International Journal of
Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

DOI: 10.31695/IJASRE.2019.33009

Volume 5, Issue 2
February-2019

The Boomerang Effect of Some Counterterrorism (CT) Measure: A Mathematical Game-Theoretic Model

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ABSTRACT

The freedom of expression, universally acknowledged as both a fundamental and foundational human right, is not only the cornerstone of democracy but indispensable to a thriving civil society. Indeed, the freedom of expression is considered the "foundational human right" of the greatest importance; hence its suppression on the advent of any CT measure cannot be overlook in any liberal society. However, since the event of the bombing of the World Trade Centre in USA in September 11th 2001 by the Al-Qaida terrorist organization, most democratic governments have responded to terrorist attacks with such CT measures that curtail or suppress the freedom of expression and other fundamental rights and liberties of its citizenry; all in the guise of countering terrorism. The decrease in privacy and the concomitant increase in security agency's surveillance powers are other important CT policies adopted by various liberal societies. *How this policy of reacting to terrorist attacks with restrictions on free-speech protections affect the likelihood of terrorism and CT measures, has dominated front burners of public discourse over the last decades. In this study, we develop a two-person two-period dynamic game-theoretic analysis of an interaction between security agency and terrorist organization; to study the possible security implications of adopting policies that curtail or suppress free-speech protections and other fundamental rights of citizens as CT measure. The study shows that in a world in which democratic governments respond to major security threat such as terrorism with restrictions on freedom of expression and other fundamental rights and liberties of its citizens, such policies seems to have serious moral vulnerability and boomerang effect of endangering government effort at preventing terrorism and thus engender more terrorist attacks by garnering undue support for the terrorist. The analysis suggests that a commitment to "respecting the fundamental rights and liberties" of the citizenry in times of duress can be of immense security-advantage. That is, if liberal societies would remain faithful to their fundamental values in the aftermath of terrorist attacks and other security threat, such a strategy possibly has the propensity to decreasing the probability of further terrorist attack, reduce cost of CT measure and hence a boost to government CT measures.*

Key words: Counter-Terrorism Measures, Free Speech Protection, Terrorist Organization, Cataclysmic Dynamic, Dynamic Game Theoretic Analysis.

1.0 INTRODUCTION

Insecurity and terrorism in particular have over the recent decade become the world most ravaging threats to global peace and security, socio-economic and political lives of the vast world population, especially since the bombing of the World Trade Centre USA in September 11th 2001 by the Al-Qaeda terrorist group. These and other socio-political decadent and ethical decay has been the drivers of the unprecedented explosion of institutions of organized crimes; with its attendant escalation of activities of kidnapping, hostage-taking, human trafficking, oil bunkering, militancy, political-assassinations, and armed robbery the world over. The quest to counter, and perhaps, finding a lasting solution to this hydra-headed problem and emerging anti-social trend - the epidemic of insurrectionary activities in human society has pegged the fate of the whole world and its entire human races on

the mercies of scholars, scientists, researchers and professionals alike in all fields of human endeavors, including intelligence and academic community to brainstorm, research, explore, and utilize newer scientific principles, methodologies, technologies, tools and practices toward countering the threat of terrorism.

In what appears to be a stroke of irony, perhaps, most democratic government in the world had resolve to launching a harsh crackdown on free-speech and other civil liberties that allegedly supports or glorify terrorism, less than a decade after the bombing of the World Trade Centre in September 11th 2001 by the Al-Qaida terrorist group. There is no doubt therefore that these counter-terrorism measures is aimed at criminalizing terrorist propaganda and other forms of support thereby raising the costs of being associated with a terrorist group for individuals who would otherwise willingly provide various kinds of support, like dissemination of propaganda, raise funds, recruit operatives, procure supplies, facilitate travel, and provide safe houses etc. Since support and logistical networks are essential requirements for terrorists to succeed[45] liberty-reducing measures were intended to make it difficult for terrorist groups to operate, by increasing the costs of terrorism.

The Nigerian government, for example, arose from the aftermath of the high profile cases of vandalism and terrorist attacks on its major oil installations, oil bunkering and kidnapping for ransom in the South-South region by the Niger Delta militant groups; frequent holocaust of attack on public offices, worship centres, educational institutions, etc., in the North East region by Boko Haram terrorist groups; and widespread incident of armed robbery, kidnapping, political assassination and other forms of organized crimes between 2009 & 2015,to enacted stringent CT measures tagged "*Terrorism Prevention Act (TPA) 2011"* and "*Terrorism Prevention (Amendment) Act (TPAA) 2013"*[37,39,43]. As observed by Amnesty International and other Human Right Organizations, some of the provisions of these Acts embody several anti-human right protection clauses and falls short of the requirements of fundamental human rights protection and even its implementations, most often, grossly violate the fundamental right and liberties of the citizenry[3].

The Acts which covers several sections, has a far reaching provisions ranging from definition and prescription of crimes of terrorism, to intelligence gathering, prevention, investigation and prosecution of terrorist suspects and other related offence. Immediately after the enactment of these Acts, young men and women that were suspected of aiding or having joined Boko Haram were picked up from their houses and on the streets and taken to military detentions and prisons. According to Amnesty International, in the first six months of the year 2013 alone, 950 men were detained unlawfully by the Nigerian government[4]. If and when, these men make it out of detentions or prisons alive (many die of disease, starvation or torture), their animosity against the government usually increased and they became easy targets for Boko Haram's recruitment efforts[37].

The Amnesty International in its recent report observed that the key provisions of the Acts are incompatible with Nigerians Human Rights obligations[3]. The organization goes further to observe that the provisions of the Acts used terms that are overbroad in scope; violate the *"legality"* requirement for criminal offences; and or unlawfully restricting a range of rights[28]. Such breaches of rights and civil liberty include freedom of thought, conscience and religion; freedom of opinion and expression; freedom of association, freedom of the media, and freedom of assembly. Thus failing to adhere to demonstrable proportionality; same provisions relating to investigation and detention is not consistent with various provision of human right laws. Some administrative provisions lack any provisions for meaningful access to effective legal remedies and procedural safeguards; and consequently infringing on the right of due process in fair hearing[28].

It is worth noted that other democratic nations are not exempted from these gross violation and abuse of fundamental human right and civil liberty of the citizenry, in the guise of CT measures. For examples, the French government has also launched a harsh crackdown on speeches that allegedly supports or glorify terrorism, less than a week after the massive public rallies in defense of freedom of expression in the aftermath of the Charlie Hebdo terrorist attack. In a circular published on 12th, January 2015, the French Minister of Justice - Christiane Taubira instructed prosecutors to take tough action against those who purposely defend or glorify terrorism. Restrictions have expanded from existing prohibitions on incitement to much broader and less defined areas such as the *"glorification"* of and *"apology"* for terrorism. Thus, within three weeks, 150 prosecutions were launched resulting in dozens of verdicts, including 18 prison sentences imposed largely for the crime of *"apologie du terrorisme"*[5]. In a similar effort to suppress terror speech, the President Francois Hollande signed on 9th, February 2015 a decree allowing the French government to ban without a court order websites suspected of advocating terrorism. The French authorities have used these new powers to block five websites, which they claimed condone terrorism[9].

The 2004 Madrid train bombings and the 2005 London terrorist attacks also added urgency to the issue of devising preventive security policies in an era of rising extremist violence and suicide terrorism. Consequently, governments of United States and other liberal democracies also adopted various liberty-reducing measures intended to make it difficult for terrorist groups to grow and operate inside liberal societies[42,46]. For instance, on 26th, October 2001, the United States president George Bush signed

DOI: 10.31695/IJASRE.2019.33009

into law the *"Patriot Act"*, which made it a criminal offense to provide support to groups designated as terrorist organizations; provisions that indirectly limit speech and other activities that might be intended or unintended to facilitate terrorist activities[28]. In 2002, Denmark enacted a CT law to criminalize instigation of acts of terrorism. In 2005, Australia included various forms of seditions into its CT laws and gave public officials the power to ban groups perceived to advocate terrorism. In 2006, United Kingdom passed the *"Terrorist Act"* that made it illegal to glorify terrorism and encourage the commission and preparation of terrorist activities[46].

However, these reactions of the Nigerian government, her French counterpart and other democratic nations to roll back protections on free-speech and other fundamental right and liberty of its citizen after a terrorist attack are representative of how democratic governments have responded to the threat of terrorism since September 11th, 2001 World Trade Centre terrorist attack; event which underscored the vulnerability of liberal societies to cataclysmic acts and revealed the potentially awful psychological, social and economic costs of failing to stop a large-scale terrorist attack.

These examples are symbolic of a larger effort of liberal societies to regulate incitement to terrorism[47]. The rationale for prohibiting terrorist advocacy and other forms of support is the worry that terrorists can exploit the civil liberties and individual freedoms on which liberal societies are built to further their violent ends[50]. Under the shield of free speech protections, for example, terrorist groups can disseminate their propaganda, recruit operatives, and raise funds, and so on. The advocacy of terrorism, if left unchecked can then effectively augment the capacity of terrorist groups to undermine the security of liberal societies. Thus, criminalizing terrorist propaganda and other forms of supports, raises the costs of being associated with a terrorist group for individuals who would otherwise willingly provide various kinds of supports such as disseminate propaganda, raise funds, recruit operatives, procure supplies, facilitate travel, provide safe houses, etc. Since support and logistical networks are essential for terrorists to succeed[45], liberty-reducing measures are intended to make it difficult for terrorist groups to operate by increase the costs of terrorism.

That democratic government curtails or suppresses free-speech protections and other fundamental rights and liberties of the citizenry in the aftermath of terrorist attacks has a well-documented empirical pattern[15,19,30,47,55,57]. The decrease in privacy and the concomitant increase insecurity agency's surveillance powers are other important CT policies adopted by various liberal societies[19]. Regardless of the security justification for such CT measures, the political incentives that drive these policy interventions are well understood: *(i)* The legislators need to alleviate public fears and respond to citizens' demands to do something about terrorism, especially in the wake of major terrorist attacks[17,22] and *(ii)* Perhaps, and most importantly, public officials need to insure themselves against the political and electoral costs that would be borne when another terrorist attack takes place, should they oppose draconic CT measures in times of crisis[13,14]. Notwithstanding the political motive behind any liberty-reducing CT measures (to increase the cost of terrorism), the empirical pattern of curtailing or suppressing free speech protections and other rights of the citizenry when bombs goes off, raises a critical fundamental security question: *how does the policy of reacting to terrorist attacks with restrictions on free-speech protection and other fundamental rights and liberties of the citizenry affect the likelihood of terrorism?*

In all the researches over the past decades to find a lasting solution to this hydra-headed problem of mankind (terrorism), scholars and policymakers have unavoidably neglected this important question, probably, because terrorist attacks are not natural disasters. And also terrorists do not wear identifying military uniforms, confined to designated geographical hubs (e.g. barracks) nor do they obey the conventional military warfare rules and regulations. A terrorist attack takes place when terrorist's effort to plan and execute a strike is not promptly checked, uncovered and foiled by the relevant security agencies in charge of terrorism prevention. Since liberty-reducing CT measures are aimed at "*increasing the cost of terrorism transforming the environment in which security agencies and terrorist groups interact"*, it is important to investigate how the expectation that free-speech protections are curtailed or suppressed after a terrorist attack affects the motivations of terrorist groups to plot and carryout further attack as well as the incentives of security agencies to foil the threat.

Terrorism, mostly ideologically (ethno-religious or ethno-political) driven crime, and ideal CT measures, mostly constrained by the heterogeneity of the terrain[45]; asymmetric nature of the battle field[27]; insufficient, and unreliable data/information and limited human resources, requires a compendium of counter-ideologically driven methods and strategies, and proactive synergies from both inter/intra ideological collaborators. Such synergies are only possible in an atmosphere that is devoid of rancor, acrimony, coercion, tension, intimidation and fear but congenial to expression of both self and nationalist opinions. An atmosphere that engenders trust and confidence building between the governed and the government, stimulate healthy civil-military relationship. A society that engenders and guarantees not only free flow of information, protect freedom of expression but respect and educate its citizens of their fundamental human right and liberty.

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Most often, accurate knowledge of what is happening, why it happens and what will happen in advance in the society is obviously part of the solution. Therefore, improper identification and classification of the nature and causes of terrorism is one of the major drivers of government counter-productive CT measures[12,33]. While, alienation of citizen from government due to unclear and improper orientation of the citizen of government's socio-economic policies and programs; gross ignorance and high rate of illiteracy and as well as other socio-economic problems such as high rate of youth unemployment and high poverty index are major drivers of terrorism ideologies[3,28,37,53].

Restrictions on free-speech and other liberty-reducing CT measures have ignited a longstanding scholarly and public debate about the tradeoffs between liberty and security[21]. Legal and political theory scholars have argued extensively whether such CT policies are normatively undesirable because they depart from established liberal-democratic principles or whether they are essential to respond effectively to terrorist threats[42]. CT Scholars have investigated empirically the effectiveness of various repressive CT tactics to show that such policies can be counter-productive[4,16,51]. Such findings have been documented in cross-sectional analyses in case studies of CT in France, Italy and India[15,45,55], and in quantitative assessments of CT policies in Israel, United Kingdom and Spain[18,25,34]. Other existing scholarship on CT has addressed several important questions about terrorism prevention, including the optimal (or suboptimal) CT policy[8,35,51], terrorism recruitment and support[50], the effect of terrorism on domestic politics and institutional design[29], to mention just a few topics as the literature is much too extensive to attempt a comprehensive review here.

However, the mechanisms by which restrictions on free-speech and other liberty-reducing CT measures affect terrorism prevention have not been quantitatively estimated. More importantly, researchers are yet to determine how the expectation of reducing free-speech protections and other liberty-reducing measures in the aftermath of a terrorist attack affects the incentives of terrorism prevention and occurrence. This question is particularly important since restricting fundamental rights and liberties of the citizenry to make it difficult for terrorist groups to operate has been the typical response of most democratic governments to major terrorist attacks. In this paper we develop a framework that allows us to scrutinize the micro-foundations of CT measures aimed at increasing the cost of terrorism and also to assess the consequences of such policies. Our aim is to use a mathematical game theoretic analysis to study the possible security implications of adopting policies that curtail or suppress free-speech protections and other fundamental human rights of citizens as CT measures. By our research, this study is the first ever dynamic game-theoretical analysis that tackles this question.

The paper uncovers novel results regarding the dynamic consequences of such and similar CT measures; results that are missing from contemporary scholarly and policy debates about terrorism prevention. The dynamic analysis underscores the importance of assessing such strategy of terrorism prevention in light of the incentives of security agencies responsible for terrorism prevention. It suggests that in an environment where politicians respond to major terrorist attacks by restricting civil liberties, security agencies try less efficient because the pain of the attack is ameliorated somewhat by the future gains from having a better CT environment (i.e. one with less free-speech); a finding that has several important institutional and policy implications. The dynamic analysis can also help understanding the effectiveness of preventive measures in situations in which governments engage in preemptive actions to foil various social harms, and, as such it contributes to a small but growing political economy of prevention.

