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A Regional Investigation of the Interrelationships Between Domestic and Transnational Terrorism: A Time Series Analysis.

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ABSTRACT

Enders, Sandler, and Gaibulloev (2011) found that domestic terrorism causes transnational terrorism, but not the reverse. This study updates Enders, Sandler, and Gaibulloev's previous analysis to include data through the fourth quarter of 2010 and provides analysis of terrorism at the regional level. Vector autoregressions are used to show that previous findings are accurate on the whole, but that there are important differences between regions. Notably, the Granger-causality for the world depends on whether Iraq and Afghanistan are included in the sample, and impulse response functions highlight the persistent effect a shock to transnational terrorism can have on domestic terrorism.

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1. Introduction

The aim of this paper is to examine the relationship between domestic and transnational terrorism on a regional basis. The issue can be complex since groups such as the Moro Islamic Liberation Front (MILF), Jabhat al-Nusra, and Al-Shabaab have primarily domestic objectives, but have undertaken transnational attacks (Abuza, 2002).

Although domestic incidents account for the majority of all terrorism, most analysis has focused on transnational incidents. Of particular note, relatively little work was done on the relationship between domestic and transnational terrorism for many years following the publication of Jongman's (1992) analysis of attacks in Western Europe. This can be attributed in large part to the global political emphasis on transnational terrorism and to the prominence of the ITERATE (International Terrorism: Attributes of Terrorist Events) dataset, which only coded international incidents (Mickolus et al., 2012). The relative lack of research on domestic terrorism may also stem from the fact that many groups undertake both domestic and transnational of attacks, complicating the relationship between the two. Take Hezbollah and Jemaah Islamiyah (JI) as examples: Enders and Sandler (2012) report that 50% of the 127 total attacks by Hezbollah listed in the GTD database were transnational, and of the 19 violent incidents committed by JI, 10 were transnational.

In a recent empirical study of the relationship between domestic and transnational terrorism, Enders, Sandler, and Gaibulloev (2011) – henceforth referred to as ESG – decomposed the Global Terrorism Database (GTD) provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (2011) (hereafter START) into domestic and transnational incidents. Upon estimating the dynamic relationship between the decomposed domestic and transnational series using a vector autoregression and an error correction model,

they found that shocks to domestic terrorism lead to subsequent increases in the number of transnational incidents, but that the reverse relationship does not hold.

The aim of this paper is to update and re-evaluate ESG's findings on a regional basis. For consistency and comparison, the same dataset and many of the same techniques will be employed, as detailed below. However, analysis will be conducted on the updated data through the fourth quarter of 2010 and will focus on a regional breakdown of terrorism. As discussed in more detail below, a regional analysis of the relationship between domestic and transnational terrorism is particularly important given the theoretical implications of ESG's findings and the significant differences in the nature of terrorism in different regions.

2. The Question of Causality

Previous findings that domestic terrorism causes transnational terrorism are surprising since domestic terrorism is generally deemed to stem from domestic causes while transnational terrorism seemingly responds to international events. Nevertheless, the ESG results are certainly plausible, and several past studies have given credence to their claims. Perhaps the strongest theoretical backing for a causal relationship between domestic and transnational terrorism is that of contagion and spillover effects, whether incidental or systematic.

Domestic Leads to Transnational: Bapat (2007) argues, for example, that domestic terrorism can lead to transnational terrorism as organizations targeting one country are either forced or choose for strategic reasons to take refuge in another. In fact, as Byman et al. (2001) point out, 73% of terrorist campaigns between 1990 and 2001 involved at least some terrorists operating from states other than their target. A similar theory posited by Addison and Murshed (2005) holds that domestic terrorists may partake in international terrorism when it will further

their domestic objectives. Under this premise, a group may attack not only their target country, but also foreign nations that back their home country. Neumayer and Plümper (2011) lend further support to Addison and Murshed's theory with their finding that attacks against United States interests are most common from terrorist organizations targeting countries that receive U.S. military aid.

As an extension of this theory, it is possible that foreign targets are desirable to domestic terrorists for their "demonstration value" and their ability to generate media attention. Terrorism is, after all, intrinsically intended to generate fear and disseminate an otherwise overlooked or ignored message. Media coverage can bring terrorist organizations credibility among their peers, and as Rosendorff and Sandler (2004) have pointed out, often aids in recruitment when the target nation reacts heavy-handedly.

Sanchez-Cuenca and De La Calle (2009) are notable skeptics of the distinction between domestic and transnational terrorism, pointing out that transnational terrorism can be an "accidental" byproduct of domestic terrorism in some cases as collateral damage from domestic attacks internationalizes incidents. Nevertheless, their argument implies that in the GTD data set domestic terrorism should appear to be causally prior to transnational terrorism.

Transnational Leads to Domestic: In addition to this strong body of evidence suggesting that domestic terrorism causes transnational terrorism, there is also significant backing for a relationship opposite that suggested by ESG. The most cited argument for transnational terrorism being causally prior to domestic terrorism is that of contagion, a concept highlighted in early terrorism research by Midralsky (1980). Global media coverage of transnational terrorist events not only brings to light the concerns of the group that carries out the attack, but it also makes clear how much impact a small group of people can have with a single

violent act. This secondary effect can lead to copy-cat attacks and the spread of terrorism to new countries and regions around the world as previously peaceful dissidents take up arms against their home countries.

The importance of demonstration effects is underscored by Gaibulloev, Sandler, and Sul (2013), who found that Lebanon's (and possibly U.S., German, Iraqi, and U.K.) transnational terrorism is the single driver of all other transnational incidents. Their argument is that media coverage of so-called high-profile events is a likely cause of this extreme cross-sectional dependence of transnational incidents. Worldwide media coverage of such incidents is likely to lead to domestic incidents as well.

The rise of al-Qaeda as a global terrorism sponsor could also lead to an increase in domestic terrorism as the umbrella organization finances affiliate groups with domestic objectives. Though most known for their international attacks, the MILF, Jabhat al-Nusra, and Al-Shabaab all have domestic objectives and would undoubtedly lack their current prominence if they had not benefited from al-Qaeda funding and training. In other words, this theory supposes that increases in international terrorism resulting from al-Qaeda's rise should be followed shortly thereafter by upswings in domestic terrorism, perpetrated through its affiliates and funded by its successes.

Differences Across Regions: Decomposing terrorism by region is particularly important since it will allow for scrutiny of regional trends. Cultural and ethnic differences are likely to result in regional variation between terrorist groups and their objectives, which could impact both the magnitude and direction of the causal relationship. Just as separatist terrorists differ from religious fundamentalists, African terrorists may differ from South American terrorists or Southeast Asian terrorists. Such differences are particularly important to study in examining the relationship between domestic and transnational terrorism, as much of the theory behind the

causal relationship is dependent upon demonstration effects and third party influences. This notion is supported by Meierrieks and Gries (2013) who show that the causal relationship between terrorism and growth is heterogeneous over time and across regions. They argue that country-specific factors, such as the persistence of terrorist activity, the level of political and economic development, political instability, and cultural affiliation all influence the effect of growth on terrorism. It is anticipated that the causal relationship between domestic and transnational terrorism will manifest itself on the regional level.

Moreover, organizations in the Middle East and North Africa, for instance, are likely aware of and influenced by the actions of Al Qaeda to a much greater extent than terrorists in South America. As a result, it should be expected that the actions of terrorists in the Middle East and North Africa would be more similar to those perpetrated by Al Qaeda. More importantly for this analysis, the frequency and veracity of their attacks should also be influenced by the ebb and flow of Al Qaeda's power to a greater degree than South American terrorist organizations would be.

Additionally, regional analysis will highlight any skewing effects a particular region might have on the global series. If, for instance, there is no relationship between domestic and transnational terrorism on the regional level, but one region has a greater preponderance of international incidents and rises over the years to comprise a greater portion of global terrorism, a simple analysis of global data could lead to the incorrect conclusion that domestic terrorism had triggered the rise in transnational terrorism.

We use a time-series approach since the causal forces that link the two types of terrorism may not manifest themselves contemporaneously. Suppose that the ESG argument is correct in that groups with domestic aims begin with domestic attacks but later branch out to transnational

attacks. Time series analysis is particularly well suited to capture the dynamic relationships implied by the hypothesis that domestic terrorism leads to transnational terrorism. Similarly, if there is a demonstration effect from well-publicized transnational attacks to domestic terrorism, the lead-lag relationships embedded in time series analysis can reveal that transnational attacks are causally prior to domestic terrorism.

3. Data and Definitions

Data will be taken from ESG's decomposition of the GTD database, as it provides the most complete historical breakdown of transnational and domestic terrorism and can be easily indexed to the very reliable ITERATE data. In accord with the definition of terrorism used by ESG in their decomposition of the GTD dataset, let terrorism be defined as any "premeditated use or threat to use violence by individuals or subnational groups against noncombatants in order to obtain a political or social objective through the intimidation of a large audience beyond that of the immediate victims." This is a fairly standard academic definition of terrorism and closely approximates the US Department of State's (2003) definition of terrorism as "premeditated, politically motivated violence against non-combatant targets by subnational groups or clandestine agents." Note that the GTD definition differs from most in that it classifies attacks in Iraq and Afghanistan against military noncombatants as terrorism. To account for the difference between the GTD definition of terrorism and more standard definitions, our formal statistical analysis is conducted twice, once with and once without incidents in Iraq and Afghanistan. Also important is the distinction between domestic and transnational terrorism employed in ESG's decomposition of the GTD dataset. For an incident to be classified as domestic, it has to be truly

homegrown terrorism without any suggestion of international intent, consequence, or collateral damage.

