BUILD A GAME-THEORETIC FRAMEWORK FOR COMMUNITY'S ROLE IN COUNTER-TERRORISM

by

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Dedication

I dedicate this research to my mothers, Mrs. Ada Iheuko, and Mrs. Rita Lori Sejebor thank you for your ever reliant support. To the men with the most remarkable minds I have ever encountered, Engr. Samuel Ibi Gekpe, and Mr. Dafe Sejebor, I am forever grateful for your inspiration.

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To my family and friends, I say a big thank you for the support, endless laughter, and reassurance that you have provided me with throughout this research. You are exceptional.

ABSTRACT

BUILD A GAME-THEORETIC FRAMEWORK FOR COMMUNITY'S ROLE IN COUNTER-TERRORISM

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Terrorism poses a major challenge to the government whenever it surfaces in any nation. It degrades the economic, infrastructural and trading systems. Furthermore, it reduces international revenues from tourism and foreign investments. Most importantly, it causes socio-ethnic tension and safety concerns to the nationals. Game-theoretic models have been widely applied to study the strategic interactions between the defender and attacker. In this thesis, we build three two-player subgames, and a three-player game-theoretic model, where the government, community and terrorist are involved. The community could support either the government or the terrorists. Both sequential and simultaneous games are studied with different orders of moves. We identify conditions where the community equilibrium strategy is to support the government. This paper finds first-mover advantage confirming previous research, identifies conditions where the community would support the government at equilibrium, and studies how robust their optimal behavior is to various external and internal factors.

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CHAPTER I:

INTRODUCTION

Background of the Problem

In 2002, the Boko Haram group was founded by Mohammed Yusuf in Maidugri, Borno state under the government of Governor Mala Kachalla. Since then, Nigeria has been plagued by intermittent terrorist attacks executed by the Islamist group. “Boko Haram” translates from Hausa, an indigenous Nigerian language, to English as “Western Education is forbidden” or “Book is a sin”. In a self-acclaimed statement, the group also refers to themselves as “Jama'atu Ahlis Sunna Lidda'awati Wal-Jihad”, meaning “People Committed to the Propagation of the Prophet's Teachings and Jihad” (CNN, 2019). The Boko Haram group allegedly withdraws from participation in Nigerian politics as it is against the central Islam notion that the group is structured and regulated by the Sharia (Islamic law). However, it is difficult to categorize their attacks as non-political since they mostly conduct political attacks and attract the attention of the ruling government.

Under the rule of Yusuf, the group was motivated by the “liberation” of the people in the Northern States from Western education, constitutions and institutions. However, when the government intervened and killed Yusuf in 2009, a new leader, Abubakar Shekau, took his place and led the violent uprising of Boko Haram terrorism in its current form. It can be argued that a contributing factor to the increasing violence from the group came from the inauguration of President Goodluck Ebele Jonathan. Other factors could have been negligence from President Jonathan’s administration regarding the importance allocated to counter terrorism measures and elevated poverty and illiteracy levels in the Northern states, which leads to lower standard of living. From observing the strategies used and the frequency of attacks by the Boko Haram terrorist group, it can be gathered that they are a credible threat to concerned nations and should

be treated as such. Based on the definition of a credible threat by Dixit and Nalebutt (1991), credible threats contain two components: “a plan of sequenced actions and the commitment to make the threat credible” (Shan and Zhuang, 2014). This paper will utilize the game theoretic approach to study and analyze the decision making and equivalent payoffs of those decisions for three players: the government, community and terrorist with the aim of finding ways to stop the community from supporting terrorists. The equilibrium payoffs for each player will be determined from examining optimal decisions by all players. The rest is organized as follows. The remainder of section 1 states the problem and presents the research question to be addressed. Section 2 will focus on the literature covering the definition of terrorism, the driving forces behind terrorism while focusing on a specific terrorist group, and the government’s and community’s roles in terrorism mitigation. Section 3 will cover the methodology of study centering around using the game theory to investigate each player’s interaction with one another under given conditions, and determining their individual payoffs. Then, Section 4 will focus on the results, two player subgames, mixed strategy equilibrium, and three player game. Finally, sections 5 and 6 will cover recommendations and conclusion, respectively.

Statement of Purpose

Potential terrorists might come from the community due to agenda set by the terrorist group or other means with a rich literature of terrorism and counter terrorism. The community might play a critical role in counter-terrorism, (e.g., obeying established safety curfew set by the government for their safety). Additionally, the community may serve as local aides to the government reporting suspicious incidents though security helplines and centers.

Following the formulation of game models, this paper will attempt to answer the following questions:

- Under what conditions could the government prevent the community from supporting terrorists?
- How willing is the community to support the government as certain external and internal factors change?

This paper will identify model parameters which might be important for leading to equilibrium involving the decision of the community supporting governmental efforts in counter-terrorism.