2.0 MATHEMATICAL GAME THEORY APPLIED TO TERRORISM

In his thesis: *"The Law of Loopholes in Action"*[24], Gelernter argued that *"every loophole will eventually be exploited; every loophole will eventually be closed"*. This law applied to terrorism means that terrorists exploit security loopholes through continual exploration and that, once discovered, specific defensive measures have to be put in place to close each loophole. The net effect of the Law of Loopholes is an ever-expanding set of security rules and requirements. Such rules and requirements are useful for helping prevent the reoccurrence of a particular type of incident. But when a determined adversary's focus is on causing general destruction and mayhem, then as one loophole is plugged, the adversary simply shifts its attention and energies to looking for and trying to exploit a different loophole.

The problem of security, of course, is that it is impossible to defend all potential targets and their associated loopholes against the threats of adversaries at all time. While it is important to implement certain new and improved defensive tactics, it is equally as important (and arguably more important) to implement offensive strategies to deter and disrupt these adversaries. The question now is; *how can the security agencies identify effective offensive and defensive strategies and tactics?* One such approach is through the use of game theory - the mathematically based study and analysis of adversarial conflicts. The classic text *"The Compleat Strategyst*"[57] characterizes games of strategy as having the following characteristics:

- ***A conflict:*** the participants (e.g., individuals, organizations, countries; known as "players" in game theory parlance) are at cross-purposes or have opposing interests.

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- ***Adversarial reaction and interaction:*** each player has some control over the course of the conflict or its outcome via one or more decisions.
- ***Outside forces:*** some aspects of the conflict are outside of the players' control and may be governed by chance or are unknown.

These characteristics clearly apply to the problem of countering terrorists and defeating terrorism. Game theoretic methods provide a structured way to examine how two adversaries will interact under various conflict scenarios. The results often provide insight into why real-world adversaries behave the way they do. The first extensive treatment of game theory was the *"Theory of Games and Economic Behavior"*[54]. But in the middle and late 20th century, a great deal of game theoretic research focused on analyzing the arms race, nuclear brinkmanship, and Cold War strategies[44]. While in the pre-September 11, 2001 era, game theory was also applied to terrorism, and post- September 11, 2001 event help to expand this works[49].

Recent applications of game theoretic methods to the study of terrorism include: assessing strategies for how nations allocate expenditures for terrorism deterrence and the resulting implications for being attacked[7,48]; measures evaluating how various military employment policies/strategies encourage or discourage states from sponsoring terrorism[6] assessing insurance risks via models that explicitly account for malicious terrorist intent[38]; determining whether or not a stated policy of non-negotiation with terrorist hostage-takers deters such behavior and under what conditions[36]; and evaluating the effects of focusing national antiterrorism policy on deterrence or prevention[49]. This article also draws inspiration from a handful of classical mathematical models applying related concept, among which are *"mathematical model for the spread of extreme ideology in a close environment"*[2], *"an effective false rumor-containing strategy"*[13], to mention but few.

2.1 The Dynamic Game Theoretic Model of Terrorism

To address the question of "*how does a policy of reacting to terrorist attacks with restrictions on fundamental rights and liberties of the citizenry affect the likelihood of terrorism?"* we set up and analyze a two-person-two-period dynamic game theoretic model of an interaction between a Security agency (S) and a Terrorist organization (T) in which the outcome of period-1 interaction determines theperiod-2 interaction.

2.1.1 The Rule of the Game:

The rule is that if no terrorist attack occurs in the period-1, the level of free-speech protections remains unchanged in the period-2 and thus the Security agency and the Terrorist group plays the same game as in the period-1. However, if a terrorist attack occurs in the period-1, then the free-speech protections are curtailed, and in this contingency, the Security agency and the Terrorist organization play a game with lower free-speech protections in the period-2.

The fact that the level of free-speech protections is lower in the period-2 if the outcome of the period-1 is a terrorist attack creates dynamic incentives. That is, the prospect of changing the level of free-speech protections should a terrorist attack occur changes the period-1 stakes of terror prevention and terror success, which in turn alters the period-1 incentives of the players. For simplicity of exposition, we suppress time superscripts from the presentation of the players' actions in the stage game and use such notations only when necessary. In each period, the structure of the interaction is as follows:

- The terrorist organization chooses a level of activities $(x \in R^{+})$in preparation for a terrorist attack,
- The security agency chooses a level of CT activities $(y \in R^{+})$aimed at detectingpossible terrorist activity, and
- The players make their decisions simultaneously.

Suppose the outcome of the stage game is denoted by a binary variable $A \in \{1,0\}$, where $(A = 1)$, denotes a successful terrorist attack and $(A = 0)$, denotes failure or absence of a terrorist attack (see figure 1). Suppose the actions of the *Security agency* (S) and the *Terrorist organization* (T) translate into a probability of a successful terrorist attack $Pr(A = 1)$, given by a twice continuously differentiable function $P(y, x) = Pr(A = 1)$. This probability increases with the level of (T) activities in preparation for an attack (x); $\left(i.e.\frac{\partial P}{\partial x} > 0\right)$, and decreases with the level of (S)effort (y) to detect and foil terrorist activity, $\left(i.e.\frac{\partial P}{\partial y} < 0\right)$. Thus, $P(x, y)$ is convex in (y), $\left(i.e.\frac{\partial^2 P}{\partial y^2} > 0\right)$; there are decreasing marginal returns to terrorism prevention in (y), and $P(x, y)$ is concave in (x), $\left(i.e.\frac{\partial^2 P}{\partial x^2} < 0\right)$- there are decreasing marginal returns to terrorism occurrence in (x).

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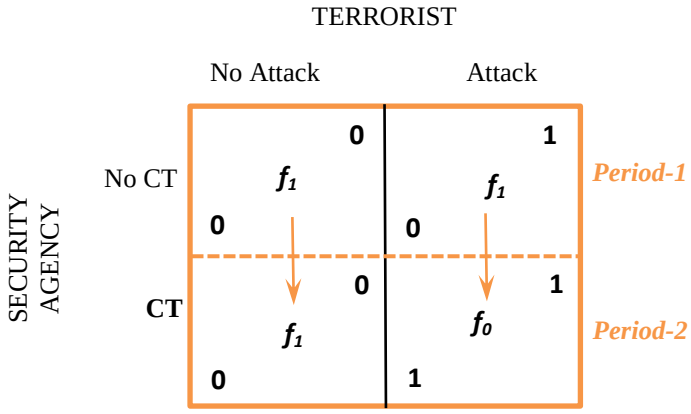

Figure 1: Payoff Matrix for the Stage Game

These parameters are intuitive and consistent with existing scholarship which depicts terrorism as an asymmetric forms of warfare, - the weapon of the weak (the terrorist organization), against the strong (the government security agencies)[27,45]. In other words, terrorists do not wear uniforms or openly confront the government; rather they want to be undetected by security agencies and have an advantage of hiding within the populace and plotting in secrecy[27]. That is, the effectiveness of the terrorists' effort to successfully execute a terror plot is higher when the security agency's effort to detect traces of terrorist activity is lower[56]. For theoretical understanding and analysis of our model, several theorems, Lemmas and propositions are formulated and prove.

2.1.2 The Player's Best-Response Function

To achieve the best-response functions that is also intuitive and consistent with empirical evidence, let the cross-partial derivative of the probability of a successful terrorist attack $P(y,x)$ be negative $\left(i.e.\frac{\partial^2 P}{\partial y \partial x} < 0\right)$. Let $Y(A)$ denotes (S) payoff if the outcome is $A \in \{1,0\}$. Let $Y(1)$ denotes (S) payoff if prevention of terrorist attack is unsuccessful, and $Y(0)$ denote (S) payoff if prevention of terrorist attack is successful. Since the objective of (S) is to prevent a terrorist attack, then $\left(Y(1) < Y(0)\right)$. And let $(Y(0) - Y(1) = \Delta_S)$ - denotes (S) stake in terrorism prevention. Let (S) cost of preventing terrorism be given by a twice continuously differentiable function $C_S(y)$. Thus, the cost is both increasing and convex in (y), respectively, $\left(i.e.\frac{dC_S}{dy} > 0,\right.$ and $\left.\frac{d^2C_S}{dy^2} > 0\right)$. To ensure that both $(S)$and (T) have a non-zero finite optimal level of effort, we assume a standard Inada conditions on the cost functions $C_S(y)$,

$$i.e.\, C_S(y): lim_{y\to 0}\frac{dC_S}{dy} = 0; \text{ and that } lim_{y\to\infty}\frac{dC_S}{dy} = \infty.$$

Theorem 2.1: Inada Conditions *- Given two inputs, capital (X) and labor (Y), the aggregate neoclassical production function for output (F) is given by $F = G(X,Y)$. If F exhibit constant returns to scale and positive and diminishing marginal products with respect to each input, for all $(X,Y) > 0$, such that:*

$$\frac{\partial G}{\partial X} = \frac{\partial G}{\partial Y} > 0, and\ \frac{\partial^2 G}{\partial X^2} = \frac{\partial^2 G}{\partial X^2} < 0$$

Then the marginal product of an input is assumed to approach infinity as this input goes to zero, and to approach zero as the input goes to infinity:

$$i.e.\, G(X,Y): \lim_{X\to 0}\frac{\partial G}{\partial X} = \lim_{Y\to 0}\frac{\partial G}{\partial Y} = \infty, and \lim_{X\to\infty}\frac{\partial^2 G}{\partial X^2} = \lim_{Y\to\infty}\frac{\partial^2 G}{\partial X^2} = 0$$

Therefore, (S) expected utility function $U_S(y,x)$ can be given by:

$$\left.\begin{aligned} U_S(y,x) &= [1 - P(y,x)]Y(0) + P(y,x) + Y(1) - C_S(y) \\ &= Y(0) - P(y,x)[Y(0) - Y(1)] - C_S(y) \\ &= Y(0) - P(y,x)\Delta_S - C_S(y) \end{aligned}\right\} \quad (1)$$

Similarly, let $X(A)$ denote (T) payoff if the outcome is $A \in \{0,1\}$, where $X(1)$ denotes (T) payoff if the outcome is successful terrorist attack, and $X(0)$ denotes (T) payoff if the outcome is unsuccessful terrorist attack. Since the objective of terrorist is to carry out a successful terrorist attack, then $\left(X(1) > X(0)\right)$. Let $(X(1) - X(0) = \Delta_T)$ denotes (T) stake in terrorism occurrence. Also let the cost of terrorist attacks be given by a twice continuously differentiable function $\left(C_T(x,f)\right)$. This cost is both increasing and convex in (x), $\left(i.e.\frac{\partial C_T}{\partial x} > 0, \text{and } \frac{\partial^2 C_T}{\partial x^2} > 0\right)$, and by theorem 2.1.1;

$$C_T(x,f): \lim_{x\to 0}\frac{\partial C_T}{\partial x} = 0, \text{and that } \lim_{x\to\infty}\frac{\partial C_T}{\partial x} = \infty$$

DOI: 10.31695/IJASRE.2019.33009

Since the cost of terrorist activities $(C_T(x,f))$ is also affected by the level of free-speech protections (f), therefore, the policy justification of curtailing free-speech protections (f) and other civil-rights and liberties of the citizenry (decrease protection on free-speech; $(i.e\, f<0)$, and increase the cost of terrorism, $(i.e.C_T(x,f)>0)$) can be formalized as follows. Let the cost of terrorist activities $C_T(x,f)$ be decreasing and concave in the level of free-speech protections (f); $\left(i.e.\frac{\partial C_T}{\partial f}<0 \text{ and } \frac{\partial^2 C_T}{\partial x \partial f}<0\right)$, then, (T) expected utility $U_T(y,x)$ is given by:

$$\left.\begin{aligned} U_T(y,x) &= [1-P(y,x)]X(0)+P(y,x)X(1)-\ C_T(x,f) \\ &= X(0)+P(y,x)[X(1)-X(0)]-\ C_T(x,f) \\ &= X(0)+P(y,x)\Delta_T-\ C_T(x,f) \end{aligned}\right\} \quad (2)$$

Thus, in each period, the structure of the interaction between (S) and (T) are given by equations (1) and (2) respectively; with the strategies that the game in period-2 depends on the outcome of period-1. That is, if no terrorist attack occurs in period-1, (S) and (T) plays the same game as in the normal level of (f). However, the level of free-speech protections (f) is reduced if a terrorist attack occurs in period-1; and in this contingency (S) and (T) play a game with lower free-speech protections $(i.e.f<0)$ in period-2.

2.1.3 The Dynamics of the Stage Game

Let (f_1) denote the level of free-speech protections in period-1 and (f_0) denote the level of free-speech protections in the period-2 in the contingency that a terrorist attack occurs in period-1, where $(f_0<f_1)$. The timing of the interaction is as follows:

- In period-1, let (S) level of effort be denoted by (y_1) and (T) level of effort be denoted by (x_1). If the outcome of the interaction in period-1 is a terrorist attack with probability $P(y_1,x_1)$, then $1-P(y_1,x_1)$ denotes probability of no terrorist attack in period-1.
- In period-2, let (S) level of effort be denoted by (y_2); (T) level of effort be denoted by (x_2); and the level of free-speech protection be (f_1) if the outcome of period-1 is no terrorist attack but decreases from (f_1) to (f_0) if the outcome of period-1 is a terrorist attack. If the outcome of the interaction in period-2 is a terrorist attack with probability $P(y_2,x_2)$; then $\left(1-P(y_2,x_2)\right)$ is the probability of no terrorist attack.

The security agency's and the terrorist organization's total utility in this two-period interaction is the sum of the first period and (discounted) second period utilities, where the security agency's and the terrorist organization's per-period utility is given by expressions (1) and (2);

$$\left.\begin{aligned} U(y,x) &= U_S(y,x)+\ U_T(y,x) \\ &= Y(0)+X(0)-[\Delta_S-\Delta_T]P(y,x)-C_S(y)-\ C_T(x,f) \end{aligned}\right\} \quad (3)$$

2.2 The Properties of the Stage Game

Before analyzing the stage game, below are some properties which are necessary for the dynamic analysis: (i) the players' unique optimal action, and (ii) the dynamic equilibrium of the stage game.