To compensate for inconsistencies in the collection criteria used by Pinkerton Global Intelligence Services, who developed the GTD dataset, and START, who maintains the dataset, this paper employs the transformations suggested by ESG. Specifically, the data is indexed to the ITERATE data by scaling down the data between 1991:2 and 1997:4 by a factor of 1/1.52 = 0.658 (the ratio of ITERATE to GTD incidents over this period). Additionally, data for 1993, which fell off the back of a truck, is interpolated as in ESG.[1]

Analysis of the dynamic relationship between domestic and transnational terrorism will focus on three regions: the Middle East and North Africa, Southeast Asia, and Sub-Saharan Africa. While a full breakout of the countries in each region is provided in the GTD codebook, a few important classifications should be noted. In particular, Sri Lanka (home of the exceedingly active LTTE) and Afghanistan are both classified as part of Southeast Asia. Also, Turkey (home of the PKK) is classified as part of the Middle East and North Africa, and Somalia and Sudan are both classified as a part of Sub-Saharan Africa. The three regions were selected because they each include a large number of incidents and together comprise the majority of global terrorism. Note that, while alternative regional classifications may be justifiable for some countries, using the regions as defined in the GTD avoids arbitrary reclassification and allows for easier comparison to studies conducted by other researchers.

Examination of transnational and domestic terrorism is also conducted at the global level, since ESG's work extended only to the end of 2007. Our analysis uses the quarterly totals of

[1] Note that the regional weights are likely to be different from the aggregate weights reported in ESG. However, since both the domestic and transnational series are multiplied by the same scalar, the vector autoregressive results are not likely to be due to the weights used in the analysis. We confirmed this conjecture by experimenting with various hypothetical weights.

domestic and transnational casualty incidents through the end of 2010. As is standard in the literature, we focus on casualty incidents because they tend to be more consistently reported than incident totals that include threats, hoaxes, and small attacks in which no one was harmed.

The summary statistics of the various regional incident series are reported in Table 1. Notice that the mean number of domestic incidents far exceeds that of transnational incidents: on average, there are 188.13 domestic incidents per quarter and only 29.63 transnational incidents per quarter. When Iraq and Afghanistan are excluded, the mean values of domestic and transnational terrorism fall to 164.31 and 25.41 incidents per quarter, respectively. Reading down the table, it should be clear that there are slightly more domestic incidents in Southeast Asia than in the Middle East. It is interesting that the mean number of incidents is always more than the median number. This reflects the fact that the distribution of incidents is skewed to the right in that each region experiences a small number of quarters containing large incident totals. Finally, note that the standard deviation of the incidents totals is approximately equal to (or smaller than) the mean number of incidents.

Time series plots of casualty incidents for the world as a whole are shown in Figure 1. Since the GTD dataset uses a nonstandard definition of terrorism, as discussed previously (*i.e.*, it classifies attacks against military noncombatants as terrorism), the numbers for Iraq and Afghanistan are skewed by the recent U.S. military interventions. As such, we show all incidents in the top panel, but exclude incidents occurring in Iraq and Afghanistan the bottom panel. Notice that the number of domestic incidents (measured on the left-hand scale) far exceeds the number of transnational incidents (measured on the right-hand scale). Although the time series plots of domestic and transnational incidents generally have the same shapes, there are periods – such as the early 1980s and mid-1990s – where the patterns diverge. As one would expect, the

transnational series spikes before the domestic series in the early 2000s when incidents in Iraq and Afghanistan are included but does not when incidents from the two countries are omitted.

Figures 2 and 3 show the breakdowns of the domestic and transnational series for the three selected regions: the Middle East plus North Africa, Southeast Asia, and Sub-Saharan Africa. Figure 2 shows all three regions and Figure 3 highlights the effect of Iraq and Afghanistan on the various incident series. At this point, it is important to recognize that several of the series have extended periods with few incidents and can be modeled as a count. As such, we fit the data using the Poisson distribution and the Negative Binomial distribution in addition to OLS.[2] Each technique has its advantages. OLS is the best technique for particularly terror prone regions, and the theory of quasi-maximum likelihood estimation suggests that the coefficients are unbiased for all regions, even though the standard errors are problematic for low-incident regions. The count models (Poisson and Negative Binomial) can be difficult to interpret but are useful because they enable us to conduct inference for regions with periods of low incident counts.

4. The Dynamic Relationship with a VAR

As ESG indicate, a vector autoregression (VAR) is ideal for modeling the relationship between domestic and transnational terrorism since it brings to light the contemporaneous and lagged relationships between the two series. Moreover, a VAR analysis imposes no *a priori* restrictions as to which variable is the independent variable and which is the dependent variable. Taking domestic and transnational casualty incidents per quarter as the variables of interest, a

[2] Results using the negative binomial were included in an earlier version of this paper that is available from the authors on request.

VAR of the following form was estimated for global terrorism (excluding incidents in Iraq and Afghanistan) as well as each of the three regions mentioned previously:[3]

$$dom_t = A_{11}(L)dom_{t-1} + A_{12}(L)trans_{t-1} + \varepsilon_{1t} \quad (1)$$

$$trans_t = A_{21}(L)dom_{t-1} + A_{22}(L)trans_{t-1} + \varepsilon_{2t} \quad (2)$$

where

$$E_{t-1}\varepsilon_{1t} = E_{t-1}\varepsilon_{2t} = 0; \quad E\varepsilon_{it}^2 = \sigma_i^2; \quad E\varepsilon_{1t}\varepsilon_{2t} = \sigma_{12}. \quad (3)$$

and where $trans_t$ is the number of transnational casualty incidents in the selected region in quarter t; dom_t is the number of domestic casualty incidents in the selected region in quarter t; the $A_{ij}(L)$ are polynomials in the lag operator L; and ε_{1t} and ε_{2t} are zero-mean, serially uncorrelated and independently distributed disturbance terms. The VAR system is such that the value of each variable depends on its own lags and the lags of the other variable. The contemporaneous relationship between the two variables is captured by the correlation between the error terms ($\sigma_{12}/\sigma_1\sigma_2$).

Following ESG, we excluded all observations prior to the fourth quarter of 1979 so as to avoid the likely undercounted and misleading GTD data from the early 1970s and to stay within the bounds of the fourth wave of terrorism (fundamentalist terrorism) as classified by Hoffman (2006) and empirically identified by Enders and Sandler (2000). For each region, the lag length of the VAR – *i.e.*, the order of the polynomials $A_{ij}(L)$ – was chosen by the multivariate BIC.

As indicated in Enders (2010), the issue of differencing is important in a VAR. Although lag length tests can be performed regardless of the order of the variables, Granger causality tests are generally inappropriate with nonstationary variables. As such, we performed standard Dickey-Fuller and Dickey-Fuller-Generalized Least Squares (DF–GLS) unit root tests on all of

[3] Gries, Krieger, and Meierrieks, (2011) also use a VAR in order to perform causality tests concerning the relationship between terrorism and the economic performance of seven Western European countries.

the variables. The results of the unit root tests are somewhat sensitive to the lag length, so we report results using both the BIC and general-to-specific (GS) methods of lag length selection in Table 2. Since it is implausible that the series are trend-stationary, each regression was estimated with an intercept, but not a deterministic trend term.

As shown in Table 2, most of the series appear to be stationary regardless of the test or lag length selection method used. If we use the 5% significance level, we can reject the null hypothesis of a unit root for the lag length selected by the GS method for both the DF and DF-GLS tests. Therefore, we estimate all VARs in levels rather than in first-differences.

Results of the Granger-causality tests for each region, reported in Table 3, are quite interesting in light of ESG's finding that domestic terrorism Granger-causes transnational terrorism but that the reverse relationship does not hold.[4] For the world as a whole, we find that the Granger-causality tests indicate that domestic terrorism and transnational do not Granger-cause each other. To see that transnational terrorism does not Granger-cause domestic terrorism, consider the fifth and sixth columns of Table 3. The *F*-statistic for the null hypothesis that all coefficients of $A_{12}(L) = 0$ is 1.26 with a *p*–value of 0.53. Similarly, as reported in columns 3 and 4, the sample value of the *F*-statistic for the test that transnational terrorism is Granger-caused by domestic terrorism is 3.79 with a *p*–value of 0.15.[5]

If you read down columns 3 and 4 of the table, it should be clear domestic terrorism always Granger-causes itself. Moreover, as reported in columns 3 and 4, domestic incidents Granger-cause transnational terrorism in the World (excluding Iraq and Afghanistan) at the 0.03

[4] Note that the table reports results using robust (*i.e.*, heteroskedastic consistent) standard errors. Results for using the Poisson distribution are reported as a diagnostic check of the OLS results. Granger-causality results using the negative binomial distribution are available from the authors.

