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# Does Terrorism Hamper Innovation Performance? Yes-New Empirical Evidence from South Asia Region

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*The contemporary literature has argued multiple factors affecting the innovation performance of a country. However, the frequency of studies exploring the terrorism-innovation nexus is quite low. To fill this gap, the current study is another attempt that quantifies the impact of terrorism on innovation performance. For empirical analysis, we utilize the data of South Asian countries over the period 2000 to 2021 and check the regression among variables by employing ARDL (autoregressive distributed lag) model. The consistency of results was checked by including the control variables i.e., FDI inflow, foreign aid, and government subsidies, and by employing the alternative estimation technique i.e., FMOLS (fully modified ordinary least square) model. The analysis infers that terrorism has a significant but negative impact on both RDE (research and development expenditures) and TMA (trademark applications) jointly pronounced as innovation performance. The increase in military expenditures, market uncertainty, and administrative costs are some possible channels through which terrorism hampers innovation. In view of the findings, we can infer the "sand the wheel" role of terrorism in determining innovation. The vital policy implication of the current analysis is that significant efforts should be exerted to ensure peace, and non-state actors responsible for fragile conditions should be handled by iron hands. This study provides robustness to existing studies exploring the terrorism-innovation nexus and adds new thoughts to limited literature.*

*Keywords: Innovation; Research and Development; Terrorism; Trademark Applications; South Asia.*

## Introduction

Terrorism is a broader term that refers to the use of extreme force and violation of peace assumptions of society by non-state actors. They aim to create fear, intimidation, or coercion for achieving the political, religious, economic, and social goals (Zheng *et al.*, 2021). In the past, major terrorist activities have been witnessed at the international level that resulted in many human causalities and economic losses. For instance, the terrorist attacks on Twin Towers of World Trade Center, New York on September 11, 2001 (Known as the 9/11 attacks) resulted in almost 2,996 human deaths, thousands were injured as a consequence of the attacks, and economic loss (both intrinsic and extrinsic) was beyond the estimates. This shows that terrorism widely disturbs the economic and social development of a country. In support, Zakaria, et al., (2019) conjectured that terrorism in Pakistan has diminished both foreign and domestic investment and has substantially enhanced government expenditures. In addition, their study indicated that terrorism has equally impeded the economic growth of Pakistan. Similar to these economic factors, the increasing terrorism can hamper other economic activities e.g., research and development activities commonly known as innovation activities. The increase in terrorism creates market uncertainty and discourages investors to get involved in any investment activities. At a macro level, the intensive terrorism activities typically augment the government defense expenditures for maintaining the peace and fighting against non-state actors and, therefore, substantially reduce the government efforts for innovation. In responding to terrorist attacks, the government may reduce the development funds necessary for innovation-related activities. Supporting this, Uddin, et al., (2022) find that the conduct of terrorist activities negatively influences the magnitude of innovation in 140 countries, resulting from high market uncertainty and the flow of more funds toward peace and defense activities. Despite some finite evidence, it is not yet common how

terrorism influences the innovation performance of a country. Thus, the current analysis is another attempt to explore the empirical nexus between multiple terrorism activities and innovation performance.

Beyond its immediate security implications, terrorism poses a severe hindrance to economic growth, societal stability, and technological advancement (Shahzad *et al.*, 2016). In the real world, South Asian nations grapple with persistent challenges arising from terrorism that disrupt not only daily life but also economic activities and innovative endeavors (Chishti *et al*., 2023). Therefore, it is imperative to understand how terrorism specifically stifles innovation because innovation is a key driver of economic prosperity and social advancement. The real-world problem lies in the need to comprehend how terrorism, as a destabilizing force, directly impedes the ability of South Asian countries to innovate and progress, thereby affecting their long-term development and prosperity. This study aims to addressing this real-world challenge because it is crucial for policymakers aiming to foster an environment conducive to innovation while concurrently addressing security concerns caused by terrorism within the region.

To better comprehend the link between terrorism and innovation performance, we can divide the discussion into micro-level and macro-level effects of terrorism on innovation performance. At the micro-level, the argument about how terrorism affects the innovation confidence of an individual person or a company is centered on the market failure and dearth of innovation confidence arising from the extreme risk of life by terrorist attacks. Tingbani, et al., (2019) asserted that various terrorist activities cause business failure at the global level, stemming from life threats, extreme safety concerns, the unwillingness of employees to work in companies located in places open to more terrorist attacks, interruption in the supply chain, and increment of cost due to more expenditures on safety measures. These factors definitely impede profitability and overall business performance. Owing to low profitability and high future uncertainty, enterprises are less likely to involve in any innovation activities (Hao *et al.*, 2022). Similarly, individual persons who aim to explore the innovation activities like registration of trademarks feel more insecure during extreme terrorist attacks, and, thus, their innovation efforts either totally become evaporated or contracted to a significant level. Haghani, et al., (2022) reviewed the scholarly research on terrorism and its effect on intellectual progression, psychological health, economic development, and political ideology. Mainly, they observed that increase in terrorist activities hamper the intellectual and psychological health of individuals, which further results in low wisdom necessary for making the innovation activities.

At a macro level, the increase in terrorist activities has an immediate effect on government expenditures and revenues. Repeated terrorist activities lead to boosting the expenditures made on effective measures against terrorist attacks and keeping the peace. The government needs to purchase more arms and ammunition to fight against terrorists, which soar the defense expenditures. Moreover, offering the monetary benefits in the shape of death gratuity to the survivors of soldiers killed in fights againts terrorists leads to amplifying the defense budget of a country. In support, Asongu, et al., (2019) vowed that terrorism impedes inclusive development and enhances military expenditures. Similarly, terrorism has an adverse effect on government revenue as it leads to shrinking tax revenue and low foreign investment. The increase in terrorism hampers both production and revenue of enterprises which further reduce the tax collections. Cevik and Ricco, (2020) indicated that the effect of terrorism on government finance and operations appear to be greater in countries experiencing frequent terrorist attacks and massive fatalities. Such dual deteriorating effects of terrorism in the shape of an increase in government expenditures and a decrease in government revenue eventually lead to declining government efforts for innovation. In such a situation, the central government is not in a position to offer subsidies for exploring the R&D and other innovation-related activities. Moreover, the decrease in government revenue leads to terminating the technology imports and reduces innovation performance as argued by Doblinger et al., (2019). These are the potential channels through which terrorism influences the innovation performance of a country.

