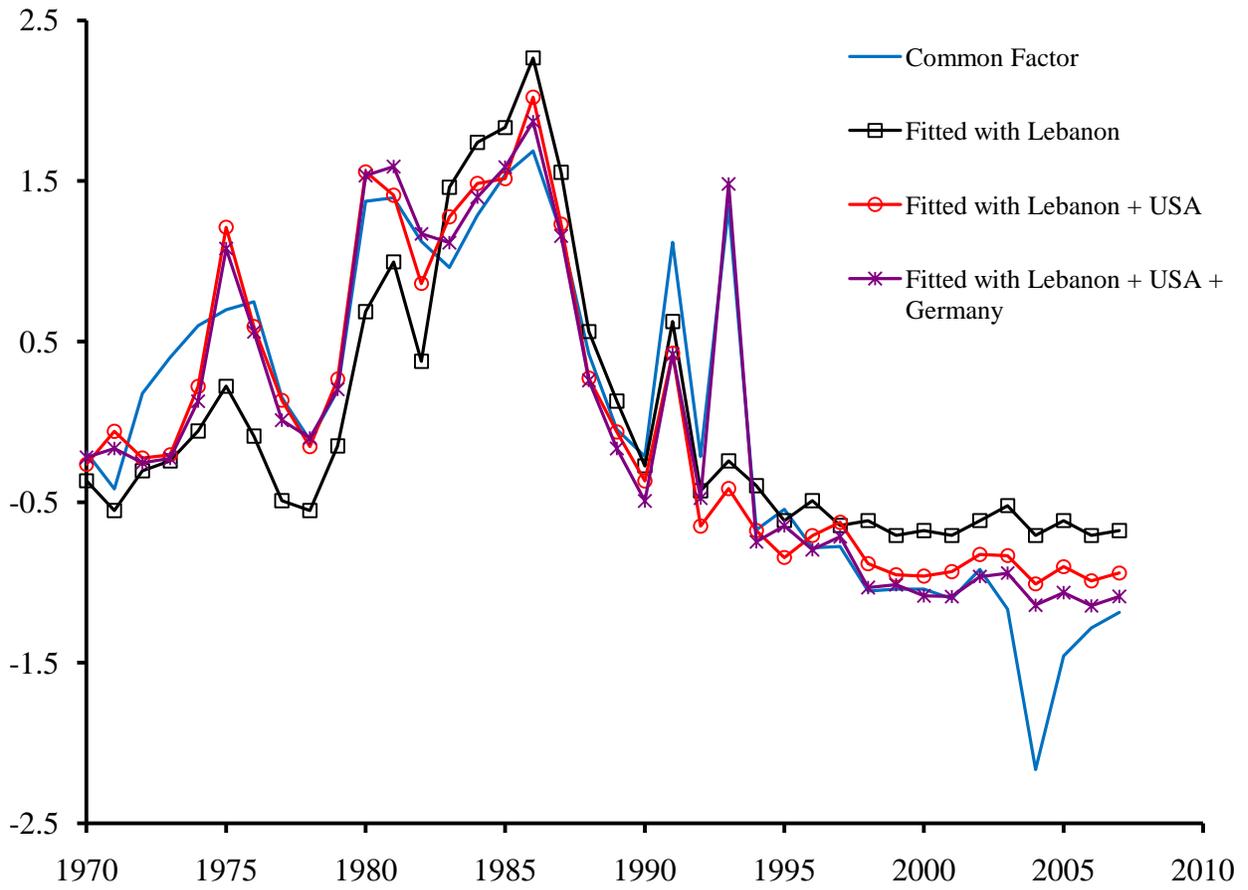
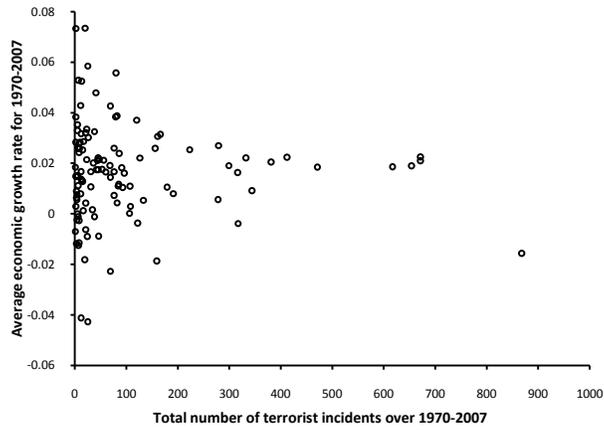


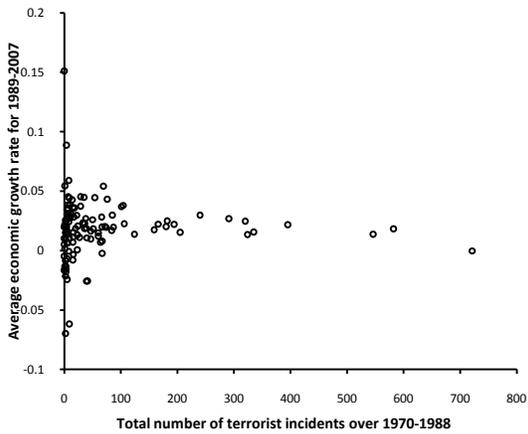
Figure 1: Estimated Common Factor and Its Determinants

Figure 2. Cross-sectional relationship between transnational terrorism and economic growth

Panel A. Relationship between transnational terrorism and economic growth



Panel B. Relationship between past terrorism and future economic growth



Panel C. Relationship between future terrorism and past economic growth

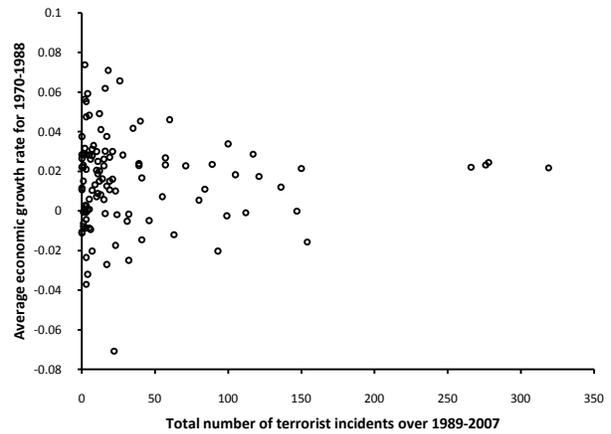


Figure 3. Cross-sectional relationship between transnational terrorism and log of RGDP level