2.2.1 The Players' Unique Optimal Action

Since the security agency's utility function (1) is concave in (y), $\left(i.e.\frac{\partial^2 U_S}{\partial y^2}<0\right)$, and its best-response function $y(x)$ strictly increasing in (x). The result is intuitive: if the terrorist organization increases its level of terrorist activities in preparation for a terrorist attack, in response, the security agency increases its level of CT effort to detect terrorist activity. Taking the partial derivative with respect to (y) of equation (1), we have

$$\frac{\partial U_S}{\partial y}=-\frac{\partial P}{\partial y}\Delta_S-\frac{dC_S}{dy}=0 \quad (4)$$

$$\frac{\partial^2 U_S}{\partial y^2}=-\frac{\partial^2 P}{\partial y^2}\Delta_S-\frac{d^2 C_S}{dy^2}<0 \quad (5)$$

Thus, (S) ***unique optimal action*** is the solution of the first order equation (4) above, and the second order condition is satisfied since the (S) optimization problem (5) is strictly concave in (y), as $\left(\frac{\partial^2 U_S}{\partial y^2}<0\right)$. Therefore, since there is a unique optimal level of CT effort for any given level of terrorist activities, we shall investigate *how changes in the level of terrorist activities affect the level of CT effort.* Similarly, (T) objective function (2) is concave in (x), $\left(i.e.\frac{\partial^2 U_T}{\partial x^2}<0\right)$ and thus the ***unique optimal*** (x) is the solution to the first-order condition:

$$\frac{\partial U_T}{\partial x}=\frac{\partial P}{\partial x}\Delta_T-\frac{\partial C_T}{\partial x}=0 \quad (6)$$

DOI: 10.31695/IJASRE.2019.33009

$$\frac{\partial^2 U_T}{\partial x^2} = \frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T}{\partial x^2} < 0 \quad (7)$$

The second order condition is also satisfied since (T) optimization problem is strictly concave in (x), as $\left(\frac{\partial^2 U_T}{\partial x^2} < 0\right)$. Moreover, (T) best response function $x(y)$ strictly decreases in (y). The result is intuitive as well: if the security agency increases its level of effort to detect terrorist activity, in response, the terrorist organization decreases its level of activities. Also since there is a unique optimal level of terrorist activities for any given level of CT effort, we can now investigate *how changes in the level of CT effort affect the level of terrorist activities.*

2.2.2 The Dynamic Equilibrium of the Stage Game

The unique equilibrium of the stage game is the solution to the system of equations (4) and (6). Since equations (4) and (6) are continuous in (x) and (y) respectively, the security agency and the terrorist organization has well-defined best-response functions, which are also continuous and we can apply the implicit function theorem to equations (4) and (6) to find the slope of $y(x)$, and $x(y)$, respectively.

Theorem 2.2: Implicit function theorem in R2 - *Consider the equation* $f(x,y) = 0$ *where* $f: R^2 \to R$, *and solving it near* (x_0, y_0). *Let* $f: R^2 \to R$ *satisfy:*

(i.) $f(x,y)$ *is partially differentiable with continuous partial derivatives;*

(ii.) $f(x_0, y_0) = 0, and$ (iii) $\frac{\partial f}{\partial y}(x,y) \neq 0$

Then there is exist an open interval IxJ *such that* $(x_0, y_0) \in IxJ$ *and*

(i.) *For every* $x \in I$ *there is a unique* $y \in J$ *such that* $f(x,y) = 0$.

Thus, we can define the implicit function; (i) $Y(x) = y; (ii)\ Y(x_0) = y_0,$ and

(iii) $Y(x)$ is *differentiable with continuous derivatives, and*

(iv) For $x \in I$; $\frac{dY}{dx} = \left(\frac{\partial f}{\partial x}(x, Y(x))\right) \Big/ \left(\frac{\partial f}{\partial y}(x, Y(x))\right)$

By Theorem 2.2, the slope of $y(x)$, and $x(y)$, of equations (4) and (6) respectively are:

$$\frac{dy}{dx} = \left(\frac{\partial^2 P}{\partial y \partial x}\Delta_S\right) \Big/ \left(\frac{\partial^2 P}{\partial y^2}\Delta_S + \frac{\partial^2 C_S}{\partial y^2}\Delta_S\right) \quad (8)$$

$$\frac{dx}{dy} = -\left(\frac{\partial^2 P}{\partial x \partial y}\Delta_T\right) \Big/ \left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{d^2 C_T}{dy^2}\Delta_T\right) \quad (9)$$

The equation (8) is strictly positive $\left(i.e.\frac{dy}{dx} > 0\right)$; which implies that security agency's best-response function $y(x)$ strictly increases in (x). While equation (9) is negative $\left(i.e.\frac{dx}{dy} < 0\right)$; which implies that the terrorist organization's best response function $x(y)$, strictly decreases in (y). These results are intuitive: (i) "*if the terrorist organization increases its level of terrorist activities in preparation for an attack, in response, the Security agency will also increase its level of* CT *effort to detect terrorist activity", and (ii). "if the Security agency increases its level of CT effort to detect terrorist activity, in response, the terrorist organization will decrease its level of activities".*

These intuitive results that $y(x)$ is strictly increasing in (x), and $x(y)$ is strictly decreasing in (y), are implications of the fact that the cross-partial derivative of $P(y,x)$ is negative, $\left(i.e.\frac{\partial^2 P(y,x)}{\partial x \partial y} < 0\right)$. Suppose $P(y,x)$ has a positive cross-partial derivative $\left(i.e.\frac{\partial^2 P(y,x)}{\partial x \partial y} > 0\right)$, this would then implies either that: (i) t*he effectiveness of the Terrorists 'effort to successfully execute a terror plot is higher when the Security agency's effort to detect traces of terrorist activity is higher,* or (ii) w*hen the Terrorists increase the magnitude of their activities to carry a terrorist attack, in response, the security agency would decrease its level of effort to foil the attack*". Of course, these contradict intuition, and lead to empirically improbable best-response functions, i.e. $y(x)$ would be strictly decreasing in (x), and $x(y)$ would be strictly increasing in (y). Also from a substantive perspective, this would also suggest that *"Terrorist organization increases the magnitude of its activities to carry an attack when the government does more to detect Terrorist activity and foil the attack".* This result would be inconsistent with empirical evidence depicting terrorism as *"the weapon of the weak in which the modus operandi of terrorists is secrecy and stealth rather than direct confrontation with military superior opponents"*[26,43].

Note: Theorem 2.1 ensures that both (S) and (T) have a non-zero finite optimal level of effort. Because if $\left(\frac{dy}{dx} > 0\right)$ and $\left(\frac{dx}{dy} < 0\right)$; then (S) best-response function $y(x)$ and the (T) best-response function $x(y)$ can only intersect once. Thus, giving the empirically intuitive assumptions that if:

DOI: 10.31695/IJASRE.2019.33009

(i.) $P(y,0)=0,\ \forall y,$ and $lim_{y\to\infty}P(y,x)=0,\ \forall x,$ and

(ii.) $P(0,x)>0,\ for\ x>0,$ and $lim_{x\to 0}\frac{\partial P(0,x)}{\partial x}>0,$

Condition (i) implies that *"if the level of terrorist activities is zero, then the probability of terrorist attack is zero since there is no terrorist plot to be stopped*"; while condition (ii) implies that *"if the level of CT effort is zero, then the probability of a Terrorist attack is positive if the Terrorists put in some effort to carry out attacks*". Thus, conditions (i) and (ii) guarantees that the best-response functions $y(x)$ and $x(y)$ intersects; as such the stage game has unique pure-strategy Nash equilibrium.

Definition 2.3: Nash Equilibrium (NE) - *Is a profile of strategies such that each player's strategy is an optimal response to the other player's strategies. A pure-strategy NE is a pure-strategy profile that satisfies the same conditions. A pure-strategy NE is said to be unique if each player has a unique best-response to his rivals' strategies. That is a strategy,* (g)*is a unique pure-strategy NE, if for each* ***i*** *and for all* $g_i'\neq g_i;\ u_i(g_i,g_{-i})>u_i(g_i',g_{-i})$.

3.0 THE ANALYSIS OF THE STAGE GAME (DYNAMICAL)

By the above results, we now investigate how the policy of reducing free-speech protections $(f<0)$, if the outcome in period-1 is a terrorist attack $\big(i.e.Y(1),X(1)\big)$ affects the player's optimal actions; equilibrium payoff; equilibrium actions and consequently, the equilibrium probability of terrorist attack. By comparative statics, we shall investigate this impact on *(i) the players' equilibrium payoffs; (ii) the players' equilibrium actions; and (iii) the equilibrium probability of a terrorist attack.* To carry out the analysis, we state some theorems and propositions as a guide.

Theorem 3.0: The Envelope Theorem- *Consider an arbitrary maximization problem where the objective function* (f) *depends on some parameter* (α)*:*

$$U(\alpha)=\max_{x_1,\,x_2} f(x_1,\,x_2,\alpha);s{:}\,t\ \frac{\partial f}{\partial x_1}=\frac{\partial f}{\partial x_2}=0$$

Where the function $U(\alpha)$ *gives the maximized value of the objective function* (f)*, as a function of the parameter* (α)*. If the second-order conditions are met, then* $(x=x^*(\alpha);\ y=x^*(\alpha))$ *implicitly define the solutions of* $U(\alpha)$*, i.e.,* $U^*(\alpha)=f(x_1^*(\alpha),(x_2^*(\alpha),\alpha)$ *is the maximum value function (or indirect objective function) when the values of* (x_1) *and* (x_2) *are those that maximize* $f(x_1,\,x_2,\alpha)$*. The envelope theorem is the assertion that for any* $(\alpha\in U)$ *and any* $(i=1,2,3,\dots,k)$*:*

$$\frac{\partial U^*}{\partial\alpha_i}(\alpha)=\frac{\partial f}{\partial\alpha_i}(x_i^*(\alpha),\alpha)$$

Proposition-1: *In the stage game, decreasing the level of free-speech protections* $(\boldsymbol{f<0})$*, decreases the Terrorist's equilibrium level of terrorist activities, and decreases the Security agency's equilibrium level of* CT *effort, (see proof in appendix).*

3.1 Effect of Change in Level of Free-Speech Protection on Player's Equilibrium Payoffs

Given the proposition-1; in this context, (S) equilibrium payoff as a function of (f) in the stage game can be given by:

$$U_S^*(f)=Y(0)-P\big(y^*(f),x^*(f)\big)\Delta_S-C_S\big(y^*(f)\big) \tag{10}$$

A simple inspection of equation (10) suggests that *"the level of free-speech protections has effects on* (S) *equilibrium payoff*" through two different channels:

(i) It changes the equilibrium level of CT effort $y^*(f)$, and

(ii) It also changes the equilibrium level of terrorist activities $x^*(f)$.

Similarly, (T) equilibrium payoff as a function of (f) in the stage game can also be given by:

$$U_T^*(f)=X(0)-P\big(y^*(f),x^*(f)\big)\Delta_T-C_T(x^*(f),f) \tag{11}$$

Also a simple inspection of equation (11) suggests that *"the level of free-speech protections affects the Terrorist organization's equilibrium payoff*" through three different channels:

(i) It changes the equilibrium level of CT effort, $y^*(f)$;

(ii) It changes the equilibrium level of terrorist activities, $x^*(f)$, and

(iii) It also changes the cost of terrorist activities, $C_T(x^*(f),f)$.

Proposition-2 below summarizes the effect of *reducing the level of free speech protections* $(\boldsymbol{f<0},)$ on the security agency and terrorists' equilibrium payoff in the stage game.

Proposition-2: *In the stage game, reducing the level of free speech protections* $(i.e.f<0)$*, increases the Security agency's equilibrium payoff, but has an ambiguous effect on the Terrorist's equilibrium payoff, (see proof in appendage).*

DOI: 10.31695/IJASRE.2019.33009

3.2 Effect of Change in Level of Free-Speech Protection on Players' Equilibrium Action

Here we analyze the dynamic effects of reducing free-speech protection on security agency's incentives to prevent attacks, and terrorist organization incentive to plan attacks, respectively. That is how the changes in (S) stake for terrorism prevention (Δ_S) and the changes in (T) stake for a successful attack (Δ_T) will affect the players' equilibrium actions in the stage game. Proposition-3 summarizes these effects.

Proposition-3: *In the stage game, the* (S)*equilibrium action increases in its stake for terrorism prevention* (Δ_S) *with increase in* $(T's)$ *stake for a successful terrorist attack* (Δ_T). *In the stage game,* (T) *equilibrium action increases in its stake for a successful terrorist attack* (Δ_T), *and decreases in* $(S's)$*stake for terrorism prevention* (Δ_S), *(see proof in appendix).*

By the Proposition-3 and the equilibrium properties (2.2.2) of the stage game, we now answer our research question: "*how does a policy of reacting to terrorist attacks with restrictions on free-speech protections and other fundamental rights and liberties of the citizenry affect the likelihood of terrorism?*" To do this, we compare the dynamical game - reducing the level of free-speech protections $(i.e. f < 0)$ with a *"bench-mark game"* – no change in the level of free-speech protections even if the outcome in the period-1 interaction is a terrorist attack". That is, we compare the game in which the level of free-speech protections in the period-2 decreases from (f_1) to (f_0), for $(f_1 > f_0)$, if the period-1 outcome is a terrorist attack with a *"benchmark game" in* which the level of free-speech protections in the period-2 remains (f_1) even if the period-1 outcome is a terrorist attack". The relevant parameters in this analysis and their substantive interpretations are as follows:

(i.) $u_i^{[2]}(f_1), for\ i \in \{T, S\}$ denote a player's period-2 equilibrium payoff in the (f_1) game,

(ii.) $u_i^{[2]}(f_0), for\ i \in \{T, S\}$ denote a player's period-2 equilibrium payoff in the (f_0) game,

(iii.) $d_S = u_S^{[2]}(f_1) - u_S^{[2]}(f_0)$ denote (S) period-2 utility difference in the games of (f_1) and (f_0),

(iv.) $d_T = u_T^{[2]}(f_1) - u_T^{[2]}(f_0)$ denote (T) period-2 utility difference in the games of (f_1) and (f_0),

(v.) $\delta_i;\ for\ \ i \in \{T, S\}$, denotes the player's discount factor.

3.2.1 The Benchmark Game

Suppose in the stage game, the level of free-speech protections is kept constant in the period-1 and the period-2 regardless of whether a terrorist attack occurs after the period-1. In other words, the level of free-speech protections in the period-2 is kept constant at (f_0). As observed in the equilibrium analysis on section 2.2.2, the interaction in period-2 has a unique equilibrium. Let $u_S^{[2]}(f_0)$ and $u_T^{[2]}(f_0)$ denote (S) and (T) period-2 equilibrium payoffs. When (S) chooses its period-1 level of CT effort, its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_S &= \underbrace{Y(0) - P(y,x)\Delta_S - C_S(y)}_{Period-1\ payoff} + \underbrace{\delta_S\left[P(y,x)u_S^{[2]}(f_0) + (1 - P(y,x))u_S^{[2]}(f_0)\right]}_{Period-2\ payoff} \\ &= Y(0) - P(y,x)\Delta_S - C_S(y) + \delta_S u_S^{[2]}(f_0) + P(y,x)u_S^{[2]}(f_0)\delta_S - P(y,x)\delta_S u_S^{[2]}(f_0) \\ &= Y(0) - P(y,x)\Delta_S - C_S(y) + \delta_S u_S^{[2]}(f_0) \end{aligned}\right\} \quad (12)$$

The term $u_S^{[2]}(f_0)$in equation (12) represents the period-2 utility from the perspective of (S) when choosing its period-1 effort and $\delta_S \in [0,1]$represents (S) *discount factor*. Similarly, when (T) chooses its period-1 action its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_T &= \underbrace{X(0) + P(y,x)\Delta_T - C_T(x,f_0)}_{Period-1\ payoff} + \underbrace{\delta_T\left[P(y,x)u_T^{[2]}(f_0) + (1 - P(y,x))u_T^{[2]}(f_0)\right]}_{Period-2\ payoff} \\ &= X(0) + P(y,x)\Delta_T - C_T(x,f_0) + \delta_T u_T^{[2]}(f_0) + P(y,x)\delta_T u_T^{[2]}(f_0) - P(y,x)\delta_T u_T^{[2]}(f_0) \\ &= X(0) + P(y,x)\Delta_T - C_T(x,f_0) + \delta_T u_T^{[2]}(f_0) \end{aligned}\right\} \quad (13)$$

The term $u_T^{[2]}(f_0)$ in equation (13) represents the period-2 utility from the perspective of (T) when choosing its period-1 action and $\delta_T \in [0,1]$represents (T) discount *factor*. Since the period-2 utilities $u_i^{[2]}(f_0), for\ i \in [s,t]$ do not affect the period-1 equilibrium incentives, therefore, (S) and (T) period-1 and period-2 maximization problems are identical, and hence, their equilibrium actions and payoffs in the period-1 and period-2 are the same.