The 9/11 attacks, perpetrated by the terrorist group al-Qaeda, stand as one of the most infamous and devastating acts of terrorism in modern history. However, the impact of terrorism is not exclusive to Western regions, and South Asia has experienced significant incidents that have left lasting scars. In 2008, the Mumbai attacks resulted in approximately 166 deaths and hundreds of injuries. These coordinated assaults targeted various locations across Mumbai, including a railway station, luxury hotels, a Jewish center, and other public spaces. Similarly, the Peshawar School Attack in 2014, resulted in the tragic deaths of 149 people, mainly children, in Pakistan. This incident underscored the vulnerability of educational institutions to acts of terrorism, leaving a deep impact on the nation. Comparing these incidents with the 9/11 attacks in the Western context highlights the global nature of terrorism and its capacity to inflict widespread harm across diverse regions. While the scale and specific targets may differ, the shared thread is the profound impact on societies, economies, and security. The choice to focus on the South Asian region in studying the link between terrorism and innovation is justified by the significant impact of such incidents within this area. These events, although differing from the 9/11 attacks in scale and method, have had profound effects on the socio-economic and political landscapes of the countries involved.

In the current study, we argue that terrorism deters the innovation performance of countries. To test this assumption, we utilize the panel data of South Asian economies over the period 2000 to 2021 and estimate the regression by employing the ARDL (autoregressive distributed lag) and FMOLS (fully modified ordinary least square) models. We measure the innovation performance of a country by two variables including percentage of research and development expenditures and total number of trademark applications. Similarly, the intensity of terrorism in a country was captured by four variables including the total number of fatal incidents, number of fatal, number of explosions, and the number of people affected in such explosions (both killed and injured). The empirical analysis shows that an increase in terrorism eventually leads to

plummeting innovation performance. The adverse effect of terrorism on innovation performance was found robust even by including the control variables i.e., FDI inflow, foreign aid, and government subsidies. The marginal effect of terrorism activities on both variables of innovation remains consistent even in the case of FMOLS model. The current study argues the "sand the wheel" role of terrorism in determining the innovation performance.

The contribution of the current analysis can be enlisted as follow: first, the current study is another attempt to explore the relationship between terrorism and innovation performance. Some recent studies like Nadeem, et al., (2021), Zheng, et al., (2021), and Uddin, et al., (2022) have attempted to explore a similar relationship between terrorism and multiple innovation activities. However, the frequency of relevant studies exploring terrorism-innovation nexus is too low specifically in the case of South Asia region. Thus, the current study is another attempt to add robust evidence to the finite literature on terrorism and innovation. Second, the ongoing analysis empirically supports the normative arguments regarding the deteriorating impacts of terrorist activities on the general interest of the state. This study advocates that extreme terrorism equally disturbs the innovation performance of a country. Practically, the empirical findings of the current analysis can be utilized to comprehend the deteriorating impact of terrorism even on innovation-related activities. The analysis probes that terrorism hampers both research and development activities and the intensity of trademark applications necessary to achieve a competitive edge at the international level. Therefore, it is suggested that the relevant authorities should utilize all possible means to control terrorism as it hampers the overall innovation pace of a country. The findings of the current study can equally be important for individual personnel aiming to indulge in R&D activities, and enterprises for making such policies that adjust the effect of terrorism on their innovation attitude.

The remaining parts of the paper were structured as follows: Section 2 offers the review of the empirical literature and hypothesis development, section 3 outlined the data and methods settings, and Section 4 presents the empirical analysis followed by Section 5, which discusses the empirical results. In Section 6, we conclude the study and list the policy implications.

## Literature Review

Similar to the discussion in the previous section, the review of empirical studies can be distributed into two avenues i.e., a review of empirical studies suggesting the micro-level effect of terrorism on innovation and a review of literature exploring the macro-level nexus between terrorism and innovation performance. At a micro level, a significant amount of literature exists that explores the direct and indirect impact of terrorism on innovation (here indirect means the effect of terrorism on innovation through different channels). By drawing upon the real options theory, Li, et al., (2022) investigated the empirical linkages between terrorism and corporate R&D investment in 48 countries and found that increased terrorism leads to reducing the R&D investment of enterprises. During extreme terrorism, the enterprises become more sensitive regarding the future return on R &D investment and therefore defer such investments. The increase in terrorist attacks hampers the innovation-based incentives of enterprises and therefore directly limits the innovation confidence of corporate managers. In another study by Do, (2022), the effect of terrorist attacks was checked on the dividend payout policy of United States enterprises. The findings of the study show that enterprises whose headquarters were located in terrorism-affected areas need to pay high cash dividends driven by high agency costs. Such an increase in dividend payout cost could lead to shrinking the flow of funds toward innovation-related activities. Krammer and Kafouros, (2022) predicted that high political instability that may arise from more terrorist attacks negatively influences the firm's innovation. Similarly, Xu and Moser, (2022) found that enterprises headquartered in high terrorism-risk areas are more likely to involve in tax avoidance, implying that terrorism disturbs the transparent functioning of enterprises which may further lead to deteriorating the innovation confidence.

Recently, the study of Fich et al., (2023) exhibits that enterprises located nearer to extreme terrorist attack areas face a decline in invention productivity. The repeated terrorist attacks promote the mobility of enterprises to other areas and therefore may face a decline in innovation-based investment due to the flow of more funds on the re-allocation of business setups. They further argued that financially constrained enterprises face acute drops in innovation performance due to terrorist attacks. In addition, the terrorism creates social unrest which further hampers the corporate behavior regarding loan acquisition and other firm-level decision making e.g., innovation investment as noted by Ghosh, (2023). Bachmann, et al., (2023) examined the impact of terrorist attacks on CEOs' pay and found that the CEOs of the companies located in terrorist attack areas demand more pay due to the high risk of life and working environment unrest. This positive effect of terrorism on CEO's pay implies that terrorism enhances administrative expenses of enterprises which can further diminish the flow of funds toward innovation investment. These studies offer empirical evidence regarding the impact of terrorism on firm-level innovation activities. Although some studies apparently describe the terrorism-innovation linkages, but the frequency of literature is still very low. Thus, the current study is another attempt to explore the nexus between terrorism and overall innovation performance (innovation by enterprises, individuals, and central government).

