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RESEARCH ARTICLE

Terrorist Incidents and Foreign Direct Investment: Results Uncovered by Relational Models in the Cases of Colombia and Peru

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Abstract

This paper seeks to examine if there is a causal link between terrorist incidents and foreign direct investment in the cases of Colombia and Peru, using large-scale and up-to-date data. The data of both parameters from the early 1970s to 2020 are involved in the analysis. The statistical characteristics of the variables entail different relational models for the examination. While the data concerning Colombia necessitate the Toda-Yamamoto test, the data concerning Peru require robust regression analysis. The Toda-Yamamoto test indicates no causality between the variables concerning Colombia. On the other hand, robust regression analysis crystallizes for Peru that there is a causality from foreign direct investment to terrorist incidents and a causality tendency from terrorist incidents to foreign direct investment. Theoretically, the results reveal that the variables do not enable establishing a causal relationship for all countries.

Keywords: Colombia; foreign direct investment; Peru; terrorist incidents.
JEL codes: F59, N46, Y10.

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1. Introduction

This study aims to conduct statistical analysis and provide theoretical insights within the framework of the country samples of Colombia and Peru to reveal whether there is a causal relationship between terrorist incidents and foreign direct investment. This paper selected these countries because they have the highest terrorist score in Latin America, as the following lines present. It will be appropriate to address existing literature in the Latin American example and the context of this study's variables to ascertain this paper's potential contribution to the literature.

Panel data-based studies[1] covering examples from individual countries[2] outside, especially in Latin America[3] attract attention in the literature by scrutinizing the relationship between terrorism and foreign direct investment. Existing studies, nonetheless, can produce incompatibility results even in the same case by depending on the databases used, the years of those databases (time series), and whether the statistical method used is correct. Literature on the subject is still developing despite all this.

However, although the literature on this subject is limited, it still teaches something in the Latin American context. For example, Jebli et al. (2019) evaluated whether there was a causal relationship between renewable energy consumption, the number of tourist arrivals, the trade openness proportion, economic growth, foreign direct investment (FDI), and carbon dioxide emissions with a panel data of 22 Central and South American countries. That study covered data between 1995 and 2010, and the only parameter it had in common with this study was FDI. In terms of FDI, they concluded that FDI contributed to the reduction of emissions and that there were short-run bidirectional causalities between FDI and gross domestic product (GDP) and between FDI and trade openness. Even though that study enjoys crucial appraisals for Central and South American countries, it needs more convenience regarding this study's concern.

Jaitman (2019) assessed the effect of crime and violence on the assignment of private and public resources and the development in Latin America and the Caribbean. She gathered that the cost of crime means consuming at least 3.5% of the regional gross domestic product. That cost was equal to the region's annual infrastructure expenditure, or approximately the share of income of the poorest 20% of the population in the area, which was twice that of developed countries. Crime in her study referred to homicide in Latin America and the Caribbean, which formed 33.5% of the world's homicides as of 2019, according to the United Nations Office on Drugs and Crime data. In her research methodology, spending contained private spending on security concerning firms and households, public spending on security inclusive of police, prison administration, and criminal justice spending, and the social cost of crime, relinquished earnings of sufferers of violent crime, chiefly homicides, and relinquished earnings of those in prison. The crime costs encompassed the loss of productive life years, the split-up of families, the wantage of social capital, shocking public trust, dissuasion of capital goods, capital escape, brain drain, internal displacement, and a general decrement of confidence in democracy. She emphasized the importance of community policing and problem-oriented policing to diminish crime in the area.

Bojanic (2014) investigated the level of corruption in Bolivia over the relationship between coca,

[1] See Lanouar and Shahzad (2020), Polyxeni and Theodore (2019), Radic (2018), Filer and Stanisic (2016), Shah and Faiz (2015), Altay et al. (2013), Kang and Lee (2007), Li (2006).

[2] For the Türkiye case, see Ari and Ibrahim (2021), Bildirici (2018), Ak and Inal (2017), and Omay et al. (2013). For Kenya's case, see Kinyanjui (2014). For the Pakistan case, see Rauf et al. (2016) and Rasheed and Tahir (2012). For the USA case, see Enders et al. (2006).

[3] The study of Enders and Sandler (1996) is an exception in this sense. Enders and Sandler studied Greece and Spain comparatively in that study.

which is the raw material for illicit cocaine production, and foreign direct investment (FDI). The data exploited by Bojanic included time series related to variables inclusive of actual FDI inflows, accurate price of coca, real total trade on GDP [(exports + imports)/GDP], and real GDP per capita between January 1993 and December 2012. Bojanic deduced via regression analysis that a less controlled and more tolerant market for coca leaves with FDI inflows degraded the corruption level in Bolivia. Bojanic also inferred that decreasing government intervention in the coca market provided the way to a less corrupt Bolivia, the world's third-largest producer of coca leaves. Bojanic also emphasizes that FDI is significant in combating corruption, as the richer the country is, the less corruption the country has.

Lutz and Lutz (2006) deduced that terrorist incidents had only temperate negative influences on foreign direct investment, the early 1980s with the effect in particular, while the tourism sector was more sensitive to it. Their data involved 23 Latin American countries from 1969 to 1988, with Colombia and Peru. However, that study comprised nearly nothing about Colombia and Peru apart from the general expression that various leftist groups intended domestic groups and foreign interests.

Moreover, the outcomes in the existing literature on Colombia are controversial. Bandyopadhyay and Younas (2014) detected the relationship between FDI and terrorism in Colombia without alleging a causal relation, stating that FDI had risen as terrorism had fallen. In addition, the assessments in their article covered the average of six-year non-overlapping periods between 1988 and 2011, such as 1988-1993, 1994-1999, 2000-2005, and 2006-2011. In other words, that study enabled nothing for Bandyopadhyay and Younas to evaluate for long terms. Bandyopadhyay and Younas (2014) denoted the link (correlation); nonetheless, they also doubted possible causality, at least underlining the need for further research on whether or not causality exists.

Powers and Choi (2012), based on the data between 1980 and 2008, evaluated that every business-related terrorist attack downed Colombia's FDI by nearly 23.2 million US dollars- roughly 4 billion US dollars from 1980 to 2008. In this sense, they deduced that Colombia was a business terrorism-prone country. The article of Powers and Choi (2012), which involved 123 developing countries for the analysis, was about whether transnational terrorism had a dissimilar influence on FDI concerning the difference between business-related terrorism and non-business-related terrorism. Colombia, however, engaged the writers' attention because of the profile in the country samples and emphasized Colombia as a notable example. In addition, the results were invalid for OECD countries. Nevertheless, the fundamental handicap in that study of PPowers and Choi (2012) was that they investigated one-directional causality from transnational terrorism (business-motivated terrorism and non-business-motivated terrorism) to foreign investment. In other words, they did not undertake to evaluate the effect of foreign direct investment on transnational terrorism in terms of bidirectional analysis.

Camacho and Rodrigues (2012) calculated the causal effect of armed conflict over firm exit by making inferences that a one-standard-deviation step-up in the count of guerrilla and paramilitary attacks in a municipality increased the odds of plant exit by 5.5 percentage points. They also specified that the influence was not uniform for all facilities in the country yet was more dominant for younger manufacturing facilities with fewer workers and poor capital levels.

Garces (2005) focused on the role of drugs in the transformation of the Colombian conflict into terrorism. She detected that the pursuit of profit through the illegal drug trade was further complicated and further disrupted social ties in the 1970s. One of the main factors that contributed to that situation was the absence of an inclusive and open political system to manage political demands and implement conflict resolution mechanisms. Consequently, according to her, the resulting individualistic methods had essential effects on Colombian politics and culture by creating a society void of ordinary pursuits.

As for Peru, a relatively old article written by Clutterbuck (1995) concerning Sendero Luminoso (the Shining Path) in Peru noticed the importance of intelligence as the ultimate battle-winning factor in combating terrorism and cocaine, the primary income resource of terrorism and degenerate army officers.

Fielding and Shortland (2012) clarified the factors that caused the intensity of civilian abuse by belligerents in the guerrilla war in Peru during the 1980s and 1990s by profiting from the monthly time-series dataset. The results of their study proved that when one belligerent in the war boomed the degree of civilian abuse, the other belligerent side gave back likewise. At least some of the violence was ex-ante as the cycle of violence in which each party responded similarly to the activity of the other. An increase in the military capacity of government forces caused solely a boost in the conflict level and higher civilian casualties. Military aid to the Peruvian government, therefore, gave rise to enhancing the level of conflict intensity and the quantity of civilian suffering while causing an increase in insurgent terror. On the other hand, foreign development aid with counter-narcotics aid opened a road to drop the level of civilian suffering, to grow the opportunity cost of at least the insurgent side, and to diminish insurgents' income.

In a study that researched the relationship between foreign direct investment, aid, and terrorism, Bandyopadhyay et al. (2014) contended that domestic and transnational terrorism dropped FDI and that collective aid alleviated the negative consequences of domestic and international terrorism, especially for those of domestic terrorism. They also gathered that bilateral aid was operative in diminishing the adverse effects of transnational terrorism on FDI. In contrast, multilateral aid was fruitful in capturing the adverse impact of domestic terrorism on FDI. However, that article examined 78 countries whose data covered 1994 to 2008. It excluded Colombia since it had outliers regarding terrorist attack data and had no specific argument for Peru, although Peru was in the 78 countries.

To summarize, the studies above do not give information on the samples of Colombia and Peru, which possess the highest scores for terrorist incidents, to allow specific comparisons. This study aims to determine whether there is a causality between these two samples' variables. Consequently, this paper will comparatively evaluate these two countries with the highest number of terrorist attacks among Latin American countries according to the Global Terrorism Database data (Table 1). These two selected countries also possess the least missing data, and data for these countries are available until 2020. The data for El Salvador, which ranks third in terms of terrorist incidents, is from 1972 to 1997. Analyzing the up-to-date data will also make this study original in terms of the existing literature.

To that end, appropriate statistical methods for each country in question will test the null hypotheses. The null hypothesis (Ho) for Colombia is that terrorist incidents (TI) are not the cause of foreign direct investment (FDI). In contrast, the alternative hypothesis (H1) for Colombia is that terrorist incidents (TI) are the cause of foreign direct investment (FDI). Similarly, the null hypothesis (Ho) for Peru is that terrorist incidents (TI) are not the cause of foreign direct investment (FDI). In contrast, the alternative hypothesis (H1) for Peru is that terrorist incidents (TI) are the cause of foreign direct investment (FDI). However, since this study will investigate a two-way relationship, it will evaluate the parameters of these hypotheses separately in their displaced form.