3.2.1 The Dynamical Game

Similar to the *benchmark* analysis above, in the period-2, the *dynamical* game also has unique pure-strategy equilibrium. Here the period-2 equilibrium payoffs depend on whether the level of free-speech protections is $(f_1 or\ f_0)$, where $(f_1 > f_0)$. Now let $u_S^{[2]}(f_0)$ and $u_T^{[2]}(f_0)$ denotes (S) and (T) period-2 equilibrium payoffs respectively, if the level of free-speech protections is(f_0).

DOI: 10.31695/IJASRE.2019.33009

And $u_S^{[2]}(f_1)$ and $u_T^{[2]}(f_1)$ denotes (S) and (T) period-2 equilibrium payoffs respectively, if the level of free-speech protections is (f_1). When (S) chooses its period-1 action, its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_S &= \underbrace{Y(0) - P(y,x)\Delta_S - C_S(y)}_{\text{Period}-1\text{ Payoff}} + \underbrace{\delta_S\left[P(y,x)u_S^{[2]}(f_0) + (1-P(y,x))u_S^{[2]}(f_1)\right]}_{\text{Period}-2\text{ payoff}} \\ &= Y(0) - P(y,x)\Delta_S - C_S(y) + \delta_S u_S^{[2]}(f_1) + P(y,x)u_S^{[2]}(f_0)\delta_S - P(y,x)\delta_S u_S^{[2]}(f_1) \\ &= Y(0) - P(y,x)\varepsilon_S - C_S(y) + \delta_S u_S^{[2]}(f_1) \end{aligned}\right\} \quad (14)$$

The terms $\left(d_S = u_S^{[2]}(f_1) - u_S^{[2]}(f_0) < 0\right)$ and $(\varepsilon_S = \Delta_S + \delta_S d_S)$ in equation (14) can be taken as (S) stake of preventing aterrorist attack in the period-1 of the *dynamical* game. Similarly, when (T) chooses its period-1 action, its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_T &= \underbrace{X(0) + P(y,x)\Delta_T - C_T(x,f_0)}_{\text{Period}-1\text{ payoff}} + \underbrace{\delta_S\left[P(y,x)u_T^{[2]}(f_0) + (1-P(y,x))u_T^{[2]}(f_1)\right]}_{\text{period}-2\text{ payoff}} \\ &= X(0) + P(y,x)\varepsilon_T - C_T(x,f_0) + \delta_T u_T^{[2]}(f_1) \end{aligned}\right\} \quad (15)$$

Similarly, the terms $\left(d_T = u_T^{[2]}(f_1) - u_T^{[2]}(f_0) < 0\right)$ and$(\varepsilon_T = \Delta_T + \delta_T d_T)$ in equation (15) can be taken as $(T's)$ stake of successful terrorist attack in period-1 of the *dynamical* game.

3.3 Comparison of Equilibrium Actions in the Benchmark and the Dynamical Games

By a similar analogy to the equilibrium analysis of the stage game, the period-1 interaction of both *benchmark* game and the *dynamical* scenario has a unique equilibrium. As observed earlier, let the equilibrium actions of (S) and (T) in period-1 of the *dynamical* game be denoted by (y_1) and (x_1), respectively, and its equilibrium probability of a terrorist attack by (P_1). Also, let the equilibrium actions of (S) and (T) in period-1 of the *Benchmark* game be denoted by $(\bar{y})$ and$(\bar{x})$, respectively, and its equilibrium probability of a terrorist attack by $(\bar{P})$. The key difference between the strategic interaction in the *benchmark* scenario and the *dynamical* game is that the prospect of changing the level of free-speech protections if the period-1 outcome is a terrorist attack alters the incentives of the players by changing the stakes of terror prevention and terror success in the period-1.

Proposition 4: In period-1, (S) *equilibrium action is lower in the dynamical game than in the benchmark* scenario *if the* period-2 *utility difference between* (f_0) *and* (f_1) *games for* (T)*is high* $(i.e.\, d_T > 0)$. *Also* (T) period-1 *equilibrium action is higher in the dynamical game than in the benchmark scenario if the* period-2 *utility difference between* (f_0) *and* (f_1) *games for* (T) *is low* $(i.e.\, d_T < 0)$, *(see proof in appendix).*

Numerical Illustration 3.3.1

Here we are considering a situation in which $(\boldsymbol{T})$ period-2 equilibrium utility increases when (f)decreases $(i.e.\, d_T < 0)$. In this scenario, $(\varepsilon_S < \Delta_S)$ but $(\varepsilon_T > \Delta_T)$. Let $P(y,x) = x(1-y); C_T(x,f) = M(f)\frac{1}{2}k_T x^2; \delta_S = \delta_T = 1; k_S = k_T = 1; M(f) = 1 - f;\ f < 1$; and $Y_S(0) = X_T(1) = 1;\ Y_S(1) = X_T(0) = 0$, (which implies that$(\Delta_S = \Delta_T = 1)$). Here we want to illustrate the moral vulnerability effect of curtailing free-speech protections in the aftermath of a terrorist attack.

Suppose that the level of free-speech protections is $(f_1 = 0)$ in the period-1 and that it decreases from $(f_1 = 0)$ to $(f_0 = -2)$, if a terrorist attack happens in the period-1. Then

(i.) In period-2; the probability of a terrorist attack is $(P_2(f_1) = 0.5)$ in the (f_1) game and $(P_2(f_0) = 0.75)$ in the (f_0) game. Also, in period-2, *S*equilibrium payoff is $\left(u_S^{[2]}(f_1) = -0.375\right)$ in the (f_1) game and$\left(u_S^{[2]}(f_0) = -0.219\right)$ in the (f_0) game; which implies that $(d_S = -0.156)$ and $(\varepsilon_S = 0.844)$. Likewise,

(ii.) In the period-2; (T) equilibrium payoff is $\left(u_T^{[2]}(f_1) = 0.125\right)$ in the (f_1) game and$\left(u_T^{[2]}(f_0) = 0.0938\right)$ in the (f_0) game; which implies that $(d_T = 0.0313)$ and $(\varepsilon_T = 0.969)$.

In the *dynamical* game: In period-1 (S)equilibrium action is $(y_1 \approx 0.45)$, and T equilibrium action is $(x_1 \approx 0.53)$, while the period-1 equilibrium probability of a terrorist attack is $(P_1 \approx 0.29)$.

In the *benchmark* game: In period-1 (S) equilibrium action, $(\bar{y} = 0.5)$; and (T) equilibrium action $(\bar{x} = 0.5)$, while the period-1 equilibrium probability of a terrorist attack, $(\bar{P} = 0.25)$.

Comparatively, we have that $(y_1 < \bar{y})$, $(x_1 > \bar{x})$, and $(P_1 > \bar{P})$.Thus the period-1 level of CT effort is lower in the *dynamical game*, while the level of *Terrorist* activities is higher. The period-1 equilibrium probability of a terrorist attack is higher in the *dynamical game* as compared to the *benchmark* game. Notice also that the period-2 equilibrium probability of a terrorist attack

DOI: 10.31695/IJASRE.2019.33009

increases when the level of free-speech protections is reduced from f_1 to f_0 if the period-1 outcome is a terrorist attack $\left((i.e. P_2(f_0) = 0.75 > P_2(f_1) = 0.5) \right)$

***Proposition 5**:* The period-1 *equilibrium probability of a terrorist attack can be higher if the level of free-speech protections is reduced when the* period-1 *outcome is a terrorist attack, (see proof in appendix).*

3.4 Effect of Reduction in Free-Speech Protection on Player's Equilibrium Probability:

Here we analyze the effect of $(f < 0)$ on the equilibrium probability of a terrorist attack in the period-2. By Proposition-1; a reduction in (f) decreases both equilibrium actions in the stage game, because the probability of a terrorist attack increases when (y) decreases, Proposition-1 also implies that there can be situations in which reducing free-speech protections increases the equilibrium probability of a terrorist attack in the period-2. In this context, how a decrease in (f) affects the probability of a terrorist attack in the period-2 is given by the sign of the following equation:

$$\frac{\partial P(y_2, x_2)}{\partial x}\frac{\partial x_2}{\partial f} + \frac{\partial P(y_2, x_2)}{\partial y}\frac{\partial y_2}{\partial f} \tag{16}$$

Here $\left(y_2 = y_2(f)\right)$ and $(x_2 = x_2(f))$ denotes the equilibrium levels of (S) effort in the period-2. The first term of equation (16) is positive while the second term is negative because (y_2) increases in(f). As a result, when the latter effect dominates, the former $P_2(f)$ increases when (f) decreases. Rearranging the terms of equation (16), the period-2 equilibrium probability of a terrorist attack increases when (f) is reduced in the aftermath of a terrorist attack if

$$\left(\frac{\partial P(y,x)}{\partial x}\right)\Big/\left(\frac{\partial P(y,x)}{\partial y}\right) + \left(\frac{\partial y(f)}{\partial f}\right)\Big/\left(\frac{\partial x(f)}{\partial f}\right) > 0 \tag{17}$$

Recall that Proposition-1 make usage of the implicit function theorem to investigate the effect of a change in (f) on the equilibrium level of (y) and (x) in the stage game. Using the expressions for the partial effect of (f) on the equilibrium actions derived in the proof of Proposition-1, the condition for the period-2 equilibrium probability of a terrorist attack to increase when $f$is reduced becomes

$$\left.\begin{array}{l} \left(\frac{\partial P(y,x)}{\partial x}\right)\Big/\left(\frac{\partial P(y,x)}{\partial y}\right) + \left(\frac{\partial^2 P(y,x)}{\partial y \partial x}\Delta_S\right)\Big/\left(-\frac{\partial^2 P(y,x)}{\partial x^2}\Delta_S - \frac{d^2 C_S}{dy^2}\right) > 0\Big|_{y^2,x^2} \\ \left(\frac{\partial P(y,x)}{\partial x}\right)\Big/\left(\frac{\partial P(y,x)}{\partial y}\right) - \left(\frac{\partial^2 P(y,x)}{\partial y \partial x}\Delta_S\right)\Big/\left(\frac{\partial^2 P(y,x)}{\partial x^2}\Delta_S + \frac{d^2 C_S}{dy^2}\right) > 0\Big|_{y^2,x^2} \end{array}\right\} \tag{18}$$

Notice that equation (18) is evaluated at the equilibrium values of (y^2) and (x^2). As such, to further characterize the conditions under which reducing (f) increases or decreases the period-2 equilibrium probability of a terrorist attack, we derive the closed-form solutions for equilibrium actions in the period-2. To this end, we present in Proposition-6; the conditions under which the period-2 equilibrium probability of a terrorist attack increases when the level of free-speech protections is reduced in the context of a parametric model.

3.5 The Security Rationale for Reducing Free-Speech Protection

Since the policy justification for curtailing free-speech and other rights and liberties in the aftermath of a terrorist attack is that such measures are necessary to fight terrorism, it is perhaps also relevant from a policy perspective to further assess this policy justification. As such, in this section, we characterize the conditions under which reducing the level of free-speech protections increases or decreases the probability of a terrorist attack in the period-2. To this end, we analyze a parametric model that allows us to derive closed-form solutions for the equilibrium actions which is necessary to investigate how a reduction in (f) affects the equilibrium probability of a terrorist attack in the period-2.The relevant the exogenous parameters of the model and their substantive interpretations are as follows:

(i.) Let $M(f)$ denote the effect of free-speech protections on the cost of terrorism,
(ii.) Let (Δ_S), denote (S) stake in preventing a terrorist attack,
(iii.) Let (Δ_T) denote (T) stake in a successful terrorist attack,
(iv.) Let $k_S$denote the marginal cost of CT effort, and
(v.) Let $k_T$denote the marginal cost of terrorist activities.

Numerical Illustration 3.5.1

Suppose the probability of a terrorist attack given by, $P(y,x) = x(1-y)$, the cost of CT effort, $C_S(y) = \frac{1}{2}k_S y^2$ and the cost of terrorism, $C_T(x,f) = M(f)\frac{1}{2}k_T x^2$. We can think of (k_S) toparameterize the (marginal) cost for CT effort. Similarly, we can think of (k_T) to parameterize the (marginal) cost for terrorist activities due to factors other than the level of free-speech protections. Also, the function $M(f)$ captures the (marginal) effect of free-speech protections on the cost of terrorism, where $M'(f) < 0$ (i.e.,

DOI: 10.31695/IJASRE.2019.33009

a higher level of free-speech protections decreases the marginal cost of terrorist activities). Given these specifications, (S) maximization problem reduces to:

$$\max_{y}\{-P(y,x)\,\Delta_S - C_S(y)\} = \{\max_{y} - x(1-y)\Delta_S - \frac{1}{2}k_S y^2\} \tag{19}$$

And the T maximization problem also reduces to:

$$\max_{y}\{P(y,x)\,\Delta_T - C_T(x,f)\} = \max_{y}\{x(1-y)\Delta_T - M(f)\frac{1}{2}k_T x^2\} \tag{20}$$

Solving the system of equations (19) and (20) given by the first-order conditions, the equilibrium actions in period-2 is:

$$y^2 = \frac{\Delta_S\Delta_T}{\Delta_S\Delta_T + M(f)k_S k_T}; \text{and } x^2 = \frac{k_S\Delta_T}{\Delta_S\Delta_T + M(f)k_S k_T} \tag{21}$$

As a result, the period-2 equilibrium probability of a terrorist attack becomes:

$$P_2(f) = \frac{M(f)k_T k_S^2\Delta_T}{[\Delta_S\Delta_T + M(f)k_S k_T]^2} \tag{22}$$

Therefore, a sufficient but not necessary condition for(P_2) to be strictly less than one $(i.e.P_2 < 1)$, (Δ_S) must be strictly greater than(k_S), $(\text{i.e.}\,\Delta_S > k_S)$.The above analysis shows *"that the cost of CT effort decreases if the outcome in the period-1 is a terrorist attack; hence such a policy intervention may have a boomerang effect of reducing the level of CT effort in the period-1, which in turn can make a terrorist attack more likely in the period-1"*. This result is summarized by proposition-7 below.