At a macro level, the impact of terrorism on innovation performance has been witnessed in the literature. For instance, Koh, (2007) reveals that the increase in terrorist attacks creates a disruption in the global economic development and diffusion of technological innovation. The study reviewed the impact of the terrorism war on R&D expenditures and the overall economy and concluded that the war against terrorism results in hampering the overall economic performance and technological innovation. Roy and Paul, (2013) studied the strategic alliance between terrorism, R&D investment, defense, and pre-emption strategies and found that terrorism has a substantial impact on R&D investment. Zheng et al., (2021) observed that countries facing high terrorism have low green innovation

performance. By enhancing the deployment cost of energy-related technologies, the increase in terrorist attacks impedes innovation in renewable energy technologies and thus obstructs overall green innovation performance. Specifically, Nadeem et al., (2021) argued that increase in terrorism has impeded the accumulated technological innovation in Pakistan. Similarly, Uddin et al., (2022) conjectured that terrorism hampers innovation confidence and this negative effect of terrorism on innovation was more stronger across developing and under-developed economies. Indirectly, Abid and Sekrafi, (2020) tested the empirical impact of terrorist attacks and the informal economy on public debt in 47 countries of the African region and found that an increase in terrorism-related activities enhances the public debt. Such an increase in public debt leads to enhancing the debt servicing expenses of the central government and therefore can limit the flow of subsidies and other financial support for exploring innovation (Olaoye, 2023). Following the census of the empirical literature, it can be hypothesized that

***$H_1$: Terrorism has a negative and statistically significant impact on innovation performance***.

Reviewing the literature on control variables-innovation nexus, Chen, et al., (2022) stated that the inflow of foreign investment has a positive effect on intra-industry innovation and radical innovation. They vowed that the positive effect of FDI on innovation was driven by competition among domestic enterprises and foreign investors. Another empirical study conducted by Chen and Zhou, (2023) produces similar results while examining the impact of FDI inflow on innovative entrepreneurship in China. They show that FDI inflow invites more entrepreneurs and thus enhances the quality and quantity of overall innovation. Similarly, Nadeem, et al., (2020) reported that the inflow of foreign aid, terrorism, and political instability negatively influence innovation-related activities in Pakistan. These factors have a crowding-out effect on innovation investment and therefore impede the overall innovation performance. However, Abate, (2022) found that foreign aid proves as a blessing for developing countries because it enhances economic growth. The increased economic growth can further accelerate innovation. Specifically, Farooq, (2023) suggested that the inflow of foreign capital in the shape of foreign official aid enhances the propensity of technological innovation in the host country. Foreign official aid provides financial assistance for exploring the R &D activities and thus enhances innovation performance. Similar to FDI and foreign aid, the literature provides empirical evidence on the government subsidies-innovation nexus. For instance, Xu, et al., (2021) conjectured that government subsidies accelerate R&D investment and other innovation-related activities in China. The financial support in the shape of subsidies provided by the central government encourages enterprises to involve in more innovative activities. This positive effect of government subsidies on innovation was also supported by Xu, et al., (2023) in the case of China.

## Data and Methods

### *Data and Sample*

To analyze the empirical relationship among variables, we utilize the annual data of South Asian economies over the period 2000 to 2021. Initially, we consider all South Asian economies including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka as sample. However, 3 out of 8 countries named Afghanistan, Bhutan, and Maldives were deleted from the sample due to missing of information on the main variables of study i.e., terrorism and innovation-related variables. The data of the remaining 5 (Bangladesh, India, Nepal, Pakistan and Sri Lanka) countries were considered for final analysis. We arrange the empirical analysis on the South Asia region because this region is facing enormous terrorism (Shahzad *et al.,* 2020), and has low innovation performance as compared to other regions like the Europe and the US (Tolliver *et al.,* 2021). Moreover, South Asia grapples with a complex blend of socio-political challenges, including a history of diverse conflicts and varying levels of terrorism across its nations. This region's unique landscape presents a diverse set of circumstances, making it an ideal ground to investigate the impact of terrorism on innovation within a dynamic and multifaceted environment.

The data on terrorism-related variables were obtained from the South Asia Terrorism Portal (SATP) which is an online source of data recorded the statistics on multiple terrorist activities happened specifically in the South Asia region. The data of other variables (innovation and control variables) were collected from WDI (world development indicators), The World Bank.

### *Definition of Variables*

In the current study, innovation performance works as a dependent variable and was measured by two variables i.e., RDE (research and development expenditures), and TMA (trademark applications). According to WDI, RDE shows the total amount of capital and current expenditures made on R&D activities by both public (central government) and private (individual and corporations) inventors, aiming to create a piece of new knowledge and technologies. It also includes the knowledge of new applications that substantially enhance the efficiency of existing systems. When referring to R&D expenditure as a percentage of GDP, it's important to note that this metric not solely capture the R&D investments made by enterprises. Typically, R&D expenditure (% of GDP) encompass all spending on R&D activities within a country, which may include investments from various sources such as government agencies, enterprises, and research institutions. However, this metric apparently reflect government-driven R&D spending, especially if the government accounts for a significant portion of the overall R&D expenditure within the country.

Similarly, TMA is the total number of applications filed to register trademarks at regional and national Intellectual Property (IP) offices. Such filing of trademarks protects the property rights of inventors and ensures that the specific trademark belongs to the inventors and therefore no other person can utilize it for any purpose without the consent of trademark holders. High trademark filings show the

intensity of innovation performance within a country. Some recent studies like Ahmad & Zheng, (2022), Uddin, et al., (2022), and Fich, et al., (2023) have utilized similar variables to measure the innovation performance of a country. Similarly, terrorism is a main explanatory variable and the effect of terrorism was captured by four underlying variables including FID (number of fatalities incidents), FAT (number of fatal), EXP (number of explosions incidents), and AFP (number of affected peoples). These variables reflect the intensity of terrorist activities and related damages. Generally, terrorism is a wider term that includes but is not limited to the use of extreme power by non-state actors for gaining multiple political, religious, social, and economic goals. The use of the underlying four variables as proxy variables were observed in some recent studies exploring the effect of terrorism on innovation and other economic decisions (Zakaria *et al.*, 2019; Xu & Moser, 2022; Bachmann *et al.*, 2023).

