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7 July 2014

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# 1 ABSTRACT

This study explores the adverse impacts of terrorism on the net Foreign Direct Investment (FDI) flows to Pakistan. Since 2003, terrorist violence has killed over 52,000 individuals in Pakistan. The unrelenting violence has substantially increased investment and security risks. This study uses time series econometrics to develop theoretically and empirically sound estimates for the impact of terrorism on FDI flows. This study has found that an increase in terrorist violence reduces FDI. Furthermore, the disaggregated analysis by individual sectors explores the nuances in considerations for FDI, where some sectors are affected while others remain immune to terrorism-related risks.

**Keywords:** Foreign Direct Investment; Terrorism; Pakistan; ARMAX Model

**JEL codes:** F23; D74; N45

# 2 INTRODUCTION AND LITERATURE REVIEW

Since the NATO's intervention in Afghanistan in 2001, Pakistan has faced intense terrorist activities. The Afghan Taliban and their allies in Pakistan have been fighting with the NATO troops and Afghan forces in Afghanistan. At the same time, Afghan and Pakistani Taliban started a violent insurgency in Pakistan (Haider, 2011 and 2013). In the past few years, terrorism has spread to all corners of Pakistan. Since 2003, more than 52,000 individuals, including 19,000 civilians, have lost their lives to terrorism (South Asia Terrorism Portal, 2014).

Recent studies have analyzed the macroeconomic determinants (Ismail and Amjad, 2014) and consequences (Malik and Zaman, 2013) of terrorism in Pakistan. Other more focused

work analyzed the impact of terrorism on Pakistan's economy, including foreign direct investments (FDI). For instance, Mughal and Anwar (2014) observed that the lack of a social safety net in Pakistan has resulted in greater remittances from expatriates to their family members who suffer from direct and indirect impacts of terrorist violence. Mehmood (2013) estimated the impact of terrorism on GDP growth, FDI, and foreign worker remittances to Pakistan during 1973 and 2008. He relied on the Global Terrorism Database along with macroeconomic indicators from the Central Bank of Pakistan and reported that Pakistan lost 33% of its real national income over this period. This is equivalent to losing 1% GDP per capita annually. The loss comes mostly in the form of reduced FDI and foreign worker remittances.

Other studies on the impact of terrorism on Pakistan, while being valuable, suffer from several methodological shortcomings. For instance, Rasheed and Tahir (2012), using annual data from 2003 to 2011, investigate the relationship between terrorist attacks and FDI inflows to Pakistan. The authors used a data set with only nine observations, which are not sufficient for time series analysis.

Using financial data from 2006 to 2008, Gul et al. (2010) found that terrorism adversely affected the performance of the Karachi Stock Exchange, Pakistan's largest bourse. However, they found a statistically insignificant, yet negative, association between terrorist activities and both FOREX and the interbank markets.

Their study, however, also had several methodological shortcomings. They examined attacks on political figures as proxies for terrorist activity and ignored frequent terrorist attacks on ordinary citizens, who, unlike politicians, are not guarded against attacks. This could be a serious limitation since ordinary citizens and businessmen are more frequently

affected by terrorism than politicians, who are well-guarded (Czinkota et al, 2005; Brandt and Sandler, 2010; and Llussá and Tavares, 2011). In addition, Gul et al. (2010) applied ordinary least squares (OLS) and ignored concerns about stationarity and serial autocorrelation. OLS is known to return spurious results if stationarity assumptions are violated.

The business community is increasingly vulnerable in Pakistan because of the confluence of terrorists and criminal elements that has resulted in an alarming increase in kidnappings for ransom. Several individuals including an American consultant (Londoño, 2013), the son of a former prime minister (Dawn, 2013), the son of the former governor of Pakistan's most populated province (Punjab) who was himself assassinated by a policeman in his own security detail (Dawn, 2011), and a vice chancellor of a university (Express Tribune, 2010) are some of the prominent figures who are being held hostage by militants for years. Several businesspersons in Pakistan's largest and most industrious city, Karachi, have been abducted and were released only after paying millions in ransom (Mirza, 2013).

### 2.1.1 Theoretical framework for Foreign Direct Investments

Foreign Direct Investments (FDI) are caused by structural market imperfections and a firm's desire to exploit its ownership advantages (Hymer, 1976). Buckley and Casson (1976, 2002) also state that market imperfections cause FDI. They argue that high risks and uncertainty in FDI lead to higher transaction and bargaining costs. Williamson (1975) explains that firms internationalize to exploit external opportunities or internal efficiencies.

The question remains, what motivates a firm to engage in FDI? Dunning (1979, 1988) frames the eclectic theory of foreign direct investment in the 'OLI' framework where a firm

must possess three types of advantages for successful FDI: ownership advantages (O), location advantages (L), and internalization advantages (I). Ownership advantages are firm-specific, such as the firm's size, product diversification, and trademarks. Location specific advantages are the characteristics of the host country, such as growing economies, natural resources, lower transportation and communication costs, growth-friendly policies, political stability, and robust judicial systems. Put simply, a firm carries out FDI only when location and ownership advantages make production abroad profitable, otherwise the firm will cover the overseas markets through other modes, e.g., licensing or trade.