Next, this study will highlight the feasibility of stopping the community from supporting terrorists. It will be significant in

- Highlighting the importance of the role of community in the mitigation of terrorism, and
- Encouraging the government to develop strategies to better encourage members of the community to support the government rather than the terrorists for the greater good of the nation.

Research Constraints

- The payoffs for the government, community and terrorist will be assigned based on literature review and data analysis,
- In the sequential game, one player must make a move before the others follow sequentially, and the move of the first player will be disclosed to the others. In the simultaneous game, all players decide their moves at the same time without knowing eithers' decisions.

CHAPTER II:

LITERATURE

Definition of Terrorism

The term "terrorism" has an array of definitions. According to (Laqueur, 1987), the sole properties of terrorism that are commonly accepted are that terrorism involves both violence and the threat of violence. The United States Department of State has defined terrorism as "politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience" (Charles, 2002). From the definition, three criteria are used to portray the essence of the word. They are political motivation, violence against noncombatants and subnational groups or clandestine agents. Terrorism is considered "politically motivated" since the primary aim of terrorist attacks is to influence the ruling government's decisions to favor the terrorists' cause. The second criteria of "violence against noncombatants" states that the attacks are targeted towards civilians and/or members of the military, who are not on active duty (noncombatants). The third criteria of "subnational groups or clandestine agents". Boko Haram is a subnational group and thus fits the definition since it is a group within a nation with members having differing political and economic system views. According to the 2020 Global Terrorism Index, Nigeria ranks 3rd with a score of 8.314 indicating a very high terrorism impact on the country (Institute for Economics & Peace, 2020). Numerous perspectives arise when comparisons are made between terrorists and freedom fighters. In this context, demonstrations by the Nigerian Niger Delta Militants are compared to those by the Boko Haram terrorist group. Both are being labelled as terrorists by some schools of thought. Although it can be gathered that both groups are motivated by the pursuit of liberation, and achieve their goals through violence and forceful motives, there is a major difference between both groups. Freedom

fighters are motivated to act against the ruling government when the government deprives the people of fundamental necessities that are standards for humane living conditions. On the other hand, terrorism acts are calculated acts of destruction on the people and infrastructure conducted with the sole purpose of causing deliberate harm to both the nation and the nation's population (Ochoche, 2013).

Terrorism and Organized Crime

Furthermore, organized crime and terrorism share notable differences. Although both organized crime and terrorism share some similarities such as the need for money (to launch attacks), some differences exist between them. These differences include the aim of organized crime and terrorism being to yield economical profits and affect political activities, respectively (Passas, 2005). While organized crime mostly pursues anonymity, terrorism seeks media coverage of attacks, where the concerned terrorist group takes responsibility for the attack as a form of intimidation and as a method to attract new followers. Another distinguishing trait between organized crime and terrorism is that terrorist attacks are ocassionally planned to target prominent governement agencies or nationally recoginsed commemoration dates and anniversaries. The potential threat that terrorism poses to the targeted community worsens with time. According to the United Nations High Commission for Refugees (UNHCR), over 3.3 million people have been displaced since the Boko Haram terrorists' attacks heightened in 2014. Within the 3.3 million, over 2.5 million of the internally displaced persons (IDPs) are reportedly in North-Eastern Nigeria, whereas over 550,000 are reportedly in the Republic of Chad, Cameroon and Niger. Also, as of 2014, there were approximately 240,000 refugees in Nigeria, Cameroon, Chad and Niger altogether (United Nations High Commissioner for Refugees, 2001-2020).

Community's and Government's Roles in Terrorism Mitigation

Generally, the community plays a vital role in the mitigation and prevention of crimes and pandemics. This could be achieved through the formation of a Neighborhood Watch group. A Neighborhood Watch is a police-enabled program that encourages members of the community to help protect themselves and support the police. According to John Woodhead, the Vice President and Executive Chairman of Queensland Neighborhood Watch Association Inc., a major issue with all association branches was receiving cooperation from the local police departments since the degree of support varied in all states. It was reported that the establishment of the Neighborhood Watch program reduced the rate of burglaries and crimes in general in the Queensland, Australia, and in the other states (Woodhead, 1990). Also, members of the community formed close-knit relationships with the police as they worked together towards achieving common goals. However, the Neigbourhood Watch might not be as effective in low crime rates areas. According to Fleming (2005), the Neigbourhood Watch despite having large numbers of volunteers are only slightly reducing crimes in areas with low crime rates. Further examining the role of the community in the fight against terrorism in Nigeria leads us to the events that occurred on May 13, 2014. Members of the boko haram terrorist group who attacked three villages in Maiduguri, Borno state were met by resistance from the community leading to the deaths of over 200 Boko Haram terrorists (CNN, 2019).