In addition, we consider some other variables i.e., FDI inflow, foreign aid, and government subsidies as control variables. The inflow of FDI shows the net capital invested by non-resident individuals in domestic enterprises aiming to acquire lasting management. It is an accumulated balance of equity capital, long-term and short-term capital, and reinvestment of earnings showing in the balance of payments. We measure the FDI inflow as a percentage of GDP (% of GDP) to better capture the intensity of FDI inflow as compared to the size of the economy of a specific country. Similarly, foreign aid is a percentage of ODA (official development assistance) received by the recipient country. It is a disbursement of loans and other financial support by the DAC (development assistance committee) to promote development and welfare in other DAC-listed countries. Such funds can be utilized by the recipient country to accelerate innovation and development as mentioned by Abate, (2022), and therefore foreign aid was considered as a determinant of innovation. The government subsidies include grants, unrequited benefits, and non-repayable transfers to private and public enterprises. Such financial support by the central government to the real sector motivates corporate managers to explore more R&D activities. Some recent studies have considered these variables as potential determinants of innovation (Shahzad *et al.*, 2020; Boeing *et al.*, 2022; Farooq, 2023). Table 1 provides a brief description of each variable, relevant role, and reference information.

Table 1

**Variables Description**

| Acronym | Variable | Measurement | Role | Reference |
|---|---|---|---|---|
| **RDE** | Research and development expenditures | Research and development expenditure (% of GDP) | Dependent | (Ahmad & Zheng, 2022; Choi, 2023) |
| **TMA** | Trademark applications | Trademark applications, resident, by count | Dependent | (Ahmad & Zheng, 2022; Choi, 2023) |
| **FID** | Fatalities incidents | Total number of fatalities incidents during a year | Independent | (Tschantret, 2018; Zakaria *et al.*, 2019; Uddin, *et al.*, 2022) |
| **FAT** | Numbers of fatal | Total number of fatal | Independent | (Tschantret, 2018; Zakaria *et al.*, 2019; Uddin et al., 2022) |
| **EXP** | Explosion incidents | Total number of explosion incidents during a year | Independent | (Tschantret, 2018; Zakaria *et al.*, 2019; Uddin *et al.*, 2022) |
| **AFP** | Number of affected peoples | Total affected peoples in explosions (injured + kills) | Independent | (Tschantret, 2018; Uddin *et al.*, 2022) |
| **FDI** | Foreign direct investment inflow | Foreign direct investment, net inflows (% of GDP) | Control | (Ali *et al.*, 2023) |
| **ODA** | Official development assistance | Net ODA received (% of GNI) | Control | (Shahzad *et al.*, 2020) |
| **SUB** | Subsidies | Subsidies and other transfers (% of expense) | Control | (Boeing *et al.*, 2022) |

*Source: we draw the estimation of variables from existing literature.*

***Research Equations***

The general relationship among variables can be presented in the form of the following function.

$$Innovation = f(FID, FAT, EXP, AFP, FDI, ODA, SUB)$$

As the analysis contains several explanatory variables, therefore the baseline multiple linear regression models can be written as

$$RDE_{it} = \beta_{\circ} + \alpha_1 FID_{it} + \alpha_2 FAT_{it} + \alpha_3 EXP_{it} + \alpha_4 AFP_{it} + \beta_1 FDI_{it} + \beta_2 ODA_{it} + \beta_3 SUB_{it} + \varepsilon_{it} \quad \text{Eq. (1)}$$

$$TMA_{it} = \beta_{\circ} + \alpha_1 FID_{it} + \alpha_2 FAT_{it} + \alpha_3 EXP_{it} + \alpha_4 AFP_{it} + \beta_1 FDI_{it} + \beta_2 ODA_{it} + \beta_3 SUB_{it} + \varepsilon_{it} \quad \text{Eq. (2)}$$

Equation (1) shows the impact of innovation proxies including FID (number of fatalities incidents), FAT (number of fatal), EXP (number of explosions incidents), and AFP (number of affected people) on RDE (research and development expenditures). It also includes the other variables i.e., FDI (foreign direct investment inflow), ODA (official development assistance), and SUB (government subsidies). Equation (2) shows the impact of all explanatory on another proxy of innovation i.e., TMA (trademark application).

However, as we employ the ARDL (autoregressive distributed lag) model for regression analysis, therefore baseline equations can be modified as follow.

$$\Delta RDE_{it} = \beta_{\circ} + \sum_{i=1}^{p} \alpha_1 \Delta RDE_{it-1} + \sum_{i=1}^{p} \beta_1 \Delta FID_{it-1} + \sum_{i=1}^{p} \beta_2 \Delta FAT_{it-1} + \sum_{i=1}^{p} \beta_3 \Delta EXP_{it-1} + \sum_{i=1}^{p} \beta_4 \Delta AFP_{it-1} + \sum_{i=1}^{p} \gamma_1 \Delta FDI_{it-1} + \sum_{i=1}^{p} \gamma_2 \Delta ODA_{it-1} + \sum_{i=1}^{p} \gamma_3 \Delta SUB_{it-1} + \varphi_1 RDE_{it-1} + \varphi_2 FID_{it-1} + \varphi_3 FAT_{it-1} + \varphi_4 EXP_{it-1} + \varphi_5 AFP_{it-1} + \varphi_6 FDI_{it-1} + \varphi_7 ODA_{it-1} + \varphi_8 SUB_{it-1} + \varepsilon_{it} \qquad eq.(3)$$

$$\Delta TMA_{it} = \beta_{\circ} + \sum_{i=1}^{p} \alpha_1 \Delta TMA_{it-1} + \sum_{i=1}^{p} \beta_1 \Delta FID_{it-1} + \sum_{i=1}^{p} \beta_2 \Delta FAT_{it-1} + \sum_{i=1}^{p} \beta_3 \Delta EXP_{it-1} + \sum_{i=1}^{p} \beta_4 \Delta AFP_{it-1} + \sum_{i=1}^{p} \gamma_1 \Delta FDI_{it-1} + \sum_{i=1}^{p} \gamma_2 \Delta ODA_{it-1} + \sum_{i=1}^{p} \gamma_3 \Delta SUB_{it-1} + \varphi_1 TMA_{it-1} + \varphi_2 FID_{it-1} + \varphi_3 FAT_{it-1} + \varphi_4 EXP_{it-1} + \varphi_5 AFP_{it-1} + \varphi_6 FDI_{it-1} + \varphi_7 ODA_{it-1} + \varphi_8 SUB_{it-1} + \varepsilon_{it} \qquad eq.(4)$$

Equation (3) & equation (4) show the ARDL model settings in which we check both long run and short run effect of explanatory variables on explained variable.