FDI typically consists of long-term investments that may not be easily reversed. In other words, the investment itself becomes a barrier to exit for Multinational Companies (MNCs), who prefer to invest in growing and stable economies (Rivoli & Salorio, 1996; Bandera & White, 1968; Lunn, 1980; Schneider & Frey, 1985). Terrorist activities in host countries, for instance, would deter MNCs to invest because they are interested in the long-term prospects of FDI.

The economic consequences of terrorism have been the subject of recent research. Li (2011), for instance, views terrorism as an extreme form of political instability that affects the FDI in several ways: Terrorism hurts physical infrastructure and human capital, imposes financial constraints, and slows economic growth. Abadie and Gardeazabal (2003) estimated that terrorism caused a 10% drop in per-capita Gross Domestic Product (GDP) in the Basque Country over two decades. Between 1975 and 1991, terrorism, on average, reduced net FDI flows to Spain by 13.5% and to Greece by 11.9% (Enders and Sandler, 1996). Becker and Murphy (2001) observed that the terrorist attacks on September 11, 2001, in the United States caused a loss of 0.06% of the US economy's total productive assets. Bloomberg et al. (2004), using the ITERATE data for 177 countries from 1968 to

2000, estimated that terrorism caused a 0.5% decline in annual national economic growth. Tavares (2004), using a cross-country dataset for the 1987-2001 time period, also found that a one standard deviation increase in terrorist incidents was correlated with a 0.2% decline in GDP. Similarly, Eckstein and Tsiddon (2004) observed that terrorist attacks reduced per-capita output by 3 to 5%, and annual per-capita consumption by about 5% in the Israeli economy.

Relying on investment data from 510 Indian farmers in 46 sub-districts during July 1978 to June 1990, Singh (2013) found that terrorism was negatively associated with the level of investment in the long term. However, these effects were small and statistically insignificant during the short term. He noticed that the cost of borrowing for farmers increased due to terrorism-related uncertainty. Another study also found that FDI inflows to 136 developing countries were significantly affected by terrorism (Alomar and El-Sakka, 2011).

Terrorist incidents in a host country, whether in the context of a developing or advanced economy, increase uncertainty, which deters foreign investors. For instance, Abadie and Gardeazabal (2008) found that FDI inflows to the US declined from 15.8% of the Gross Fixed Capital Formation in 2000 (before 9/11 attacks) to 1.5% in 2003. At the same time, FDI outflows of the Gross Fixed Capital Formation increased from 7.2 % in 2000 to 7.5% in 2003. The authors also observed a 5% decline in the net foreign direct investment for a one standard deviation increase in the terrorist risk.

Terrorism increases transaction costs because of higher spending on increased security measures (Johnston and Nedelescu, 2005; Abadie and Gardeazabal, 2008). Additional security costs may cause a firm to lose its price competitiveness in international markets

(Moshirian, 2006). Terrorist incidents also trigger a drop in asset prices and the flight of capital, causing an increase in borrowing costs for firms (IMF, 2001b; Johnston and Nedelescu, 2005).

MNCs may experience higher operating costs because of the higher taxes required to combat terrorism and to improve security. Terrorism also causes governments to be more vigilant with private financial transactions to prevent funding of terrorist activities from abroad (Li, 2011). Terrorism causes an increase in defense budgets, which ultimately redirects resources away from more productive uses.

Earlier research in political instability and FDI has returned mixed findings. Several studies (e.g. Schneider and Frey, 1985; Woodward and Rolfe, 1993) report a negative correlation between political instability and FDI inflows. Abadie and Gardeazabal (2008) observed a negative correlation between direct investments and terrorist violence. Similarly, Nigh (1985) finds that both international and intra-nation conflicts affect FDI from the US multinationals. However, Fatehi-Sedeh and Safizadeh (1989) find a statistically insignificant association between political stability and FDI.

Other research suggests that investors respond to terrorism in a heterogeneous manner (Agrawal, 2010). An analysis of FDI inflows from 34 OECD member countries for 12 industrial sectors from 1985 to 2009 shows a significant but inconsistent relationship between terrorism and FDI. From a list of 12 broad industrial sectors, FDI inflows for manufacturing, trade, repair, and construction returned a statistically significant negative correlation with terrorist events, whereas other sectors were found to be statistically insignificant. Agarwal (2010) observed that the ability of investors to absorb or discount future risk is influenced by other economic or political factors.

Terrorism related uncertainty and risk affect other aspects of the economy, such as trade. For instance, terrorism reduces bilateral trade flows because strict border regulation adds to the transaction costs. Fratianni and Kang (2006) suggest that terrorism redirects some trade from neighbouring to more distant countries. Similarly, Nitsch and Schumacher (2004), using data on 200 countries from 1960 to 1993, observed that a 100% increase in terrorist attacks decreased bilateral trade by 4%.