Table 1: *Terrorist incident number by country in Latin America*

Country	**Total incidents**	**Period**	**Country**	**Total incidents**	**Period**
Argentina	826	1970 to 2020	El Salvador	5320	1972 to 1997
Bolivia	326	1970 to 2020	Guatemala	2055	1970 to 2020
Brazil	295	1970 to 2020	Guyana	33	1978 to 2020
Chile	2499	1970 to 2020	Mexico	600	1970 to 2020
Colombia	**8915**	1970 to 2019	Paraguay	120	1970 to 2020
Costa Rica	69	1970 to 2019	**Peru**	**6111**	1973 to 2020
Cuba	30	1991 to 2007	Uruguay	82	1970 to 2016
Dominican Republic	89	1970 to 2017	Venezuela	320	1970 to 2020
Ecuador	245	1970 to 2020			

Source: Data extracted from the Global Terrorism Database and formatted for study.

Similar structures produce similar results. The Latin American experience is instructive for countries in other geographies as scholars, politicians, and followers of political science and related disciplines can observe closely. Issues such as coups, transition processes to democracy, human rights (Inter-American Court of Human Rights), security, and political economy (1994 Mexican financial crisis) are informative to draw scientific conclusions. Similarly, the issue of the kind of relationship between foreign direct investments and terrorist attacks in Colombia and Peru, where far-left organizations are influential, deserves attention and interest.

To say just briefly, this study's specific contribution is to analyze whether foreign direct investment has clout in terrorist incidents and whether terrorist incidents influence foreign direct investment in the cases of Colombia and Peru (Figure 1). Case studies say so much for any individual country compared to those supplied by panel data analysis designed for more general conclusions.

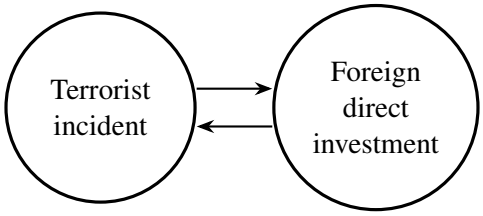

Figure 1: *The model for Colombia and Peru*

2. Conceptual framework and modus operandi

This study adopts the terrorism concept in the database (GTD), from which statistical data on terrorist incidents are obtained. GTD includes non-state terrorism acts. Acts in GTD contain armed assault, unarmed assault, assassination, bombing/explosion, hijacking, hostage taking (barricade incident), hostage taking (kidnapping), and facility/infrastructure attack. There are three criteria in the GTD records in addition to the reserve record. Recorded data in the database must fulfill at least two criteria. Criterion 1 expresses that the designed action has to accomplish a political, economic, ecclesiastical, or social purpose. Providing benefits in terms of economic goals alone is not enough. The designed action needs to target systemic economic shifts. Criterion 2 states there is serious evidence aiming at coercing, intimidating, or sending another message to a broader audience rather than the victim. It is not crucial whether each individual acting is conscious of the end. The essential issue is to take into account the action as a whole. It is enough for the criterion of purposiveness that the designers or decision-makers behind the attacks are for coercion, intimidation, or public disclosure. Criterion 3 means the action has to be outside the condition of legitimate warfare activities. If civilians or non-combatants are deliberately targeted, then criterion 3 is satisfied (University of Maryland, 2021).

There is another definition except the criteria set in the database. It is a reserve record called Doubt Terrorism Proper. If there is a doubt among GTD experts about whether an attack is a terrorist attack, they do such a coding. According to one of four possible alternative definitions, GTD analysts code such uncertainty as 1) Insurgency/Guerrilla Movement, 2) Internecine Conflict Action, 3) Mass Murder, or 4) Purely Criminal Act (University of Maryland, 2021).

This paper exploits the quantitative research model. The primary variables in this paper are terrorist incidents and foreign direct investment. While the Global Terrorism Database-GTD (2022a; 2022b) is the resource of the data about terrorist incidents, the World Bank (2023b; 2023a) is the resource of the data on foreign direct investment. In this context, correlation and regression analysis are comprehensive for both countries between 1970 and 2020, yet it started in 1973 for Peru. The data distribution is as follows as of August 17, 2023- since GTD makes regular updates in the database, this study in question has considered the data in the last review made on August 17, 2023.

The data distribution by year for each country is below (Table 3). This study used arithmetic means of near dates for Colombia's missing values: The arithmetic mean of the data between 1970 and 1975 for 1971 and 1974 and the arithmetic mean between 1978 and 1997 for 1993. If this study had utilized the arithmetic mean of data between 1970 and 2020 for any missing year, the arithmetic mean would be 186, which would have been abnormal values for 1971 and 1974. The results of missing data are also in the relevant footnotes.

Peruvian data start from 1973. For the missing value concerning 1976, the arithmetic mean of the data between 1973 and 1979 satisfies the missing value of 1976. For the missing value concerning 1993, the arithmetic mean between 1981 and 1994 satisfies the missing value for 1993. For the missing values concerning 2010 and 2011, the arithmetic mean of the data between 1998 and 2020 satisfies the values of those years, for the values in these periods are close to each other; otherwise, abnormal values for the years 1976, 2010, and 2011 emerge. The findings of missing data are also present in the relevant footnotes.

Table 2: *Terrorist incident number by year for Colombia and Peru*

Colombia				Peru			
Year	Incident number	Year	Incident number	Year	Incident number	Year	Incident number
1970	1	1996	409	1973	3	1996	42
1971	**5**	1997	598	1974	3	1997	58
1972	2	1998	94	1975	2	1998	5
1973	6	1999	116	**1976**	**3**	1999	5
1974	**5**	2000	137	1977	4	2000	3
1975	10	2001	207	1978	4	2001	3
1976	22	2002	150	1979	3	2002	2
1977	80	2003	98	1980	64	2003	1
1978	158	2004	37	1981	149	2004	3
1979	140	2005	42	1982	350	2005	2
1980	141	2006	43	1983	536	2006	1
1981	172	2007	30	1984	592	2007	4
1982	222	2008	133	1985	352	2008	1
1983	234	2009	138	1986	568	2009	4
1984	237	2010	136	1987	627	**2010**	**5**
1985	382	2011	94	1988	355	**2011**	**5**
1986	307	2012	115	1989	630	2012	9
1987	337	2013	149	1990	495	2013	13
1988	427	2014	231	1991	658	2014	12
1989	492	2015	136	1992	383	2015	10
1990	349	2016	110	**1993**	**445**	2016	4
1991	420	2017	119	1994	91	2017	8
1992	523	2018	206	1995	44	2018	5
1993	**309**	2019	230			2019	1
1994	201	2020	171			2020	2
1995	123						

Note: Bold character means calculated values for missing data.
Source: Data extracted from the Global Terrorism Database and formatted for the study.

Figures 2 and 3 illustrate the data concerning each country. Tables 3, 4, and Appendices A and B make clear whether the variables hold a normal distribution for exact analysis. Appendices A and B also include extreme values for each country.[4]

[4]See Tez Yardim Platformu (2021) for extreme values and normality test reference values. The explanation and the results

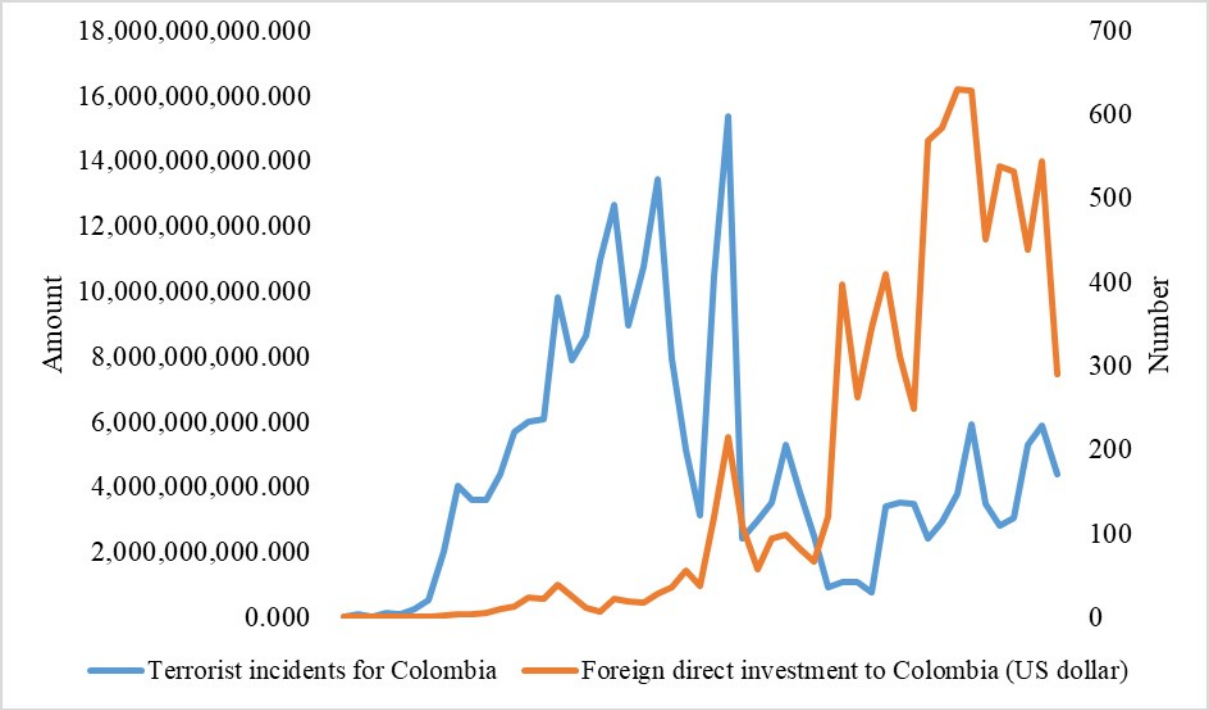

Figure 2: The data for Colombia's variables

Source: Data extracted from the Global Terrorism Database and formatted for the study.

