What is Transnational Terrorism

Transnational terrorism is a “premeditated threatened or actual use of force or violence to attain a political goal through fear, coercion, or intimidation” and when its ramifications transcend national boundaries through the nationality of the perpetrators and/or human or institutional victims, location of the incident, or mechanics of its resolution (Mickolus et al. 1989).
Research Question

Do social, economic, and political factors influence the environment conducive to terrorist activities?
If so, how?

Counter-Terrorism Strategies

- Strategies and terrorism formats:
  - Strategies focusing on terrorism of certain format (mental detection)
  - Strategies less sensitive to terrorism format (international sanctions, financial aid, education assistance)

- Protective vs. responsive strategies
  - If protective strategies is more desirable to thwart terrorism, then we need to think about factors encouraging/discouraging terrorism participation.
Does Poverty Breed Terrorism?

**Some say Yes**
- Alesina et al. (1996) suggest that poor economic conditions increase the probability of political coups.
- Hess and Orphanides (2001) show that the frequency of war is greater following recessions than economic growth.
- Blomberg and Hess (2002) suggest that economic recessions increase the probability of internal/external conflicts.
- Blomberg, Hess and Weerapana (2004) find that economic recessions increase the probability of terrorist activities in democratic high-income countries.
- Li and Schaub (2004) find that economic development decreases the number of international terrorist incidents.
- Fearon and Laitin (2003) conclude that poverty has a significant positive effect on violent domestic conflicts.

**Some say No**
- Piazza (2006) finds no significant relationship between terrorism and income equity, per capita GDP growth, unemployment, and so forth.
- Abadie (2006) finds no significant relationship between risk of terrorism and economic variables.
- Krueger and Laitin (2003) suggest that poor countries do not generate more terrorism than rich countries with similar levels of civil liberties.

Do Other Economic Conditions Matter?

**Political freedom?**
- Abadie (2006) finds a countries with intermediate levels of political freedom are more prone to terrorism than countries with high or low levels of political freedom.
- Li (2005) shows that democratic participation reduces transnational terrorism.

**Education?**
- Stern (2000) attributes involvement in terrorist acts to lack of adequate education.

**Religion?**
- Enders and Sandler (2000) attribute the increase in the severity of terrorist attacks to the growth of religious terrorism.
- Stern (2000) attributes involvement in terrorist acts to lack of adequate education.

**Others like trade, income equality, unemployment, etc?**
- Li and Schaub (2004) find that trade, foreign direct investment, and portfolio of investment have no direct positive effect on the number of terrorist events.
- Muller and Seligson (1990) and London and Robinson (1989) show that income inequality is a significant predictor of political violence.
What is Our Specific Mission

- Separate the impacts of socio-economic and political factors on
  - Likelihood of terrorism participation
  - Number of terrorism participation at country level
- Investigate the relationships of terrorism participation and
  - income (nonlinear?)
  - education (nonlinear?)
  - effects of religion
  - openness to trade (negative?)
  - unemployment (positive?)
  - economic freedom (negative?)

Data Sources

- The chronological data on transnational terrorism events was obtained from Dr. Edward Mickolus (Vinyard Software Inc.), including
  - incident date, incident’s country of origin, location of incident, up to three nationalities of victims, and up to three nationalities of perpetrators.
- Socio-economic and political variables
  - World Bank data base
  - CIA world factbook
  - Various National Statistics Services
  - Heritage Foundation
Dependent Variable

- The dependent variable is **annual counts of terrorism events by country and year** in which citizens of a particular country were documented as perpetrators.
  - The annual count of terrorism events for Philippines in 2000 is seven, which means that the Philippine nationals were documented as perpetrators for seven transnational terrorism incidents in 2000.
- The original chronological data documents up to three nationalities of perpetrators for each terrorism incident.
  - On March 15, 1982 three Salvadorans, two Nicaraguans, one Chilean and others were arrested for intending to kidnap an unidentified American diplomat. This incident increases the annual count of terrorism events by one for Salvador, Nicaragua, and Chile each.

Documented with known nationalities vs. unknown nationalities

- Unknown: either the perpetrators or their nationalities were not traceable.