Terrorism also impacts tourism in the afflicted countries and regions. Enders et al. (1992) examined tourism data for seven Western European countries covering the period between 1968 and 1988. They found that terrorism deterred tourists from some, but not all countries. Between January 1997 and December 2006, terrorism caused a decline of six million tourists in Turkey, which reduced tourism spending by $700 million in 2006 alone (Yaya, 2009).

The literature review exposes the gaps in methodology and scope. Most studies have focused on aggregated FDI, implying that the impact of terrorism does not differ by industrial sectors. In Pakistan's context, most studies used inadequate modelling tools that failed to account for the time series-specific attributes of the data. Our proposed methodology, in the following section, addresses these shortcomings.

# 3 DATA AND METHODOLOGY

The purpose of this study is to determine if the frequently occurring terrorist violence in Pakistan has an impact on the FDI flows to Pakistan. The literature suggests that terrorist violence creates uncertainty and increases risks that may deter FDI flows. Earlier research has tested the assumptions using the time series data and ARIMA models. Building on the

published literature, this study also uses time series data for net FDI flows to Pakistan and fatalities resulting from terrorist violence.

## 3.1 DATA

We obtained the time series data on net FDI from the State Bank of Pakistan (SBP). The time series data are differentiated by major industrial sectors. One of the key motivations for this study was to determine the impact of terrorism on net FDI to particular industrial sectors. It is quite possible that certain industrial sectors may not be sensitive to the instability and accentuated risk as a result of the nature of investments or the immediacy of the need of their products. At the same time, higher risks may be indicative of even higher payoff for FDI. The disaggregated data on the net FDI thus allows us to determine the impact of terrorist activities on net FDI to industrial sectors in Pakistan.

The FDI data covers the period of July 2001 to November 2011. SBP reports NFDI inflows for several aggregated industrial sectors. At the aggregate level, NFDI flows demonstrated a tendency to increase from 2001 until 2007, and plummeted afterwards **(**Figure 1**).** At the sectoral level, we have shortlisted the top-10 grossing sectors for NFDI inflows to Pakistan (Figure 2**)**. The communications sector received the highest investment, followed by finance/banking, and oil and gas. This study analyzes monthly FDI at the sectoral level. We excluded sectors that had infrequent transactions.