Proposition-6: *Reducing the level of free-speech protections increases the equilibrium probability of a terrorist attack in the period-2 if* $\left(\frac{\Delta_S\Delta_T}{k_S k_T} - M(f) > 0,\right)$*and decreases the equilibrium probability of a terrorist attack in the period-2 otherwise, (see proof in appendix).*

Proposition-6 implies that the probability of a terrorist attack in the period-2 increases when the level of free-speech protections is reduced if $\left(\frac{\Delta_S\Delta_T}{k_S k_T} - M(f) > 0\right)$. Notice that expression $\left(\frac{\Delta_S\Delta_T}{k_S k_T} - M(f) > 0\right)$ is a function of the exogenous parameters of the model, and thus we can characterize the conditions under which a reduction in free-speech protection (f) leads to an increase in the equilibrium probability of a terrorist attack in the period-2. A simple inspection of this expression shows that the inequalities is more likely to be satisfied when (Δ_S) and $(\Delta_T)$are higher and when (k_S) and (k_T) are lower. In other words, reducing the level of free-speech protections is more likely to be counter-productive:

(i.) *When* $(S's)$*stake for preventing a terrorist attack is higher,*
(ii.) *When* $(T's)$*stakefor a successful terrorist attack is higher,*
(iii.) *When* (S)*marginal cost is lower, and*
(iv.) *When*(T)*marginal cost is lower.*

3.6 Cost Implication of Reducing Free-speech Protection

Let's consider a version the dynamical model in which the cost of CT effort in period-2 decreases if the outcome in the period-1 is a terrorist attack. As mentioned earlier, the rationale of such policies is to reduce the likelihood of a terrorist attack by decreasing the cost of CT effort. To investigate this expectation, let the cost of CT be given by:

$$C(k_S, y) = k_s c(y) \tag{23}$$

Where $c(y)$ is increasing and convex in (y) and the parameter (k_s) affecting the marginal cost of CT effort. Here we want to analyze how a policy of reducing (k_s) if the period-1 outcome is a terrorist attack affects the players' incentives and the equilibrium probability of a terrorist attack in the period-1. The relevant parameters in this analysis and their substantive interpretations are as follows:

(i.) $u_i^{[2]}(k_s), for\ i \in \{T,S\}$ denote a player's period-2 equilibrium payoff in (k_s) game,
(ii.) $u_i^{[2]}(k_S^0), for\ i \in \{T,S\}$ denote a player's period-2 equilibrium payoff in (k_s) game,
(iii.) $d_S = u_S^{[2]}(k_s) - u_S^{[2]}(k_S^0)$, denote the *Security* agency's period-2 utility difference in the games of k_s and k_S^0,
(iv.) $d_T = u_T^{[2]}(k_s) - u_T^{[2]}(k_S^0)$ denote the *Terrorist* organization's period-2 utility difference in the games of (k_s) and(k_S^0)
(v.) $\delta_i,\ for\ i \in \{T,S\}$ denote a player's discount factor.

Before we proceed, the Lemma bellow will be useful in our analysis on how changes in (k_s) affect the players' equilibrium actions and payoffs in the associated stage game:

Lemma-3.3: *In the stage game, a decrease in the marginal cost of* CT *effort will increase both* (S) *equilibrium action and equilibrium payoff, while decreasing both* (T) *equilibrium action and equilibrium payoff, (see proof in appendix).*

DOI: 10.31695/IJASRE.2019.33009

3.7. Effect of Change in Free-Speech Protection on Cost of CT Effort and Terrorism

Given the lemma 3.3; we present an equilibrium analysis of the stage game in which (k_s) decreases in the period-2 if a terrorist attack occurs in period-1. Suppose that the marginal cost of CT effort decreases from (k_s) to $(k_S^0), (i.e\ k_s > k_S^0)$ in period-2 if period-1 outcome is a terrorist attack. Similarly, we want to compare two scenarios:

(i) A situation in which the cost of CT effort does not change in period-2 even if the period-1 outcome is a terrorist attack, and

(ii) A situation in which the cost of CT effort in period-2 decreases if the period-1 outcome is a terrorist attack.

3.7.1 The Benchmark Game

By a similar logic to the analysis on section 3.1, the *Security* agencies and the *Terrorist's* period-1 maximization problems are similar to the period-2 maximization problems since the period-2 equilibrium payoffs do not affect the period-1 equilibrium incentives. As a result, the equilibrium actions and payoffs in the period-1 and the period-2 are the same.

3.7.2 The Dynamical Game

In the dynamical game, when S chooses its period-1 action, its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_S &= \underbrace{Y(0) - P(y,x)\Delta_S - k_S c(y)}_{\text{Period}-1\text{ Payoff}} + \underbrace{\delta_S\left[P(y,x)u_S^{[2]}(k_S^0) + [1-P(y,x)](k_S)\right]}_{\text{Period}-2\text{ payoff}} \\ &= Y(0) - P(y,x)\Delta_S - k_S c(y) + \left[\delta_S P(y,x)u_S^{[2]}(k_S^0) + \left[\delta_S u_S^{[2]}(k_S) - \delta_S P(y,x)u_S^{[2]}(k_S)\right]\right] \\ &= Y(0) - P(y,x)\varepsilon_S - k_S c(y) + \delta_S u_S^{[2]}(k_S) \end{aligned}\right\} \quad (24)$$

Where $\left(d_S = u_S^{[2]}(k_S) - u_S^{[2]}(k_S^0) < 0\right)$ and $(\varepsilon_S = \Delta_S + \delta_S d_S)$. Since (S) period-2 equilibrium payoff is higher in the (k_S^0) game than in the (k_S) game, (S)stake for terrorist prevention is lower in the *dynamical* game than in the *benchmark* scenario $(i.e\ \varepsilon_S < \Delta_S)$. Similarly, when (T)chooses its period-1 action, its total utility (the sum of first and discounted period-2 utilities) is:

$$\left.\begin{aligned} U_T &= \underbrace{X(0) + P(y,x)\Delta_T - C_T(x)}_{Period-1\ payoff} + \underbrace{\delta_T\left[P(y,x)u_T^{[2]}(k_T^0) + [1-P(y,x)]u_T^{[2]}(k_T)\right]}_{period-2\ payoff} \\ &= X(0) + P(y,x)\varepsilon_T - C_T(x,) + \delta_T u_T^{[2]}(k_T) \end{aligned}\right\} \quad (25)$$

Where $\left(d_T = u_T^{[2]}(k_T) - u_T^{[2]}(k_T^0) < 0\right)$ and $(\varepsilon_T = \Delta_T - \delta_T d_T)$. Since (T) period-2 equilibrium payoff is lower in the (k_T^0) game than in the (k_T) game, then (T) stake for a successful terrorist attack is lower in the period-1 of the *dynamical* game than in the *benchmark* game $(i.e\ \varepsilon_T < \Delta_T)$.

3.8. Comparison of Cost CT Effort in Benchmark and Dynamical Game

The major difference between the strategic interaction in the *dynamical* and the *benchmark* scenario is that: in the *dynamical* game the prospect of reducing the cost of CT if period-1 outcome is a terrorist attack decreases the *S's* stake for terrorism prevention and also decreases the *T's* stake for a successful terrorist attack in period-1. This scenario implies that, *"the prospect of reducing the cost of CT in the aftermath of a terrorist attack induces a boomerang effect by decreasing the period-1 level of CT effort*". This result can be summarized as follows by proposition-7.

Proposition-7: *The* period-1 *equilibrium level of* CT *effort is lower in the dynamical than in the benchmark game, (see proof in appendix).*

Numerical Illustration 3.8.1

To illustrate the boomerang effect of reducing the cost of CT in the aftermath a terrorist attack, we analyze a variant of the parametric model previously introduced in numerical illustration 3.3.1. Let $P(y,x) = x(1-y)$; $C_S(y,k_S) = \frac{1}{2}k_S y^2$; $C_T(x,f) = M(f)\frac{1}{2}k_T x^2$;$\delta_S = \delta_T = 1$; $k_T = 1$; $k_S > 0$; $M(f) = 1 - f$; $f = 0$; and $Y_S(0) = X_T(1) = 1$; $Y_S(1) = X_T(0) = 0$ which implies $\Delta_S = \Delta_T = 1$.

Suppose that in the period-1 $k_S = 2$ and that the marginal cost of CT decreases from $k_S = 2$ to $k_S^0 = 1$ if period-1 outcome is a terrorist attack. As obtained in Numerical Illustration 3.3.1, by implication:

(i.) In period-2; *(S)* payoff will be: $u_S^{[2]}(2) = 0.5$ in the k_S game and $u_S^{[2]}(1) = -0.375$ in the k_S^0 game; which gives $d_S = -0.125$ and $\varepsilon_S = 0.875$.

DOI: 10.31695/IJASRE.2019.33009

(ii.) In the period-2; *(T)* payoff will be: $u_T^{[2]}(2) = 0.222$ in the k_S game and $u_T^{[2]}(1) = 0.125$ in the k_S^0 game, which gives $d_T = 0.097$ and $\varepsilon_T = 0.903$.

***In the dynamical game*:** *Security Agency* period-1 equilibrium action is $y_1 \approx 0.28$; *T* period-1 equilibrium action is $x_1 \approx 0.65$ and the period-1 equilibrium probability of a terrorist attack is $P_1 \approx 0.47$.

In the benchmark game: *Security Agency* period-1 equilibrium action is $\bar{y} \approx 0.33$; *T* period-1 equilibrium action is $\bar{x} \approx 0.667$, and the period-1 equilibrium probability of a terrorist attack is $\bar{P} \approx 0.44$. Thus, we have $y_1 < \bar{y}$ and $P_1 < \bar{P}$; a result that is summarize in proposition-8 below.

Proposition 8: *The period-1equilibrium probability of a terrorist attack can be higher in the game in which the cost of CT decreases in the aftermath of a terrorist attack, (see proof in appendix).*

The implication of Proposition-8 is that "*it is better from a security standpoint not to increase the CT budget in the aftermath of a terrorist attack; as the prospect of such policy intervention could make a terrorist attack more likely".*

4.0 RESULT OF THE ANALYSIS

In this section we present the result of analysis of the dynamic equilibrium of the stage game; a brief comparison of equilibrium property of the *benchmark* game with the *dynamical* game; security rationale of reducing free-speech protection; and the cost implication of CT efforts.

4.1 Effect of Reduction in Free-speech Protection on Dynamic Equilibrium of the Stage Game

In the analysis of the stage game, we saw that reducing the level of free-speech protections $(i.e. f < 0)$ has two major effects on the equilibrium actions of both players: (i.) it has a *direct effect* on the *Terrorist*'s equilibrium action because it increases its marginal cost. (ii.) It has a *strategic effect* on the *Security* agency's equilibrium action; an effect that comes through how the *Security* agency changes its equilibrium action in response to changes in the equilibrium level of terrorist activities. The mechanics of the strategic effect is as follows: Evidently, reducing the level of free-speech protections $(i.e. f < 0)$ increases the cost of terrorist activities $(C_T(x, f)$, which in turn decreases the Terrorist organization's equilibrium action (x). Since the Security agency's CT effort $y(x)$ increases in (x), reducing free-speech protections decreases the Security agency's equilibrium action y.

By proposition-1, the change in the level of free-speech protections that affect the change in the Security agency's equilibrium action, have zero effect on its equilibrium payoff, (a simple implication of the envelope theorem). Since reducing the level of free-speech protections decreases the equilibrium level of terrorist activities, then a lower level of terrorist activities increases the Security agency's payoff. This implies that reducing the level of free-speech protections increases the Security agency's equilibrium payoff in the stage game.

Also, the change in the level of free-speech protections that affected the change in the terrorist's equilibrium action, have zero effect on its equilibrium payoff; a simple implication of the envelope theorem too. On the other hand, reducing the level of free-speech protections decreases the Security agency's equilibrium action; which equals an increase in the terrorist's equilibrium payoff.

By cost implication, reducing the level of free-speech protections increases the marginal cost of terrorist activities; which equals a decrease in the terrorist's equilibrium payoff. Depending on which effect dominates, the terrorist's equilibrium payoff in the stage game can decrease or increase when free-speech protection is reduced. Hence by Proposition-2, reducing the level of free-speech protections increases the Security agency's equilibrium payoff, but has an ambiguous effect on the terrorist's equilibrium payoff in the stage game.

Intuitively, the Security agency's equilibrium action increases in its stake for terrorism prevention, with increase in the Terrorist's stake for a successful terrorist attack. While the Terrorist's equilibrium action increases in its stake for a successful terrorist attack, (Δ_T) with a decrease in the Security agency's stake for terrorism prevention (Δ_S).

By Proposition-3, a higher Security agencies stake in terrorism prevention (Δ_S) increases its equilibrium action in the stage game. This is intuitive since a higher (Δ_S) means that the Security agency has a higher advantage from stopping a terrorist attack, which augments the Security agency's incentives to put more effort to stop a terrorist attack. On the other hand, an increase in (Δ_S) decreases the Terrorist's equilibrium action since a higher (Δ_S) increases the Security agency's equilibrium action, thus, the terrorist's will decrease its action when the level of CT effort is higher.

DOI: 10.31695/IJASRE.2019.33009

Proposition-3 also implies that a higher terrorist's stake in causing attack $(i.e. \Delta_T > 0)$ will increase the Terrorist's equilibrium action in the stage game. This is also intuitive as well since a higher (Δ_T) means that the Terrorist group gets a bigger benefit from a successful attack, which increases the organization's incentives to put more effort into devising a terrorist attack.

On the other hand too, a higher (Δ_T) increase the Security agency's equilibrium action in the stage game since a higher (Δ_T) increases the Terrorist's equilibrium action, (i.e. the Security agency's action increases when the level of terrorist activities is higher). Proposition-2 also indicates that the Security agency's equilibrium payoff increases when the level of free-speech protections decreases. This implies that the security agency's period-2 equilibrium payoff is higher if the level of free-speech protections is reduced from (f_1) to (f_0), $i.e.\ u_S^{[2]}(f_0) < u_S^{[2]}(f_1)$. Furthermore, the Terrorist equilibrium payoff can decrease or increase when the level of free-speech protections decreases. This implies that the terrorist period-2 equilibrium payoff can be higher or lower if the level of free-speech protections is reduced from(f_1) to (f_0).

4.2 Comparison of the Benchmark Game with the Dynamical Game Analysis

Comparing the *Security* agency's period-1 total utility in the *benchmark* game and the *dynamical* game (i.e. equations (12) and (14)); we can see that the *Security* agency's stake in terrorism prevention decreases from (Δ_S) to (ε_S), $(i.e. \Delta_S > \varepsilon_S$, since $\delta_S \in [0,1])$. The *security* agency's stake in preventing a terrorist attack is lower in the *dynamical* game since the *security* agency's period-2 equilibrium payoff is higher in the game in which the level of free-speech protections is lower. Since the period-1 equilibrium actions determine which game is played in the period-2 and since the *Security* agency prefers the (f_1) game in the period-2, the *Security* agency's stake of preventing a terrorist attack in the period-1 is lower in the *dynamical* game.

Similarly, comparing the *Terrorist's* period-1 total utility in the *benchmark* game and the *dynamical* game (i.e. equations (13) and (15)); we saw that the *Terrorist's* stake in preparing for attack changes from (Δ_T) *to* (ε_T). Here (ε_T) can be higher or lower than (Δ_T), depending on whether the *Terrorist's* period-2 equilibrium payoff decreases or increases when the level of free-speech protections decreases from (f_1) to (f_0).