[5] If all coefficients of $A_{12}(L) = 0$, lagged values of transnational terrorism do not appear in the equation for domestic terrorism and if all coefficients of $A_{21}(L) = 0$, lags of domestic terrorism do not appear in the equation for transnational terrorism.

level, and in the Middle East (excluding Iraq), Southeast Asia (excluding Afghanistan), and Sub-Saharan Africa at the 0.00 level.[6] Reading down columns 5 and 6, except for Sub–Saharan Africa, we find that domestic terrorism is never Granger-caused by transnational terrorism. Hence, the results are generally consistent with those of ESG in that (1) domestic incidents tend to evolve independently of transnational incidents and (2) transnational incidents (except for Iraq and Afghanistan) are Granger-caused by domestic incidents. The results are robust to the use of a Poisson count data model with robust standard errors. The major exception is Sub-Saharan Africa, where there is bidirectional causality between domestic and transnational incidents.

From a theoretical perspective, the finding that domestic terrorism causes transnational terrorism across all regions suggests that terrorist groups transition away from purely domestic attacks as they age, be it in response to (*i*) increased foreign support for their home country, (*ii*) "demonstration value" and media attention, or (*iii*) as a way to escape increasing domestic pressure. The bidirectional causality observed in Sub-Saharan Africa is an important exception and can likely be explained by the confluence of micro, group level factors (e.g., desire for media attention, base migration to a country other than the home/target, etc.) and the macro impact of contagion, as discussed previously and first addressed by Midralsky, Crenshaw and Yoshida (1980).

Unlike other regions, which only displayed unidirectional causality, Sub-Saharan Africa may have been particularly prone to the effects of contagion because of the presence of a number of "failed states." As such, in the Sub-Saharan region there is a prevalence of emigration across oft loosely guarded and soft borders. As Al-Qaeda and other successful terrorist groups came to Africa to train and African terrorists themselves moved from region to region, disaffected groups

[6] Results are also available from the authors for estimation with a negative binomial distribution.

across the continent were exposed to some of the most active and violent terrorists in the world. Given ample opportunity, many of these groups had reason to turn toward the tactics of their neighbors, both near and far, and terrorism spread throughout Sub-Saharan Africa. In other regions, contagion simply did not have as great of an impact, either because of hard boarders and political structure (e.g. Southeast Asia), or because of early adoption across the region (e.g. Middle East).

Although the Granger-causality tests are revealing, an important qualification is in order. It is well-known that neglecting a structural break can lead Granger-causality tests to be oversized. (i.e., they find too much causality). The issue of structural breaks is particularly relevant, as Enders, Liu, and Prodan (2009) find evidence of multiple (and offsetting) smooth structural changes in various terrorism series. However, as discussed in Enders (2010), breaks tend to manifest themselves as unit-root processes. Since the unit-root tests suggest that our variables are stationary, we are reasonably comfortable with the results of the causality tests. Nevertheless, to probe further and stay on the side of caution, we also performed innovation accounting (i.e., variance decompositions and impulse response functions) without imposing the results of the Granger-causality tests.

Table 4 reports the variance decompositions using a Choleski decomposition of the regression residuals. Since there is no *a priori* information as to the most appropriate causal ordering, we present the decompositions for each ordering. When we view domestic as causally prior to transnational terrorism, for the world as a whole, domestic terrorism explains almost all of its forecast error variance (FEV) for all horizons. Domestic terrorism explains only 3.7% of the one-step-ahead FEV of transnational terrorism. However, after 12 quarters, domestic terrorism explains as much as 19.6% of the FEV of transnational terrorism. Reading down the

rest of columns 3 and 4 of the table, it should be clear that transnational terrorism responds to domestic terrorism but that domestic terrorism (except for Sub-Saharan Africa) exhibits little response to transnational terrorism.

As shown in columns 5 and 6 of the table, the variance decompositions are somewhat different when we reverse the causal ordering. When transnational terrorism is casually prior to domestic terrorism, we find that after 12 months domestic terrorism explains about 96.5% of its own FEV and 10.7% of the FEV of transnational terrorism. Excluding Iraq and Afghanistan,domestic terrorism explains 23.1% of the FEV of transnational terrorism. The rest of column 5 indicates similar results for the Middle East (when Iraq is excluded from the sample) and Southeast Asia (without Afghanistan). These results are consistent with those of ESG in that we find an increase in instances of domestic terrorism generally spill over into an increase in transnational incidents. Interestingly, the results also carry the important implication that the extent to which spillover effects occur varies by region, with Southeast Asia particularly prone to spillovers.

Impulse response functions of the VARs for the world (without Iraq and Afghanistan), the Middle East (without Iraq), Southeast Asia (excluding Afghanistan), and Sub−Saharan Africa are shown in Figures 4, 5, 6, and 7, respectively. The impulse response functions are of particular interest, as they bring to light the direction, magnitude, and timing of the causal relationships. In order to highlight the influence of transnational terrorism, we show the impulse responses for each series for the case in which transnational terrorism is causally prior to domestic terrorism.[7] Since we do not impose the results of the Granger causality tests on the model and we assume that transnational terrorism is causally prior to domestic terrorism, this scenario maximizes the

[7] Impulse response functions for the reverse ordering are available in an unpublished referee's appendix.

effects of transnational terrorism shocks and minimizes the effects of domestic terrorism shocks. Nevertheless, we find significant evidence that domestic terrorism spills over into transnational terrorism.

For each region, the top row of the figure shows the responses of transnational terrorism and the bottom row shows the responses of domestic terrorism. The dashed lines in the figures show the 95% bootstrap confidence band around the impulse responses. Figure 4 indicates that, for the world, a one standard deviation shock to transnational terrorism (equal to about 8.6 incidents) is quite persistent in that the series is statistically different from zero for about 9 quarters. However, as shown in the lower-left panel, transnational terrorism does not have a statistically significant effect on domestic terrorism. As can be seen in the lower-right panel, a domestic terrorism shock (equal to about 48 incidents) is also quite persistent in that the domestic terrorism series remains above its mean for almost three years. Finally, as shown in the top-right panel, the domestic shock has a positive and persistent effect on transnational terrorism. On impact, transnational terrorism jumps by 1.8 incidents. After 12 quarters, the cumulated sum is an additional 20.9 transnational incidents.

For the Middle East (See Figure 5), a one-standard deviation shock to transnational terrorism (equal to about 3.5 incidents) quickly dissipates. Nevertheless, on impact, the transnational shock causes domestic terrorism to increase by about 6 incidents per quarter. After one year, domestic terrorism is still elevated by almost two incidents per quarter. The lower-right hand panel of the figure indicates that a one standard deviation domestic terrorism shock, equal to about 14 incidents, is also persistent, with domestic terrorism remaining 2 incidents above its mean after seven quarters. Even though the transnational shock has a small initial effect on transnational terrorism (about 0.75 incidents per quarter) the effects are persistent. After three

years, the cumulated total is more than 3.6 transnational incidents. Interestingly, the impulse responses for Southeast Asia (shown in Figure 6) and Sub-Saharan Africa (shown in Figure 7) tell a very similar story.

Overall, the innovation accounting reinforces ESG's argument that domestic terrorism influences the level of transnational terrorism. The result is quite robust to the causal ordering so long as incidents in Iraq and Afghanistan are excluded from the analysis. However, the influence of transnational terrorism on domestic terrorism is not as straightforward as the ESG findings. When (*i*) we do not impose the results of the causality tests, and (*ii*) treat transnational terrorism causally prior to domestic, we find that domestic terrorism in the Middle East and Sub-Saharan Africa display small, albeit positive and significant, responses to a transnational terrorism shock.

5. Time-Varying Correlations

As detailed in Chapter 5 of Enders (2010), the causal ordering in a VAR is important when the variables are contemporaneously correlated. Given the findings in the last section, it seems worthwhile to examine the time-varying correlation coefficient between domestic and transnational terrorism.

An interesting way to examine the contemporaneous relationship between domestic and transnational terrorism is to use a multivariate GARCH model. Note that equation (3) imposes the standard assumption that the correlation between innovations in domestic and transnational terrorism is constant. Recall that the correlation coefficient between the two errors is $\sigma_{12}/\sigma_1\sigma_2$. Since the variances (*i.e.*, σ_1^2 and σ_2^2) and the covariance (σ_{12}) are all constant, it follows that the correlation coefficient (ρ) is also constant. Instead, it is possible to allow the correlation coefficient to be time-varying. This is particularly interesting because we anticipate that the two series are more likely to move together in some periods than in others. We follow the procedures

described in Enders (2010) and estimate equations (1) and (2) allowing for the possibility that the correlation between the two series is greater in some periods than in others. As in our previous estimations, we used the multivariate BIC to select the lag length of the VAR. The key difference between the results of Section 3 and those reported here is that we relax equation (3) and estimate (1) and (2) as a multivariate GARCH(1, 1) model with a BEKK specification. Specifically, we estimate equations (1) and (2) simultaneously in such a way that the correlation between the errors is the time-varying function:[8]

$$\rho_t = E_{t-1}\left[\varepsilon_{1t}\varepsilon_{2t} / \sqrt{\varepsilon_{1t}^2 \varepsilon_{2t}^2} \right] \tag{4}$$

The interesting feature of (4) is that we are able to obtain the time-varying correlation between the two error terms—hence, unlike a standard VAR, we can allow the contemporaneous relationship between the two series to be stronger in some periods than in others.