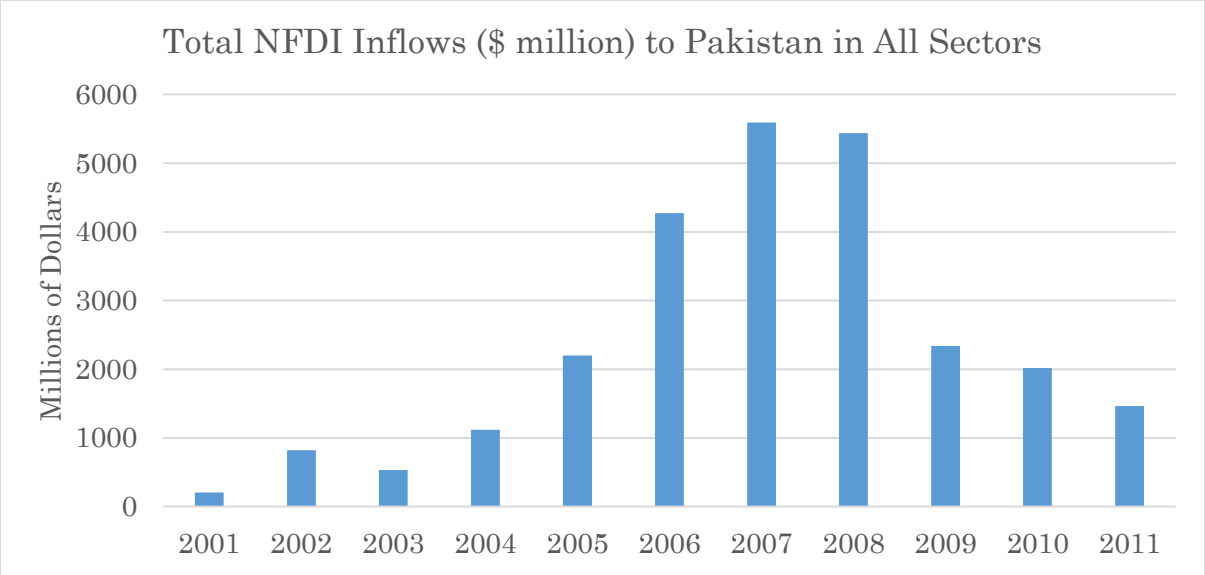


*Figure 1: NFDI inflows to Pakistan at aggregate level from 2001-2011*

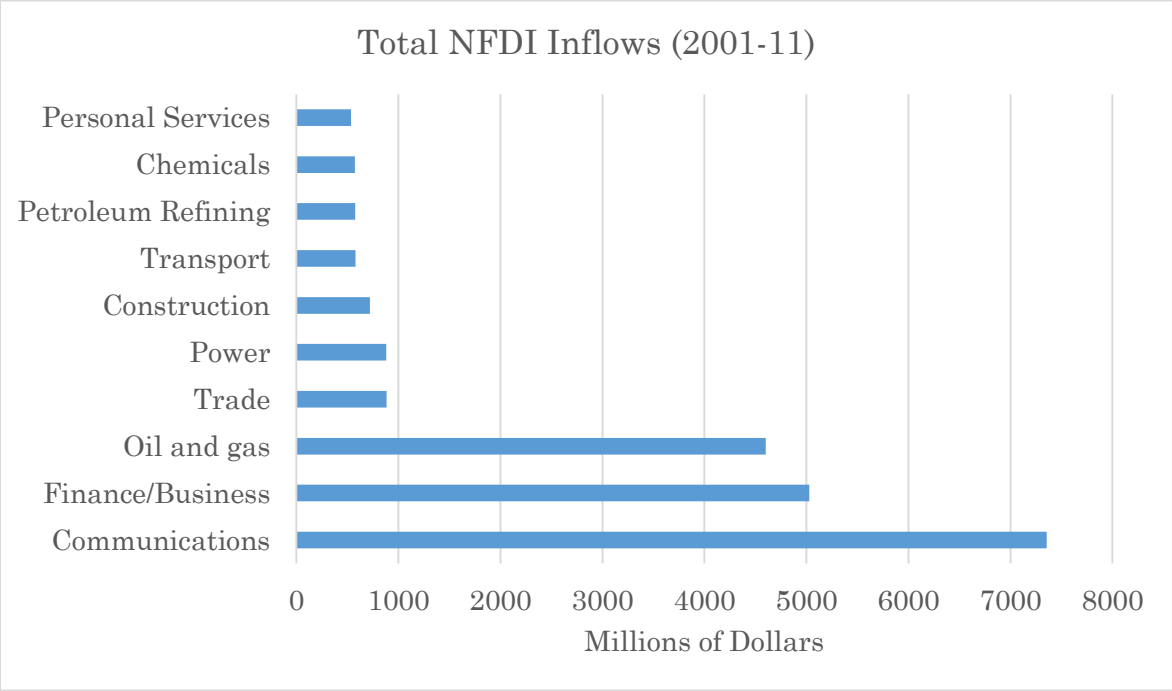


*Figure 2: NFDI inflows to Pakistan in top 10 sectors from 2001-2011*

We obtained the data on terrorism-related fatalities from South Asia Terrorism Portal (SATP). Defining what constitutes terrorism could be a complicated endeavour. One person's freedom fighter is another person's terrorist. We have followed SATP's definition of terrorism, which states that an "act or acts of criminal violence, or the sequence of actions leading to such an act or acts, which is/are intended to intimidate the public, coerce or unduly compel a government or public authority to perform or abstain from performing any act; or to destabilize or destroy the fundamental political, constitutional, economic or social structures of a country; or to overawe any public functionary or government agency."[1]

SATP diligently maintains data on terrorist activities and has provided aggregate monthly statistics on deaths and injuries for civilians, law enforcement personnel, and those identified as terrorists. SATP compiles statistics from incidents reported by the news media. To date, no other source for information is available that tabulates and provides detailed accounts of terrorist activities in Pakistan for the study period. Other sources with similar data, such as International Terrorism: Attributes of Terrorist Events (ITERATE), and Global Terrorism Database (GTD) at the University of Maryland, either do not cover the entire time period or lack event-specific narratives that are available from SATP.

SATP data has maintained statistics on terrorism-related fatalities in Pakistan since 2003. The terrorist-related violence peaked in June 2009 (Figure 3). The monthly time series data presents a breakdown of casualties by civilians, security force personnel, and insurgents. In this paper we have used the number of total deaths including civilians, security personnel, and insurgents, as a proxy for terrorist violence in Pakistan.

[1] We thank SATP for providing us their definition of terrorism upon request. The definition is not available online. Dr. Ajai of SATP provided this definition in personal communication with the authors.

The choice of a proxy for terrorist activities is not without controversy. In earlier research, country risk ratings have been used as a proxy for terrorism-related activities (Abadie and Gardeazabal, 2008). It has been argued that the number of casualties is a poor indicator of terrorism because terrorist incidents are of different magnitude and significance. For cross-sectional studies, this argument may be valid. However, for monthly time series data, as is the case in our study, the frequency of events and the number of fatalities do account for the difference in magnitude and significance of terrorist attacks.