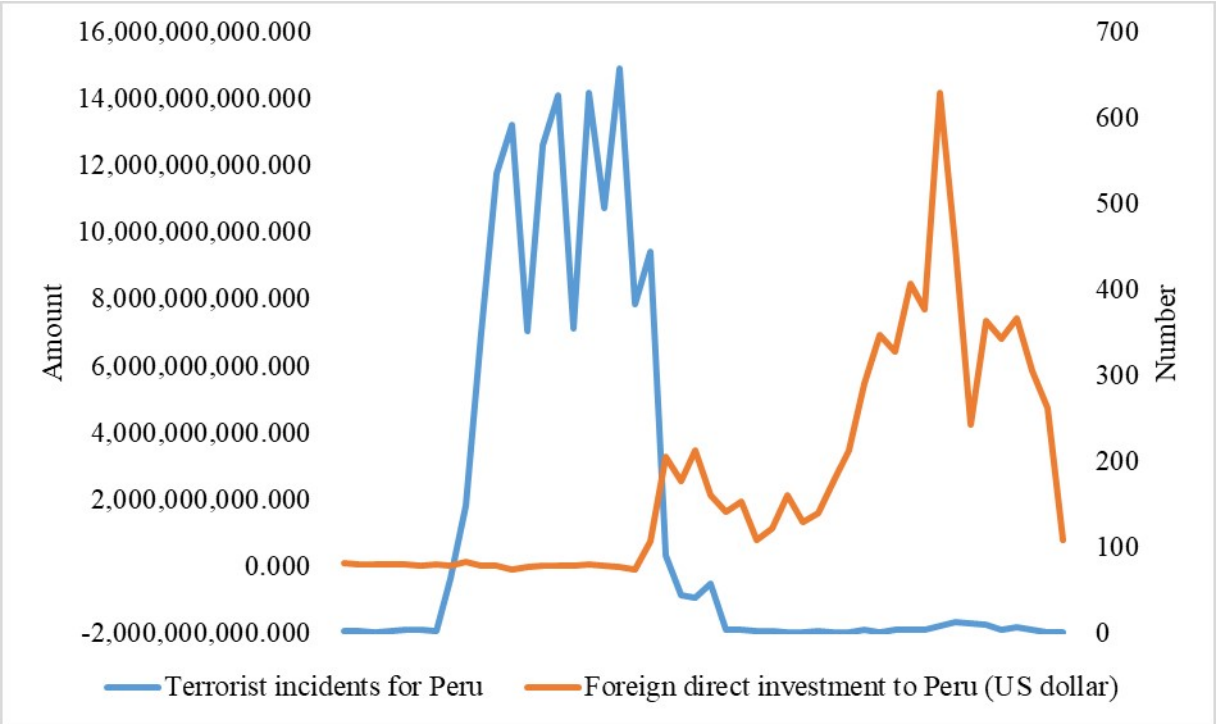

Figure 3: The data for Peru's variables

Source: Data extracted from the Global Terrorism Database and formatted for the study.

Table 3: *Normality test for Colombian data*

Evaluation parameters	**Values of terrorist incident**		**Values of foreign direct investment**		**Reference value**	**Result**	
	Skewness	**Kurtosis**	**Skewness**	**Kurtosis**		**Terror incidents**	**Foreign direct investment**
Investigation of skewness/kurtosis values	1.017	0.576	1.072	-0.360	between -1.50 and +1.50	Normal distribution	Normal distribution
Dividing skewness /kurtosis values by standard error	3.05 (1.017/0.333)	0.88 (5.576/0.656)	3.22 (1.072/0.333)	-0,55 (-0.360/ 0.656)	between -1.96 and +1.96	Non-normal distribution	Non-normal distribution
The absolute values of the skewness coefficients	3.05	-	3.22	-	Skewness coefficients less than twice the standard errors	Non-normal distribution	Non-normal distribution
Control of extreme values/ z score	No extreme value		No extreme value		between -3 and +3	Normal distribution	Normal distribution
Test result to be applied						**Spearman correlation test**	

Table 4: *Normality test for Peruvian data*

Evaluation parameters	**Values of terrorist incident**		**Values of foreign direct investment**		**Reference value**	**Result**	
	Skewness	**Kurtosis**	**Skewness**	**Kurtosis**		**Terror incidents**	**Foreign direct investment**
Investigation of skewness/kurtosis values	1.373	0.249	1.429	1.832	between -1.00 and +1.00	Non-normal distribution	Non-normal distribution
Dividing skewness /kurtosis values by standard error	4 (1.373/0.343)	0.37 (0.249/0.676)	4.17 (1.429/0.343)	2.78 (1.832/ 0.674)	between -1.96 and +1.96	Non-normal distribution	Non-Normal Distribution
The absolute values of the skewness coefficients	4	-	4.17	-	Skewness coefficients less than twice the standard errors	Non-normal distribution	Non-normal distribution
Control of extreme values/ z score	No extreme value		One extreme value (year 2021 z score is 3.49098)		between -3 and +3	Normal distribution	Non-normal distribution
Test result to be applied						**Spearman correlation test**	

of the normality test are mainly used in this study to persuade the readers thoroughly since it is quite possible to run into the fact that some studies that took place in the literature made their analysis as if their data had a normal distribution. However, performing an analysis like VAR in the case of non-normal distribution is not appropriate. See Ceyhan and Gunduz (2019).

2.1. Correlation Results

Normality test results for Colombia and Peru demonstrate that the time series of both countries do not have a normal distribution (Tables 3 and 4, and Appendices A and B). For this reason, the Spearman correlation test is appropriate for both countries. The resulting value for Colombia in Table 5 is not statistically significant since the significance value is bigger than $p = 0.05$.[5]

Table 5: *Correlation results for Colombia*

		Spearman's rho	
		TI	FDI
TI	Correlation coefficient	1.000	.105
	Sig. (2-tailed)	.462	
	N	51	51
FDI	Correlation coefficient	.105	1.000
	Sig. (2-tailed)		.462
	N	51	51

On the other hand, the results for Peru in Table 6 are statistically significant, and this relationship is moderate, with -0.427 (- 42.7%) for the entire data series.[6] In other words, there is a moderate negative relationship between both variables. The explained variance (R2) is 0.1823 (18.23 percent). However, it needs to provide information about the effect of independent and dependent variables in the relationship since correlation explains the impact of variables on each other. For this reason, regression analyzes are necessary.

Table 6: *Correlation results for Peru*

		Spearman's rho	
		TI	FDI
TI	Correlation coefficient	1.000	-.427**
	Sig. (2-tailed)	.002	
	N	48	48
FDI	Correlation coefficient	-.427**	1.000
	Sig. (2-tailed)		.002
	N	48	48

**Correlation is significant at the 0.01 level (2-tailed).

2.2. Advanced test results for regression analysis

Since the data for both countries do not provide a normal distribution, it is not appropriate to make traditional regressions with these data. To that end, further regression analyzes are necessary for clear-cut appraisals. This study will perform unit root tests of the data to determine lag degrees for further analysis. Hence, this paper will determine the proper causality test for each country. Appendix C illustrates the PP and ADF unit root test results in this context.

[5] A similar result applies to analysis with missing data. In this analysis, the significance value of 0.939 is greater than $p = 0.05$.

[6] The relationship is also moderate for the missing data series, which is -0.472 (-47.2%). The explained variance is 0.2227 (22.27 percent) for the missing data series.

2.2.1 Advanced test results for Colombia

The outputs indicate for Colombian data that the series are stationary when the first difference is taken (Appendix C). When the first difference (I1) is taken, all models are stationary at a one percent significance level ($p < 0.01$). Therefore, the Toda-Yamamoto test is appropriate as the series becomes stationary when the first difference is taken (Toda and Yamamoto, 1995; Gulgun, 2021). In other words, the Toda-Yamamoto causality test is preferred because no matter the variables' cointegrated level, they are included in the analysis in their random order.

Table 7: *VAR analysis of TI and FDI for Colombia*

Lag	LogL	LR	AIC	SC	HQ
0	-1417.412	NA	60.400	60.480	60.430
1	-1360.410	106.727*	58.145*	58.381*	58.234*
2	-1358.865	2.761	58.250	58.643	58.398
3	-1355.062	6.474	58.258	58.810	58.465
4	-1352.285	4.490	58.310	59.019	58.577

Internal cause variables: TI, FDI
External cause variables: C
Sample: 1970 - 2020
Included observations: 47
* indicates lag order selected by the criterion.

VAR analysis (Table 7) demonstrates that the appropriate lag value (k) is one. This value validates the four information criteria: LR, AIC, SC, and HQ. In addition, the unit root test for the variables indicates that dmax is the maximum order of integration, and it is one as well (see Appendix C). Thanks to the Toda-Yamamoto analysis, lag degree (k as freedom degree) and integration degree (dmax as maximum order of integration) are summed (k+dmax), and this number (k+dmax) is included in the analysis. According to this formula, the lag length included in the study is two (k+dmax). Thus, a two-lag Toda-Yamamoto equation is solved (Tables 8 and 9). After the main equations are created, the Wald test evaluates whether the variables have a causal relationship over these main equations (Tables 10 and 11).

Table 8: *Estimation method: Seemingly unrelated regression*

	Coefficient	Probability
C(1)	0.716	0.000
C(2)	-0.037	0.797
C(3)	-0.000	0.591
C(4)	0.000	0.818
C(5)	72.505	0.012
R-squared	0.515	
Durbin-Watson statistic	1.989	

Sample: 1972 - 2020
Included observations: 49
Total system (unbalanced) observations: 98
Linear estimation after one-step weighting matrix
Equation 1: $TI = C(1) * TI(-1) + C(2) * TI(-2) + C(3) * FDI(-1) + C(4) * FDI(-2) + C(5)$

Table 9: *The Toda-Yamamoto equation for FDI*

	Coefficient	Probability
C(6)	-1,403,244	0.649
C(7)	-1,830,501	0.551
C(8)	0.645	0.000
C(9)	0.274	0.082
C(10)	1,170,000,000	0.055
R-squared		0.845
Durbin-Watson statistic		1.940

Estimation method: Seemingly unrelated regression
Sample: 1972 - 2020
Included observations: 49
Total system (unbalanced) observations: 98
Linear estimation after one-step weighting matrix
Equation 2: $FDI = C(6) * TI(-1) + C(7) * TI(-2) + C(8) * FDI(-1) + C(9) * FDI(-2) + C(10)$

The first equation indicates whether there is causality from FDI towards TI. Here, the coefficients in front of the FDI, namely $C(3)$ and $C(4)$, are taken into account - $C(5)$ represents the Constant. The second equation indicates whether there is causality from TI to FDI. Here, the coefficients in front of TI, namely $C(6)$ and $C(7)$ are taken into account - $C(10)$ represents the Constant.

While investigating causality in the Toda-Yamamoto test, the basis coefficients are tested to be zero collectively and different from zero. In this respect, the Wald test results are below.

Table 10: Wald test for causality for Equation 1

Test statistic	Value	df	Probability
Chi-square	0.801	1	0.371

Null hypothesis: C(3)=C(4)=0

Table 11: Wald test for causality for Equation 2

Test statistic	Value	df	Probability
Chi-square	2.042	1	0.315

Null hypothesis: C(6)=C(7)=0

The data demonstrate no unidirectional or bidirectional causality between the variables of the two equations because the probability value for both equations is greater than 0.05 ($p > 0.05$). That means there is no causality from terrorist incidents to FDI, and vice versa.[7] Hence, it needs to fail to reject the null hypotheses. Table 12 below indicates the results.

[7]The case with missing data has also been calculated, but no different result emerges.