By proposition-3, the *security* agency's equilibrium actions increases when (Δ_S) and (Δ_T) are higher. This implies that the *security* agency's equilibrium action is lower in the *dynamical* game than in the *benchmark* game. Intuitively, its follows that: (i) *decreasing the security agency's stake for terrorism prevention from* (Δ_S) *to* (ε_S) *has a direct effect of reducing the security agency's incentive to prevent a terrorist attack, and (ii) at the same time, decreasing the terrorist stake for a successful terrorist attack from* (Δ_T) *to* (ε_T) *reduces the terrorist incentives for terrorist activities.*

Since the level of CT effort decreases when the level of terrorist activities is lower, a decrease in the *Terrorist* stake for a successful terrorist attack reduces the *security* agency's level of CT effort. Both the direct and the strategic effect work in the same direction to decrease the level of CT effort in the period-1 of the *dynamical* game as compared to the *benchmark* scenario.

By Proposition-3, also the *Terrorist* equilibrium action decreases in (Δ_S) and increases in (Δ_T). This implies that the *Terrorist* equilibrium action is higher in the *dynamical* game than in the *benchmark* game. Intuitively, it follows that: (i) i*ncreasing the terrorist stake for a successful terrorist attack from* (ε_T) *to* (Δ_T) *has a direct effect of increasing terrorist incentives for terrorist activities, and (ii) at the same time, decreasing the security agency's stake for terrorism prevention from* (Δ_S) *to* (ε_S) *has a strategic effect of increasing the terrorist incentives for terrorist activities since the terrorist equilibrium action is higher when the level of* CT *effort is lower.*

Therefore, both the direct and the strategic effect work in the same direction to increase the level of terrorist activities in the period-1 of the d*ynamical* game as compared to the *benchmark* scenario. In the *dynamical* game, we have that $(\Delta_S > \varepsilon_S)$ and $(\Delta_T > \varepsilon_T)$, and by Lemma-3.3, these implies that the *security* agency's equilibrium action increases in (Δ_S) and (Δ_T) which implies the *Security* agency's equilibrium action is lower in the *dynamical* game than in the *benchmark* scenario. Intuitively this implies that: (i) a *lower stake for terrorism prevention decreases the Security agency's incentives relative to the benchmark game, and at the same time, (ii) a lower stake for a successful terrorist attack decreases the Terrorist's level of activities.*

Since the CT effort decreases when the level of terrorist activities is lower, a reduction in the *Terrorist's* stake for a successful attack decreases the *Security* agency's level of CT effort. Both the direct and the strategic effects work in the same direction to decrease the equilibrium level of CT effort in the period-1 of the *dynamical* game.

By numerical illustration 3.3.1, the period-1 level of CT effort is lower in the *dynamical* game while the level of terrorist activities is higher. The period-1 equilibrium probability of a terrorist attack is higher in the *dynamical* game as compared to the *benchmark*

DOI: 10.31695/IJASRE.2019.33009

game. Thus, the period-2 equilibrium probability of a terrorist attack increases when the level of free-speech protections is reduced from (f_1) to (f_0) if the period-1 outcome is a terrorist attack $(i.e., P_2(f_0) = 0.75) > (P_2(f_1) = 0.5)$.

And by Numerical illustration 3.5.1, in the *dynamical* game, the *Security* agency's period-1 equilibrium action is $(y_1 \approx 0.28)$, while the *Terrorist's* period-1 equilibrium action is $(x_1 \approx 0.65)$, and the period-1 equilibrium probability of a terrorist attack is $(P_1 \approx 0.47)$. In the *benchmark* game**,** the *Security* agency's period-1 equilibrium action is $(\bar{y} \approx 0.33)$, while the terrorist's period-1 equilibrium action is $(\bar{x} \approx 0.67)$, and the period-1 equilibrium probability of a terrorist attack is $(\bar{P} \approx 0.44)$. Thus, we have $(y_1 < \bar{y})$ and $(P_1 > \bar{P})$. By proposition-4, these results implies that the policy of reducing the level of free-speech protections in the aftermath of a terrorist attack will have boomerang effect on the period-1 incentives by either increasing the level of terrorist activity or decreasing the level of CT effort.

4.3 The Security Implication of Reducing Free-Speech Protection

By Proposition-1, reducing (f_1) to (f_0) will increase the equilibrium probability of a terrorist attack in the period-2 of the stage game; while by Proposition-4, reducing (f_1) to (f_0) will either decrease the level of CT effort or increase the level of terrorist activities in the period-1 (or both as shown in numerical illustration 3.3.1). The implication of these result is that the policy of reducing free-speech protection in the aftermath of terrorist attack may have a boomerang effect of boosting the terrorist's support since either $(y_1 < \bar{y})$ or $(x_1 > \bar{x})$ or both. On the other hand, Proposition-5 indicates that a commitment to restrain reducing the level of free-speech protections in the aftermath of a terrorist attack can make a terrorist attack less likely. Hence, an expectation that liberal society will remain faithful to their fundamental values even in times of duress can in fact reduce the likelihood of terrorist attack.

In summary, the analysis shows that a policy of reducing the level of free-speech protections in the aftermath of a terrorist attack may have a boomerang effect of boosting the terrorist's support and can make a terrorist attack more likely. The mechanism for such effect is as follows: (i) When choosing their period-1 actions, the *Security* agency and the *Terrorist* take into account how reducing the level of free-speech protections (if the outcome of the period-1 is a terrorist attack) will affects their payoffs in the period-2, (ii) The reduction from (f_1) to (f_0) increases the *Security* agency's period-2 utility; whereas the effect of such a policy on the *Terrorist's* period-2 utility is ambiguous. This implies that a reduction from (f_1) to (f_0) (if the outcome of the period-1 is a terrorist attack) decreases the *Security* agency's period-1 stake for terrorism prevention and can decrease or increase the *Terrorist's* period-1 stake for a successful terrorist attack. (iii) Regardless of how the terrorist's period-1 stake for a successful terrorist attack is affected, reducing free-speech protections in the aftermath of a terrorist attack either decreases the period-1 level of CT effort or increases the period-1 level of terrorist activity (or both), with the overall effect of making a terrorist attack more likely in period-1.

The result of the analysis shows that such a policy intervention also has a boomerang effect of reducing the level of CT effort in the period-1, which in turn can make a terrorist attack more likely in the period-1 of the stage game. In other words, reducing the level of free-speech protections is more likely to be counter-productive than justify the policy implication: (i) *When the Security agency's stake for preventing a terrorist attack is higher; (ii) When the Terrorist's stake for a successful terrorist attack is higher; (iii) When the Security agency's marginal cost is lower, and (iv) when the Terrorist organization's marginal cost is lower.* These parameters can have various substantive interpretations, therefore scholars could derive policy and empirical implications regarding the conditions under which reducing the level of free-speech protections is likely to be ineffective.

4.4 The Security Implication of Reducing the Cost of CT Effort

By Lemma-3.3, reducing the marginal cost of CT effort decreases the level of terrorist activities and increases the level of CT effort in the stage game. The intuition is as follows: (i) Reducing the marginal cost of CT effort (k_S) has a direct effect on the incentives of the security agency by decreasing its marginal cost, which in turn induces the agency to increase its level of CT effort. (ii) At the same time, reducing the marginal cost of CT effort (k_S) has a strategic effect on the incentives of the terrorist organization. Since the level of terrorist activities decreases with the level of CT effort, reducing (k_S) induces the terrorists to decrease its equilibrium action in the stage game.

The intuition of Lemma-2 is similar to that of Proposition-3. For one, the effect of changes in (k_S) that works through the *security* agency's equilibrium action has a negligible effect on its equilibrium payoff. As a result, the effect of a reduction in the marginal cost of CT effort on the *security* agency's equilibrium payoff is determined by how such a change affects the *Terrorist* equilibrium action in the stage game. Since the *Terrorist* equilibrium action decreases in (k_S), and the equilibrium probability of a terrorist attack increases in (x); then reducing the marginal cost of CT increases the *security* agency's equilibrium payoff in the stage game. A similar reasoning applies to why reducing the marginal cost of CT decreases the terrorist's equilibrium payoff - since the *security* agency's equilibrium action is higher when (k_S) is reduced and the equilibrium probability of a terrorist attack decreases

DOI: 10.31695/IJASRE.2019.33009

when the level of CT effort is higher, then reducing the marginal cost of CT will decrease the terrorist's equilibrium payoff in the stage game.

Therefore, by Proposition-7, the prospect of reducing the cost of CT in the aftermath of a terrorist attack induces a boomerang effect of decreasing the period-1 level of CT effort. Thus, by Proposition-8, it is better from a security standpoint not to increase the CT budget in the aftermath of terrorist attack, as the prospect of such policy intervention can make a terrorist attack more likely.

4.5 The General Implications of the Result:

Fundamentally, the dynamic analysis exposes the possible detrimental consequence of the policy of restricting free-speech protections in the aftermath of a terrorist attack in the guise of increasing the cost of terrorism and reducing the cost of CT effort. In the context of our model, the security rationale would imply that a reduction in free-speech protection from (f_1) to (f_0) if the outcome in the period-1 is a terrorist attack, should decrease the probability of a terrorist attack in the period-2. But on the contrary, notice that the boomerang effect documented above does not depend on whether a reduction in free-speech protection decreases or does not decrease the probability of a terrorist attack in the period-2. In other words, Proposition-4 holds regardless of whether the liberty-reducing measures aimed at increasing the cost of terrorism have their intended policy benefits or not.

Furthermore, the equilibrium analysis of the stage game suggests that the policy justification for such CT measures might not be valid even on its own terms. That is, by Proposition-1, a reduction in free-speech protection will decrease both the terrorist and security agency's equilibrium actions in the stage game. The policy justification for imposing such CT measure is that, *by increasing the cost of terrorism, such policies will decrease the incidence of terrorism.* But on the contrary, this dynamic game-theoretic analysis shows that the policy justification for restraining free-speech protection is questionable on its own terms.

4.6 The Philosophy and Outcome of the Boomerang Effect

Commenting on the dynamic effect of inaccurate identification and classification of the nature and causes of Boko Haram terrorist which has resulted in military-offensive CT strategy and "*collective punishment approach"* of the Nigerian government, terrorism scholars observed that "*the policies of restricting the freedom of expression and other fundamental rights and liberties of the citizenry in the aftermath of terrorist attack often create disaffection and blowback effect,…fueled and heighten animosity throughout the civilian population towards the government*". This will then increase support and funding for the radical terrorist group and in addition, cause more recruitment to the terrorist organization[10,28,37,39]. They observed that such anti-terrorism measures often create disaffection, rancor, acrimony, coercion, tension, fears and ideological intolerance in the society; hence helping to fueled and heighten animosity throughout the civilian population towards the government as well as fanning the amber of enmity between the governed and the government[16,33,34].

Psychologically, every ethno-ideologically driven terrorism are derivatives of a specific part of the population and are perceived to fight for the cause and rights of their group, hence terrorist oftentimes find great support within their home population and their cause is oftentimes seen as a legitimate one by the home population[29,35]. Moreover, ethno-ideologically driven terrorism has common underlying issues that cause the violence to escalate and because ethno-ideological groups are oftentimes closely intermingled and connected to the population they represent, *"they seek and promote this identity through terrorist activities, which (i) creates communal bonds that result from the retaliation of the government or rival communities, and (ii) the inevitable persecution that follows draws attention to their cause among the larger population, thus, increasing their numbers and financial support"*[12,16,18,37].

Therefore, every form of infringement on the civil-right and liberty of the local populations such as the use of *"collective punishment approach"* and "*indiscriminate violence"* by the security agency will be seen as a resistible threat to their collective existence. Such measures could fueled and heighten animosity throughout the civilian population towards the government and as well as fanning the amber of enmity between the governed and the government. Oftentimes, the situation would cause a boomerang effect by inciting *"Herostratos syndrome"* in the susceptible population and also elicit unwarranted sympathy, motivation and support and as well as increase recruits for the terrorist, thereby engendering more terrorist attacks[16,33,34] - a condition which is at variance with government justification for adopting the anti-terrorism measures.

4.7 Addressing the Herostratos Syndrome and the Boomerang Effects

The study recommends that in a society in which democratic governments respond to major security threat such as terrorism with restrictions on freedom of expression and other fundamental rights and liberties of its citizens in the guise to prevent the spread of terrorist propagandas, such policies could engendered "*collective punishment approach"* and the use of "*indiscriminate violence"* against the civilian population by the security agencies. This could have serious moral vulnerability and a boomerang effect of

DOI: 10.31695/IJASRE.2019.33009

garnering undue sympathy, motivation and support for the terrorist, and inciting *"Herostratos syndrome"* in the susceptible population, thereby jeopardizing government's effort at preventing terrorism. Therefore to prevent the boomerang effect, an ideal anti-terrorism measure should include a commitment: (i) to properly identify and classify the nature and causes of terrorism, and as well as proactive measure to ameliorating the causes - such as high rate of illiteracy, poverty, youth unemployment, alienation of the masses from government's policies and programs, (ii) to psychologically delegitimize terrorism and its propaganda among the local population *(i.e. taking the local populations' support away from the terrorist's organization)*; (iii) to routinely sensitize, oriented and educate the masses of government's policies and programs and as well as the danger of terrorist ideology; and (iv) to remain faithful to its fundamental social values by *"respecting the fundamental human rights and liberties"* of the citizen and cooperate with the local population in times of duress can be of immense security-advantage. These factors have the capacity of creating not only the needed awareness and correct some of the misgivings/erroneous ideologies of the terrorist among the local population; engender trust and confidence building between the governed and the government; stimulate healthy civil-military relationship; delegitimized terrorism and its propaganda among local population but also boost efficient and reliable intelligence gathering for proper identification and smart-targeting of terrorists and causes of terrorism.

4.7.1 The De-legitimization of Terrorism and its Propaganda

Since terrorists do not wear identifying military uniforms, are not confine to designated geographical hubs (e.g. barracks) nor do they obey the conventional military warfare rules and regulation; therefore ideal CT measures must include a commitment to psychologically de-legitimize terrorism and its propaganda among local population . For effective and efficient de-legitimization process, government must give the local population more legitimacy and concession in order to gain their cooperation and supports. The security agencies must promote, encourage and protect the privacy of local population who can serve as necessary informants. They must cooperate and work together with the moderate local population, motivate and respect their fundamental human right and liberty as these will engender trust and confidence building between the governed and the government; garner the necessary moral supports for the initiation of an all-inclusive, proactive and efficient *"in group policing"* mechanism between the security agencies and the local population; and facilitate and encourage efficient intelligence gathering[28,37,39]. *"In group policing"* and cooperation with the local population will yield much more result than government crackdowns on citizen's civil-right and liberty; and the collective punishment approach and as well as the indiscriminate violence strategies of military force since the locals have much better intelligence as to who are, and where the terrorists are located in their community.

Moreover, taking the local populations support away from the terrorist's organization will creates serious havoc for the terrorists and its cause receives less attention and therefore becomes delegitimized. These efforts are not only the necessary and sufficient conditions but imperative because every ethno-ideological driven terrorism are derivatives of a specific part of the population and are perceived to fight for the cause and rights of their group. Hence they oftentimes find great support within their home population and their cause is oftentimes seen as a legitimate one by the home population. Moreover, ethno-ideologically driven terrorism has common underlying issues that cause the violence to escalate and because ethno-ideological groups are oftentimes closely intermingled and connected to the population they represent, they seek and promote this identity through terrorist activities, which (i) creates communal bonds that result from the retaliation of the government or rival communities, and (ii) the inevitable persecution that follows, draws attention to their cause among the larger population, thus increasing their numbers and financial support.