***Methodology Discussion***

In this study, we employ the ARDL model and check the robustness through FMOLS (fully modified ordinary least square) model. We also employ a set of preliminary techniques including a cross-section dependence test, unit root test, and cointegration test arguing to employ the ARDL model. As the underlying countries exist in the same region (South Asia), therefore the probability of co-dependency of the series is high. The economic decisions of each country may influence by other neighboring countries which may cause the issue of cross-section dependence. To test this assumption, we develop the equation (5) and test it by employing the family of cross-section dependence techniques argued by Breusch and Pagan, (1979), and Pesaran, (2004). The analysis shown in Table 4 accepts the null hypothesis (Ho) i.e., no cross-section dependence among the series.

We also check the stationarity status of the series by employing the simple unit root test. The motivation for checking the stationarity issue is that all the variables are macroeconomic in nature and therefore no trend or stationery can be expected. To test this assumption, we choose two techniques coined by Im, et al., (2003), and Dickey & Fuller, (1979) and report the analysis in Table 5. The statistical analysis (shown in Table 5) implies a mixed trend i.e., some variables are stationary at the I(0) condition while others are stationary at I(1) condition. This mixed trend of variables regarding the stationary further argues to check the cointegration. In doing so, we develop equation (6) and check the cointegration by employing the Johansen Cointegration test. The reported analysis in Table 6 assumes the existence of cointegration. Leaning on the empirical findings of pre-estimation techniques, we select the ARDL model suggested by Pesaran, et al., (2001) and check the consistency of results through the FMOLS model which was argued by Phillips & Hansen, (1990). The studies arranged by Nadeem, et al., (2021), and Uddin, et al., (2022) have utilized similar models for estimating the regression among variables.

The utilization of the ARDL and FMOLS models within the current study setting presents a robust and well-suited analytical approach. The ARDL model is particularly apt due to its capacity to handle small sample sizes, a common characteristic in studies involving time series and panel data, as is the case with this research covering the period from 2000 to 2021 of South Asia region. Its flexibility in accommodating both short and long-term relationships among variables aligns perfectly with the study's objective of examining the impact of terrorism on innovation performance over an extended period. Additionally, the inclusion of control variables such as FDI inflow, foreign aid, and government subsidies complements the ARDL model, allowing for a comprehensive assessment of the nuanced interplay between terrorism and innovation while considering other influential factors. On the other hand, employing the FMOLS model further bolsters the robustness of the findings by providing alternative estimation techniques. Its capacity to address endogeneity concerns and potential omitted variable bias enhances the credibility of the results obtained through the ARDL model. By corroborating the findings from two distinct yet complementary analytical approaches, the study ensures a more comprehensive and reliable assessment of the impact of terrorism on innovation performance in the South Asian context, thereby strengthening the validity and depth of the research outcomes.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=0}^{N-1} \sum_{j=i+1}^{N} \rho ij\right) \qquad eq.(5)$$

$$\rho_{it} = \mu_i \rho_{it-1} + \hat{\gamma}_{it} \qquad eq.(6)$$

**Results Presentation**

***Descriptive and Correlation Analyses***

Table 2 presents the descriptive analysis of variables. The mean value of RDE is 0.663 which is a percentage (% of GDP) of research and development expenditures made by both public and private sectors. The standard deviation of RDE is 0.312, showing the dispersion of statistics across the countries. The mean value of TMA is 4.785 which is a logarithmic expression of the total number of trademark applications filed during a year. Similarly, the mean values of FID, FAT, EXP, and AFP show the strength of total terrorist activities and related damages (damages in the shape of human causalities). The mean value of FDI is 1.704, showing the percentage (% of GDP) inflow of foreign

investment as compared to the GDP during a year. The mean value of ODA is 0.485 which is a percentage (% of gross national income) of foreign official aid received by underlying economies during a year. The mean value of SUB is 33.928 (% of total expenses), showing the percentage of expenses in the shape of subsidies and other transfers made by the central government. The skewness and kurtosis values of variables speak about the normal distribution of variables.

Furthermore, we have computed the average values of variables across the sampled countries, consolidating these statistics in Table A1. These averages offer valuable insights into the prevailing trends and the scale of terrorist attacks, shedding light on their consequential impact on research and development (R&D) and other innovation endeavors within these nations. This presentation of average values serves as a comprehensive overview, providing a clearer understanding of the patterns and magnitude of terrorist incidents and their subsequent influence on innovation initiatives across the diverse spectrum of countries included in our study. Table 3 shows the correlation analysis for the variables of the study. We also test the multicollinearity among variables and report the VIF (variance inflation factor) values at the bottom of Table 3. Most values are in the range of 3, demonstrating that there is no issue of multicollinearity.

Table 2

**Descriptive Analysis**

| | Mean | Median | Max. | Min. | Std. Dev. | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| **RDE** | 0.663 | 0.814 | 0.909 | 0.100 | 0.312 | -1.108 | 2.326 |
| **TMA** | 4.785 | 5.102 | 5.473 | 3.369 | 0.744 | -1.003 | 2.291 |
| **FID** | 839.350 | 547.000 | 2666.000 | 0.000 | 672.028 | 1.015 | 3.795 |
| **FAT** | 2053.750 | 1035.500 | 11064.000 | 0.000 | 2438.038 | 2.639 | 10.482 |
| **EXP** | 250.850 | 217.500 | 466.000 | 0.000 | 150.448 | -0.133 | 2.041 |
| **AFP** | 861.100 | 533.000 | 2660.000 | 0.000 | 822.872 | 0.805 | 2.268 |
| **FDI** | 1.704 | 1.665 | 3.620 | 0.765 | 0.663 | 1.043 | 4.685 |
| **ODA** | 0.485 | 0.160 | 2.456 | 0.092 | 0.703 | 1.856 | 5.000 |
| **SUB** | 33.928 | 35.570 | 44.648 | 20.386 | 7.290 | -0.274 | 1.944 |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: This table shows the summary of descriptive analysis.*