Table 12: *Toda-Yamamoto causality test results for Colombia*

Null hypothesis	Test statistics Chi-square value	Probability
TI is not the Granger cause of FDI	2.042	0.315
FDI is not a Granger cause of TI	0.801	0.371

2.2.2 Advanced test results for Peru

Robust Least Squares (RLS), which consider the extreme value (Table 4), is suitable for Peru because there is an extreme value in the time series related to Peru. Therefore, an RLS analysis determines whether a short-term relationship is appropriate for a non-normal distribution. The M-estimation considers the dependent variable extremes, while the S-estimation considers the independent variable (regressor) extremes. As for MM-estimation, extreme values in both dependent and independent variables are considered.[8] M-estimation and S-estimation will be applied in this study since each variable will be separately included in the analysis as an independent and dependent variable to see if there is a bidirectional relation. Table 13 demonstrates Peru's results of robust regression analysis in which terrorist incident is the dependent variable.

Table 13: *Robust regression analysis for TI and FDI for Peru*

Variable	Coefficient	Prob.	R-squared
FDI	0.00000000048[9]	0.000	0.597
C	2.469	0.000	
Dependent variable: TI			
Method: Robust least squares, M-estimation			
Sample: 1973 - 2020			
Included observations: 48			

As seen in Table 12, the constant C coefficient value and the coefficient value of FDI as an independent variable are statistically significant. Probability (significance) values are 0.000 and 0.000, respectively $(p < 0.01)$. The explained variance (R^2) is nearly 0.60 (0.597). The independent variable (FDI) has an explanatory power of approximately sixty percent on the dependent variable (TI). The formulated equation is as follows. Direct foreign investment to Peru affects terrorist incidents.

$$TI = 2.469 + 0.00000000048 \cdot FDI^{10} \tag{3}$$

This equation indicates that, for example, a foreign direct investment of one billion dollars causes approximately three 2.95 terrorist attacks, while mounting this investment by another nine billion dollars increases terrorist attacks by approximately four times 4.32. Of course, these results are not values observed, but they are possible values expected due to the formula.

On the other hand, as seen in Table 14, where the constant C coefficient value is statistically significant, the coefficient value of TI as an independent variable is not statistically significant. Probability (significance) values are 0.000 $(p < 0.01)$ and 0.070 $(p > 0.05)$, respectively. That means terrorist attacks do not affect foreign direct investment to Peru. However, if the significance level is accepted

[8] For detailed information on estimation types of RLS, see EViews (2018).

[9] All numbers in the related tables have been expressed in numbers with no more than three decimals. Yet, more than three decimals have been preferred here since the effect of the coefficient is evident at the billion level.

[10] See previous footnote.

at 0.10, it can be assumed that there is a causal tendency. In other words, if the margin of error in the prediction is increased to ten percent, it can still be said that there is a causal tendency, and the explained variance R^2 is 6.9 percent.[11] That means the independent variable TI has an explanatory power of approximately seven percent on the dependent variable FDI.

Table 14: *Robust regression analysis for FDI and TI for Peru*

Variable	Coefficient	Prob.	R-squared
TI	-1219314	0.070	0.069
C	6.930	0.000	
Dependent variable: FDI			
Methods: Robust least squares, S-estimation			
Sample: 1973 - 2020			
Included observations: 48			

Based on these tests, it is possible to briefly describe the following: at the 95 percent confidence interval, foreign direct investment (FDI) is the cause of terrorist incidents (TI). Therefore, the alternative hypothesis (H_1) that FDI is the cause of TI is accepted. In the 90 percent confidence interval, both variables are the cause of each other. In this case, both alternative hypotheses are accepted. The other alternative hypothesis (H_1), which is that TI is the cause of FDI, is also accepted. Table 15 indicates the robust regression analysis results for Peru as a whole.[12]

Table 15: *Robust regression results for Peru*

	Causality Result for $p < 0.05$	
Null hypothesis (H_0) for Peru	H_0	H_1
TI is not the cause of FDI	$\surd$	$\times$
FDI is not the cause of TI	$\times$	$\surd$

	Causality tendency Result for $0.05 \leq p = 0.07 < 0.10$	
Null hypothesis (H_0) for Peru	H_0	H_1
TI is not the cause of FDI	$\times$	$\surd$

There is no causal relationship between the variables in the context of Colombia. However, there is a relationship in the Peruvian case, and the terrorist organization profile and target type explain this relationship. When the data is compared according to target types (Figures 4 and 5), it is evident that attacks targeting the business are at the forefront in Peru (Figure 4). Considering the period subject to this study for both countries, far-left organizations such as the Revolutionary Armed Forces of Colombia (FARC), the National Liberation Army of Colombia (ELN), and Shining Path in Peru that are hostile to capitalism and liberal values are at the forefront. However, in terms of targets, private citizens and properties are remarkable in Colombia (Figure 4), while the business is remarkable in Peru (Figure 5).[13]

[11] There are different appraisals in the literature about the significance value. Some scholars suggest that one percent and five percent values are all right for the significance value; others express that evaluations are also okay at the ten percent error level. In addition, another appraisal is that a value of $0.05 \leq p < 0.10$ is considered borderline significant, or that means a tendency towards significance. For details, see Akbulut (2022).

[12] A similar result is also valid for tests performed with missing data. In the test performed with missing data, the probability value is 0.529. In this sense, if the significance value is accepted as 0.10, it can be said with a 90 percent probability that foreign direct investments to Peru are affected by terrorist attacks.

[13] Sixty-four of the Colombia-related data covering other targets such as police and military are included only in the business group here. In Peru, six of the data covering at the same time other targets, such as police and government, are included in the business group here.

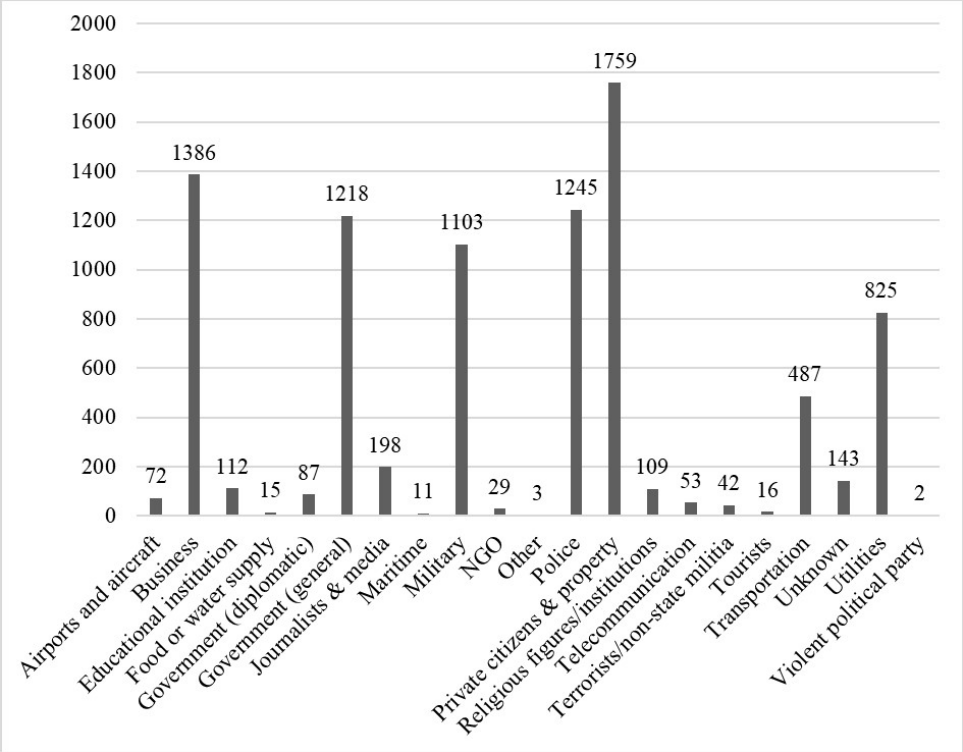

Figure 4: Target type of terrorist incidents in Colombia

Source: Data extracted from the Global Terrorism Database and formatted for the study.

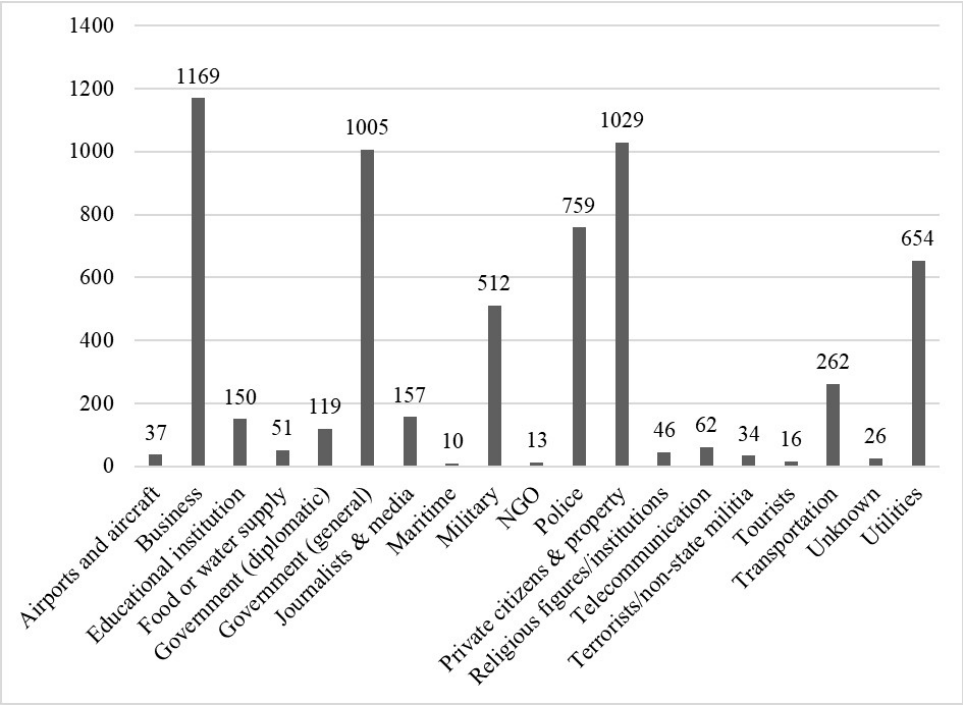

Figure 5: The target type of terrorist incidents in Peru

Source: Data extracted from the Global Terrorism Database and formatted for the study.