The estimated values of ρ_t for the world (with and without Iraq and Afghanistan) are shown in Figure 8. Given that the point estimates are sometimes quite volatile, the figures show the time-varying correlation coefficient (the dashed line) and smoothed values (the solid line) using exponential smoothing with a smoothing weight of 0.1.[9] Panels 1 and 2 of the figure have similar shapes in the early portion of the sample. Nevertheless, the correlations including Iraq and Afghanistan are generally smaller, and more erratic, than those shown in Panel 2. Both exhibit a steady decline in the late 1980s to the point where the correlation actually becomes negative. Both begin an increase in early 1990s that might be attributable to the fall of the Soviet Union. Thereafter, the total world series levels off at almost 0.4 until it begins a slow decline in

[8] As discussed in Enders (2010), the BEKK specification imposes a quadratic form on the GARCH coefficients so that the estimated variances are necessarily positive. Given that (1) and (2) each have as many as four lags of each variable, the multivariate GARCH(1, 1) system can have a total of 29 coefficients. In order to save space, the estimated coefficients are not reported here; they are available from the authors upon request.

[9] Specifically, the smoothed values in period t (S_t) are constructed as $S_t = S_{t-1} + w(\rho_t - S_{t-1})$ where w is the smoothing weight.

2004. In contrast, the smoothed correlations shown in the lower panel rise from a low of –0.50 in 1991:3 to a high of 0.78 in 2007:2. The important point is that the two types of terrorism exhibit substantial and sustained co-movements throughout the first decade of the 21st century. Moreover, since 2007, the correlations between the two types of terrorism have been declining. The withdrawal of US troops and the stabilization of Iraq likely led to the sharp decline in transnational terrorism and could be responsible for the recent decline in the correlation.

The three panels of Figure 9 show the time-varying correlations for the Middle East plus North Africa (excluding Iraq), Southeast Asia (excluding Afghanistan), and Sub-Saharan Africa. For these three regions, a moderate positive correlation is shown for the majority of the sample period. Nevertheless, the smoothed correlations are usually largest for the Middle East. Perhaps the most interesting result is that the correlations for the Middle East, Southeast Asia, and Sub–Saharan Africa have been generally rising during the last few years of the sample. As such, while the relationship between domestic and transnational terrorism appears to have been weakening at the global level, it may have actually been strengthening in the regions we examine.

6. Conclusion

Vector autoregressions on the decomposed GTD database reveal a strong, but time-varying, causal relationship between domestic and transnational terrorism for the world as a whole and for three key regions. This finding largely confirms the conclusions drawn by ESG in their previous analysis of the dynamic relationship. Regional analysis of domestic and transnational terrorism also adds to previous work by bringing to light the effect of transnational violence on domestic terrorism in the Middle East and North Africa when incidents in Iraq are included. Further, evaluation at the regional level highlights discrepancies in the strength of the

effect between regions, and GARCH models highlight the variation in the correlations over time. As a final note, it is important to recognize that, even though the effect of transnational incidents on domestic terrorism is too weak to withstand Granger-causality, impulse response functions indicate that a large transnational shock actually does result in a statistically significant increase in domestic terrorism across regions, though not for the world as a whole.

Given our key finding that domestic terrorism causes subsequent transnational terrorism, governments such as the United States should be wary of domestic terrorism abroad as it is likely to spill over into transnational attacks. From a policy perspective, countries that are frequently targeted in transnational attacks should focus the majority of their counterterrorism resources on the Middle East. Not only does the Middle East account for a preponderance of terrorism incidents, but it also has the greatest positive correlation between domestic and transnational terrorism.

Still, political leaders should tread carefully. Though definitional issues cloud the picture (i.e., attacks against military noncombatants are classified as terrorism), we find that the causal relationship is reversed and transnational terrorism causes domestic terrorism when incidents in Iraq and Afghanistan are included. Given the results of impulse response functions, which indicate that a large (one standard deviation or greater) shock in transnational terrorism has a positive and persistent effect on the number of domestic incidents, the relationship uncovered in the Middle East is likely nontrivial. This finding is a clear deviation from ESG's previous results and indicates that governments should be particularly careful when intervening in violence prone regions with the aim of either "fighting terrorism" or "peacekeeping." Irrespective of intent, increased military presence is likely to create a "shock" in overall violence, leading to a subsequent rise in incidents of both transnational and domestic terrorism.

Our findings suggest that governments could benefit from a dramatic shift in political thought on terrorism. Domestic and transnational terrorism do not happen in a vacuum, but are intrinsically intertwined, and targeting either with a broad military effort is likely to result in an increase in both. As the recent rise in correlation between the two types of terrorism at the regional level indicates, it is more important now than ever for governments to view terrorism holistically when devising strategies to mitigate its effects.