The important role of the community in detering adverse activities in their nation cannot be overstated. While highlighting the importance of the community's role in the prevention of global issues, we examine community responses and roles in deterring a recent global pandemic, the spread of the COVID-19 virus, social distancing, increased personal and household hygiene, observing self-quarantine, obeying the federal

quarantine orders, and obeying the orders by essential facilities are some of the ways the community helped reduce the coronavirus spread (Harvard Health Publishing, 2020). Another highly important role that members of the community play is in supporting one another in crisis. Having support is fundamental for members of affected communities especially for children and young adults, who may not fully comprehend an on-going crisis. Community support in crisis can include discounted supplies in neighborhood stores, offering assistance to neighbors whenever needed, and keeping one another informed on the new changes or policies (Boudreau, 2020).

The government focuses majorly on deterrence as a form of terrorism mitigation. They deter the attacks by instilling doubt and fear within the nationals regarding terrorism and the punishments for acts of terrorism if prosecuted. However, deterrence has not always been effective. In fact, it could discourage innocent members of the community from providing tips as they fear being punished as severely as the terrorists if they are assumed to be members of the terrorist groups. Richardson et al. (2007) offered three strategies of terrorism mitigation that are considered "superior strategies" to deterrence. The proposed strategies influence the terrorism by "decreasing the utility of terrorism to terrorists" and by "attempting to increase the opportunity cost". The strategies are polycentricity, diffusing the attention of the media and offering positive incentives. Polycentricity focuses on creating more than one core/center for the system. In a case where one part of the system is attacked or negatively impacted, the other parts can take control. This is expected to reduce the vulnerability of the overall system and thus decrease the utility of terrorism to terrorists. The concept of diffusing the media suggested by the authors is by the government curtailing credit given to terrorist groups for acts of terrorism in the media. This is expected to reduce the utility of terrorism to the terrorists since gaining public recognition is a major motivating factor for terrorists.

However, this strategy is a double-edged sword since it could create media confusion in the community. Individuals will not be completely informed on whether there are more than one existing terrorist groups on attacks or the extent to which their safety is threatened, which can lead to further distrust for the media and government. The last strategy involves giving positive incentives to the terrorists as a mitigation method by "reintegrating terrorists and providing access the political process, and welcoming repentants" (BBC News, 2020). Although this strategy might be welcoming to the terrorists since it includes access to political processes (which is usually the aim of the attacks) and pardon to "repentants", a number of questions arise and must be considered. How does the government decide on the extent of political access to provide to the terrorists? How does the government ensure that "repentants" truly have repented? Do the "repentants" face the judicial system? Will the community accept "repentants" after the damage they have already caused? These questions are extremely critical to the success of this strategy to increase opportunity costs for terrorists.

Studying the Driving Forces behind Terrorism Using the Boko Haram Insurgency as a Case Study

To provide a closer look at the driving forces behind the Boko Haram Insurgency, Alozieuwa (2012) examined various theories, including the Relational/Vengeance Theory, Human Needs/Socio-Economic Perspective, Political Feud Perspective, Islamic Theocratic State Theory and the Conspiracy Theory. After careful examination, it was concluded that originally the Boko Haram attacks were solely driven by religion but evolved to being influenced heavily by politics. In an attempt to develop thorough understanding of the political implication of Boko Haram attacks on Nigeria, Chukwurah et al. (2015) conducted a study. It was gathered that there was an increment of Boko Haram activities as a president from Southeastern Nigerian was inaugurated in 2010. Six

sectors were examined during this research. They are the tourism, transportation, infrastructural, commercial, core service and agricultural sectors. The transportation agencies experienced a drastic decline in passengers travelling to the North Nigeria with the uprising of Boko Haram attacks. Tourism from the North, which produced approximately 80 billion naira yearly (the highest in Nigeria), experienced a standstill and then a decline. Infrastructures have been severely damaged, and both foreign and local contractors assigned to be engaged in the rehabilitation of these infrastructures have fled those states due to concern for their safety. The commercial sector, which comprised of corner shops, indigenous markets and small to medium businesses, experienced approximately a 73.7% decline and people live on their savings or migrate. The core services such as schools, hospitals, hotels and parks are moving their businesses to other parts of the country. The agricultural sectors are affected since farm lands are no longer being tended to and farmers are concerned for their safety.

Access to improved education, employment, infrastructures such as healthcare facilities and thus a better standard of living might mitigate terrorism in the Northern parts of Nigeria since the poverty and illiteracy levels are relatively high in those regions. However, the members of this terrorist group are in fact exposed to Islamic education, which when misinterpreted could influence them to develop a sense of misguided purpose to facilitate the forceful spread of the religion by any necessary means. Adesoji (2010, pp. 100-104) found that exposure to Western education was not the solution since "For them, it is a passion, a belief system. I do not believe that exposure to formal western education is the key to mitigate these terrorists". On the other hand, Adetoro (2012) suggested that thorough state reforms focusing on both infrastructural and structural and considerable poverty relief programs would curtail Boko Haram attacks and other ethno-religious crises in Nigeria. This was concluded after a study was

conducted considering poverty and political alienation as major indicators for the Boko Haram Insurgency. Although poverty might be a major factor to consider, the Boko Haram terrorist group might be solely driven by greed and personal vendetta. These are not strange grounds in Nigeria especially when the pursuit of power and political motives are involved.