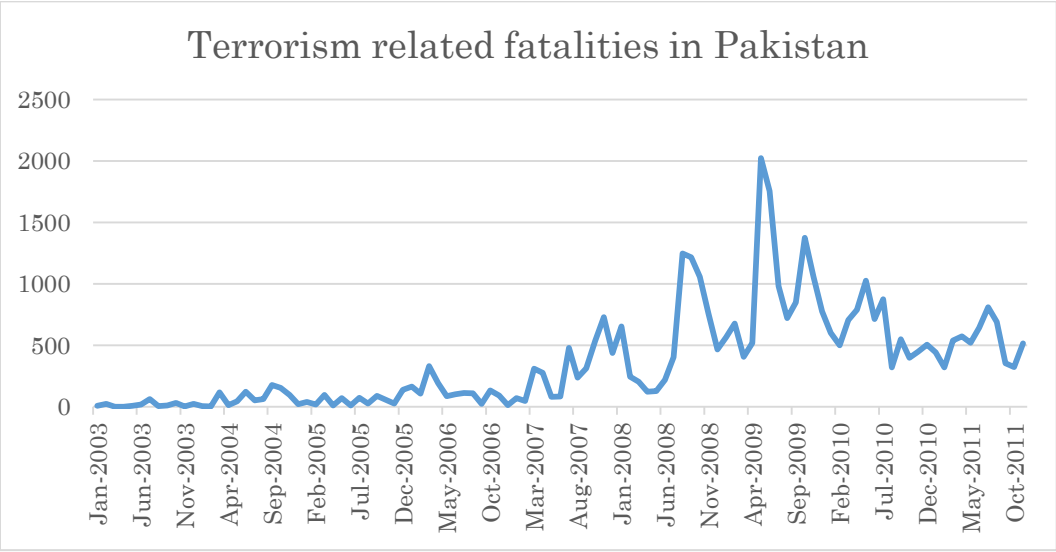


*Figure 3: Terrorism related fatalities in Pakistan*

While the NFDI inflows are available from July 2001 to November 2011, the fatalities data are available for January 2003 to November 2011. Thus, this study is confined to the period of January 2003 to November 2011.

## 3.2 METHODS

The literature review conducted earlier helped us select the Auto-regressive Integrated Moving Average (ARMAX) models with exogenous variables as the preferred modelling

platform. Several studies in the past have used the same modelling framework because it is particularly suited for the time series nature of our data set. While other time series techniques, such as VAR or VECM, have been used in the past, we believe that these models are not suited for our needs primarily because we believe that the causality in our models occurs in only one plausible direction, i.e., terrorism impacts (causes) FDI and not the other way around.

This study analyzes the impact of terrorism on FDI flows to individual industrial sectors, in addition to the impact on total FDI flows. This is done to determine whether the impact varies by industrial sector. We have estimated ARMAX models for each sector and treated terrorism-related fatalities as the exogenous variable to determine the impact of terrorism on the sector's NFDI inflows. As mentioned earlier, only the top-10 sectors by FDI flows are included in this study. We estimated 11 models, one for the total NFDI and 10 sectoral FDI.

We adopted the following methodology for the analysis:

1. Test stationarity for FDI flows for individual industrial sectors.
2. Determine the lag structure for autoregressive and moving average components of the ARMAX models.
3. Estimate ARMAX models for FDI flows for individual sectors.
4. Conduct tests to determine residuals are white noise.

We estimated an ARMAX model with robust standard errors, which is also recommended by Cameron and Trivedi (2009) to control for a mild violation of the distribution assumption that the variance equals the mean. Also, for state-space models in general and ARMAX and ARIMA models in particular, the robust or quasi–maximum likelihood estimates (QMLEs)

of variance are robust to the symmetric non-normality in disturbances, including, as a special case, heteroskedasticity (Stata, 2009).

The theoretical model is presented below:

$$NFDI_{i,t} = \alpha + \beta T_t + \Phi NFDI_{i,t-1} + \varepsilon_t$$

Where $NFDI_{i,t}$ is the net foreign direct investment in sector $i$ at time $t$, $T_t$ is terrorism-related fatalities at time $t$, and $\varepsilon_t$ is the disturbance term [N~iid (0,σ)].

A simple ARMAX ($p$, $q$) model can be expressed as:

$$NFDI_{i,t} = \alpha + \beta_1 NFDI_{i,t-1} + \cdots + \beta_p NFDI_{i,t-p} + \delta_0 T_t + \delta_1 T_{t-1} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \cdots - \theta_q \varepsilon_{t-q}$$

In this form, the model has lagged dependent and independent variables and a moving average disturbance. We assume that the errors are independently and identically distributed, with zero mean, constant variance, and zero covariance. Prior to running the ARMAX model on each of the time series, we applied the Johansen Cointegration test to determine whether a long-run equilibrium relationship exists between the two time series. We found no evidence of co-integration.

We present the results in the next section followed by a discussion of results.

# 4 RESULTS

Summary statistics on monthly time series data for net FDI flows and terrorism-related violence in Pakistan are presented in Table 1. Our sample indicates that on average, 28 bomb blasts occurred each month in Pakistan during the study period (July 2001 to November 2011), resulting in approximately 358 casualties per month. The average

monthly FDI flows equalled $208 million. Communications, financial business, and the oil and gas sectors, respectively, received the highest monthly net FDI flows.

