Terrorism and FDI Flows: Cross-country Dynamic Panel Estimation

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1. Introduction

After the September 11 terrorist attacks, the economic impacts of terrorist activities has attracted wide attention from policy makers and academics. Through the risks with possible future terrorist incidents, the huge cost associated with terrorist incidents and the significant redistribution of economic resources motivated a better understanding the economic consequences of terrorism.

Terrorism might aggravate economic performance through increases of costs, which include an increase in insurance premium, the disruptions of the transportation system, the severe tightening of border controls, and increase of public spending on homeland security and military operations. Even with the measurement problems such as aggregation issues, the definition of damage, and the causality of the indirect effects etc., OECD estimated costs resulting from the terror attacks of September 11 of 14 billion USD for the private sector, 1.5 billion USD for state and local government enterprises, 0.7 billion USD for the US federal government, and 11 billion USD for the rescue and clean-up operations (Lenain et al., 2002). An increase of transaction costs might affect the flows of commodity trade as well as financial capitals. While the impact of terrorism on trade and capital flows may vary across time and place, terrorism generally imply additional costs for transactions so that, if anything, we would expect a negative association between terrorist activity and the volume of trade and capital flows.

The policy responses to prevent and detect terrorism are enacted on borders and include closer inspections on people, vehicles and goods as well as more restrictive immigration regulations. And there is the risk of a direct destruction of traded goods. Studying the empirical effects of terrorism on international trade, Nitsch and Schumacher (2004) find that conflicts, broadly defined, has significant effects on bilateral trade flows; a doubling in the number of terrorist incidents is associated with a decrease in bilateral trade by about 4%.

Furthermore, the shrinkage of terrorism-related insurance coverage stemming from the perception of greater risks, higher transaction costs may have a detrimental impact on investment, as lenders become wary of greater potential risks, although there is no strong

evidence yet of such a pattern.

This paper is to investigate the impact of terrorism on the flow of foreign direct investment (FDI) which is one of the recent features of the world economy. Most of developing countries consider FDI inflows as one of the most important channels for economic development.

One of the important questions raised by FDI literature is what the determinants that locate multinational enterprises are. Potential determinants of FDI location have been extensively studied (Coughlin et al., 1991; Friedman et al., 1992, 1996; Wheeler and Mody, 1992; Head et al., 1995; Chen, 1996; Barrel, 1999; Cheng and Kwan, 2000). Main determinants of FDI location suggested by the studies above can be summarized by four categories: agglomeration effects, infrastructure effects, factor cost effects and market access effect.

Agglomeration effects might be due to positive linkages among projects. One of incentives is the spillover effects created by research and development. The second is confidence and the possibility that firms cluster. For example, firms are not sure as to whether a particular country (region) is a good location for FDI and thus take the success of one firm as a signal of underlying national (regional) characteristics. A third incentive arises from the supply of, and demand for, intermediate goods (see Fujita et al., 1999 for a general overview).

Second, most of developing countries have tried to attract FDI through special economic policies such as an establishment of special economic zones and construction of new roads. This infrastructure lead for FDI investors to decrease setup cost of new local establishments in host countries (Chen, 1996; Cheng and Kwan, 2000).

Third, a significant part of multinational activity tends to take the forms of firms shifting a state of their production process to low-cost locations. The economic analysis of this shift based on the idea that different parts of the production process have different input requirement. For example, it may be profitable to move production of labor-intensive goods to labor-abundant countries while the headquarter services are left in home country (Helpman, 1984, 1985; Helpman and Krugman, 1985).

Fourth, switching from direct exports to local production will bring cost savings. Obviously local production can save through avoiding transport cost and trade barriers such as tariff and other nontrade barriers. Furthermore, for example, local production with collaboration with local firms through joint venture can decrease the cost to deal with foreign regulation, tax, and administration. Theoretical modeling based on distinct firms with an increasing returns to scale predicts that FDI is more likely to replace exports the larger is the market because the plant-specific fixed cost may be spread over more units of output as the market size increases. And larger markets will tend to have more local firms, and consequently more intense competition than smaller markets. This will lead to a lower price and be particulary damaging to the profitability of exporting, tipping the firm's decision in favor of local production (Horstmann and Markusen 1987; Markusen and Venables, 1998).