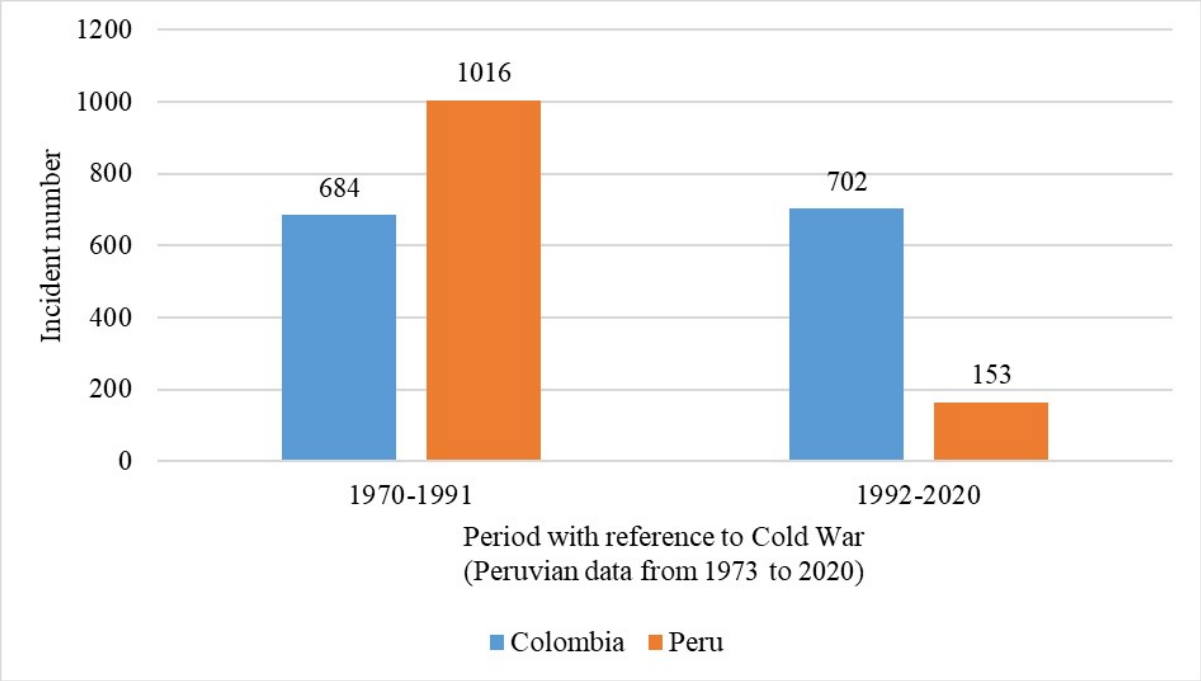

Figure 6: Distribution of terrorist incidents against business by period

Source: Data extracted from the Global Terrorism Database and formatted for the study.

Figures 4 and 5 also suggest that terrorist incidents against businesses account for approximately 15.55 percent of total incidents in Colombia, while this rate is approximately 19.13 percent in Peru. Figure 6 also indicates the frequency of terrorist incidents against the business. While terrorist incidents against businesses in Peru were intense in the period 1970-1991 (the period from the first available data until the dissolution of the USSR), terrorist incidents against businesses in Colombia remain stable. In this sense, in the Peruvian example, it is evident that the pressure of terrorism on the business world has decreased. It also demonstrates the influence of far-left ideology on foreign direct investment in Peru during that period. In Colombia, this pressure against business continues to be severe, and it has even increased, but it does not cause a correlation or causality. Naturally, this lack of relationship in Colombia reflects itself in the statistical tests of this study.

3. Conclusion

This paper evaluated whether terrorist incidents affect foreign direct investment and vice versa. Colombia and Peru have the highest scores of terrorist incidents in Latin America, so this paper included them in the analysis for an exhaustive evaluation. Regarding methodology, the data related to Colombia suggest a Toda-Yamamoto analysis, although the data about Peru offers robust regression analysis. Colombia includes 51 years between 1970 and 2020, while Peru covers 48 years between 1973 and 2020.[14]

Colombia's and Peru's experiences vary. There is no causality between terrorist incidents and foreign direct investment in the case of Colombia. On the other hand, there is causality from foreign direct investment to terrorist incidents and vice versa in the case of Peru. However, there is a causality from foreign direct investment to terrorist incidents, while there is a causality tendency from terrorist incidents

[14]This study has also investigated the following studies for appropriate statistical analysis. For details, see Ozmen et al. (2019), Colak et al. (2019), Aslanargun, A. and Yazici, B. and Kantar, M. and Senoglu, B. and Usta, I. (2018), Greenacre, M. and Colak, E. and Kilinc, B. K. and Kumtepe, E. G. and Arslan, G. and Aksoy, H. K. (2018), Turanli and Guris (2018), Guris et al. (2017), Kapetanios et al. (2003), Anderson and Vahid (1998), Luukkonen et al. (1988), White and Domowitz (1984).

to foreign direct investment. In the Peruvian case, the explanatory power of foreign direct investment on terrorist incidents is approximately eight and a half times greater than the explanatory of terrorist incidents on foreign direct investment. Compared to Colombia, the results for Peru indicate that the profile of terrorist organizations and their goals and strategies are decisive. The Peru example pinpoints causality between variables; hence, it also points out nuances in fighting against terrorism because the fight against terrorism requires taking into account the differences between right-wing and left-wing terrorist organizations in attracting foreign direct investment.

Colombia's and Peru's examples make clear that there is no scientific basis for theorizing the relationship between terrorist incidents and foreign direct investment. In this sense, there is no general template explaining the relationship between these two variables for all countries and extending it to all countries. However, this study highlights that terrorist organizations' identification of the business as a specific target reveals the target type as an essential parameter in examining the relationship between these two variables.

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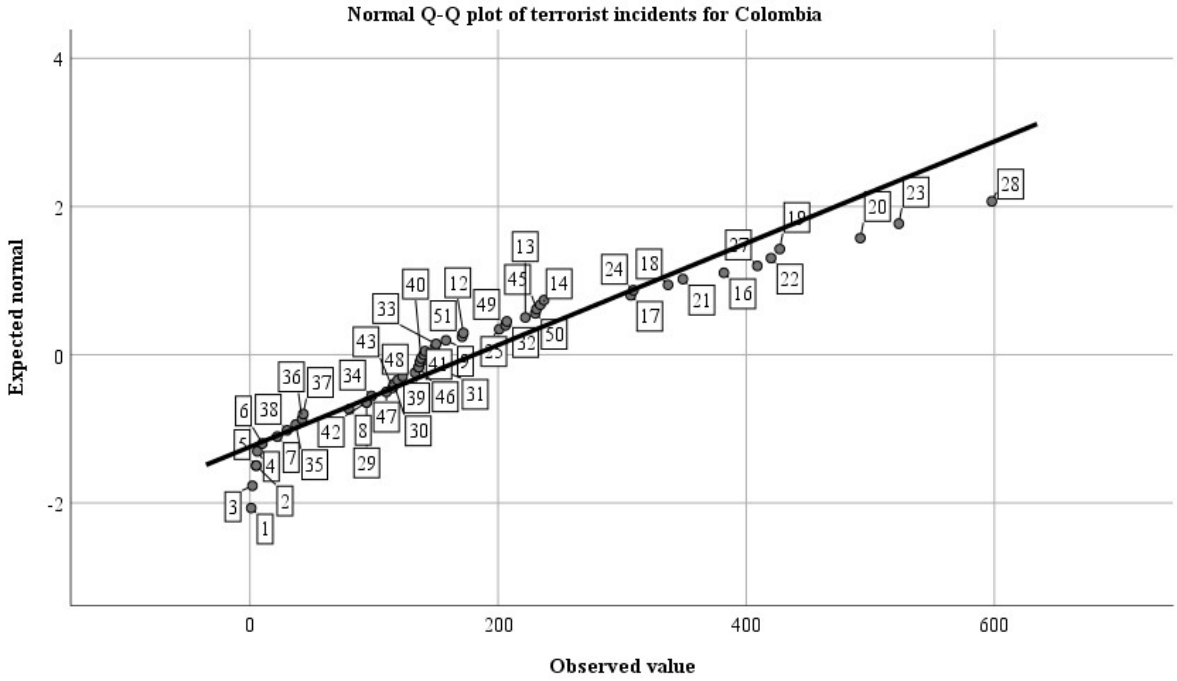
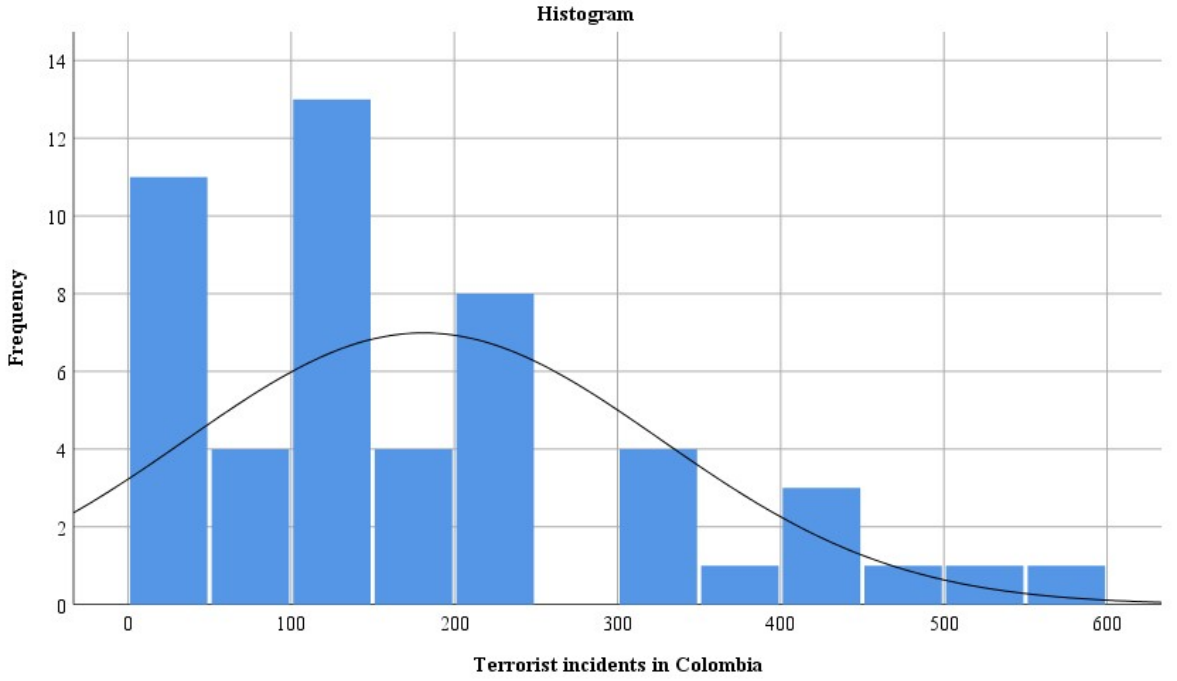
A. Appendix 1