Counts vs. Incidents

Transnational Terrorism Data

<table>
<thead>
<tr>
<th></th>
<th>Terrorism incidents</th>
<th>Terrorism counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With known nationalities only</td>
<td>Including Unknown nationality</td>
</tr>
<tr>
<td>Documented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5,504</td>
<td>8,162</td>
</tr>
<tr>
<td>During 80s</td>
<td>3,038</td>
<td>4,651</td>
</tr>
<tr>
<td>During 90s</td>
<td>2,466</td>
<td>3,511</td>
</tr>
<tr>
<td>Study sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,677</td>
<td>2,748</td>
</tr>
<tr>
<td>During 80s</td>
<td>1,493</td>
<td>1,542</td>
</tr>
<tr>
<td>During 90s</td>
<td>1,184</td>
<td>1,206</td>
</tr>
</tbody>
</table>
Dependent variable: Annual Counts of Terrorism Events in the Sample

<table>
<thead>
<tr>
<th>Event counts</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>841</td>
<td>233</td>
<td>92</td>
<td>52</td>
<td>42</td>
<td>26</td>
<td>127</td>
<td>1413</td>
</tr>
<tr>
<td></td>
<td>(59.52)</td>
<td>(16.49)</td>
<td>(6.51)</td>
<td>(3.68)</td>
<td>(2.97)</td>
<td>(1.84)</td>
<td>(8.99)</td>
<td>(100)</td>
</tr>
</tbody>
</table>

Small number of event counts—91% of observations have at most five event counts.

Excess zeros: 60% of observations have a zero count of terrorism event participation.

Independent Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>GDP per capita ($1,000)</td>
<td>6.62</td>
<td>8.86</td>
<td>0.07</td>
<td>44.76</td>
</tr>
<tr>
<td>GINI</td>
<td>GINI index (0=perfectly inequity; 1=perfectly equity)</td>
<td>0.40</td>
<td>0.11</td>
<td>0.19</td>
<td>0.74</td>
</tr>
<tr>
<td>PV1</td>
<td>population ratio living under $1/day</td>
<td>0.11</td>
<td>0.15</td>
<td>0.00</td>
<td>0.71</td>
</tr>
<tr>
<td>PV12</td>
<td>population ratio living on $1 to $2/day</td>
<td>0.15</td>
<td>0.15</td>
<td>0.00</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>Education measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literacy</td>
<td>population ratio who can read and write</td>
<td>0.82</td>
<td>0.20</td>
<td>0.29</td>
<td>1.00</td>
</tr>
<tr>
<td>Primary</td>
<td>percent of labor force with primary education as the highest achieved</td>
<td>0.38</td>
<td>0.18</td>
<td>0.03</td>
<td>0.85</td>
</tr>
<tr>
<td>Secondary</td>
<td>percent of labor force with secondary education as the highest achieved</td>
<td>0.29</td>
<td>0.19</td>
<td>0.00</td>
<td>0.79</td>
</tr>
<tr>
<td>Tertiary</td>
<td>percent of labor force with tertiary education as the highest achieved</td>
<td>0.15</td>
<td>0.11</td>
<td>0.00</td>
<td>0.54</td>
</tr>
</tbody>
</table>
### Independent Variables (cont’)

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Religion measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christian</td>
<td>Christian population ratio</td>
<td>0.63</td>
<td>0.37</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Muslim</td>
<td>Muslim population ratio</td>
<td>0.18</td>
<td>0.32</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Hindu</td>
<td>Hindu population ratio</td>
<td>0.02</td>
<td>0.10</td>
<td>0.00</td>
<td>0.81</td>
</tr>
<tr>
<td>Buddhist</td>
<td>Buddhist population ratio</td>
<td>0.05</td>
<td>0.19</td>
<td>0.00</td>
<td>0.95</td>
</tr>
<tr>
<td>Other religion</td>
<td>population ratio with other regions</td>
<td>0.07</td>
<td>0.09</td>
<td>0.00</td>
<td>0.66</td>
</tr>
<tr>
<td>No religion</td>
<td>population ratio with no religions</td>
<td>0.06</td>
<td>0.15</td>
<td>0.00</td>
<td>0.94</td>
</tr>
<tr>
<td><strong>Other variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td>unemployment rate</td>
<td>0.09</td>
<td>0.06</td>
<td>0.00</td>
<td>0.36</td>
</tr>
<tr>
<td>Openness to trade</td>
<td>(export+import)/GDP</td>
<td>0.67</td>
<td>0.52</td>
<td>0.09</td>
<td>4.97</td>
</tr>
<tr>
<td>Freedom</td>
<td>economic freedom (1=highest; 5=lowest economic freedom)</td>
<td>3.01</td>
<td>0.64</td>
<td>1.80</td>
<td>4.78</td>
</tr>
</tbody>
</table>