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Figure 1: Global Terrorism

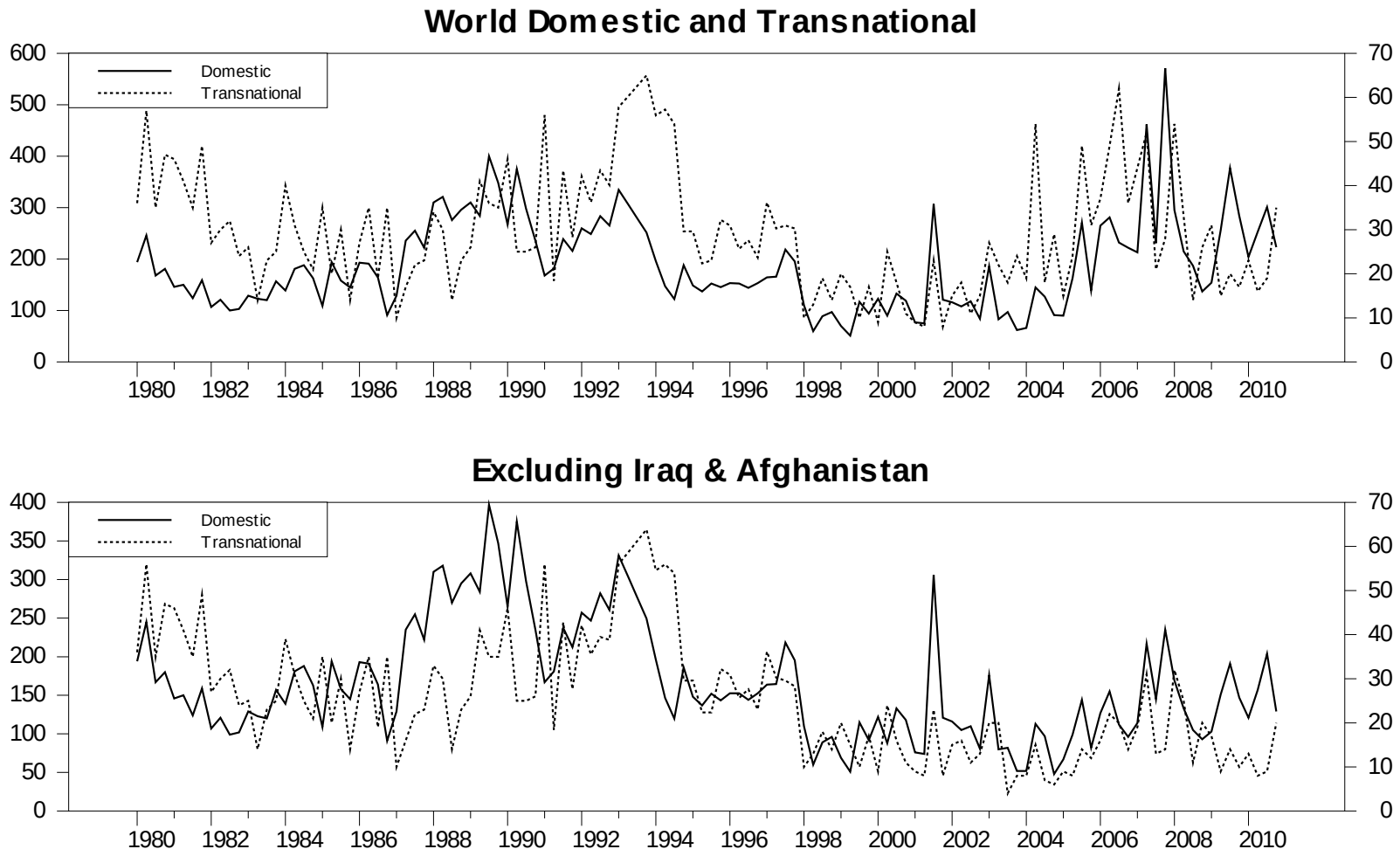


Figure 2: Domestic and Transnational Terrorism

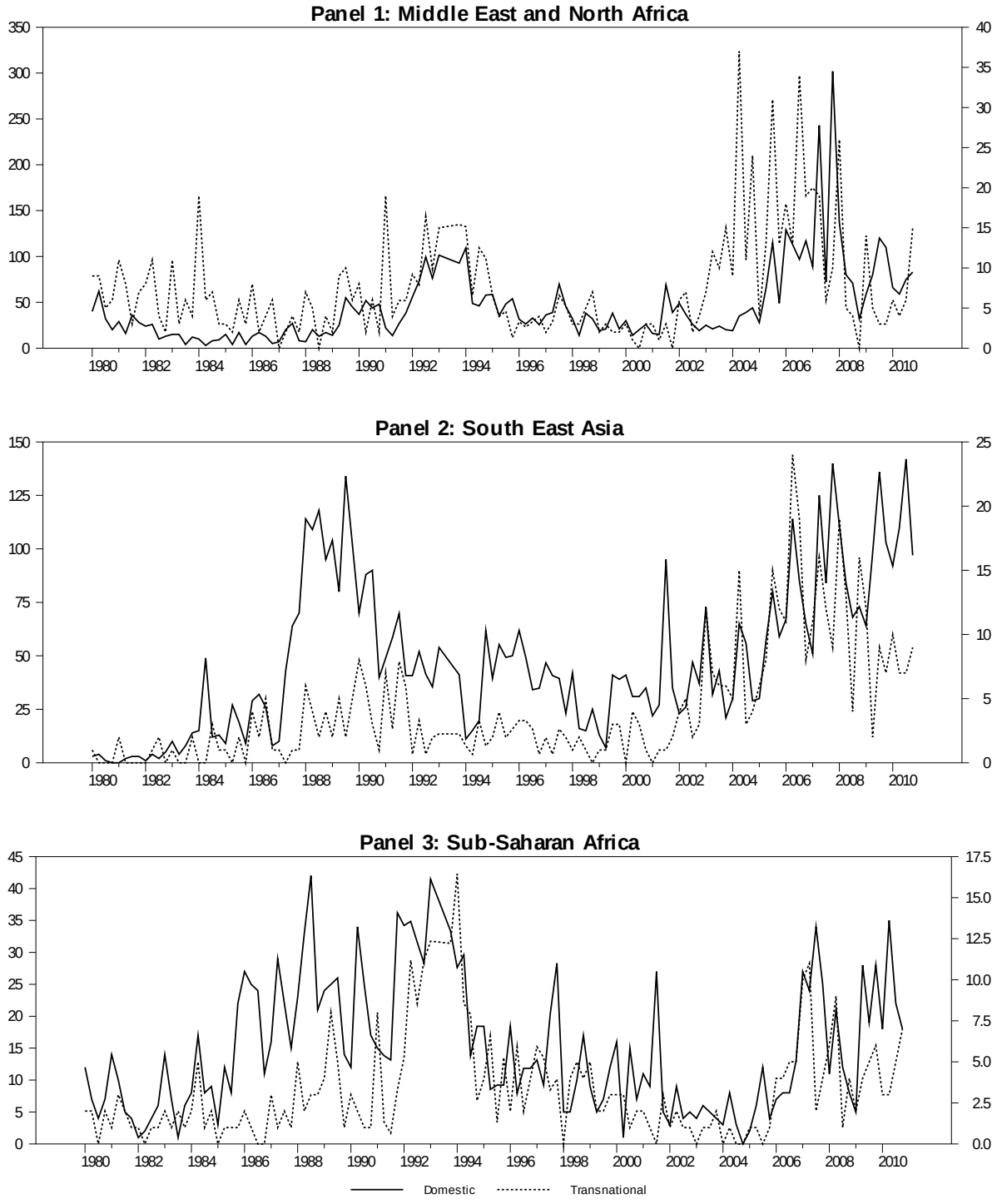
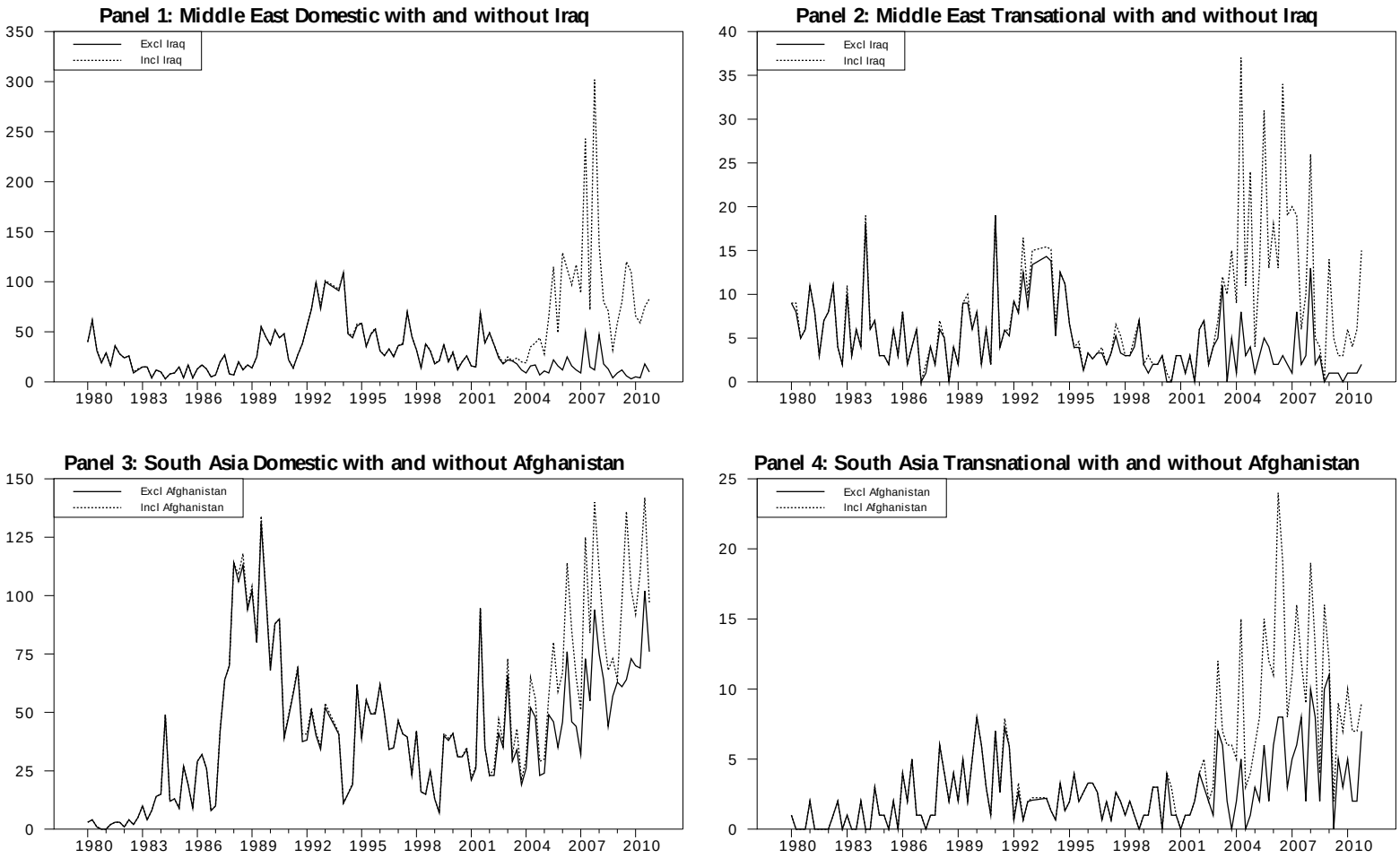