One possible issue is a possible endogeneity of the terrorist activities, i.e., economic conditions might cause terrorism. For example, Li and Schaub (2004) test the effect of economic globalization on the number of transnational incidents. Their empirical results show that trade, FDI, and portfolio investment have no direct effects on transnational incidents within countries and the economic development of a country and its top trading partners reduce the number of terrorist incidents inside the counties. And supporting the findings of several related issues of Hess and Orphanides (1995, 2001) and Blomberg and Hess (2002), Blomberg et al. (2004) explore the links between the incidence of terrorism and the state of the country's economy. They find that economic activity and terrorism are not independent, showing that high income and democratic countries appear to have a higher incidence of terrorism, and a lower incidence of economic contractions. Furthermore, terrorism appears to be related to the economic business cycle: period of economic weakness increase the likelihood of terrorist activities.

In order to consider possible issues raised in estimation, this paper uses Panel System GMM estimation (Holtz-Eakin et al., 1988; Arellano and Bond, 1991; Ahn and Schmidt, 1995, 1997; Arellano and Bover, 1995; Blundell and Bond, 1998). Then we found that terrorism and other economic activities play significant role in attracting FDI. They are

economic freedom, average tariff rate, income per capita and exports.

The paper is organized as follows. Section 2 describes several indicators of terrorism. Section 3 and 4 present the estimation methodology and the result and Section 5 concludes.

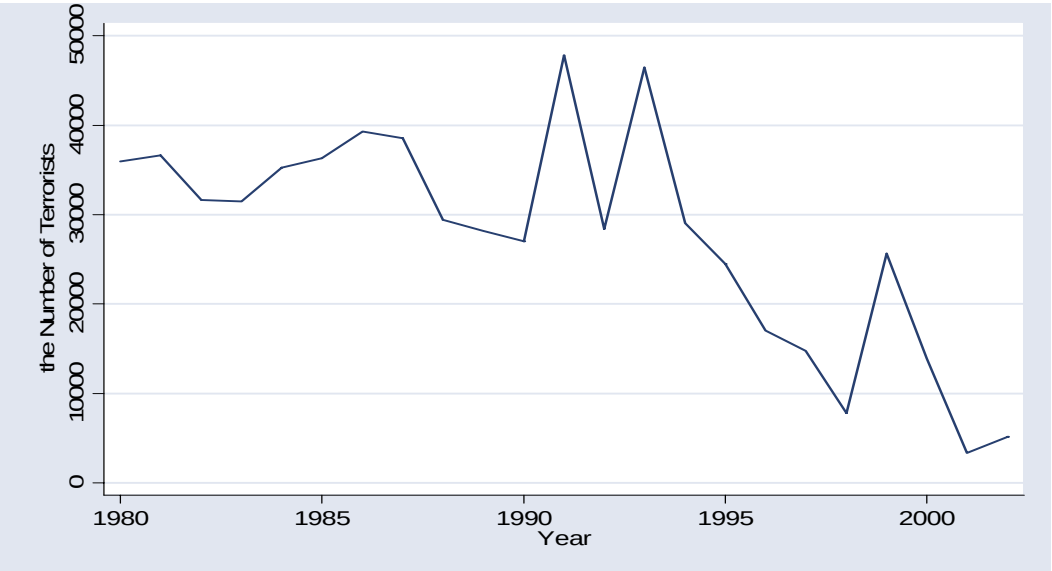
2. Terrorism

The data of terrorist activities are from the latest update of the International Terrorism: Attributes of Terrorists Events (ITERATE) data set from Mickolous et al (2003). The ITERATE data set which provides a detailed chronology of terrorist events around the world since 1968 attempts to standardize and quantify characteristics, activities, and impacts of international terrorist groups. The types of incidents included in the data are: kidnapping, barricade and hostage seizure, occupation of facilities without hostage seizure, letter or parceling bombing, incendiary bombing, arson, Molotov cocktail, explosive bombing, armed attack employing missiles, armed attack-other, including mortars, bazookas, aerial hijacking, takeover of non-aerial means of transportation, assassination or murder, sabotage not involving explosives or arson, exotic pollution, nuclear weapons threat, theft or break-in threat, conspiracy, hoax, sniping, shout-out with police, arms smuggling, car bombing and suicide bombing. The raw data consists of 5 categories. First, there are incident characteristics of each event (timing, type of accident, location start etc.). Second, there are the terrorist characteristics which include the number of terrorists, their nationality etc. Third, victim characteristics describe the number, nationalities, and types of victims. Fourth, the life and property losses are recorded. They are total individuals wounded and killed, and amount of damage etc. Finally, terrorist logistical success or failure is recorded.