Mitigating acts of terrorism could be facilitated by considering all factors available and necessary, strategically studying the interactions between concerned/affected parties, and exploring to understand how both external and internal factors affect the interactions between these parties. The game-theoretic approach is a mathematical method of analysis used to determine the interactions between two or more players. This approach considers possible actions from each player and then uses payoffs to determine the optimality of the move. Generally, the government should combat terrorists as that serves the society far more than when no action is taken; however, this is not always the case (Daniel, 2005). Ochoche (2013) performed game theoretic studies using four models 1, 2A, 2B and 3. In the first model, which was zero-sum, the equilibrium strategy for both the terrorist group and the government were to terrorize and combat, respectively. The second model considered a scenario where the home zone states increased the cost of terrorism and initiated cease fire incentives. The equilibrium strategy remained the same. Model 2B considered increasing the cost of terrorism (a decrease in the payoff). This resulted in cease fire and combat being the dominant strategies for the terrorist group and government, respectively. Ochoche's fourth model analyzed the condition that the terrorist group had an understanding with the home zone state and moved operations to other states excluding that home zone state from attacks. The dominant strategies would be to terrorize and compromise for the terrorist group and state government, respectively. This approach endangers another state, and does not solve

the terrorism problem for the nation or the home zone state. Also, there were no guarantees that the terrorists would continue to comply with the agreement. However, it was unclear how an agreement was reached. The proposed counter-terrorism strategies include increasing the cost of terrorism, initiating cease fire and hindering alliance between state government and terrorist groups. This paper only considers simultaneous games between the government and the terrorist and the payoffs were determined with stylized values.

CHAPTER III:

METHODOLOGY

Introduction

This chapter will cover the methodology of the games for the research. First, we will provide a brief introduction into the notation of both the sequential and the simultaneous games for the two-plyer subgames, and three-players game. Then, we will provide literature justifying and exploring the government's, and community's decisions, respectively. Afterwards, the game-theoretic formulation, and payoff notation will be explained.

Notation

A n-tuple (player) game can be mathematically represented in Equation (1)

$$G = (N, S, \mu) \tag{2}$$

where $N = \{1,2,3,\ldots,n\}$ $S = \{S_1, S_2, S_3 \ldots, S_n\}$ and $\mu = \{\mu_1, \mu_2, \mu_3, \ldots, \mu_n\}$ are the set of players, strategy profile, and payoff sets, respectively.

Assume $m_i = (a_i^0, a_i^1, a_i^2, \ldots, a_i^{n-1})$ *to be the sequential actions taken by player* $i \in N$.

The zero-sum game in a tactical game is one that for all

$$\boldsymbol{s} = \{s_1, s_2, s_3, \ldots, s_n\} \in S, \tag{3}$$

$$\mu_1(s) + \mu_2(s) + \mu_3(s) + \ldots + \mu_n(s) = 0 \tag{4}$$

All players play to maximize their payoffs. Two strategies s_i and s_i^0 are given so that in any strategy combination, the result from s_i is greater than that from s_i^0. In a set of $s_1, s_2, s_3, \ldots, s_n$, if

$$\mu_i(s_1, s_2, s_3, s_i \ldots, s_n) \geq \mu_i(s_1, s_2, s_3, s_i^0 \ldots, s_n)$$

$s_i \in S$, where s_i represents player i's strategies

For the simultaneous game, the Nash equilibrium is reached at $\boldsymbol{s} = \{s_1, s_2, s_3, \ldots, s_n\}$

First, we develop sequential and simultaneous two-player subgames between the government and terrorist, government and community, and community and terrorist using decision variables and parameters in Table 3.*1* to determine the players interaction in those different subgames while considering external and internal factors. Next, we compare the solutions from both the sequential and simultaneous games, and the players' mixed strategy. Finally, a three-player game is developed to further investigate these interactions.

Justification of the Government's Decisions

The sequential game proceeds as follows. The government can choose to either heighten security or engage the community. If the government chooses to heighten security, then they must consider defense strategy against the terrorists, cost of the defense, and the impact factor. Generally, the government aspires to target the terrorists while minimizing the damage to infrastructures, casualty, societal ties, and so on.