Table A1: Descriptives for Colombia

		Statistic	Std. error
Terrorist incidents	Mean	181.059	20.381
	5% trimmed mean	170.733	
	Median	140.000	
	Variance	21185.176	
	Std. deviation	145.551	
	Minimum	1.000	
	Maximum	598.000	
	Range	597.000	
	Interquartile range	140.000	
	Skewness	1.017	.333
	Kurtosis	.576	.656
	95% confidence interval for mean		
	Lower bound	140.122	
	Upper bound	221.996	




Histogram
Frequency
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12
10
8
6
4
2
0
0
100
200
300
400
500
600
Terrorist incidents in Colombia

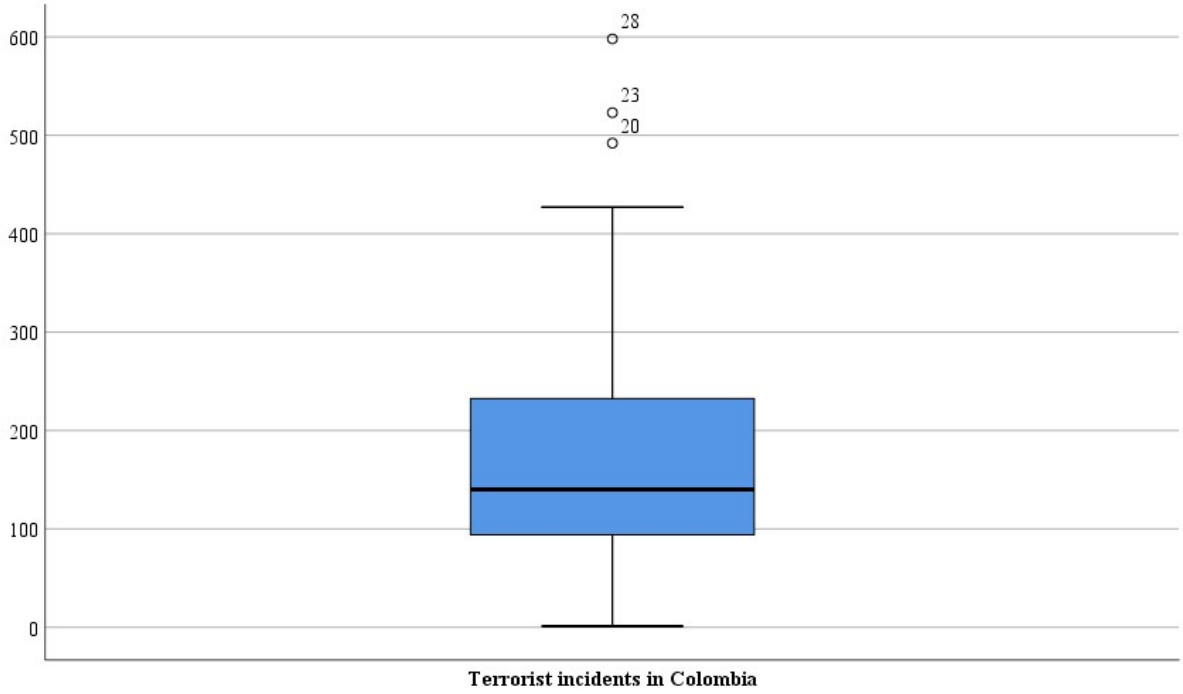
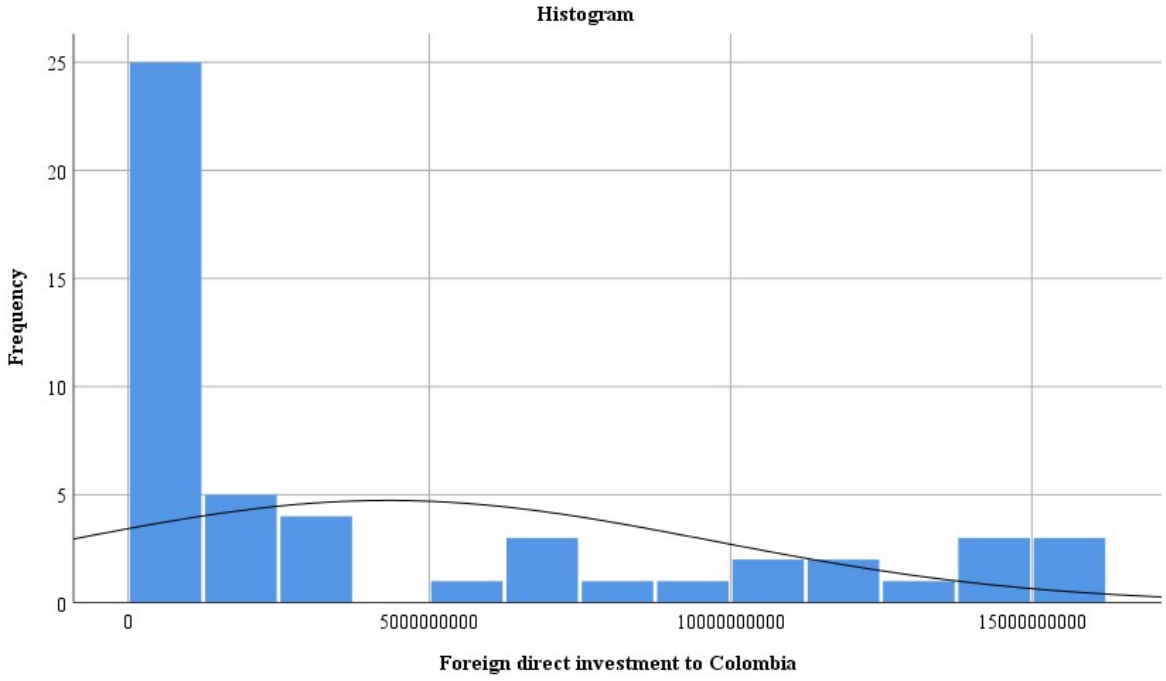
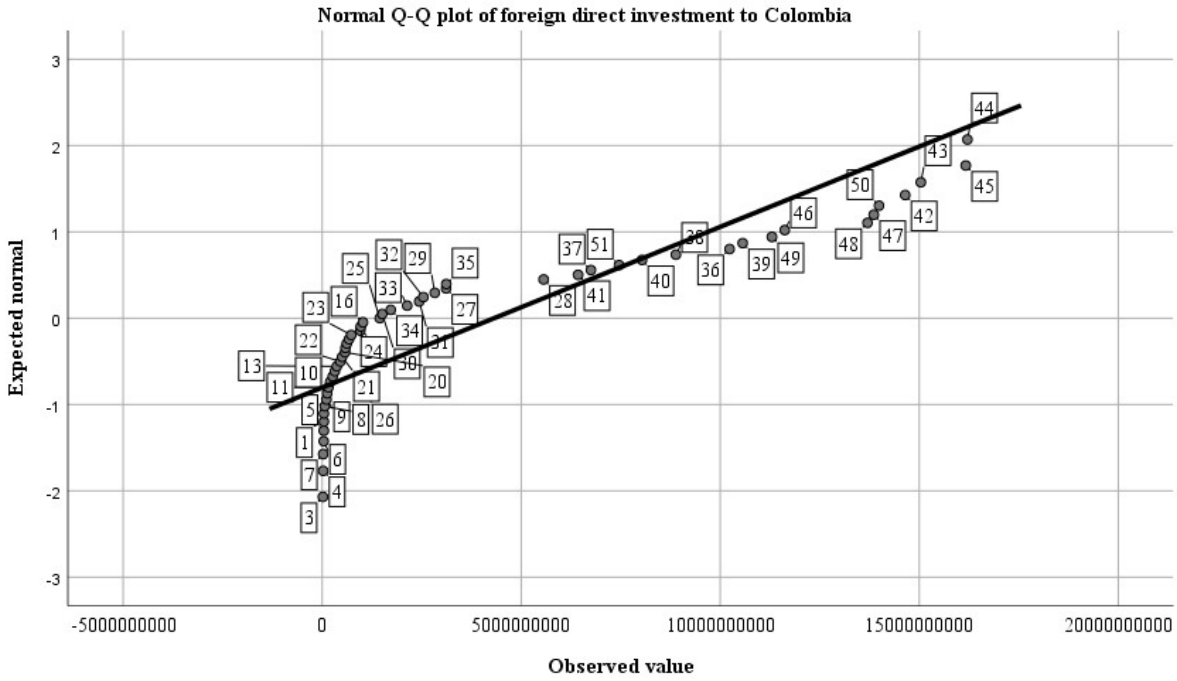
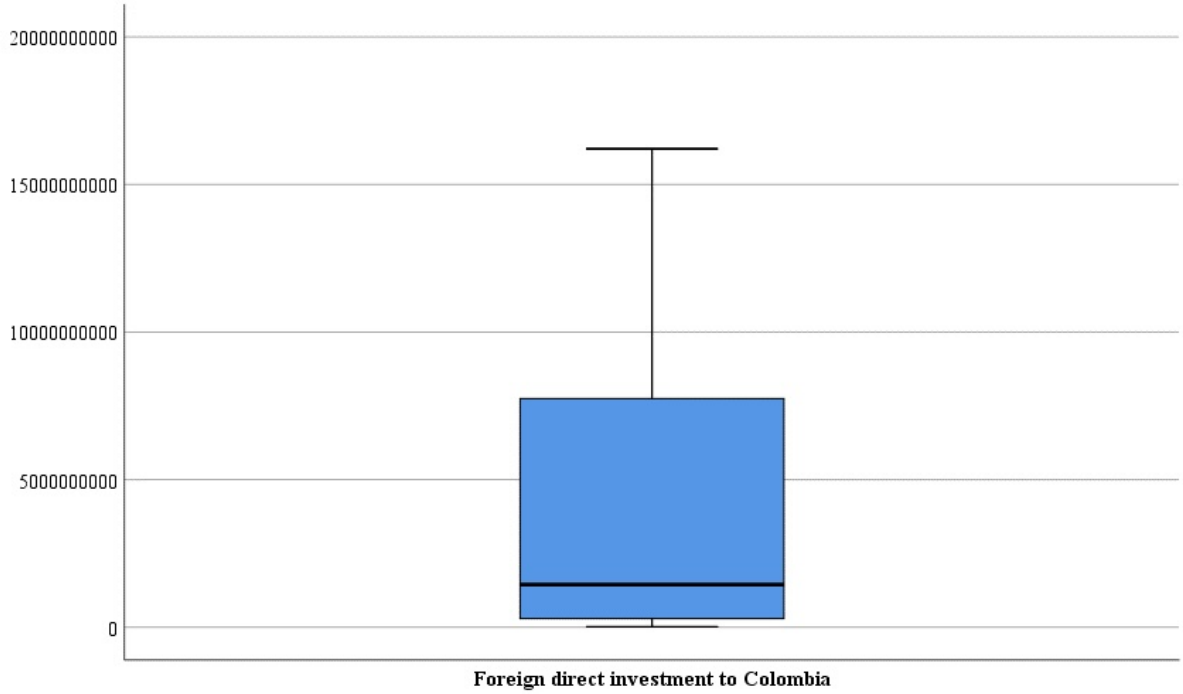