4.7.2 Proper Identification and Classification of the nature and Causes of Terrorism

Democratic government must painstakingly encourage measures that properly identify and classify the nature and prime causes of terrorism and as well as its propaganda with the aim to judiciously tackling them; while remaining faithful to its fundamental social values even in the time of duress. Governments' socio-economic and political reforms and development objectives should include a proactive and mandatory masses oriented policy implementation plan to solving both the causes of terrorism and as well as the problems caused by terrorism. Prominent among these are high rate of illiteracy, high poverty and youth unemployment indices. Such strategy has the propensity of decreasing the probability of further terrorist attacks, reduce the spread of terrorist propagandas and hence boost government's CT measures.

4.7.3 Routine Sensitization, Enlightenment and Education of the Masses of Government's Policies and Programs

Cheng, et al[13] while proposing "an effective rumor-containing strategy" in the mist of limited rumor-containing budget, emphasized the efficacy of suppressing false-rumor by the use of the truth as a panacea to curtailing its propagation. Therefore, a proactive actions plan to suppress the spread of terrorist propagandas by implementing an effective and efficient counter-information system to clarify the uncertainties or doubts and correct the erroneous or misconstrued information-content of terrorist propaganda, is a panacea to reducing the probability of the susceptible population being persuaded to support or join the organization and spread their propagandas. An all-inclusive system of governance that emphasize proper sensitization, enlightenment and education of the citizens about government's socio-economic and political philosophy, ideologies, policies and

DOI: 10.31695/IJASRE.2019.33009

programs, will help to create the needed awareness, educate and prepare the masses psychologically to resist terrorist propagandas and as well as attracting the citizens' overwhelming support and defense of government policies and programs. These would save much of the resources hitherto spent on indiscriminate apprehension, arrest, imprisonment and rehabilitation of suspected terrorists and propagators of terrorist ideologies.

4.7.4 Provision of Mass Literacy and Compulsory Qualitative Education

Major index of terrorism prevention is education. As much as education is the key to any nation's socio-economic development, it is also the key to ethno-ideological crimes like terrorism. According to UNICEF, Amnesty International and Human Right Watch, illiteracy is a major driving force behind most ethno-ideologically driven terrorism, especially in Africa; as illiterate youths below the age of 18 form about 45% of the entire population of most terrorist organization such Boko Haram, ISIS, AQIM, AlQaeda, Al-Shabab, etc.[3,4,28]. This underlying issue has advanced the establishment of most Islamic schools with Islamic fundamentalist curricula in their related countries. This provide only but obsolete learning environment than the state funded modern schools. These schools are main recruitment opportunity for ethno-ideological driven terrorist organizations[3,53]. Therefore government socio-economic reforms and development plan that incorporate mandatory mass literacy and compulsory qualitative education of the susceptible youth population is one of the panaceas to effective terrorism prevention.

4.7.5 Good Governance and Collaborative Effort

Finally, the general weakness of most central governments and high levels of corruption in the society make it easier for terrorism to thrive in Africa than in countries with effective security, intelligence and military capacities as well as efficient educational system[14]. Further complicating the strategic CT situation in Africa are the vast cultural and ethnic differences across geographical boundaries; thus making the gathering and interpretation of intelligence information difficult[4,14]. Hence the fight against terrorism is not a job which can be undertaken by one single Nation's security agency, but requires collaborative team work and input from a wide range of national and international organizations including law enforcement agencies, the military, the intelligence services, the financial sector, the diplomatic service and health organizations. The key to success is organization, cooperation and coordination, while a prerequisite for success is good governance. This is central to the effective administration of a state's resources, the rule of law, and the development of a strong civil society. Only if such a structure is in place can the war against terror, which is fuelled by dissatisfaction and ignorance, be won.

5.0 CONCLUSION

In the wake of incessant high profile terrorism and other insurgency activities that characterized the 21st century, liberal society began witnessing what has become almost a rite of violation of fundamental human right and citizens' liberty by democratic nations, by curbing freedom of expression and restricting other fundamental rights and liberties of the citizenry in a guise to preventing the propagation of terrorist propaganda and increasing the cost of terrorism. In this article, we develop a two-person two-period dynamic game-theoretic model of an interaction between security agency and terrorist organization to study the possible security implications of adopting policies that curtail or suppress free-speech protections and other fundamental rights of citizens as CT measure. The study shows that in a world in which democratic governments respond to major security threat such as terrorism with restrictions on freedom of expression and other fundamental rights and liberties of its citizens, such policies seems to have serious moral vulnerability and boomerang effect of garnering undue support for the terrorist; engender more terrorist attacks and thus endangering government effort at preventing terrorism.

When terrorists strike there is an overwhelming political obligation to fix things so that the events will not be repeated, however, the *"what if something awful happens again"* syndrome has created a political climate in which it is easier for liberty-reducing CT laws to be enacted since no politician wants to be blamed for another terrorist strike, and since no politician want to be termed lackadaisical in respect of safeguarding security. To aggravate the problem, situations of crisis such as the aftermath of a terrorist attack, afford security agencies opportunities to push for CT measures that were not be attainable in normal circumstances. As Proposition-3 indicates, security agencies have incentives to push for liberty-reducing and privacy-invading CT policies with concomitant increase in government's surveillance powers in the aftermath of a terrorist attack, regardless of their ineffectiveness and unethical implications.

While the symbolic and political rationales of restricting citizen rights and liberties in the aftermath of a terrorist attack are clear, perhaps less understood implications are the potential boomerang deleterious effects of such measures. Our dynamic model analysis shows that the prospect of curtailing free speech protections in the aftermath of a terrorist attack has a moral vulnerability and a boomerang effect, which can make a terrorist attack more likely in the period-1. Moreover, such CT measures can also make a terrorist attack more likely even in the period-2; a situation that undermines the policy justification for adopting such policies on its own terms.

DOI: 10.31695/IJASRE.2019.33009

The analysis has implications for contemporary debates regarding how to balance anti-terrorism protections with individual freedoms. It shows that even if one accepts that restrictions on freedom of expression and other liberty-reducing policies are effective at increasing the costs of terrorism; such measures does not necessarily have the intended security benefit. At the least, the analysis suggests that "*the burden of empirical proof should be on the proponents of liberty-reducing* CT *measures who must show that such policies are effective in preventing terrorist attacks"*. The result that the efficacy of free-speech restrictions is questionable on efficiency grounds is especially important since laws restricting free-speech might pose fundamental challenges to the institutional and social fabric of liberal-societies beyond their questionable effect on security. The language of anti-incitement statutes synonymous with such policies invariably contains indeterminate terms such as *"incitement", "glorification"* and *"encouragement of terrorism"*, an ambiguity that gives government officials the ability to purge political viewpoints or to sanction speech that has little chance of inciting violence, should they intend to do so.

Concerned about such proliferation of anti-terrorism laws, three international *rapporteurs* on freedom of expression (the UN Special Rapporteur on Freedom of Opinion and Expression, the OSCE Representative on Freedom of the Media, and the Special Rapporteur on Freedom of Expression of the Organization of American States, OAS) adopted in December 2005 a Joint Declaration, which states that: "*While it may be legitimate to ban incitement to terrorism or acts of terrorism, States should not employ vague terms such as 'glorifying' or 'promoting' terrorism when restricting expression. Incitement should be understood as a direct call to engage in terrorism with the intention that this should promote terrorism, and in a context in which the call is directly causally responsible for increasing the actual likelihood of a terrorist act occurring*"[30]. Most fundamentally, efforts to target speech that may lead to incitement place at risk values that citizens in liberal-societies deem essential, such as freedom of speech, freedom to dissent, right to privacy and family life, freedom of expression etc., especially when anti-terrorism incitement provisions do not require a direct link between speech and incitement or intentions to induce violence.

Furthermore, the study suggests that the effectiveness of liberty-reducing CT measures should be considered in the light of the incentives of bureaucratic agencies responsible for terrorism prevention instead of the susceptibility of the local population. In this context, scholars and governmental reports have documented various security agency complicities in terrorism and other organized crimes. Taking the Nigerian environment for example, the Daily Post of August 29, 2017 stated that a fully kitted military officer was among 30 kidnappers, armed robbery suspects arrest in Kogi state Nigeria; *"Two Policemen, Naval Officer were Paraded For Armed Robbery, Kidnap"* in Kogi state Nigeria - live Channels TV broadcast, 10th October 2017*; "Police Arrest Two Ex-Military Officers for Alleged Robbery" in* Katsina state Nigeria-Live Channel TV broadcast, 5thJanuary 2018, to mention just a few. Other complicities are bureaucratic culture of rewarding quantity over quality; a focus on short-term at the expense of long-term strategic analysis; inability to connect the dots, among other problems[23]. Scholars have also pointed out numerous bureaucratic inefficiencies in collecting, analyzing, and sharing intelligence[9,26].

Scholars have widely documented that preventive policies that reduce citizen's rights and liberties to presumably making it difficult for terrorist groups to operate inside liberal societies might instead make terrorist activity more difficult to detect, which can aggravate the bureaucratic inefficiencies. In general, our analysis suggests that security agencies would prefer to magnify the threat of terrorism (use propaganda) so as to justify and augment their CT powers. This finding, for example, is consistent with empirical observations regarding the use of informants and agents provocateurs to instigate terrorist acts; a tactic that has been documented, at least, since the nineteenth century struggle against anarchist terror[11].

The notion that policing terror sometimes turnout to encouraging it is not a thing of the past. The FBI, of course, has a long history of infiltrating dissident organizations and in many instances acting as agents' provocateurs to instigate violence. In the context of the US fight against Al-Qaeda terrorism, the security agencies has routinely used paid informants not to capture existing terrorists, but often to cultivate them by offering ideas and incentives that encourage individuals to engage in terrorist activity[1]. This fact was collaborated by Human Rights Watch and the press reports have documented that FBI-involved agents orchestrated several well-known terror plots of the last decade, including the Miami Seven; the Washington DC Metro bombing plot; the New York City subway plot; and the attempt to blow up Chicago's Sears Tower, among others[28].Other evidences include the *"Illusion of Justice: Human Rights Abuses in US Terrorism Prosecutions"*[28]; *"Government agents 'directly involved' in most high-profile US terror plots"*[52]*; "Deploying Informants, the FBI Stings Muslims"*[40]. In the case of the *"Newburgh Four",* for example, who were accused of planning to blow up synagogues and attack a US Military base, a US District Judge said, *"I believe beyond a shadow of a doubt that there would have been no crime here except the government instigated it, planned it and brought it to fruition*", *"Documents provide rare insight into FBIs terrorism stings"*[41].

However, since restricting the rights and liberties of the citizen has been a typical response of democratic governments to major terrorist attacks, we need to understand the security consequences of such CT measures which, although might increase the cost of terrorism, cannot completely suppress terrorist activity. This study provides a necessary first step analysis of the boomerang effect

DOI: 10.31695/IJASRE.2019.33009

of such policies. It suggests that in a society in which democratic governments respond to major terrorist attacks with restrictions on rights and liberties of its citizenry, such policy interventions have a moral vulnerability and boomerang effect which can make a terrorist attack more likely. The analysis underscores the fact that a commitment to respect the fundamental rights and liberties of the citizenry in times of duress can be security-beneficial. That is if liberal societies were to remain faithful to their fundamental values in the aftermath of terrorist attacks, such a strategy possibly would decrease the probability of a terrorist attack.

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DOI: 10.31695/IJASRE.2019.33009

APPENDIX:

Proof of Proposition-1: *Let the unique pure strategy equilibrium* (y^*, x^*) *be the solution to the system of equations (4) and (6). Applying the Inada conditions on the cost functions ensure that the equilibrium actions are interior. Since both (4) and (6) are continuous in* (f)*, the security agencies and the terrorist organization's best response functions are continuous in* (f) *and we can apply the implicit function theorem to see how the equilibrium actions vary with an increase in* (f)*. The dependence of* $(y^*(f), x^*(f))$ *on* (f) *is found by totally differentiating the system of equations (10) with respect to* (f)*, which yields the system of equations:*

$$-\frac{\partial^2 P}{\partial y^2}\Delta_S\frac{dy}{df}-\frac{\partial^2 P}{\partial y\partial x}\Delta_S\frac{dx}{df}-\frac{d^2C_S}{dy^2}\frac{dy}{df}=0 \qquad (1A)$$

$$\frac{\partial^2 P}{\partial x^2}\Delta_T\frac{dx}{df}+\frac{\partial^2 P}{\partial y\partial x}\Delta_T\frac{dy}{df}-\frac{\partial^2 C_T}{\partial x^2}\frac{dx}{df}-\frac{\partial^2 C_T}{\partial f\partial x}=0 \qquad (1B)$$

Solving equations (1A) and (1B), simultaneously for $\left(\frac{dy}{df}\right)$, *and* $\left(\frac{dx}{df}\right)$ *we have,*

$$\frac{dy}{df}=\left(\frac{\partial^2 C_T}{\partial x\partial f}\frac{\partial^2 P}{\partial y\partial x}\Delta_S\right)\Big/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S-\frac{d^2C_S}{dy^2}\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T-\frac{\partial^2 C_T}{\partial x^2}\right)+\left(\frac{\partial^2 P}{\partial y\partial x}\right)^2\Delta_S\Delta_T \qquad (1C)$$

Since the denominator and the numerator of equation (1C) are positive, $\left(\frac{dy}{df}>0\right)$ *thus,* $(y^*(f))$ *is increasing in* (f)*, as claimed. Similarly,*

$$\frac{dx}{df}=\frac{\partial^2 C_T}{\partial x\partial f}\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S-\frac{d^2C_S}{dy^2}\right)\Big/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S-\frac{d^2C_S}{dy^2}\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T-\frac{\partial^2 C_T}{\partial x^2}\right)+\left(\frac{\partial^2 P}{\partial y\partial x}\right)^2\Delta_S\Delta_T \qquad (1D)$$

The denominator and numerator are both equation (1D) is positive $\left(\frac{dx}{df}>0\right)$ *and, as a result, the equilibrium level of* $(x^*(f))$ *increases in* (f)*, as claimed.* ∎

Proof of Proposition-2: *Appling the envelope theorem on equation (10), the effect of a change in* (f) *on the security agency's equilibrium expected payoff in the stage game is given by the sign of the equation:*

$$\frac{\partial U_S^*}{\partial f}=-\left(\frac{\partial P(y^*,x^*)}{\partial x}\frac{\partial x^*}{\partial f}\Delta_S\right) \qquad (2A)$$

The sign of right-hand side of equation (2A) is negative $\left(\frac{\partial U_S^*}{\partial f}<0\right)$*, thus, the security agency's equilibrium expected payoff is strictly increasing with a decrease in* (f)*. Similarly, using the envelope theorem on equation (11), the effect of a change in* (f) *on the terrorist's equilibrium expected payoff in the stage game is given by the sign of the equation:*

$$\frac{\partial U_T^*}{\partial f}=\left(\frac{\partial P(y^*(f),x^*(f))}{\partial x}\frac{\partial y^*(f)}{\partial f}\Delta_T\right)-\frac{\partial C_T(x^*(f),f)}{\partial f} \qquad (2B)$$