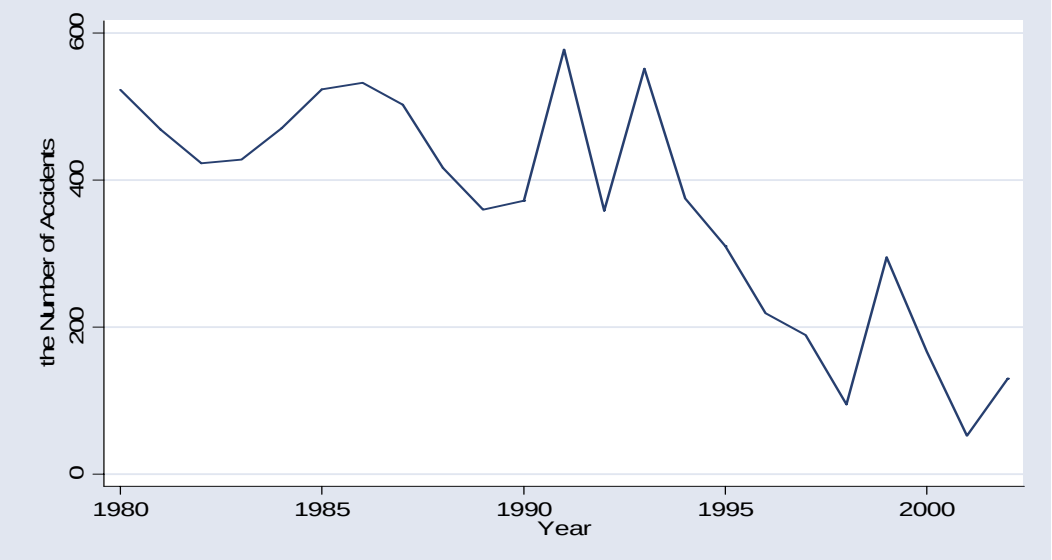
Since there is no consistent definition of terrorism, we use several measures of terrorism: the number of terrorists in attack force (Terrorists), the number of incidents (Incidents), the number of victims (Victims), and the number of victims per accidents (Victims per accident). Next question is on the flow or stock of terrorism definition. For

example, the variable which might be assumed to affect FDI amount is the number of individuals wounded last year or the accumulated number of individuals wounded until previous year of FDI decision.

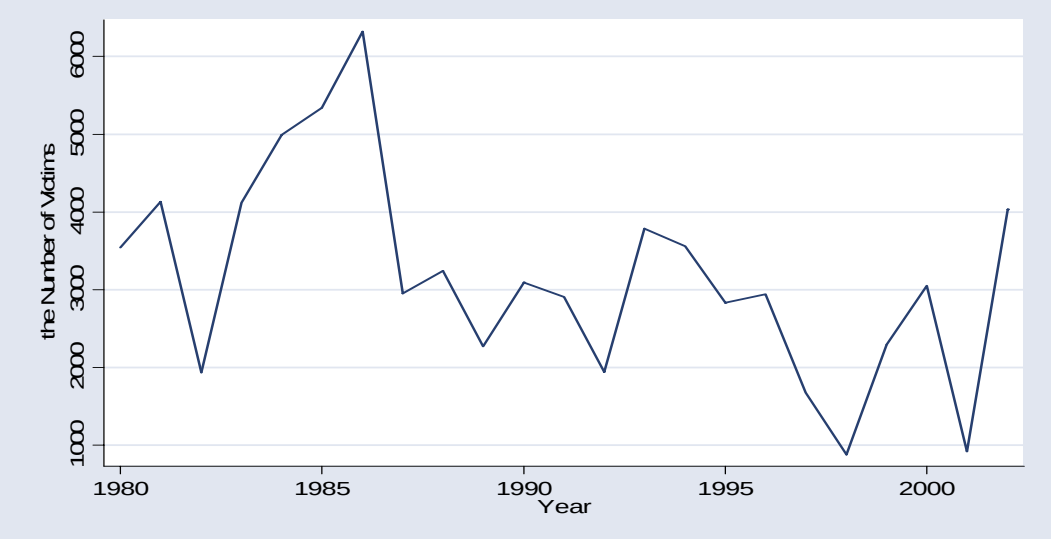
Figures 1-4 depicts the number of each variable over years.