600
500
400
300
200
100
0
28
23
20
Terrorist incidents in Colombia

Table A2: Descriptives for Colombia

		Statistic	Std. error
Foreign direct investment	Mean	4318168935.360	752242091.606
	5% trimmed mean	3911099276.171	
	Median	1446497261.336	
	Variance	28859276383554390000.000	
	Std. deviation	5372083058.140	
	Minimum	18457070.000	
	Maximum	16210419015.982	
	Range	16191961945.982	
	Interquartile range	7769746177.084	
	Skewness	1.072	.333
	Kurtosis	-.360	.656
	95% confidence interval for mean		
	Lower bound	2807246227.760	
	Upper bound	5829091642.960	



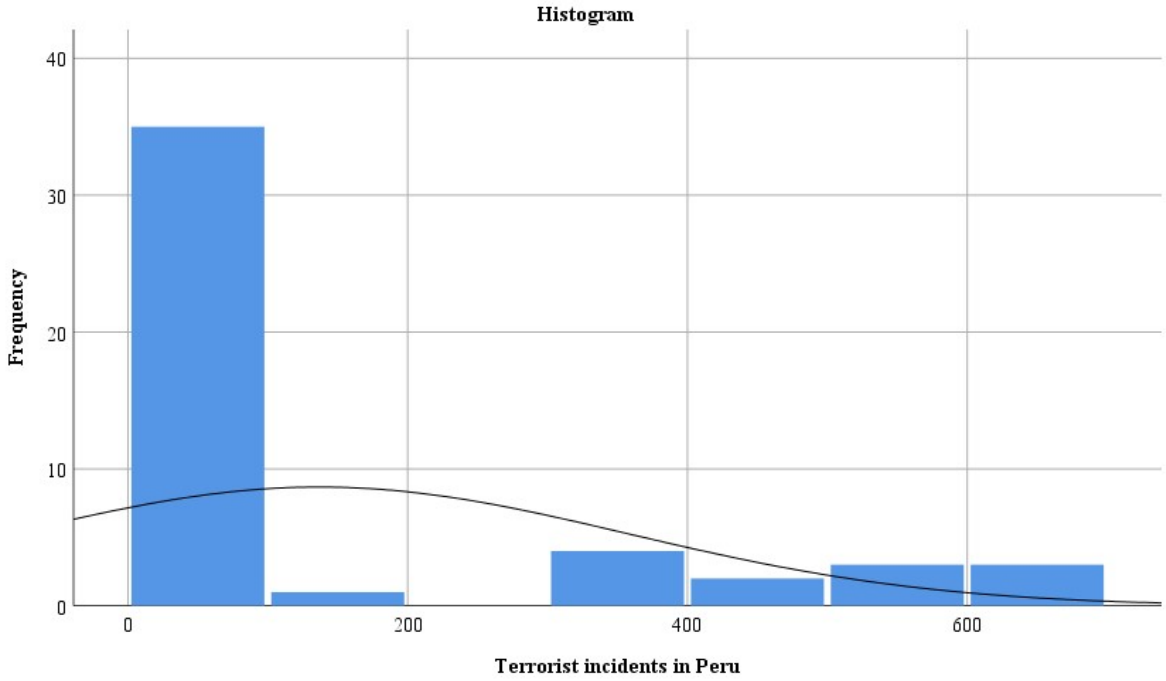

Normal Q-Q plot of foreign direct investment to Colombia
Expected normal
Observed value
3
2
1
0
-1
-2
-3
-5000000000
0
5000000000
10000000000
15000000000
20000000000

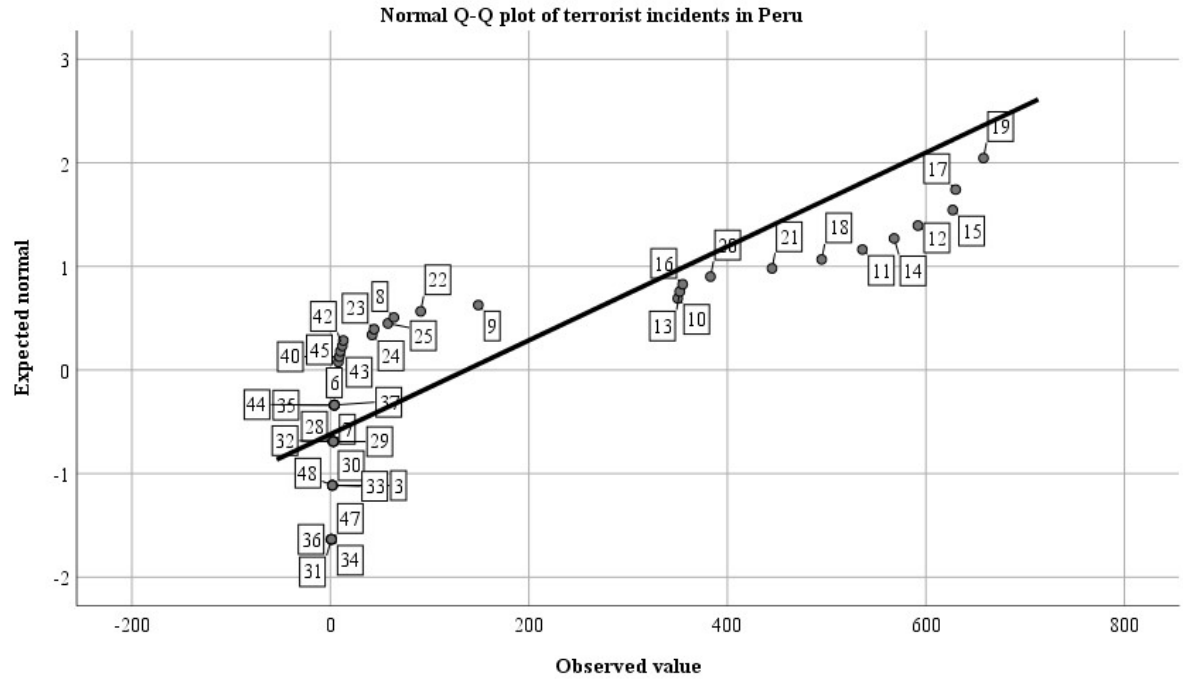

20000000000
15000000000
10000000000
5000000000
0
Foreign direct investment to Colombia

B. Appendix 2

Table A3: Descriptives for Peru: Terrorist Incidents

		Statistic	Std. error
Terrorist incidents	Mean	136.854	31.853
	5% trimmed mean	116.384	
	Median	5.000	
	Variance	48702.936	
	Std. deviation	220.687	
	Minimum	1.000	
	Maximum	658.000	
	Range	657.000	
	Interquartile range	296.750	
	Skewness	1.373	.343
	Kurtosis	.249	.674
	95% confidence interval for mean		
	Lower bound	72.773	
	Upper bound	200.935	




Normal Q-Q plot of terrorist incidents in Peru
Expected normal
Observed value
3
2
1
0
-1
-2
-200
0
200
400
600
800