Table 3

**Correlation Analysis**

| | RDE | TMA | FID | FAT | EXP | AFP | FDI | ODA | SUB |
|---|---|---|---|---|---|---|---|---|---|
| **RDE** | 1.000 | | | | | | | | |
| **TMA** | 0.682 | 1.000 | | | | | | | |
| **FID** | 0.027 | -0.058 | 1.000 | | | | | | |
| **FAT** | -0.293 | -0.336 | 0.687 | 1.000 | | | | | |
| **EXP** | 0.204 | 0.126 | 0.683 | 0.724 | 1.000 | | | | |
| **AFP** | 0.099 | -0.012 | 0.645 | 0.640 | 0.660 | 1.000 | | | |
| **FDI** | 0.337 | 0.338 | 0.186 | 0.171 | 0.254 | 0.265 | 1.000 | | |
| **ODA** | -0.634 | -0.656 | 0.046 | 0.378 | 0.069 | -0.038 | -0.194 | 1.000 | |
| **SUB** | 0.656 | 0.635 | -0.366 | -0.446 | -0.190 | -0.386 | 0.270 | -0.644 | 1.000 |
| Multicollinearity Test | | | | | | | | | |
| **VIF** | 3.019 | 2.891 | 3.771 | 2.881 | 3.890 | 1.888 | 2.091 | 2.991 | 3.651 |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: This table shows the summary of correlation analysis.*

### *Graphical Analysis*

Figure 1 demonstrates the trend between R&D expenditures and other variables used for measuring terrorism. It can be viewed that after 2013, all lines showing the terrorism-related variables are descending while the trend line of R&D is ascending, inferring the inverse relationship between R&D activities and terrorism. The decrease in terrorism leads to accelerating the innovation performance of a country. Figure 2 shows the trend analysis between terrorism-related variables and another proxy of innovation i.e., trademark applications. The inverse relationship between terrorism and trademark can be observed in Figure 2.

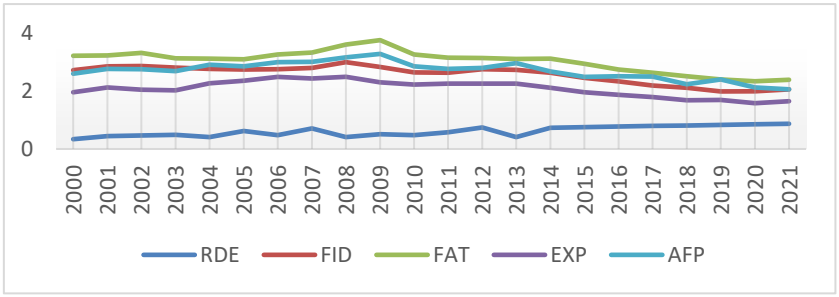


**Figure 1.** R& D and Terrorism

*Acronyms: RDE=research and development expenditures, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples Source: self-elaboration. Note: This figure shows the relationship between research and development expenditures and other proxies of terrorism.*


**Figure 2.** Trademark Applications and Terrorism

*Acronyms: TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples Source: self-elaboration. Note: This figure presents the relationship between trademark applications and other proxies of terrorism.*

***Pre-Estimation Analysis***

As described in the methodological discussion section, we employ some preliminary techniques including a cross-section dependence test, unit root test, and cointegration test, and report the analyses in Tables 4, 5, & 6 relatively. These techniques provide robustness to the implication of the ARDL model as a final estimation technique.

Table 4

**Cross-section Dependence Analysis**

| Test | Statistics | D.F | Probability |
|---|---|---|---|
| **Breusch-Pagan LM** | 8.047 | 6 | 0.234 |
| **Pesaran scaled LM** | 0.590 | - | 0.554 |
| **Pesaran CD** | -0.903 | - | 0.366 |

*Note: The insignificant p-values accept the null hypothesis and probe that cross-sections are not dependents on each other. Source: self-elaboration..*

Table 5

**Unit Root Testing**

| | (IPS) | | (ADF) | |
|---|---|---|---|---|
| **Variables** | **At Level** | **At first difference** | **At level** | **At first difference** |
| **RDE** | (0.409) | (-10.176) | (0.3.247) | (69.781) |
| | 0.658 | 0.000 | 0.517 | 0.000 |
| **TMA** | (0.956) | (-3.935) | (8.078) | (37.555) |
| | 0.830 | 0.000 | 0.621 | 0.000 |
| **FID** | (-0.865) | (-10.383) | (13.024) | (92.809) |
| | 0.193 | 0.000 | 0.222 | 0.000 |
| **FAT** | (-1.422) | - | (16.434) | - |
| | 0.075 | | 0.087 | |
| **EXP** | (-1.554) | - | (19.594) | - |
| | 0.060 | | 0.033 | |
| **AFP** | (-1.533) | - | (17.142) | - |
| | 0.062 | | 0.071 | |

| | (IPS) | | (ADF) | |
|---|---|---|---|---|
| **Variables** | **At Level** | **At first difference** | **At level** | **At first difference** |
| **FDI** | (-1.675) | - | (16.446) | - |
| | 0.045 | | 0.087 | |
| **ODA** | (-2.050) | - | (18.772) | - |
| | 0.020 | | 0.043 | |
| **SUB** | (0.405) | (-6.631) | (5.384) | (48.771) |
| | 0.657 | 0.000 | 0.715 | 0.000 |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: The reported values show the mixed trend of stationarity i.e., some are stationary at level I(0) while others are stationary at first difference I(1).*.

Table 6

**Cointegration Analysis**

| ***Kao Residual Cointegration Test*** | | |
|---|---|---|
| **Test Name** | **t-statistics** | **Probability** |
| **ADF** | -0.460 | 0.022 |
| **Residual Variance** | 0.003 | - |
| **HAC Variance** | 0.008 | - |

*Note: the insignificant p-value (p≤0.05) of ADF test accept the null hypothesis i.e., no cointegration among series. Source: self-elaboration.*

### *Main Regression Analysis*

To estimate the designed equations, we employ the panel ARDL model and report the analysis in regression Table 7. The estimated values show that all proxy variables of terrorism including FDI, FAT, EXP, and AFP have a negative and statistically significant relationship with RDE. Their coefficient values are -0.009, -0.007, -0.035, and -0.007 relatively. Comparing the coefficient values, it can be seen that EXP (number of explosion incidents) has a greater impact as compared to other companion variables, referring that R&D activities are more sensitive towards explosion incidents. In the case of TMA, FID and EXP have significant while FAT and AFP have insignificant relationships with TMA (trademark applications). All control variables have statistically significant and positive relationships with both RDE and TMA, inferring that FDI, ODA, and SUB are the key determinants of innovation in South Asia region.