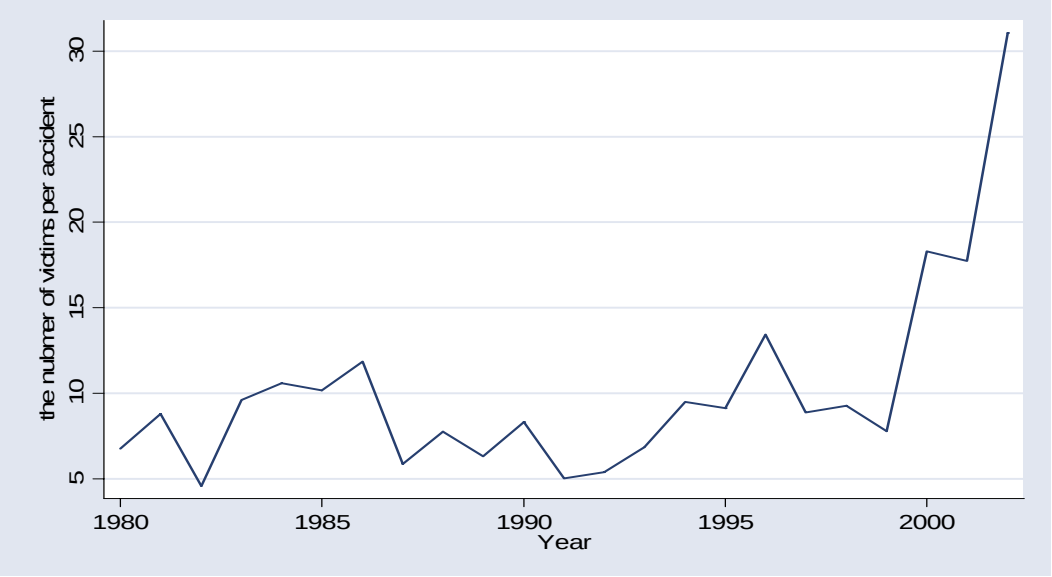
Annual Trend of the Number of Terrorists: 1980-2002



Annual Trend of the Number of Accidents: 1980-2002



Annual Trend of Victims: 1980-2002



Annual Trend of Victims per Accidents per year: 1980-2002

Table 1 describes summary statistics of terrorism variables which are used in the estimation.

Table 1: Summary Statistics of Terrorism Variables

	1980-84	1985-89	1990-94	1995-99	2000-02	Total
Terrorists	474.5	444.9	467.6	291.3	179.7	406.7
	(854.8)	(816.5)	(1143.2)	(650.1)	(260.3)	(867.4)
Accidents	6.4	6.1	5.8	3.6	2.8	5.4
	(10.8)	(10.3)	(12.5)	(6.9)	(2.9)	(10.2)
Victims	52.1	52.1	40.0	35.5	64.6	47.0
	(142.8)	(161.7)	(96.7)	(77.8)	(148.3)	(128.5)
Victims per accident	10.5	9.1	9.0	14.3	23.4	11.5
	(25.5)	(25.5)	(23.6)	(51.3)	(56.3)	(32.3)

3. **Model Specification**

Assume the following FDI determination equation in country in year t.

$$f_{it} = \alpha_1 + (1+\alpha_2)F_{it-1} + \beta' X_{it} + \eta_i + \omega_t + v_{it}, \tag{1}$$

where f_{it} is FDI flows into a country i in year t and F_{it-1} represents accumulated stock of FDI flows until year $t-1$, which reflects accumulation effect.

Since FDI flows f_{it} can be rewritten as $F_{it} - F_{it-1}$, equation (1) can be rewritten as a dynamic panel regression form:

$$\begin{aligned} F_{it} &= \alpha_1 + \alpha_2 F_{it-1} + \beta' X_{it} + u_{it}, \\ u_{it} &= \eta_i + \omega_t + v_{it},\ i = 1,2,...,N, t = 1,2,...,T. \end{aligned} \tag{2}$$

This equation is a dynamic panel regression with a lagged dependent variable on the right hand side. We assume the time-specific effect, ω_t, as fixed, unknown constants, which is equivalent to putting time dummies in the regression. The treatment of the country-specific effect, η_i, requires extra care. In is known that, in a dynamic panel regression, the choice between a time-specific effect and a random-effect formulation has

implications for estimation that are of a different nature than those associated with the static model (Anderson and Hsiao, 1981, 1982; Hsiao, 1986). Further, it is important to ascertain the serial correlation property of the disturbances in the context of our dynamic model, as that is crucial for formulating an appropriate estimation procedure. Finally, the issue of reverse causality will have to be addressed. We have to deal with the potential endogeneity of both the lagged dependent variable and the explanatory variables arising from the feedback effects of FDI on the local economy. These econometric issues will all have profound implications for specifying an appropriate model and its estimation.