### Methodology

- **Count data analysis**
  - Poisson
  - Negative binomial (NB)
  - Zero-inflated Poisson (ZIP)
  - Zero-inflated negative binomial (ZINB)
  - Two-part model
  - Selection model

- **Pooled vs. panel estimation**
Poisson Regression Model

- **Poisson**
  - Equal mean and variance
  - Over-dispersion
  - Conditional mean: \( \lambda_i(x_i) = E(y_i \mid x_i) = \exp(x_i \beta) \)

- **Probability density function:**
  \[
  f(y_i \mid x_i) = \frac{\exp(-\lambda_i) \lambda_i^{y_i}}{y_i!}
  \]

NB Regression Model

- The NB Regression model adds an error term to the conditional mean of the Poisson to model the unobserved heterogeneity.
- Conditional mean
  \[
  E(y_i \mid x_i) = \exp(x_i \beta + \epsilon_i)
  \]

- Probability density function
  \[
  f(y_i \mid x_i) = \frac{\Gamma(y_i + 1/\alpha)}{y_i! \Gamma(1/\alpha)} \left( \frac{1}{1 + \alpha \lambda_i} \right)^{1/\alpha} \left( \frac{\lambda_i}{1 + \alpha \lambda_i} \right)^{y_i}
  \]

- Conditional mean:
  \[
  E(y_i \mid x_i) = \lambda_i
  \]

- Variance:
  \[
  VAR(y_i \mid x_i) = \lambda_i (1 + \alpha \lambda_i)
  \]
ZIP Regression Model

- The ZIP regression model accounts for excess zeros,
  \[ y_i = 0 \quad \text{with probability} \quad \pi_i \]
  \[ y_i \sim \text{Poisson}(\lambda_i) \quad \text{with probability} \quad 1 - \pi_i \quad (y_i = 0, 1, 2, \ldots) \]

- Prob. of having an extra zero which is not subject to
  the Poisson distribution,
  \[ \pi_i = \frac{\exp(-z_i \gamma)}{1 + \exp(-z_i \gamma)} \]

- Conditional mean:
  \[ E(y_i \mid x_i) = (1 - \pi_i) \lambda_i \]

- Variance:
  \[ \text{VAR}(y_i \mid x_i) = \lambda_i (1 - \pi_i) (1 + \lambda_i \pi_i) \]

ZINB Regression Model

- Conditional mean
  \[ E(y_i \mid x_i) = (1 - \pi_i) \lambda_i \]

- Variance
  \[ \text{VAR}(y_i \mid x_i) = \lambda_i (1 - \pi_i) (1 + \lambda_i (\pi_i + \alpha)) \]
Model Specification Tests

- Test on $\alpha = 0$ compares specifications of nested model, i.e., ZINB versus ZIP, or Poisson vs. NB.
- The Vuong test (likelihood ratio test) compares specifications of non-nested models, i.e., ZINB vs. NB, or ZIP vs. Poisson.

Two-Part Model vs. Selection Model

- Participation equation
  - Whether participated (dependent VAR=1) or not (dependent VAR=0)

- Frequency equation applies only on observations with a positive count.
  - Two-part model: two equations are disjoined
  - Selection model: two equations are connected through the Mills’ ratio that is calculated based on the participation equation and incorporated in the frequency equation.
Model Specification Tests for Our Data

- After estimating the ZINB model, two statistical tests are conducted:
  - The Vuong test favors the ZINB model over the standard NB model (*Vuong-statistic*=8.26 and *p*-value=0)
  - The Student-t test favors the NB model (*t*-statistic=20.17 and *p*-value=0).
- Results suggest that the over-dispersion still exists even after controlling for excess zeros. ZINB model is more appropriate specification for our data than the Poisson, NB, and ZIP models.