According to the United Nations, the government heightens security by securing both domestic and international borders, constricting financial regulations, increasing the involvement of police authorities, improving the criminal justice system, and establishing legal alliance with other countries with terrorist threats to help convict terrorists in their courts (Smith, 2020). By defending, the government may monitor websites and online content, to take down hate speech, and suspicious activities. The Dutch government has implemented numerous actions to strengthen its defense against terrorism. The Royal Netherlands Air Force surveys the Dutch airspace on a 24 hours basis. Also, the police closely monitor people who they suspect to be terrorist threats to society (Government of

the Netherlands, 2016-2020).The “Counterterrorism Alert System” established by the Dutch government notifies the government and primary sectors about terrorist threats (2016-2020). Such sectors as drinking water, and energy companies. Other impactful strategies by the government to form defense against terrorism can be exemplified through the North Atlantic Treaty Organization (NATO). NATO narrows efforts towards terrorism mitigation through improving awareness of terrorist threats, setting up capabilities to prepare and adequately respond to threats, and forming alliances/partnerships with neighboring countries and other international actors (NATO, 2019).

According to Zycher (2003) annual costs of deaths and injuries from moderate, severe, and nuclear cases in the United States were estimated at $11 billion, $183 billion, and $465 billion, respectively before the September 11 attacks. These values are based on the estimates that one life is worth $4million, and one injured individual is worth $40,000. After the September 11 attacks, government spending for reconstructing, humanitarian activities, defense, and domestic security functions have been estimated at $95 billion (Zycher, 2003). The government can engage the community through the establishing community enrichment programs, and protecting and rewarding informants. The Office for Victims of Crime (OVC) U.S. Department of Justice, provides 24/7 crisis counselling services in English and Spanish to victims of terrorism and mass violence through the ‘Terrorism and Special Jurisdictions Program’ (2020). Also, OVC provides victim compensation to the affected states for the welfare of the affected within the state. Other organizations that provide support are ‘The Dougy Center’, ‘National Organization of Parents of Murdered Children’, and ‘VictimConnect’ (Office for Victims of Crime, 2020).

The United States' government through the Federal Bureau of Investigation (FBI) established the FBI Counterterrorism Center in 1996 (Watson, 2002) for combating terrorist activities on both domestic and international levels. The Nigerian government has made efforts to engage the community through providing incentives to the community. Recently, the Zamfara State Governor, Bello Matawalle has offered two cows to the indigenous people for every AK-47 or weapon returned to the government (BBC News, 2020). Zamfara is a state in northwestern Nigeria with approximately 67.5% people living in poverty (BBC News, 2020). A lucrative business in Zamfara State is farming, especially animal herding, and cows are highly valued by the average herdsman. Also, over 8,000 people have been killed through crimes related to terrorism, theft, and inter-ethnic tension in Zamfara and its neighboring states, which makes this incentive not only relevant but necessary. Another way that the government can engage the community is through organizations such as the U.S. Intelligence Community (IC) Civilian Joint Duty Program, which offers civilians with professional opportunities to strengthen collaboration with the government and community. Also, the program impacts the participating civilians with enhanced career prospects through trainings and exposure to the processes involved in intelligence (Office of the Director of National Intelligence, 2020).

Exploring Different Options for the Community

The community can choose either to support the government or support the terrorist. The community can support the government by reporting suspicious activity to the police authorities, become involved in campaigns organized by the government to influence the children, and youth, and refrain from voluntary recruitment by the terrorist. In 2007, the U.S. government established the Nationwide Suspicious Activity Reporting (SAR) Initiative (NSI) which is a collective effort by the Federal Bureau of Investigation,

Department of Homeland Security, state, local, tribal, and territorial law enforcement partners (Joint Counterterrorism Assessment Team, 2020). This initiative informs on how to safely report suspicious activities to the appropriate authorities.

Game Theoretic Model Formulation

Game theory is a mathematical method that studies the strategically interdependent behavior between players (Barron, 2013). Interdependence refers to the fact that an action from one player affects the other and vice versa. For this paper, three players will be considered: the government, community and the terrorists. The payoffs will be determined based on literature review and analysis of their interests.

The government (G) has two options of heightening security and engage the community. The terrorist (T) has the options of attack and not attacking. The community (C) takes the supporting role of either supporting the government or the terrorist group. The game tree is presented below.