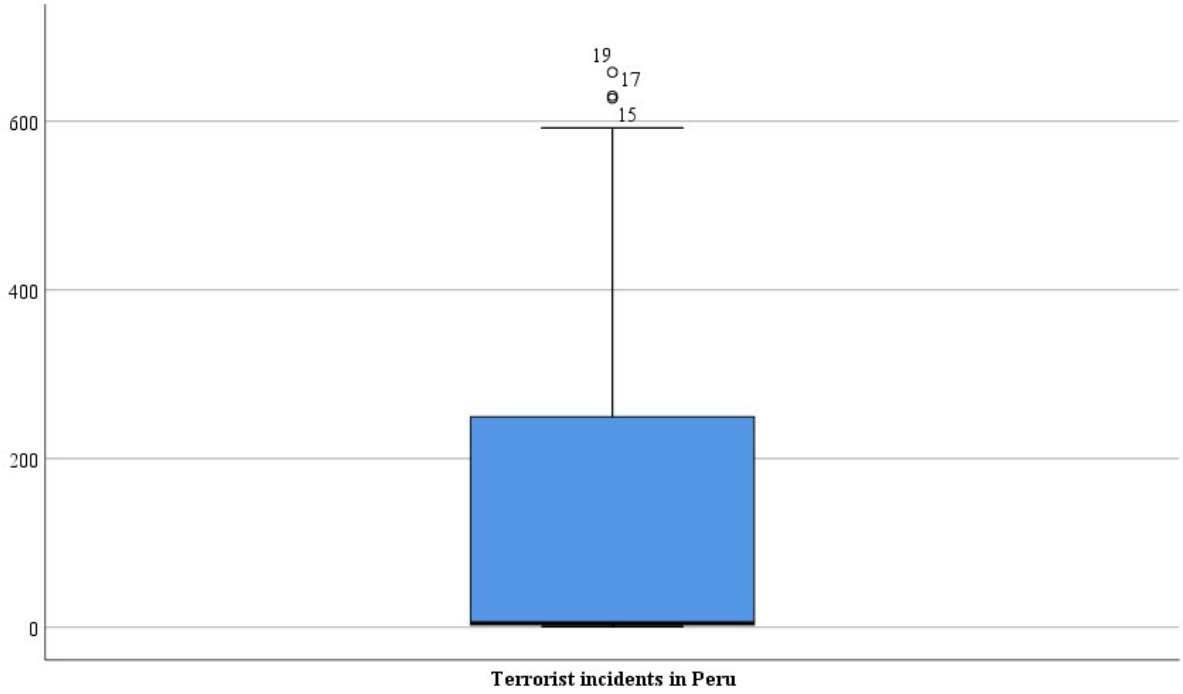
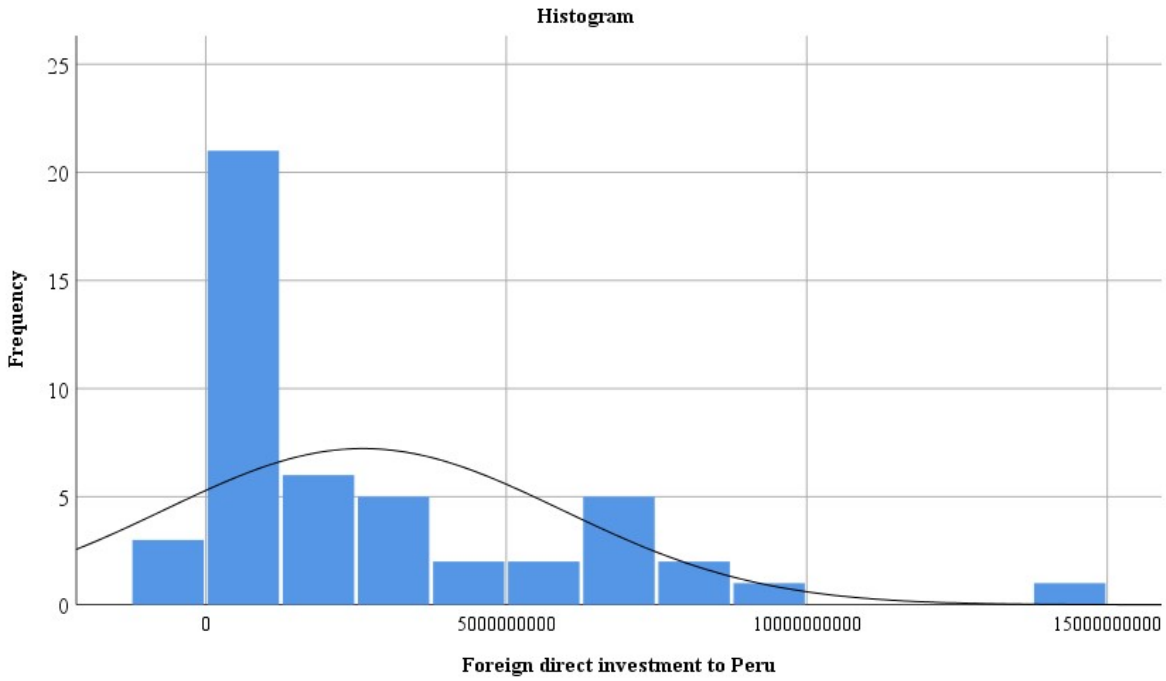
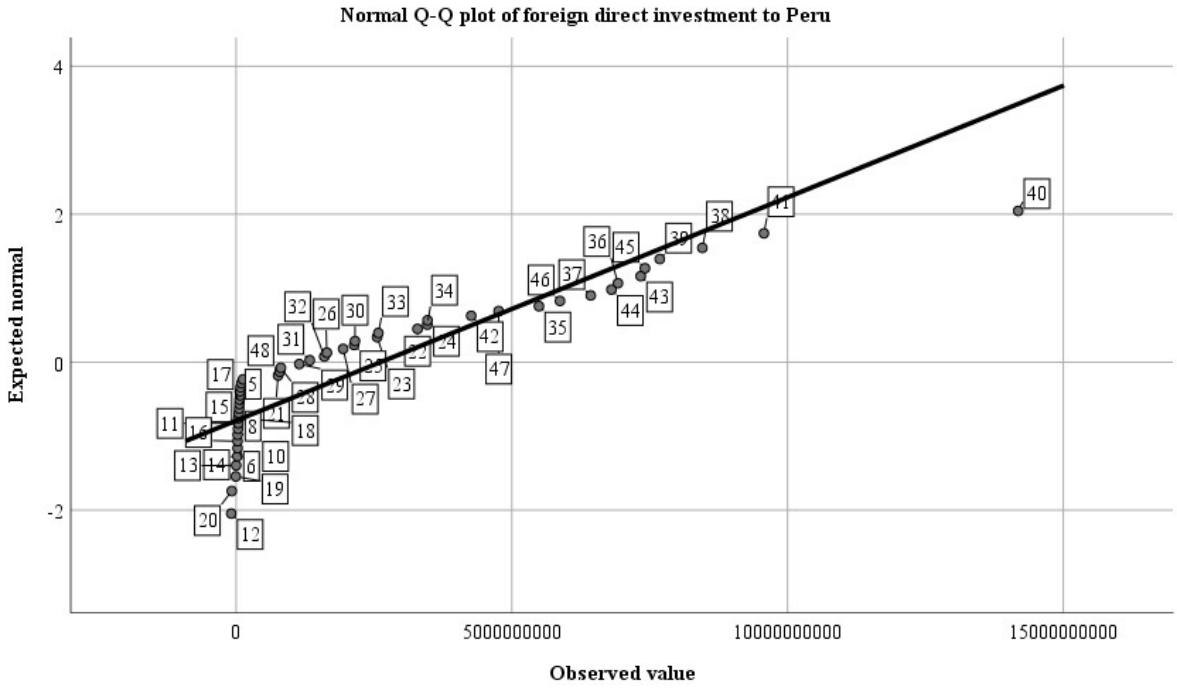
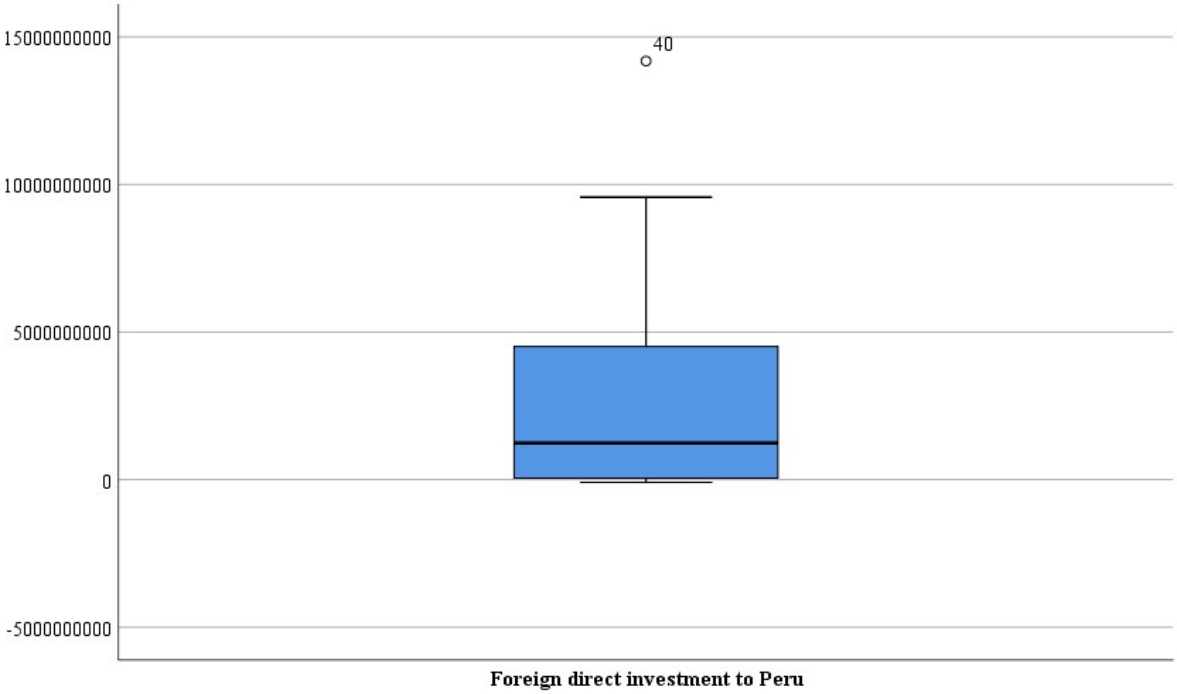

600
400
200
0
Terrorist incidents in Peru

Table A4: Descriptives for Peru: Foreign Direct Investment

		Statistic	Std. error
Foreign direct investment	Mean	2616099088.346	478218276.944
	5% trimmed mean	2282608677.943	
	Median	1239633536.520	
	Variance	10977250579379116000.000	
	Std. deviation	3313193411.103	
	Minimum	-89000000.000	
	Maximum	14182387604.310	
	Range	14271387604.310	
	Interquartile range	4586430963.348	
	Skewness	1.429	.343
	Kurtosis	1.832	.674
	95% confidence interval for mean		
	Lower bound	1654048006.211	
	Upper bound	3578150170.481	




Normal Q-Q plot of foreign direct investment to Peru
Expected normal
Observed value
4
2
0
-2
0
5000000000
10000000000
15000000000


15000000000
10000000000
5000000000
0
-5000000000
40
Foreign direct investment to Peru

C. Appendix 3

Table A5: Unit root test table (PP) for terrorist incidents in Colombia

	TI	FDI
at level	with constant	
	t-statistic -2.983	-1.364
	prob. 0.043**	0.592
	with constant & trend	
	t-statistic -2.888	-2.785
	prob. 0.175	0.210
	without constant & trend	
	t-statistic -1.747	-0.696
	prob. 0.077*	0.410
at first difference	with constant	
	t-statistic -9.204	-8.548
	prob. 0.000***	0.000***
	with constant & trend	
	t-statistic -9.817	-8.417
	prob. 0.000***	0.000***
	without constant & trend	
	t-statistic -9.275	-8.559
	prob. 0.000***	0.000***

Table A6: Unit root test table (ADF) for terrorist incidents in Colombia

	TI	FDI
at level	with constant	
	t-statistic -2.949	-1.541
	prob. 0.047**	0.505
	with constant & trend	
	t-statistic -2.902	-2.864
	prob. 0.171	0.183
	without constant & trend	
	t-statistic -0.733	-0.908
	prob. 0.394	0.318
at first difference	with constant	
	t-statistic -6.744	-8.510
	prob. 0.000***	0.000***
	with constant & trend	
	t-statistic -6.832	-8.385
	prob. 0.000***	0.000***
	without constant & trend	
	t-statistic -6.777	5264
	prob. 0.000***	0.000***

Table A7: Unit root test table (PP) for foreign direct investment to Peru

	FDI	TI
at level	with constant	
	t-statistic -1.838	-1.690
	prob. 0.358	0.430
	with constant & trend	
	t-statistic -2.296	-2.113
	prob. 0.428	0.526
	without constant & trend	
	t-statistic -1.369	-1.399
	prob. 0.157	0.148
at first difference	with constant	
	t-statistic -7.540	-9.046
	prob. 0.000***	0.000***
	with constant & trend	
	t-statistic -7.498	-9.075
	prob. 0.000***	0.000***
	without constant & trend	
	t-statistic -7.635	-9.137
	prob. 0.000***	0.000***

Table A8: Unit root test table (ADF) for foreign direct investment to Peru

	FDI	TI
at level	With constant	
	t-statistic -1.912	-1.262
	prob. 0.324	0.639
	with constant & trend	
	t-statistic -2.364	-2.321
	prob. 0.393	0.476
	without constant & trend	
	t-statistic -1.445	-1.057
	prob. 0.137	0.258
at first difference	with constant	
	t-statistic -7.497	-9.381
	prob. 0.000***	0.000***
	with constant & trend	
	t-statistic -7.454	-9.395
	prob. 0.000***	0.000***
	without constant & trend	
	t-statistic -7.586	-9.487
	prob. 0.000***	0.000***

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. And (no) not significant. MacKinnon (1996) one-sided p-values