*Table 1: Summary statistics for FDI flows and terrorism related casualties*

| Variable | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Net FDI in All Sectors | 125 | 176.3 | 172.4 | 17.0 | 1010.7 |
| Net FDI in Communications | 125 | 50.2 | 107.2 | -38.1 | 632.5 |
| Net FDI in Financial Business | 125 | 33.9 | 68.4 | -24.7 | 579.9 |
| Net FDI in Oil and Gas | 125 | 31.1 | 23.3 | 8.3 | 126.7 |
| Net FDI in Trade | 125 | 6.1 | 6.8 | -13.5 | 26.8 |
| Net FDI in Power | 125 | 6.1 | 23.4 | -68.0 | 230.7 |
| Net FDI in Construction | 125 | 4.9 | 5.3 | 0.0 | 28.3 |
| Net FDI in Transport | 125 | 3.9 | 3.8 | 0.2 | 17.6 |
| Net FDI in Petroleum Refining | 125 | 3.9 | 4.8 | -3.5 | 20.2 |
| Net FDI in Chemicals | 125 | 4.0 | 7.7 | -14.4 | 72.8 |
| Net FDI in Personal Services | 125 | 3.6 | 3.1 | -0.5 | 19.6 |
| Total Casualties | 107 | 358.4 | 394.3 | 1.0 | 2024.0 |

** FDI numbers are in 2001 constant dollars (millions).*

## 4.1 UNIT ROOT TESTS

This paper uses an ARMAX model to investigate the relationship between terrorism-related violence and NFDI inflows to Pakistan. The ARMAX model is an extension of the Box–Jenkins autoregressive moving average (ARIMA) model with exogenous variables. ARMAX models require the dependent variable to be stationary, i.e., having constant mean and variance, and constant auto-covariances over time. We have therefore tested each dependent variable for stationarity using the unit root tests.

We have used the Augmented Dickey Fuller (ADF) tests to test the null hypothesis that a unit root exists, or that the underlying time series is *I(1)*. ADF tests require that we specify the number of lags. Baketi (2013, pp. 383) recommends that the frequency of the time series

should be used for specifying the number of lags. We are using the monthly time series data; hence we have conducted ADF tests with 12 lags for each time series. The results are reported in Table 2. We fail to reject the null hypothesis of unit root for all except the FDI flows in the Chemicals sector. Based on the results in Table 2, we treat all time series (including Chemicals) as *I(1)* and estimate the ARMAX models with first-differenced data as the dependent variables.

*Table 2: Augmented Dickey Fuller Tests for stationarity*

| Augmented Dickey Fuller Test (12 lags) | ADF test statistics | Critical Value (at 5 %) |
|---|---|---|
| NFDI in All Sectors | -1.35 | -2.9 |
| NFDI in Communications | -1.39 | -2.9 |
| NFDI in Financial Business | -2.07 | -2.9 |
| NFDI in Oil and Gas | -0.88 | -2.9 |
| NFDI in Trade | 0.03 | -2.9 |
| NFDI in Power | -2.61 | -2.9 |
| NFDI in Construction | -1.68 | -2.9 |
| NFDI in Transport | -1.58 | -2.9 |
| NFDI in Petroleum Refining | -1.85 | -2.9 |
| NFDI in Chemicals* | ***-3.28*** | -2.9 |
| NFDI in Personal Services | -1.42 | -2.9 |

***** *We reject the null hypothesis of Unit Root.*

## 4.2 ARMAX MODELS

The ARMAX models require one to first specify the order (*p)* for the auto-regressive (AR) part and (*q*) for the moving average (MA) disturbances. We used autocorrelation and partial autocorrelation functions to determine the adequate structure of lags required by the model. Results are presented in Table 3.

*Table 3: Lag structure for variables based on AC and PAC tests*

| Time Series | Number of lags for autoregressive term | Number of lags for moving average term |
|---|---|---|
| NFDI in All Sectors (D1*) | 1,2,4,5,9 | 1, 6 |
| NFDI in Communications (D1) | 1,2,3,4,5,8,9 | 1 |
| NFDI in Financial Business (D1) | 1,2 | 1 |
| NFDI in Oil and Gas (D1) | 1,2,5, 8 | 1,2,3,6,9, 12 |
| NFDI in Trade (D1) | 1,2 | 1,3 |
| NFDI in Power (D1) | 1,2,3,4 | 1 |
| NFDI in Construction (D1) | 1,3,4 | 1 |
| NFDI in Transport (D1) | 1,2 | 1 |
| NFDI in Petroleum Refining (D1) | 1 | 1 |
| NFDI in Chemicals (D1) | 1,2,3,4 | 1 |
| NFDI in Personal Services (D1) | 1,2,4, 6,9 | 1 |

The lag structures specified in Table 3 help us specify the model. The time series data for all sectors is differenced. The numbers of casualties are included in the model without any transformation. Results for the total FDI flows, Communications, Finance and Business, Oil and Gas, and Trade are presented in Table 4 and the results for the remaining sectors are presented in Table 5. We estimated a model for each time series using the specified lag structures in Table 3. However, we systematically reduced the number of lags and settled the final models based on AIC and BIC. Thus Table 4 and Table 5 present the final models that returned the lowest values for AIC and BIC. We were also motivated by concerns for parsimony and preferred simple over more complex specifications. Lastly, the reported standard errors are semi-robust and were generated using the robust option in Stata.