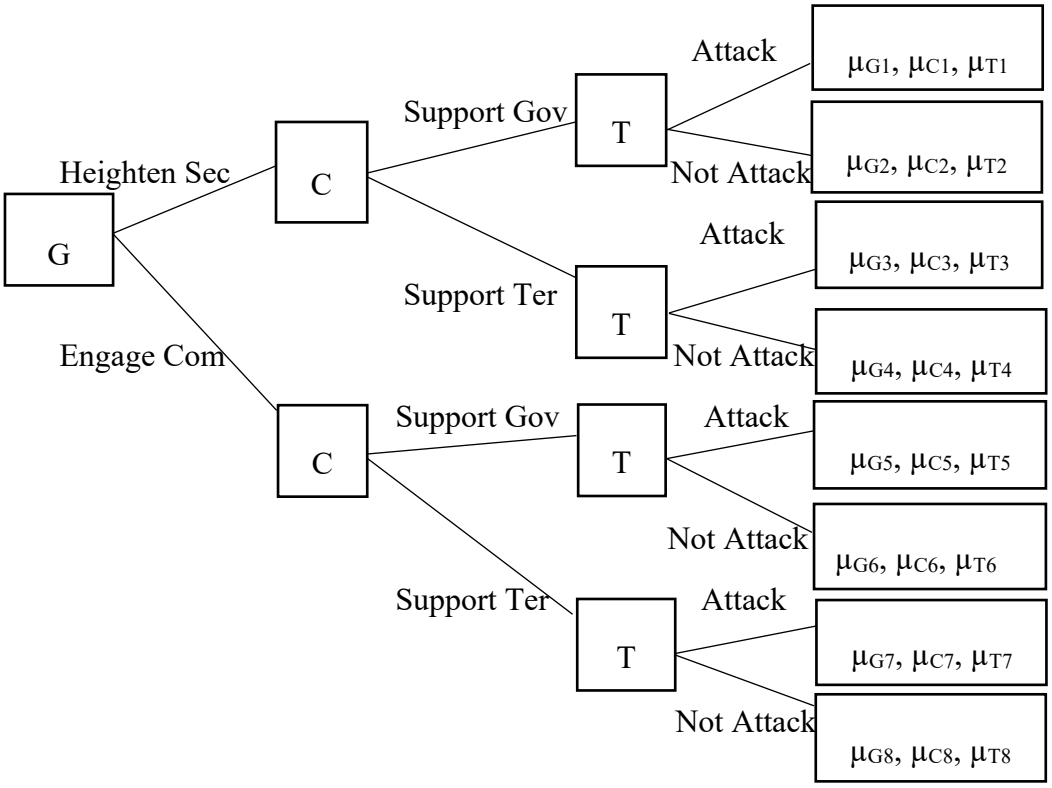

Figure 3.1. Game Tree with Three Players: The Government, Terrorist and Community including their Payoffs.

Payoff Function

To derive a better understanding of the player interactions, and overall game, payoff functions, their definition, and other notations are outlined in Table 3.1 below.

Table 3.1
Payoff Functions and Definitions for Each Player Including Other Notations

Players	*Description*
G	Government
C	Community
T	Terrorist
Decision Variables	*Description*
{H, EC}	Government heightens security or engages community
{SG, ST}	Community supports government or terrorist
{A, NA}	Terrorist attacks or not
Government's Payoffs	
Parameters	*Description*
L_G	Impact factor to government – loss to the government after defense
I_G	Impact to government for engaging the community when the terrorist attacks
J_G	Loss to government when government heightens security and community supports terrorist

Table 3.1, cont'd
Payoff Functions and Definitions for Each Player Including Other Notations

Government's Payoffs	
Parameters	*Description*
H_G	Loss to government when government engages the community and community supports terrorist
V_G	Benefit to government when government engages the community and community supports government
C_D	Cost of defense to the government
C_E	Cost of engaging the community to the government
Community's Payoffs	
Parameters	*Description*
S_E	Impact to community when government engages the community and community supports government
S_W	Impact to community when government engages the community and community supports terrorist
S_G	Impact to community for supporting government when government heightens security
S_T	Impact to community for supporting the terrorist when government heightens security.
I_C	Impact to community for supporting the government when terrorist attacks
T_C	Impact to community for supporting the terrorist when terrorist attacks
X_C	Benefit to community for supporting government when terrorist does not attack
P_C	Loss to community for supporting terrorist when terrorist does not attack

Table 3.1, cont'd
Payoff Functions and Definitions for Each Player Including Other Notations

Terrorist's Payoff	
Parameters	*Description*
L_T	Impact factor to terrorist, i.e. cost of damages done by the terrorist after attack
O_T	Impact to terrorist when government engages community when the terrorist attacks
K_T	Impact on terrorist when community supports government and terrorist attacks
B_T	Benefit to terrorist when community supports terrorist and terrorist attacks
MC	Media coverage for terrorist attacks
C_A	Cost of attack to the terrorist
Other Notations	
{Y, N}	Possible Equilibrium or Not a Possible Equilibrium, respectively
{μ}	Assigned payoff

CHAPTER IV:

RESULTS

Two-Player Games

We first consider a two-player sequential subgame between the government and terrorist, as shown in Figure 4.1. Then, we progress to consider the subgames between the government and community, and the community and terrorist as shown in Figure 4.2 and Figure 4.3, respectively.