The sign of equation is equation (2B) is ambiguous, that is

$$\left(\frac{\partial P(y^*(f),x^*(f))}{\partial x}\frac{\partial y^*(f)}{\partial f}\Delta_T\right)>0 \text{ , and } -\frac{\partial C_T(x^*(f),f)}{\partial f}<0$$ ∎

Proof of Proposition-3: *The dependence of* $\{y^*(\Delta_S), x^*(\Delta_S)\}$ *on* (Δ_S) *can be found by totally differentiating equations (4) and (6) with respect to* (Δ_S)*, and then solving simultaneously to obtain the values for* $\left(\frac{dy}{d\Delta_S}\right)$ *and* $\left(\frac{dx}{d\Delta_S}\right)$*, respectively.*

Thus,

$$\left.\begin{aligned}\frac{d}{d\Delta_S}\left(\frac{\partial U_S(y,x)}{\partial y}\right)&=\frac{d}{d\Delta_S}\left(-\frac{\partial P(y,x)}{\partial y}\Delta_S-\frac{dC_S(y)}{dy}\right)=0\\&=-\frac{\partial P}{\partial y}-\frac{\partial^2 P}{\partial y^2}\Delta_S\frac{dy}{d\Delta_S}-\frac{\partial^2 P}{\partial y\partial x}\Delta_S\frac{dy}{d\Delta_S}-\frac{d^2C_S(y)}{dy^2}\frac{dy}{d\Delta_S}=0\end{aligned}\right\} \qquad (3A)$$

And,

$$\left.\begin{aligned}\frac{d}{d\Delta_S}\left(\frac{\partial U_T(y,x)}{\partial x}\right)&=\frac{d}{d\Delta_S}\left(-\frac{\partial P(y,x)}{\partial x}\Delta_T-\frac{\partial C_T(x,f)}{\partial x}\right)=0\\&=\frac{\partial^2 P}{\partial x^2}\Delta_T\frac{dx}{d\Delta_S}+\frac{\partial^2 P}{\partial y\partial x}\Delta_T\frac{dy}{d\Delta_S}-\frac{\partial^2 C_T}{\partial x^2}\frac{dx}{d\Delta_S}=0\end{aligned}\right\} \qquad (3B)$$

Solving equations (3A) and (3B) simultaneously, we have

$$\frac{dy}{d\Delta_S}=\frac{\partial P}{\partial y}\left(\frac{\partial^2 P}{\partial x^2}\Delta_T-\frac{\partial^2 C_T}{\partial x^2}\right)\Big/\left(\frac{\partial^2 P}{\partial x^2}\Delta_T-\frac{\partial^2 C_S}{\partial x^2}\right)\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S-\frac{d^2C_S}{dy^2}\right)+\left(\frac{\partial^2 P}{\partial y\partial x}\right)^2\Delta_S\Delta_T=0 \qquad (3C)$$

The denominator and the numerator of equation (3C) are positive $\left(i.e.\frac{dy}{d\Delta_S}>0\right)$*, and thus,* $(y^*(\Delta_S))$ *increases in* (Δ_S)*, as claimed.*

Also,

$$\frac{dx}{d\Delta_S}=-\left(\frac{\partial^2 P}{\partial y\partial x}\frac{\partial P}{\partial y}\Delta_T\right)\Big/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_s-\frac{d^2C_S}{dy^2}\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T-\frac{\partial^2 C_T}{\partial x^2}\right)+\left(\frac{\partial^2 P}{\partial y\partial x}\right)^2\Delta_S\Delta_T=0 \qquad (3D)$$

In the above equation (3D) the denominator is positive while the numerator is negative, thus, the equilibrium level of $(x^*(\Delta_S))$ *is decreasing in* (Δ_S)*,*$\left(i.e.\frac{dx}{d\Delta_T}<0\right)$ *as claimed.*

DOI: 10.31695/IJASRE.2019.33009

Similarly, the dependence of $(y^*(\Delta_T), x^*(\Delta_T))$ *on* (Δ_T) *can also be found by totally differentiating (4) and (6) with respect to* (Δ_T) *and the solving simultaneously to determine the values of* $\left(\frac{dy}{d\Delta_T}\right)$ *and* $\left(\frac{dx}{d\Delta_T}\right)$ *respectively.*

Thus,
$$\left.\begin{aligned}\frac{d}{d\Delta_T}\left(\frac{\partial U_S(y,x)}{\partial y}\right) &= \frac{d}{d\Delta_T}\left(-\frac{\partial P(y,x)}{\partial y}\Delta_S - \frac{dC_S(y)}{dy}\right) = 0\\ &= -\frac{\partial^2 P}{\partial y^2}\Delta_S\frac{dy}{d\Delta_T} - \frac{\partial^2 P}{\partial y\partial x}\Delta_S\frac{dx}{d\Delta_T} - \frac{d^2C_S(y)}{dy^2}\frac{dy}{d\Delta_T} = 0\end{aligned}\right\} \quad (3E)$$

And,
$$\left.\begin{aligned}\frac{d}{d\Delta_T}\left(\frac{\partial U_T(y,x)}{\partial x}\right) &= \frac{d}{d\Delta_T}\left(\frac{\partial P(y,x)}{\partial x}\Delta_T - \frac{\partial C_T(x,f)}{\partial x}\right) = 0\\ &= \frac{\partial P}{\partial x} + \frac{\partial^2 P}{\partial x^2}\Delta_T\frac{dx}{d\Delta_T} + \frac{\partial^2 P}{\partial y\partial x}\Delta_T\frac{dy}{d\Delta_T} - \frac{\partial^2 C_T}{\partial x^2}\frac{dx}{d\Delta_T} = 0\end{aligned}\right\} \quad (3F)$$

Solving equations (3E) and (3F) simultaneously, we have

$$\frac{dy}{d\Delta_T} = \left(\frac{\partial P}{\partial x}\frac{\partial^2 P}{\partial y\partial x}\Delta_S\right)/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S - \frac{d^2C_S}{dy^2}\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T}{\partial x^2}\right) + \left(\frac{\partial^2 P}{\partial x\partial y}\right)^2\Delta_S\Delta_T \quad (3G)$$

In equation (3G) above, the denominator and the numerator are positive $\left(i.e.\frac{dy}{d\Delta_T} > 0\right)$ *and, as a result* $(y^*(\Delta_T))$ *is increasing in* (Δ_T)*, as claimed.*

$$\textit{Also,}\quad \frac{dx}{d\Delta_T} = \frac{\partial P}{\partial x}\left(\frac{\partial^2 P}{\partial y^2}\Delta_S + \frac{d^2C_S}{dy^2}\right)/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S - \frac{d^2C_S}{dy^2}\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T}{\partial x^2}\right) + \left(\frac{\partial^2 P}{\partial x\partial y}\right)^2\Delta_S\Delta_T \quad 3H)$$

Similarly, the denominator and the numerator of equation (3H) are positive $\left(i.e.\frac{dx}{d\Delta_T} > 0\right)$ *and, as a result, the equilibrium level of* $(x^*(\Delta_T))$ *is increasing in* (Δ_T) *as claimed.* □

Proof of Proposition-4: *We need to consider two cases. The case that* $(d_T > 0)$*, and the case that* $(d_T < 0)$*. Suppose* $(d_T > 0)$*, this implies that both* $(\varepsilon_S < \Delta_S)$ *and* $(\varepsilon_T < \Delta_T)$*. By Proposition 3;* $\left(y^*(\Delta_S, \Delta_T)\right)$ *is increasing in* (Δ_S) *and* (Δ_T) *which implies that* $(\bar{y} < y_1)$*, as claimed. Similarly, suppose* $(d_T < 0)$*, this implies that both* $(\varepsilon_S < \Delta_S)$ *and* $(\varepsilon_T > \Delta_T)$*. By Proposition 3 also,* $\left(x^*(\Delta_S, \Delta_T)\right)$ *decrease in* (Δ_S) *and increases in* (Δ_T)*, which imply that* $(\bar{x} < x_1)$*, as claimed.*

Recall that the terrorist's period-2 equilibrium payoff can decrease or increase when the level of free-speech protections decreases from (f_1) *to* (f_0)*; therefore we need to consider two (exhaustive) cases:*

(i.) The terrorist stake in a successful terrorist attack in the period-1 of the dynamic game is higher than the benchmark game $(i.e.\, d_T < 0)$*, and*

(ii.) The terrorist stake in a successful terrorist attack in the period-1 of the dynamic game is lower than the benchmark game$(i.e.\, d_T > 0)$*.*

Considering first, the situation in which the terrorist period-2 equilibrium payoff decreases when (f)*, decreases* $(i.e.\, d_T > 0)$*, in this scenario, both* $(\varepsilon_S < \Delta_S)$ *and* $(\varepsilon_T < \Delta_T)$*.* □

Proof of Proposition-5: *Solution of Example-2 proves the statement of the proposition.*

Proof of Proposition-6: *Differentiating equation (22) with respect to* (f) *gives*

$$\frac{dP_2}{df} = \left[\frac{dM}{df}k_T k_S^2\Delta_T(\Delta_S\Delta_T - M(f)k_S k_T)\right]/[\Delta_S\Delta_T + M(f)k_S k_T]^3 \quad (6A)$$

Since $\left(\frac{dM}{df}k_T k_S^2\Delta_T < 0\right)$*, equation (6A) is negative if* $\left(\frac{\Delta_S\Delta_T}{k_S k_T} - M(f) > 0\right)$*, and positive otherwise, as claimed.* □

The Cost of Counterterrorism

Proof of Lemma-3.3: *The unique pure strategy equilibrium* (y^*, x^*) *in the stage game is the solution to the following system of equations:*

$$\frac{\partial P(y,x)}{\partial y}\Delta_S - \frac{dc}{dy}k_S = 0; and \quad (6B)$$

$$\frac{\partial P(y,x)}{\partial x}\Delta_T - \frac{\partial C_T(x,f)}{\partial x} = 0 \quad (6C)$$

The dependence of $\left(y^*(k_S), x^*(k_S)\right)$ *on* (k_S) *can be found by totally differentiating equations (6B) and (6C) with respect to* $\left(k_S\right)$*, which yields the system of equations:*

$$\left(\frac{\partial P}{\partial y}\frac{dy}{dk_S} - \frac{\partial P}{\partial x}\frac{dx}{dk_S}\right)\frac{\partial P}{\partial y}\Delta_S - \left(\frac{dc(y)}{dy}\frac{dy}{dk_S}k_S - 1\right)\frac{dc(y)}{dy} = 0 \quad (6D)$$

$$\textit{And}\qquad \left(\frac{\partial P}{\partial x}\frac{dx}{dk_S} + \frac{\partial P}{\partial y}\frac{dy}{dk_S}\right)\frac{\partial P}{\partial x}\Delta_T - \frac{\partial^2 C_T(x,f)}{\partial x^2}\frac{dx}{dk_S} = 0 \quad (6E)$$

DOI: 10.31695/IJASRE.2019.33009

Solving equations (6D) and (6E) simultaneously for $\left(\frac{dy}{dk_S}\ and\ \frac{dx}{dk_S}\right)$, *we have*

$$\frac{dy}{dk_S} = \frac{dc}{dy}\left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T}{\partial x^2}\right)/\left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T)}{\partial x^2}\right)\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S - \frac{d^2 c}{dy^2}k_S\right) + \left(\frac{\partial^2 P}{\partial y \partial x}\right)^2 \Delta_S \Delta_T\Big\} \quad (6F)$$

In equations (6F) above, the denominator is positive and the numerator is negative and, as a result, $\left(y^*(k_S)\right)$ *increases when* (k_S) *decreases, as claimed.*

$$Also\ \frac{dx}{dk_S} = \left(-\frac{\partial^2 P}{\partial y \partial x}\frac{dc}{dy}\Delta_T\right)/\left(-\frac{\partial^2 P}{\partial y^2}\Delta_S - \frac{d^2 c)}{dy^2}k_S\right)\left(\frac{\partial^2 P}{\partial x^2}\Delta_T - \frac{\partial^2 C_T}{\partial x^2}\right) + \left(\frac{\partial^2 P}{\partial y \partial x}\right)^2 \Delta_S \Delta_T\Big\} \quad (6G)$$

In equations (6G) above, the numerator and denominator are positive, as a result, the equilibrium level of $\left(x^*(k_S)\right)$ *decreases when* (k_S) *decreases, as claimed.* □

Proof of Lemma-3.4: *The security agency's equilibrium payoff - as a function of* (k_S) *in the stage game is the following:*

$$U_S^*(k_S) = Y_S(0) - P\left(y^*(k_S), x^*(k_S)\right)\Delta_S + k_S c\left(y^*(k_S)\right) \quad (6H)$$

Applying the envelope theorem, the effect of a change in (k_S) *on the security agency's equilibrium expected payoff in the stage game is given by the sign of the following expression*

$$\frac{\partial U_S^*}{\partial k_S} = -\frac{\partial P\left(y^*(k_S), x^*(k_S)\right)}{\partial x}\frac{\partial x^*}{\partial k_S}\Delta_S - c\left(y^*(k_S)\right) \quad (6I)$$

The sign of right-hand side of equation (6I) is negative because both $\left(-c\left(y^*(k_S)\right) < 0\right)$ *and* $\left(-\frac{\partial P\left(y^*(k_S), x^*(k_S)\right)}{\partial x}\frac{\partial x^*}{\partial k_S}\Delta_S < 0\right)$. *As a result, the security agency's equilibrium expected payoff in the stage game strictly increases with a decrease in* (k_S). *Similarly, the terrorist equilibrium payoff (as a function of* (k_S) *in the stage game is*

$$U_T^*(k_S) = X_T(0) - P\left(y^*(k_S), x^*(k_S)\right)\Delta_T + C_T(x^*(k_S), f) \quad (6J)$$

Using the envelope theorem too, the effect of a change in (k_S) *on the terrorist equilibrium expected payoff in the stage game is given by the sign of the following equation:*

$$\frac{\partial U_T^*}{\partial k_S} = \frac{\partial P\left(y^*(k_S), x^*(k_S)\right)}{\partial y}\frac{\partial x^*}{\partial k_S}\Delta_T \quad (6K)$$

The sign of right-hand side of equation (6K) is positive because $\left(\frac{\partial P\left(y^*(k_S), x^*(k_S)\right)}{\partial y}\frac{\partial x^*}{\partial k_S}\Delta_T > 0\right)$. *As a result, the terrorist equilibrium expected payoff in the stage game decreases when* (k_S) *decreases.* □

Proof of Proposition-7: *In the dynamic game, we have* $(\varepsilon_S < \Delta_S)$ *and* $(\varepsilon_T < \Delta_T)$. *By Lemma-1;* $\left(y^*(\Delta_S, \Delta_T)\right)$ *increases in* (Δ_S) *and* (Δ_T) *, which implies that* $(y_1 < \bar{y})$, *as claimed.* □

Proof of Proposition-8: *Example-2 above proves the statement of the proposition.* □

DOI: 10.31695/IJASRE.2019.33009