Figure 3: Middle East and South Asia



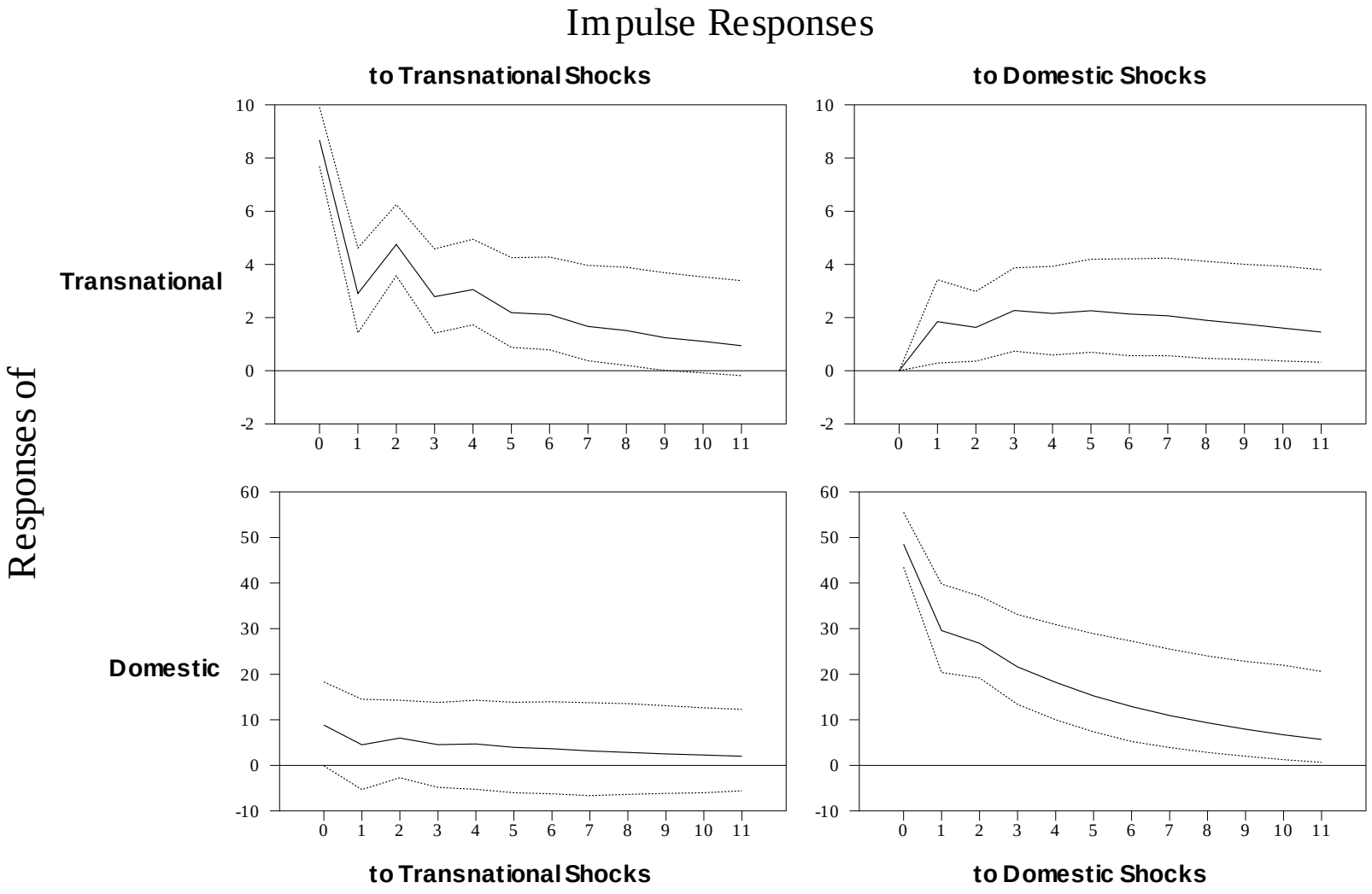


Figure 4: Impulse Responses for the World

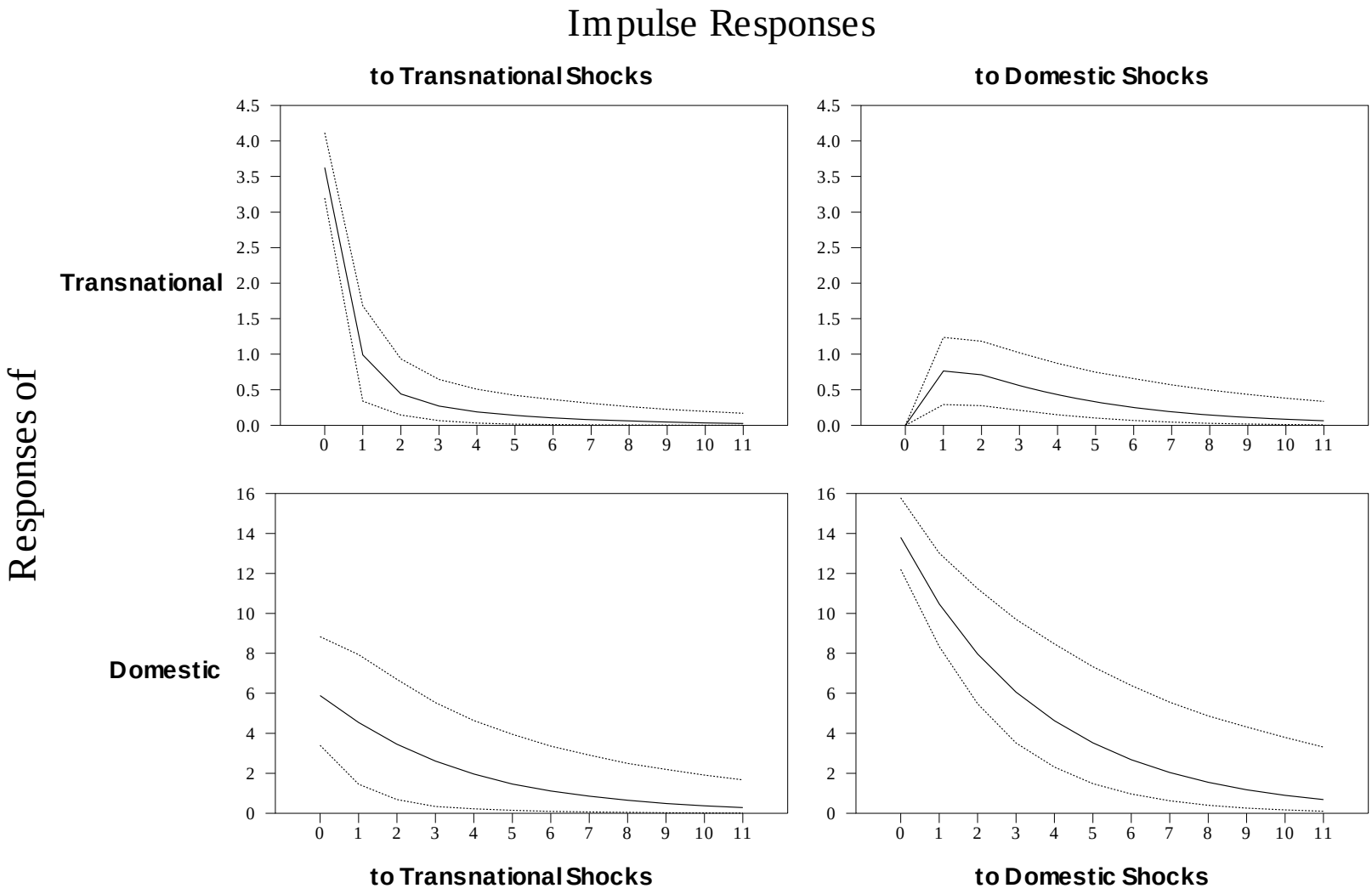


Figure 5: Impulse Responses for the Middle East

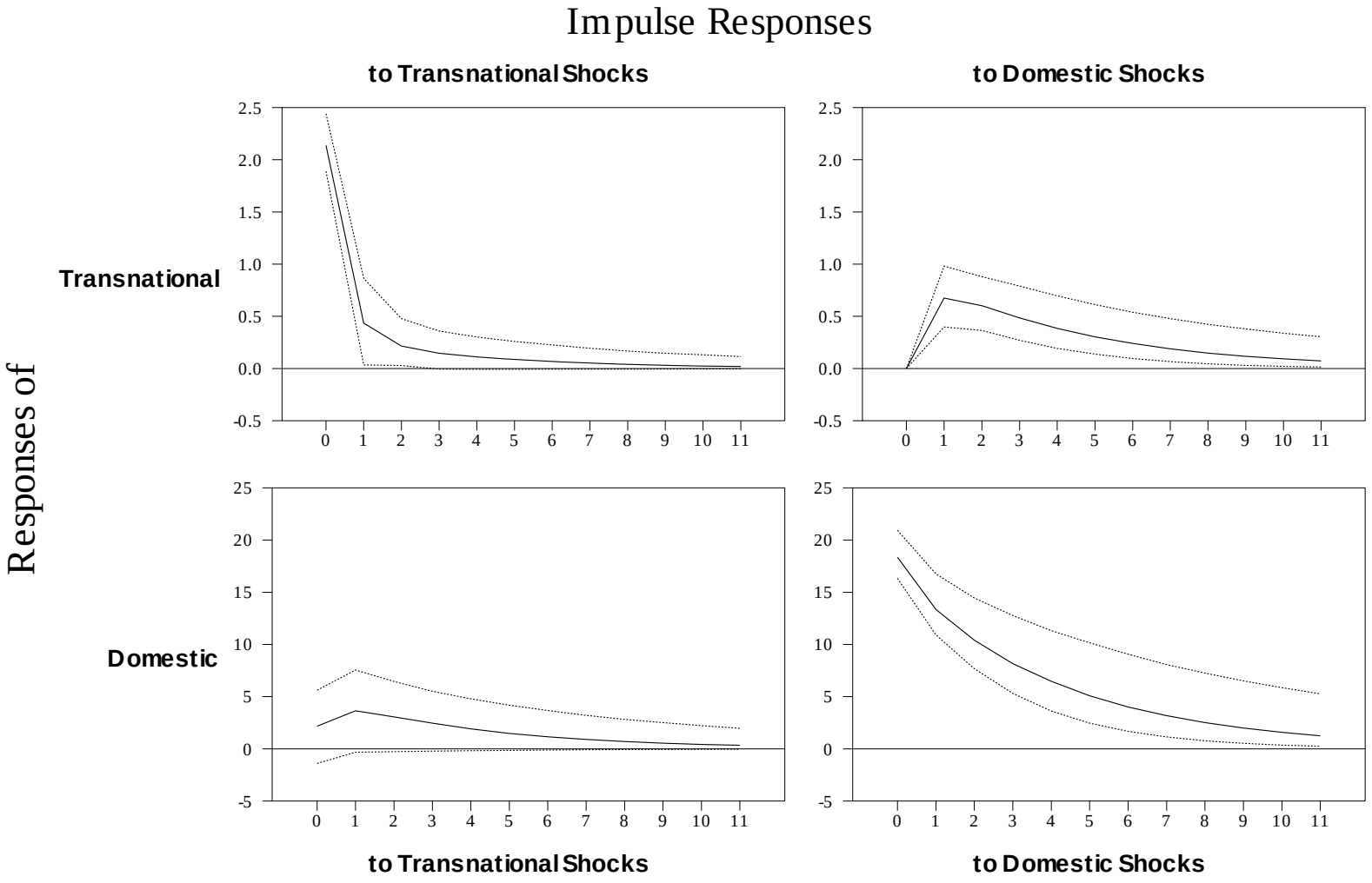


Figure 6: Impulse Responses for South East Asia

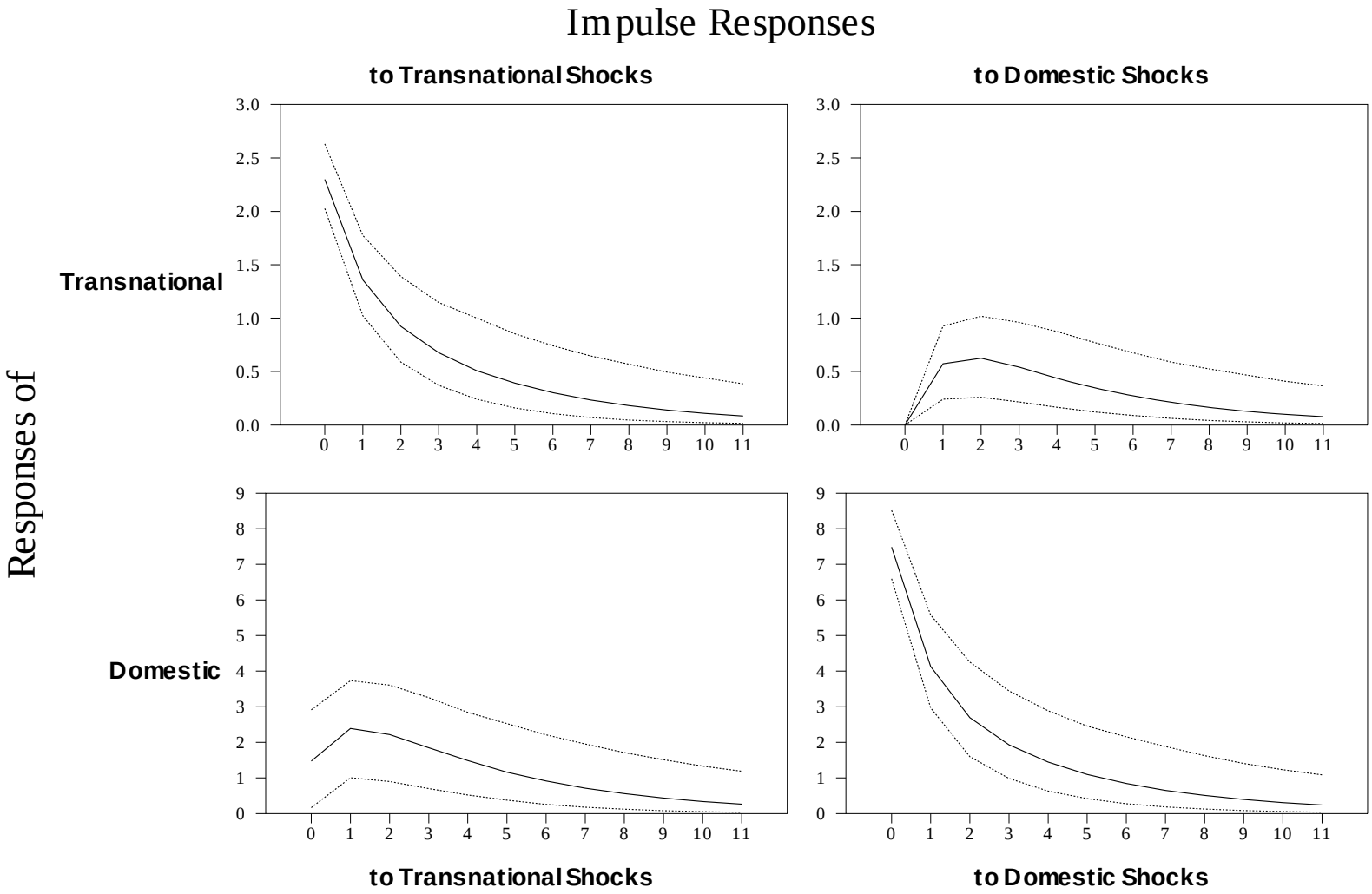


Figure 7: Impulse Responses for Sub-Saharan Africa

Figure 8: Time-Varying Correlations

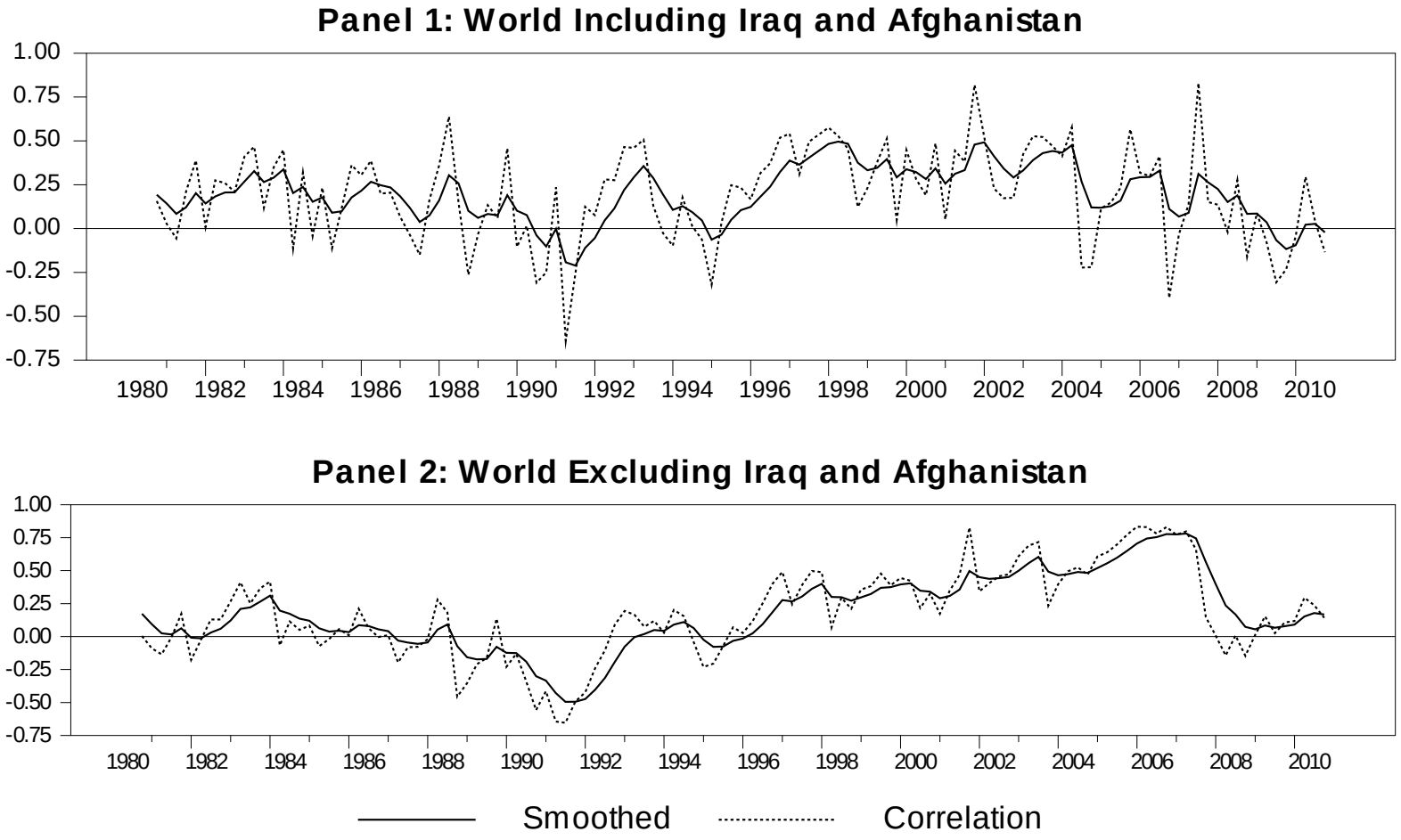


Figure 9: Time-Varying Correlations For Selected Regions

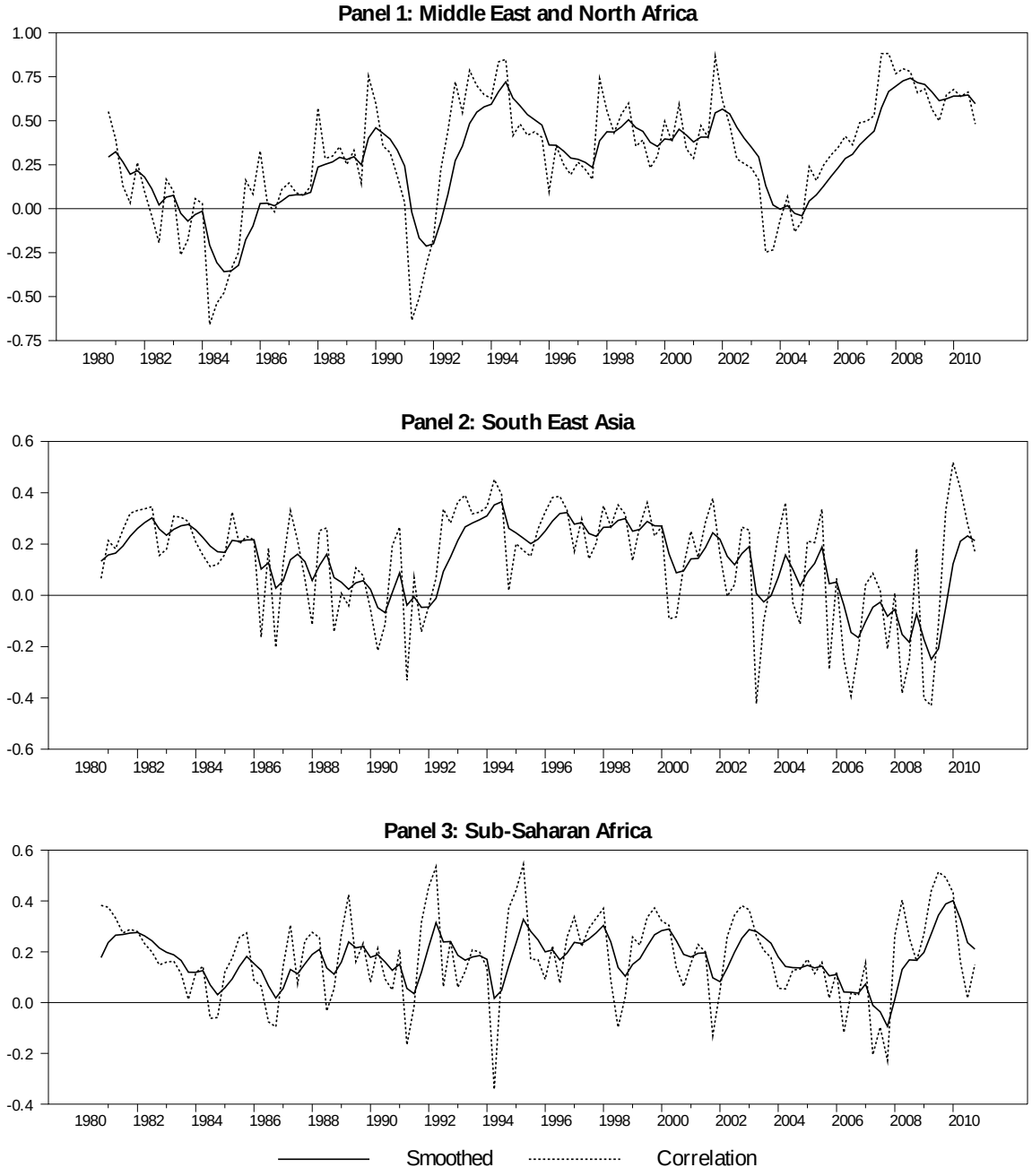


Table 1: Summary Statistics of the Casualty Series: 1979:4 – 2010:4

Region	Mean	Median	Std. Dev.	Maximum	Minimum
World (Domestic)	188.13	164.00	89.50	571.00	49.00
World (Trans.)	29.63	27.00	13.75	65.00	8.00
World Excluding Iraq and Afgh. (Domestic)	164.31	148.00	75.49	397.00	48.00
World Excluding Iraq and Afgh. (Trans.)	25.41	23.00	13.86	64.00	4.00
Middle East (Domestic)	45.58	32.00	43.03	302.00	3.00
Middle East (Trans.)	7.66	6.00	6.76	37.00	0.00
Middle East Excl. Iraq (Domestic)	28.18	20.00	22.99	109.00	3.00
Middle East Excluding Iraq (Trans.)	4.89	4.00	3.98	19.00	0.00
Southeast Asia (Domestic)	47.90	41.00	35.92	142.00	0.00
Southeast Asia (Trans.)	4.12	2.00	4.65	24.00	0.00
Southeast Asia Excluding Afgh. (Domestic)	41.44	39.00	29.00	131.00	0.00
Southeast Asia Excluding Afgh. (Trans)	2.65	2.00	2.49	11.00	0.00
Sub-Saharan Africa (Domestic)	15.03	12.00	10.49	42.00	0.00
Sub-Saharan Africa (Trans.)	3.34	2.00	3.23	16.00	0.00

Table 2: Results of the Unit Root Tests