Government and Terrorist

Figure 4.1 shows the sequential game between the government and the terrorist. In this sequential game, the government makes the first move, and the terrorist is aware of the government's move before their move is made. When the government heightens security (H), the payoffs are $-\mathrm{L_G} - \mathrm{C_D}$ or $-\mathrm{C_D}$ depending on if the terrorist attacks or does not attack, respectively. When the government engages community (EC), the payoffs are $-\mathrm{I_G} - \mathrm{C_E}$ and $-\mathrm{C_E}$ depending on if the terrorist attacks or not, respectively. On the other hand, the terrorist payoffs are $L_T + MC - C_A$ or 0 depending on if they attack or not when the government heightens security. Similarly, the terrorist payoffs are $L_T + O_T + MC - C_A$ or 0 depending on if they attack or not when the government engages community.

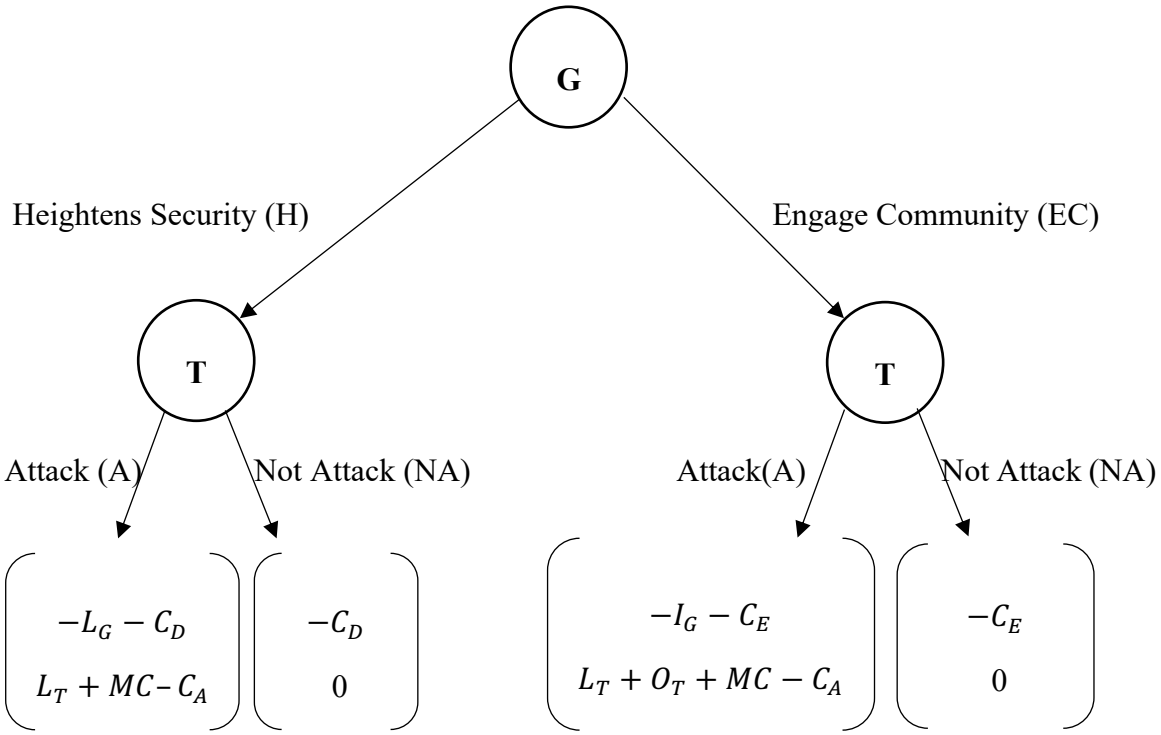

Figure 4.1. Game Tree of the Sequential Subgame between the Government (G) and the Terrorist (T).

Table 4.1
Possible Equilibria for Sequential Subgame between Government and Terrorist

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[H, A]	$[-L_G - C_D, L_T + MC - C_A]$	$\{C_A < min\{L_T + MC, L_T + O_T + MC\}, C_E > L_G + C_D - I_G\}$
2	[H, NA]	$[-C_D, 0]$	$\{L_T + O_T + MC < C_A < L_T + MC, C_E > L_G + C_D\}$ *or* $\{L_T + MC < C_A < L_T + O_T + MC, C_E > C_D - I_G\}$ *or* $\{C_A > max\{L_T + MC, L_T + O_T + MC\}, C_E > C_D\}$
3	[EC, A]	$[-I_G - C_E, L_T + O_T + MC - C_A]$	$\{C_A < min\{L_T + MC, L_T + O_T + MC\}, C_E < L_G + C_D - I_G\}$
4	[EC, NA]	$[-C_E, 0]$	$\{L_T + O_T + MC < C_A < L_T + MC, C_E < L_G + C_D\}$ *or* $\{L_T + MC < C_A < L_T + O_T + MC, C_E < I_G - C_D\}$ *or* $\{C_A > max\{L_T + MC, L_T + O_T + MC, C_E < C_D\}$