Model Specification Test for Our Data (con’t)

- The two-part model and the selection model provide similar estimation results.
  - The Mills ratio is not significant in the frequency equation of the selection model.
Model Specification Test for Our Data (con’t)

- Panel estimation does not provide prediction as good as the estimation on the pooled data (Table 2).

Estimation Results

- Results from the five models (Poisson, NB, ZIP, ZINB, two-part models) are robust
- Statistically significant variables in all five models
  - GINI index: positive
  - unemployment rate: positive
  - openness to trade: negative
  - economic freedom index: positive (the lower the economic freedom, the higher the likelihood and the frequencies of terrorism participations)
  - population ratio living on one to two dollars a day
Estimation Results Relating to Income Measures

- Incorporated variables of income measures:
  - GDP per capita and its square term
  - Poverty indicators: % of population living on one dollar or one to two dollars a day.
  - Gini index

- Results on GDP per capita:
  - A non-linear effect of GDP per capita on the frequencies of terrorism participation.
  - Implications: an increase of GDP per capita increases (decreases) frequencies of terrorism participation when a country is at a relatively lower (higher) level of per capita income.

- Results on poverty indicators:
  - Increasing the proportion of population living on less than one dollar per day decreases, while increasing the proportion of population living on one to two dollars per day increases the likelihood of participation in terrorism acts.
  - Both have positive effects on frequency of participation in transnational terrorism.

- Implications: Marginal improvements from the extreme poverty may enable the disadvantaged to materialize their hatred for the societies which they deem responsible for, or contributing to, their impoverished living conditions, and/or which they view as threats to their culture.

- Results on GINI index: the GINI index has a positive effect on the likelihood and the frequencies of terrorism participation.

Estimation Results Relating to Education Measures

- Variables incorporated of education measures:
  - Literacy ratio
  - Labor force primary, secondary, or tertiary education

- Estimation results:
  - Literacy is insignificant on probability of terrorism participation, but has significant and positive effects on the frequencies of terrorism participation.
  - Primary and tertiary education variables have no significant effect on likelihood of participation. Both have negative effect on frequency of terrorism participation.
  - The results on secondary education are mixed across models.
  - Improving education from primary to secondary level increases, while improving education level from secondary to tertiary level decreases the frequencies of terrorism participation.

- Implications: Limited education may increase the frequency of participation in transnational terrorism, while advanced education levels may deter the participation frequency.
Other Estimation Results

- Religion measures
  - Percentage of population who practice organized religions like Christianity, Hinduism, Buddhism, and Islam, relative to no religion, has significant and positive effect on the frequencies of terrorism participation.

- Time trend
  - Decade dummy has a significant, negative effect on probability as well as frequency of participation in transnational terrorism. These results suggest that the 1990s relative to the 1980s had lower probability and frequency of participation in terrorism events.

Conclusions

- Per capita income has a nonlinear effect on terrorism participation.
- Extreme poverty may preclude the opportunities to participate in terrorism acts and relative alleviation of poverty levels may provide marginal resources to participate in terrorism acts and materialize accumulated hatred.
- Limited education may increase but advanced education may decrease the frequency of terrorism participation.
- Openness to trade, income equality, employment opportunities, and religion, may have significant effects on probability and frequency of terrorism participation.
Cautions on Interpretations of the Results

- The dataset was constructed using a limited amount of best available information and involved extrapolation of socio-economic estimates over the periods for which data was not available. Caution is warranted for interpretation of the results.

- The findings should be interpreted as no more than a preliminary support of the idea that socioeconomic factors may play a role in encouraging/discouraging terrorist behavior.

- Further studies based on either more complete records or on alternative approaches, which would avoid reliance on observational data, are necessary to fully understand the linkage between socioeconomic factors and participation in transnational terrorism acts.