Table 7

**Effect of Terrorism on Innovation Performance**

| | ***ARDL Model*** | | | |
|---|---|---|---|---|
| | ***RDE as a dependent*** | | ***TMA as a dependent*** | |
| | ***Coefficients*** | ***Probability*** | ***Coefficients*** | ***Probability*** |
| **Variables** | ***Long Run equation*** | | | |
| **FID** | -0.009*** | 0.000 | -0.005*** | 0.027 |
| **FAT** | -0.007*** | 0.000 | -1.490 | 0.662 |
| **EXP** | -0.035*** | 0.000 | -0.003*** | 0.000 |
| **AFP** | -0.007*** | 0.000 | 0.036 | 0.743 |
| **FDI** | 0.257*** | 0.000 | 0.141* | 0.101 |
| **ODA** | 0.277*** | 0.000 | 0.393*** | 0.000 |
| **SUB** | 0.053*** | 0.000 | 0.032*** | 0.000 |
| | ***Short run Equation*** | | | |
| **COINTEQ01** | -0.233** | 0.081 | 0.024*** | 0.019 |
| **D(FID)** | -0.004 | 0.369 | 0.001*** | 0.000 |
| **D(FAT)** | 0.001*** | 0.039 | -0.723 | 0.340 |
| **D(EXP1)** | 0.001** | 0.055 | 0.008 | 0.889 |
| **D(AFP)** | -0.001 | 0.744 | -0.289 | 0.110 |
| **D(FDI)** | -0.262 | 0.374 | 0.045** | 0.084 |
| **D(ODA)** | 0.316 | 0.001 | 0.133*** | 0.041 |
| **D(SUB)** | 0.030*** | 0.000 | 0.014 | 0.714 |
| **C** | 1.291 | 0.149 | 0.912 | 0.374 |
| Mean dependent variable | | 0.215 | 0.307 | |
| S.E. of regression | | 0.215 | 1.069 | |
| Akaike info criterion | | 0.289 | 1.680 | |
| Schwarz criterion | | 3.182 | 2.061 | |
| Log likelihood | | 56.017 | -40.071 | |
| Hannan-Quinn criterion | | 1.291 | 1.044 | |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: ***, **, * expresses the significance level at 1%, 5%, and 10 % relatively.*

***Robustness Check***

For robustness, we employ the FMOLS model and report the results in Table 8. The estimated coefficient values show that all underlying variables of terrorism i.e., FID, FAT, EXP, and AFP have statistically significant but negative coefficient values both in the case of RDE and TMA, providing the robustness to the main empirical analysis reported in Table 7. In the case of RDE, the coefficient values of FID, FAT, EXP, and AFP are -0.007, -0.004, -0.002, and -0.003 relatively, implying the degree of change in research and development expenditures due to the change in underlying terrorism-related variables. Similarly, the coefficient values of FID, FAT, EXP, and AFP are -0.001, -0.021, -0.006, and -0.008 relatively in the case of TMA which serves as another proxy of innovation. We can see that all variables are significant at a 1 % level and have negative coefficient values, implying the adverse effect of terrorism on innovation performance. A detailed discussion on estimated coefficient values has been made in next section.

Table 8

**Robustness Check**

| | ***FMOLS Model*** | | | |
|---|---|---|---|---|
| | ***RDE as a dependent*** | | ***TMA as a dependent*** | |
| ***Variables*** | ***Coefficients*** | ***Probability*** | ***Coefficients*** | ***Probability*** |
| **FID** | -0.007*** | 0.000 | -0.001*** | 0.000 |
| **FAT** | -0.004*** | 0.000 | -0.021*** | 0.000 |
| **EXP** | -0.002** | 0.084 | -0.006*** | 0.000 |
| **AFP** | -0.003 | 0.189 | -0.008*** | 0.000 |
| **FDI** | 0.096*** | 0.000 | 0.044*** | 0.000 |
| **ODA** | -0.212 | 0.287 | 0.024*** | 0.029 |
| **SUB** | 0.016*** | 0.000 | 0.002 | 0.111 |
| *Adjusted R-square* | | 0.282 | 0.395 | |
| *S.E. of regression* | | 0.062 | 0.046 | |
| *Long run variance* | | 0.003 | 0.008 | |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: ***, **, * expresses the significance level at 1 %, 5 %, and 10 % relatively.*

**Discussion on Results**

In this study, we aim to check the effect of terrorism on the innovation performance of South Asia region countries. We employ the ARDL model as an estimation technique and report the results in regression Table 7. The empirical findings support the adverse effect of all terrorism-related activities including FID (number of fatalities incidents), FAT (number of fatal), EXP (number of explosions incidents), and AFP (number of affected people) on overall innovation performance. The terrorist attacks enhance market uncertainty, divert the intention of investors for innovation investment, enhance administrative costs, and restrict overall business operations (Shahzad *et al.,* 2016). All these factors negatively influence innovation confidence. At an international level, extreme terrorism put a country into market isolation and confines the country's access to international research collaborations and the latest technologies (Altmann & Giersch, 2022). Moreover, the repeated terrorist attacks directly restrict the inflow of foreign capital in the shape of investment and therefore the affected country faces a severe deficiency of foreign capital needed for exploring innovation-related technologies. Another channel through which terrorism hampers innovation is an increase in military expenditures and the overall defense budget which shrinks the government efforts e.g., R&D subsidies for supporting innovation-related activities (Li *et al.,* 2022). Due to the high risk of life and repeated threats by terrorists, the increase in terrorism accelerates the migration of skilled labor and other knowledge workers to the other safest countries of the world (Helbling & Meierrieks, 2022), and put the prey country into the more bad situation regarding the innovation performance. The increase in terrorist attacks directly restricts the exploration of R&D activities and thus hinders the overall rate of innovation. In brief, there are multiple channels through which terrorism negatively influences innovation performance. Some recent studies like Nadeem, et al., (2021), Uddin, et al., (2022), and Fich, et al., 2023) have suggested a similar impact of terrorism on the innovation performance of a country.