Following Holtz-Eakin et al. (1988), Arellano and Bond (1991), Ahn and Schmidt (1995, 1997), Arellano and Bover (1995), and Blundell and Bond (1998), we address the above-mentioned econometric issues under a Generalized Method of Moments (GMM) framework.

The GMM approach starts with the first-differenced version of (2).

$$\Delta F_{it} = \alpha_2 \Delta F_{it-1} + \beta' \Delta X_{it} + \Delta u_{it}, \; i = 1, 2, ..., N, t = 1, 2, ..., T, \tag{3}$$

in which the country-specific effects are eliminated by the difference and Δ represents the first difference of each variable.

Under the assumption of serially uncorrelated level residuals, values of F lagged two periods or more qualify as instruments in the first-differenced system, implying the following moment conditions:

$$E[F_{it-1} \Delta u_{it}] = 0 \quad for \, t = 3, ..., T \text{ and } s \geq 2. \tag{4}$$

But GMM estimation based on (4) alone can be highly inefficient. In most cases, it is necessary to make use of the explanatory variables as additional instruments.

Here the issue of endogeneity due to reverse causality becomes critical. For strictly exogenous explanatory variables both past and future ΔX are valid instruments:

$$E[\Delta X_{it-s}\Delta u_{it}]=0 \quad for\, t=3,...,T \text{ and all } s. \tag{5}$$

But using (5) for $s<2$ will lead to inconsistent estimates if reverse causality exists in the sense that $E[X_{ir}v_{it}]\neq 0$ for $r\geq t$. To allow for this possibility, one may assume X to be weakly exogenous, i.e., $E[X_{is}v_{it}]=0$ for $s<t$, which implies the following subset of (5):

$$E[\Delta X_{it-s}\Delta u_{it}]=0 \quad t=3,...,T \text{ and } s\geq 2. \tag{6}$$

Equations (4)-(6) imply a set of linear moment conditions to which the standard GMM methodology applies. The consistency of the GMM estimator hinges on the validity of these moment conditions, which in turn depends on maintained hypotheses on the level residuals being serially uncorrelated and the exogeneity of the explanatory variables. It is therefore essential to ensure that these assumptions are justified by conducting specification tests (Arellano and Bond, 1991).

The overall validity of the moment conditions is checked by the Sargan test. The null hypothesis of no misspecification is rejected if the minimized GMM criterion function registers a large value compared with a chi-squared distribution with the degree of freedom equal to the difference between the number of moment conditions and number of parameters. Another diagnostic is the Sargan-difference test that evaluates the validity of extra moment conditions over that of weak exogeneity (i.e., (6) is nested in (5)), the stronger assumption of strict exogeneity will be in doubt if these extra moment conditions are rejected by the Sargan-difference test.

To check the serial correlation property of the level residuals, we rely on the Arellano-Bond m_1 and m_2 statistics. If the level residuals were indeed serially uncorrelated, then, by construction, the first-differenced residuals in (3) would follow a MA(1) process which implies that autocorrelations of the first-order are non-zero but the

second or higher-order ones are zero.[1] Based on the differenced residuals, the Arellano-Bond m_1 and m_2 statistics, both distributed as $N(0,1)$ in large sample, test the null hypotheses of zero first-order and second-order autocorrelation, respectively. An insignificant m_1 and/or significant m_2 will issue warnings against the likely presence of invalid moment conditions due to serial correlation in the level residuals.

Notice that the first-differencing operation not only eliminates unobserved country-specific effects but also time-invariant explanatory variables for which only cross-sectional information is available. Moreover, as demonstrated by Ahn and Schmidt (1995, 1997) and Blundell and Bond (1998), under a random-effect model, the first-differenced GMM estimator can suffer from serious efficiency loss, for there are potentially informative moment conditions that are ignored in the first-difference approach. It motivates us to explore additional moment conditions that make use of information in the level equation (1).