The results are organized as follows in Table 4 and Table 5. The model specification is presented in the first row. The second row is merely an index representing results for FDI flows. The third column lists the names of individual time series. Variables and estimated results are listed in the first column. The model for total FDI flows was specified as ARIMA

(1,1,1), suggesting that the time series was differenced once and the model includes an auto-regressive component as well as a disturbance.

*Table 4: ARMAX models for total FDI flows and top-four industrial sectors by FDI volumes*

| | ARIMA (1,1,1) | ARIMA (1,1,1) | AR(2) I(1) MA(1) | AR(2) I(1) MA(1) | AR(2) I(1) MA(1) |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| **VARIABLES** | **Total FDI** | **Communications** | **Financial Business** | **Oil and Gas** | **Trade** |
| casualties | -0.0218*** | -0.0101*** | -0.0059*** | -0.0009 | -0.0008** |
| | (0.0032) | (0.0026) | (0.0014) | (0.0007) | (0.0003) |
| AR(1) | 0.1042 | 0.1326 | | | |
| | (0.1459) | (0.1991) | | | |
| AR(2) | | | 0.0410 | -0.2397*** | -0.0224 |
| | | | (0.0946) | (0.0887) | (0.1419) |
| MA(1) | -1.0000*** | -1.0000*** | -1.0000*** | -0.8863*** | -0.7728*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0648) | (0.1047) |
| sigma | 134.2255*** | 99.8714*** | 63.9449*** | 18.2513*** | 5.5294*** |
| | (17.8867) | (17.5793) | (18.1459) | (1.6719) | (0.6166) |
| Constant | 8.7713*** | 3.5345*** | 2.3201*** | 0.5873** | 0.1756 |
| | (1.5476) | (1.2082) | (0.7223) | (0.2552) | (0.1682) |
| ll | -678.31165 | -646.65308 | -599.03994 | -463.5802 | -335.27352 |
| aic | 1366.6233 | 1303.3062 | 1208.0799 | 937.1604 | 680.54705 |
| bic | 1379.9875 | 1316.6703 | 1221.444 | 950.52454 | 693.91119 |
| Observations | 107 | 107 | 107 | 107 | 107 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table 5: ARMAX models for bottom six industrial sectors by FDI volume*

| | ARIMA (1,1,1) | AR(3) I(1) MA(1) | AR(2) I(1) MA(1) | ARIMA (1,1,1) | AR(2) I(1) MA(1) | ARIMA (1,1,1) |
|---|---|---|---|---|---|---|
| | 6 | 7 | 8 | 9 | 10 | 11 |
| **VARIABLES** | **Power** | **Construction** | **Transport** | **Petroleum refining** | **Chemicals** | **Personal services** |
| casualties | -0.0009 | -0.0004*** | 0.0003 | -0.0006 | -0.0002** | -0.0003*** |
| | (0.0005) | (0.0001) | (0.0004) | (0.0005) | (0.0001) | (0.0001) |
| AR(1) | 0.0341 | | | 0.0742 | | 0.2338*** |
| | (0.0659) | | | (0.3256) | | (0.0776) |
| AR(2) | | | -0.1598 | | 0.0773 | |
| | | | (0.1172) | | (0.0594) | |
| AR(3) | | -0.0344 | | | | |
| | | (0.1053) | | | | |
| MA(1) | -1.0000*** | -1.0000*** | -0.5560*** | -0.5724** | -1.0000*** | -1.0000*** |
| | (0.0000) | (0.0000) | (0.1213) | (0.2425) | (0.0000) | (0.0000) |
| sigma | 24.6393*** | 4.9865*** | 2.7696*** | 3.7116*** | 4.6176*** | 2.4532*** |
| | (9.2819) | (0.5971) | (0.2923) | (0.4474) | (0.6675) | (0.3560) |
| Constant | 0.2718 | 0.1707*** | -0.1620 | 0.2187 | 0.0994*** | 0.1434*** |
| | (0.2208) | (0.0472) | (0.1464) | (0.2025) | (0.0317) | (0.0288) |
| ll | -496.99727 | -326.12237 | -261.09264 | -292.31005 | -317.79005 | -249.9466 |
| aic | 1003.9945 | 662.24474 | 532.18527 | 594.62011 | 645.5801 | 509.89319 |
| bic | 1017.3587 | 675.60888 | 545.54941 | 607.98425 | 658.94424 | 523.25733 |
| Observations | 107 | 107 | 107 | 107 | 107 | 107 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Based on the results presented earlier, we find that casualties returned a statistically significant and negative impact on the total net FDI flows. This suggests that the growth in total FDI flows (remember the time series is first-differenced) is impacted negatively by the increase in terrorism related fatalities. A quick scan of the results reveals that terrorism related violence has a negative and statistically significant impact on the following sectors:

- Total FDI flows
- Communications
- Finance and Business
- Trade
- Construction
- Chemicals
- Personal services

At the same time, FDI flows to the following sectors reported a negative, yet statistically insignificant impact of terrorism-related fatalities:

- Oil and Gas
- Power
- Transport
- Petroleum refining

### 4.2.1 White noise tests

After estimating the parameters, we performed several tests to determine if the estimated residuals were indeed white noise, a precondition for a good model fit. Table 6 presents the results of the Augmented Dickey-Fuller (ADF) Test and the Phillip-Peron (PP) Test for white noise. The results of these tests indicate that the residuals meet the conditions for white noise.

*Table 6: White Noise Tests of residuals*

| Time Series | ADF test statistics on residuals | PP test statistics on residuals | Critical Value (at 5 %) |
|---|---|---|---|
| NFDI in All Sectors (D1*) | -10.14 | -10.16 | -2.89 |
| NFDI in Communications (D1) | -10.09 | -10.12 | -2.89 |
| NFDI in Financial Business (D1) | -10.53 | -10.53 | -2.89 |
| NFDI in Oil and Gas (D1) | -5.78 | -11.20 | -2.89 |
| NFDI in Trade (D1) | -10.84 | -10.82 | -2.89 |
| NFDI in Power (D1) | -10.29 | -10.29 | -2.89 |
| NFDI in Construction (D1) | -10.63 | -10.67 | -2.89 |
| NFDI in Transport (D1) | -10.43 | -10.43 | -2.89 |
| NFDI in Petroleum Refining (D1) | -10.25 | -10.26 | -2.89 |
| NFDI in Chemicals (D1) | -10.12 | -10.12 | -2.89 |
| NFDI in Personal Services (D1) | -10.10 | -10.12 | -2.89 |

# 5 DISCUSSION OF RESULTS

This paper explores the impact of terrorism-related risks and uncertainty on net FDI flows to various industrial sectors in Pakistan. The literature reviewed earlier suggested that terrorism imposes additional costs and creates inefficiencies that make the host country less desirable for FDI. The results presented in the last section confirm the findings of earlier research. We, too, have found a negative correlation between terrorism-related casualties and FDI flows to Pakistan.

Our results, however, are slightly more nuanced. We have found a statistically significant, negative impact between total FDI flows and terrorism for Pakistan. However, when we break down the FDI flows by industrial sector, we obtain mixed results. Certain industrial sectors report statistically significant impacts while others do not. This begs the question: why some sectors are more impacted by others?

Given the limited information brought to bear in the models presented here, it is not possible to explore the reasons behind why significance is found for some sectors and not in others. We can still draw some general conclusions. We can divide the industrial sectors into urban or service-oriented sectors, and the raw industrial sectors. Examples of service-oriented sectors are communications, business and finance, construction, and personal services. These sectors are the ones that report a statistically significant and negative impact of terrorism. The urban nature of these sectors puts them close to terrorism, which in Pakistan is largely concentrated among a handful of large cities. The industrial sectors, such as oil and gas, petroleum financing, and power attract investments in remote areas that have largely avoided terrorism. Thus, we find a negative, yet statistically insignificant impact of terrorism on such sectors. The transport sector, which also returns an insignificant relationship, appears to be an anomaly given the urban orientation of the sector and numerous targeted attacks on transport infrastructures and services.

# 6 CONCLUSIONS

This study has estimated the negative impact of terrorist violence on Pakistan's economy, in particular on FDI flows. The study has found a significant impact of terrorism-related fatalities on net FDI flows to Pakistan. This impact, however, is largely confined to certain sectors, namely communications, financial business, trade, construction, and personal services. Other sectors, such as oil and gas, power, and petroleum financing returned negative, yet statistically insignificant results, suggesting that the firms involved in those sectors can obtain higher abnormal profits because of higher risks.

The government of Pakistan estimates billions of dollars of economic losses resulting from NATO's war in Afghanistan (Pakistan Economic Survey, 2014). Some of these costs are a

direct result of the militancy and violence that has targeted civilians, law enforcement agencies, and public infrastructure. The uncertainty, chaos, and other economic inefficiencies resulting from such violence have hurt Pakistan's economy on several levels, including rendering the country less attractive for investments.

Using time series econometrics, as well as data on net FDI flows and terrorism-related fatalities, this study offers further proof of a direct link between terrorism and FDI flows to Pakistan. The study has further illustrated that FDI flows to certain industrial sectors (urban and service-oriented) are more susceptible to terrorism than other sectors that attract investments to remotely located facilities.

# 7 ACKNOWLEDGEMENTS

The authors would like to express their gratitude to Ioana Moca and Dr. Mazhar Mughal for comments and edits that have helped improve this paper.

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