Region	DF (BIC)	DF (GS)	DF–GLS (BIC)	DF–GLS (GS)
World (Domestic)	-3.389	-5.405	-2.023	-3.380
World (Trans.)	-3.605	-6.084	-2.323	-4.123
World Excluding Iraq and Afgh. (Domestic)	-3.158	-4.402	-2.071	-2.806
World Excluding Iraq and Afgh. (Trans.)	-2.713	-4.814	-1.436	-2.918
Middle East (Domestic)	-2.743	-5.559	-2.135	-4.549
Middle East (Trans.)	-2.324	-7.289	-2.210	-7.038
Middle East Excl. Iraq (Domestic)	-2.971	-4.073	-2.465	-3.273
Middle East Excluding Iraq (Trans.)	-4.262	-7.609	-4.283	-7.641
Southeast Asia (Domestic)	-2.628	-3.726	-1.582	-2.585
Southeast Asia (Trans.)	-1.889	-4.858	-1.320	-4.040
Southeast Asia Excluding Afgh. (Domestic)	-2.889	-3.998	-1.717	-2.693
Southeast Asia Excluding Afgh. (Trans)	-3.295	-7.426	-2.208	-5.688
Sub-Saharan Africa (Domestic)	-4.953	-4.953	-3.549	-3.549
Sub-Saharan Africa (Trans.)	-3.236	-4.804	-2.439	-3.768

For the Dickey-Fuller (DF) tests the 5% and 10% critical values are −2.89 and −2.58, respectively. For the DFGLS test, the 5% and 10% critical values are −1.95 and −1.62, respectively.

Table 3: Granger Causality Tests

		Robust OLS				Robust Poisson			
		Domestic		Trans.		Domestic		Trans.	
Region	**Dependent Variable**	*F*-Stat	*p*-value	*F*-Stat	*p*-value	*F*-Stat	*p*-value	*F*-Stat	*p*-value
World	Domestic	88.24	0.00	1.26	0.53	83.62	0.00	1.92	0.38
	Trans.	3.79	0.15	62.91	0.00	4.84	0.09	78.20	0.00
World (Excluding Iraq and Afgh.)	Domestic	120.52	0.00	0.20	0.91	137.04	0.00	0.93	0.63
	Trans.	6.79	0.03	92.70	0.00	10.74	0.01	107.88	0.00
Middle East	Domestic	48.69	0.00	2.64	0.27	52.99	0.00	6.80	0.03