In addition to terrorism, the empirical analysis demonstrates the positive effect of FDI inflow on both R&D activities and trademark applications. The inflow of foreign investment fosters innovation-related activities by ensuring the transfer of knowledge and needed capital for exploring R&D activities (Chen *et al.,* 2022). In addition, foreign investment upsurges the mark competition regarding product quality and price and urges domestic enterprises to make more innovations necessary for meeting the competition. The inflow of FDI is an important channel for transferring modern technology and production knowledge from developed to developing countries like South Asia (Ali *et al.,* 2023). The flow of FDI towards developing economies enables the relocation of modern technology because foreign investors are more optimistic and thrilled for earning high profitability through a substantial revolution in existing production systems. In literature, the study of Chen and Zhou, (2023) inferred the similar impact of FDI on regional entrepreneurship in China. Similarly, the positive effect of foreign aid on innovation can be explained as it offers direct financial assistance to the recipient country for exploring more R&D activities. The efficient utilization of foreign aid can be proved as blessing for the recipient country because it enhances the overall economic development of a country as mentioned by Farooq, (2023). Such an increase in economic development has a positive spillover effect on innovation

performance. Lastly, government financial support in the shape of subsidies directly encourages entrepreneurs to involve in more R&D activities and thus enhances the pace of innovation. Government subsidies to the private sectors of an economy enable them to release more funds for innovation-related activities e.g., R&D activities as documented by Boeing, et al., (2022). Summarizing, the analysis reveals the negative effect of terrorism-related activities on both R&D expenditures and trademark applications jointly known as innovation performance. We find the positive effect of all three control variables including FDI inflow, foreign aid, and government subsidies on the innovation performance of a country. We find robust evidence of the relevant role of underlying variables on innovation performance (as mentioned in Table 8).

**Conclusion and Policies**

This study explores the empirical linkages between terrorism and innovation performance. We arrange the empirical analysis on South Asian countries over the period 2000 to 2021 and employ the ARDL (autoregressive distributed lag) model for regression analysis. The estimated results show that all terrorism-related variables including the number of fatalities incidents, number of fatal, number of explosions incidents, and number of affected people in explosions have negative and statistically significant effects on both RDE (research and development expenditures) and TMA (trademark applications). The increase in terrorist attacks assumes to hamper innovation confidence because it enhances the market uncertainty, administrative cost of enterprises, military expenditures, and brain flights to other peaceful economies of the world. However, we find the positive effect of all control variables including FDI inflow, foreign aid, and government subsidies on innovation performance. Based on the findings, we conjecture the "sand the wheel" role of terrorism in determining innovation. This study provides robustness to the empirical findings of the studies conducted by Nadeem, et al., (2021) and Uddin, et al., (2022) and has following policy implications:

As the analysis suggests that terrorist activities negatively determine innovation, therefore it is recommended to strictly take action against increasing terrorist activities. Security institutions and other relevant officials should ensure a peaceful environment and should take immediate action against non-state actors involved in such terrorist activities. Terrorism is a deep-rooted issue that emerged from social injustice, unequal distribution of wealth, extreme poverty, lack of education, and discrepancy in the delivery of necessities of life by the state. Therefore, the central government should ensure the better incorporation of the aforementioned factors in order to curb the increasing terrorist activities. Such control of terrorism will bring multiple benefits in the shape of peace, rapid growth, and better innovation performance. As terrorism is a global issue and each country of the world can be equally affected (for example 9/11 attacks in the United States), therefore it is suggested that international partnering countries and relevant agencies should provide the necessary assistance to the South Asian countries for fighting against terrorism. In addition, the private sector and other individuals involved in R&D activities should devise such strategies that adjust the effect of terrorist attacks on innovation. These strategies include but are not limited to remote working during extreme terrorism, enhancing safety measures, and high financial resistance against terrorist attacks. To enhance innovation even during terrorist attacks, more focus on inviting foreign investors to invest in industrial units, effective utilization of foreign aid, and enhancing the allocation of subsidies can be proved as effective tools.

The current study has some shortcomings that open the doors for future research: first, the study was conducted on the panel of South Asia while each economy may respond differently to terrorism. Due to unequal economic development across the underlying countries, the response of countries regarding the innovation performance to the terrorist attacks may be different from others. Another limitation of the current study is that we consider the whole span of the study as a unique sample while two major events occurred i.e., the 9/11 attacks in 2001 and COVID-19 spread at the end of 2019 during the sampled span (2000-2021). During these two events, the magnitude of terrorism's effect on innovation may differ from the rest of the years. Therefore, future studies can be conducted either by distributing the sample or by introducing the year dummy. In addition, some other potential variables like governance quality and economic complexity can be considered as moderating variables in the nexus between terrorism and innovation while conducting the future studies.

**Appendix**

Table A1

**Average Values Across the Countries**

| Variables | Bangladesh | India | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|
| **RDE** | 0.555 | 0.754 | 0.205 | 0.512 | 0.142 |
| **TMA** | 3.871 | 4.431 | 3.192 | 4.224 | 3.662 |
| **FID** | 69.681 | 622.727 | 178.409 | 710.363 | 308.409 |
| **FAT** | 105.181 | 1365.636 | 639.545 | 2952.182 | 1891.682 |
| **EXP** | 22.636 | 157.522 | 45.500 | 324.409 | 71.500 |
| **AFP** | 120.454 | 534.431 | 79.636 | 1570.409 | 448.727 |
| **FDI** | 0.834 | 0.956 | 0.256 | 1.129 | 1.182 |
| **ODA** | 1.408 | 2.498 | 4.837 | 1.220 | 1.195 |
| **SUB** | 32.367 | 48.155 | 64.608 | 3.222 | 26.464 |

*Acronyms: RDE=research and development expenditures, TMA=trademark applications, FID= Number of fatalities incidents, FAT= Numbers of fatal, EXP= number of explosions incidents, AFP= number of affected peoples, FDI=foreign direct investment inflow, ODA= official development assistance, SUB=subsidies Source: self-calculation. Note: This table shows the summary of average values. It is important to note that three countries including Afghanistan, Bhutan, and Maldives were excluded from sample due to missing information on some variables of study.*

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