Following Blundell and Bond (1998), we augment the first-differenced moment conditions (4)-(6) by the level moment conditions:

$$E[u_{it}\Delta F_{it-1}] = 0 \quad t = 3,...,T, \tag{7}$$

which amounts to using lagged differences of F as instruments in the level equation (1).

In addition, for strictly exogenous explanatory variables, the appropriate level moment conditions would be

$$E[u_{it}\Delta X_{it-s}] = 0 \quad t = 3,...,T, \text{ and all } s. \tag{8}$$

For weakly exogenous explanatory variables, the appropriate level moment conditions would be

[1]There should be an evidence of significant negative first-order serial correlation in differenced

$$E[u_{it}\Delta X_{it-s}] = 0 \quad t = 3,...,T, \text{ and all } s \geq 1. \tag{9}$$

The Blundell-Bond system GMM estimator is obtained by imposing the enlarged set of moment conditions (7)-(9). By exploiting more moment conditions, the system GMM estimator is more efficient than the first-differenced GMM estimator that uses only a subset (4)-(6). The validity of the level moment conditions (7)-(9) depends on a standard random effects specification of the level equation in (1), plus additional assumptions on the initial value generating process and the absence of correlation between region-specific effects and the explanatory variables in first-differences. The reader is referred to Blundell and Bond (1998) for details.

The efficiency gain from imposing the level moment conditions certainly does not come free; we need extra assumptions and the violation of which may lead to bias. For example, the presence of correlated country-specific effects will invalidate some of the level moment conditions, leading to inconsistent system GMM estimates. The first-differenced estimator, in contrast, remains consistent in this case. Thus, it is important to conduct specification tests to justify the use of the additional level moment conditions. Since the first-differenced moment conditions are nested within the augmented set, the additional level moment conditions can be evaluated by the Sargan-difference test described above. In addition, invalid level moment conditions can also be detected by the Sargan over-identification test from the system GMM estimation.

4. **Data and Estimation Results**

FDI indicators are drawn from UNCTAD website and other independent variables are from the World Bank. In addition to transaction advantage variables, the institutional environment has been shown to affect the ownership strategies. As an institutional environment variable, Economic Freedom Indices, constructed by the Fraser Institute, are used. The summary index is based on 23 components designed to identify the consistency of institutional arrangements and policies with economic freedom in seven major areas and

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residuals and no evidence of second order serial correlation in the differenced residuals.

the data are released on a scale of 1 to 10 in five-year periods from 1970 to 1995, and annually thereafter.[2] The core ingredients are personal choice, legal protection of property rights, freedom of exchange, reliance on markets, use of money, and market allocation of capital. Individuals have economic freedom when: (a) the property they have acquired without the use of force, fraud, or theft is protected from physical invasions by others and (b) they are not forced to use, exchange, or give their property to another as long as their actions do not violate the identical rights of others. And to see the effect of trade barrier, mean tariff rate is used as an indicator, which is from a component of Economic Freedom index.

Table 2 shows the estimation results of equation (1) by panel estimation while Table 3 shows those of Panel system GMM estimation of equation (2). Except for the number of terrorists, other terrorist variables do not show negative and significant coefficients. However, all other variables show negative ones even though they are not significant.

Fom Table 2, the positive and significant coefficient for the lagged FDI stock supports a strong agglomeration effect which implies that the countries with more FDI stock a year ago tend to attract more FDI during current year. Income per capita shows a negative and significant coefficient showing that the countries with lower income per capita tend to attract more FDI flows. The countries with larger exports and lower tariff rate have higher values of FDI flows, which shows that trade id positively related with FDI flows. And economic freedom index has positive correlation with FDI flows. This FDI flows more to the countries with higher economic freedom, i.e., better property rights, good legal protection etc.

Considering possible endogeneity of independent variables, Table 3 shows the estimation results of Panel system GMM estimation. All variables show consistent estimation results with those of Table 2. In particular, all terrorist variables play a negative role in attracting FDI for all model specifications. Furthermore all model specifications satisfied specification tests and AR test. Over the all specifications, we assume that lagged FDI stock, GDP per capita and exports are assumed as endogenous variables and economic

[2] The missing data of other years are generated by the linearly interpolate method.

freedom index, average tariff rate and terrorist variables are assumed as strictly exogenous ones.

5. Conclusion

By using FDI and terrorist data between 1980 and 2002, this paper investigates the role of terrorism on FDI. Consistently with our hypothesis, the estimation results show that terrorism is negatively and significantly related with FDI flows. The specifications under the consideration of possible endogeneity of control variables strengthen the significant role of terrorism variables. Furthermore other control variables which are shown to be important factors in previous studies are shown to be significant.