	Trans.	2.18	0.34	32.49	0.00	2.38	0.31	48.24	0.00
Middle East (Excluding Iraq)	Domestic	77.53	0.00	0.00	0.95	76.14	0.00	0.44	0.51
	Trans.	8.24	0.00	3.99	0.05	8.85	0.00	3.87	0.05
Southeast Asia	Domestic	112.50	0.00	0.67	0.88	115.54	0.00	1.67	0.64
	Trans.	6.49	0.09	55.57	0.00	21.68	0.00	96.18	0.00
Southeast Asia (Excluding Afgh.)	Domestic	117.58	0.00	1.52	0.22	127.89	0.00	5.92	0.02
	Trans.	23.36	0.00	1.77	0.18	34.14	0.00	3.63	0.06
Sub-Saharan Africa	Domestic	52.45	0.00	8.64	0.00	62.40	0.00	7.36	0.01
	Trans.	11.712	0.00	28.56	0.00	14.814	0.00	31.368	0.00

Table 4: Forecast Error Variance Accounted for by Domestic Shocks

		Domestic Causally Prior		Transnational Causally Prior	
Region	**Steps**	**Domestic**	**Transnational**	**Domestic**	**Transnational**
World	1	100.0	3.7	96.3	0.0
	4	99.3	13.0	96.7	5.7
	8	99.4	17.8	96.6	9.2
	12	99.4	19.6	96.5	10.7
World (Excluding Iraq and Afgh.)	1	100.0	3.3	96.7	0.0
	4	100.0	17.2	96.5	9.0
	8	99.9	28.9	96.0	18.3
	12	99.8	34.2	95.7	23.1
Middle East	1	100.0	8.3	91.7	0.0
	4	98.2	14.6	86.4	4.2
	8	95.5	16.2	80.9	4.9
	12	94.4	16.8	78.9	5.3
Middle East (Excluding Iraq)	1	100.0	15.2	84.8	0.0
	4	100.0	27.0	84.5	9.1
	8	100.0	29.2	84.5	11.3
	12	100.0	29.5	84.5	11.6
Southeast Asia	1	100.0	6.8	93.2	0.0
	4	99.5	12.2	91.2	2.4
	8	98.2	16.9	87.6	4.5
	12	96.6	19.5	84.7	5.9
Southeast Asia (Excl. Afghanistan)	1	100.0	1.4	98.6	0.0
	4	98.6	21.2	95.3	18.3
	8	98.4	25.7	94.8	22.6
	12	98.4	26.3	94.8	23.2
Sub-Saharan Africa	1	100.0	3.7	96.3	0.0
	4	92.7	20.8	83.7	10.9
	8	90.4	24.9	80.6	14.2
	12	90.2	25.4	80.2	14.6