Table 2: Panel Estimation

	Model 1		Model 2		Model 3		Model 4	
	Fixed	Random	Fixed	Random	Fixed	Random	Fixed	Random
Log(terrosist)	-0.047	-0.052						
	(2.16)*	(2.53)*						
Log(incidents)			-0.045	-0.064				
			(0.8)	(1.24)				
Log(victims)					-0.024	-0.02		
					(1.08)	(0.94)		
Log(victims per terror)							-0.022	-0.013
							(0.77)	(0.46)
Lagged FDI stock	0.434	0.541	0.427	0.538	0.428	0.542	0.432	0.543
	(5.25)**	(8.90)**	(5.10)**	(8.75)**	(5.13)**	(8.88)**	(5.18)**	(8.89)**
Log(per capita gdp)	-0.604	-0.318	-0.584	-0.321	-0.567	-0.333	-0.562	-0.334
	(1.42	(3.89)**	(1.37)	(3.84)**	(1.33)	(4.01)**	(1.32)	(3.98)**
Log(exports)	1.156	0.573	1.186	0.586	1.19	0.587	1.19	0.586
	(5.56)**	(6.11)**	(5.68)**	(6.20)**	(5.69)**	(6.20)**	(5.69)**	(6.20)**
Economic Freedom	0.323	0.347	0.323	0.351	0.329	0.362	0.333	0.366
	(4.19)**	(5.56)**	(4.14)**	(5.52)**	(4.27)**	(5.79)**	(4.31)**	(5.80)**
Log(mean tariff)	0.064	0.17	0.059	0.166	0.065	0.173	0.063	0.172
	(0.66	(2.07)*	(0.6)	(2.00)*	(0.66)	(2.10)*	(0.64	(2.09)*
Constant	-21.623	-11.389	-22.583	-11.814	-22.886	-11.887	-22.988	-11.912
	(5.93)**	(7.48)**	(6.27)**	(7.74)**	(6.39)**	(7.79)**	(6.42)**	(7.81)**
Observations	811	811	811	811	811	811	811	811
Number of Countries	83	83	83	83	83	83	83	83
Overall R-squared	0.74	0.77	0.74	0.77	0.74	0.77	0.74	0.77
Sigma_u	1.303	0.767	1.331	0.779	1.348	0.778	1.355	0.784
Sigma_e	0.856	0.856	0.858	0.858	0.858	0.858	0.858	0.858
Rho	0.699	0.446	0.706	0.452	0.712	0.451	0.714	0.455
Hausman statistics (p-value)	23.55(0.001)		27.82(0.0001)		3.34(0.765)		25.84(0.0002)	

Note: Robust z statistics in parentheses; significant at 5%; ** significant at 1%

Table 3: Dynamic Panel System GMM Estimation

	Model 1	Model 2	Model 3	Model 4
Log(Lagged FDI stock)	0.909	0.909	0.907	0.908
	(522.05)**	(488.91)**	(304.59)**	(491.02)**
Log(per capita gdp)	-0.053	-0.053	-0.055	-0.056
	(16.88)**	(14.88)**	(20.08)**	(22.56)**
Log(exports)	0.114	0.114	0.117	0.116
	(48.48)**	(42.55)**	(25.18)**	(53.20)**
Economic Freedom	0.026	0.026	0.025	0.026
	(39.78)**	(29.58)**	(14.24)**	(17.92)**
Log(mean tariff)	0.04	0.039	0.041	0.043
	(16.25)**	(10.58)**	(16.53)**	(19.87)**
Log(terrosist)	-0.003			
	(14.47)**			
Log(incidents)		-0.003		
		(3.75)**		
Log(victims)			-0.004	
			(10.84)**	
Log(victims per terror)				-0.006
				(17.13)**
Constant	-1.576	-1.584	-1.628	-1.603
	(49.84)**	(45.93)**	(21.46)**	(55.39)**
Observations	870	870	870	870
Number of countries	83	83	83	83
Hansen Overiden. Test	77.89(0.9)	78.14(0.9)	76.66(0.9)	77.04(0.9)
AR(1)	-1.95(0.05)	-1.95(0.05)	-1.95(0.05)	-1.95(0.05)
AR(2)	-0.71(0.48)	-0.68(0.50)	-0.67(0.50)	-0.72(0.47)

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