Sequential Game Solution

In the sequential game, from solving the subgame between the government and terrorist above, all four cases present feasible equilibria provided the conditions are met. They are:

1. When the cost of attack is low ($C_A < min\{L_T + MC,\ L_T + O_T + MC\}$), and the cost of engaging the community to the government are high $[C_E > L_G + C_D - I_G]$, the government will heighten security and terrorist will attack.
2. When the cost of attack is medium ($L_T + O_T + MC < C_A < L_T + MC$) if $O_T < 0$ and the cost of engaging the community to the government are high ($C_E > L_G + C_D$), or when the cost of attack is medium but not greater than associated benefits ($L_T + MC < C_A < L_T + O_T + MC$) if $O_T \geq 0$ and the cost of engaging the community to the government are relatively high ($C_E > C_D - I_G$), or when the cost of attack is high ($C_A > max\{L_T + MC, L_T + O_T + MC\}$), and the cost of engaging the community to the government is high ($C_E > C_D$), the government will heighten security and terrorist will not attack.
3. When the cost of attack is low ($C_A < min\{L_T + MC,\ L_T + O_T + MC\}$) the community supports either the government or the terrorist, and the cost of engaging the community to the government is low ($C_E < L_G + C_D - I_G$), the government will engage the community and terrorist will attack.
4. When the cost of attack is medium but not greater than associated benefits ($L_T + O_T + MC < C_A < L_T + MC$) and the cost of engaging the community to the government are low ($C_E < L_G + C_D$), or when the cost of attack is medium ($L_T + MC < C_A < L_T + O_T + MC$) and the cost of engaging the community to the government are relatively low ($C_E < L_G + C_D$), or when the cost of attack is high ($C_A > max\{L_T + MC, L_T + O_T + MC\}$), and the cost of engaging the community to the government is low ($C_E < C_D$), the government will engage the community and terrorist will not attack.

However, considering that this subgame is a sequential game where the terrorist is aware of the government's moves before their move is selected, the most desirable outcomes for

the government will be one that minimizes the impact of the damage to the community by the terrorist, and defends the community and nation as a whole. Hence, the most desirable equilibrium for the government will be [H, NA] and [EC, NA] where the terrorist does not attack provided the conditions in Table 4.1 for these cases are met. [EC, A] will not be a desirable equilibrium for the government since when the government engages the community, the terrorist will prefer to attack to get a higher payoff than otherwise which is not desirable to the government under the given conditions. [H, A] will not be a desirable equilibrium for the government since when the government heightens security, the terrorist will prefer to attack to get a higher payoff than otherwise under the given conditions.

For the terrorist, the most desirable equilibrium is the one where the most damage to the community is achieved. Hence, the equilibrium for the terrorist will be [H, A] and [EC, A] where the terrorist attacks provided the conditions in Table 4.1 for these cases are met. [EC, NA] will not be a desirable equilibrium for the terrorist since if the government chooses to engage the community, the terrorist will prefer not to attack to receive a higher payoff than otherwise under the given conditions. [H, NA] will not be a desirable equilibrium for the terrorist since if the government chooses to heighten security, the terrorist will prefer not to attack to get a higher payoff than otherwise under the given conditions.

Next, considering a simultaneous game where neither player knows the moves of the other player, both players' moves are made at the same time solely based on the best outcome for the individual player regardless of the other player's move as shown Table 4.2. To determine the conditions for equilibrium, we'll use best response analysis to find the equilibrium. First, we will evaluate the player's payoffs from the government's perspective. Then, we will evaluate the payoffs from the terrorist's perspective.

Table 4.2
Simultaneous Subgame between the Government (G) and the Terrorist (T).

G	**T**	
	Attack (A)	Not Attack (NA)
Heighten Security (H)	$[-L_G - C_D, L_T + MC - C_A]$	$[-C_D, 0]$
Engage Community (EC)	$[-I_G - C_E,\ L_T + O_T + MC - C_A]$	$[-C_E, 0]$

Table 4.3
Possible Equilibria for Simultaneous Subgame between Government and Terrorist

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[H, A]	$[-L_G - C_D, L_T + MC - C_A]$	$\{C_A < L_T + MC, C_A < L_T + O_T + MC, C_E > L_G + C_D - I_G\}$
2	[H, NA]	$[-C_D, 0]$	$\{C_A > max\{L_T + MC, L_T + O_T + MC\}\}, \{L_T + MC < C_A < L_T + O_T + MC\} C_E > C_D\}$
3	[EC, A]	$[-I_G - C_E, L_T + O_T + MC - C_A]$	$\{C_A < L_T + MC, C_A < L_T + O_T + MC, C_E < L_G + C_D - I_G\}$
4	[EC, NA]	$[-C_E, 0]$	$\{C_A > max\{L_T + MC, L_T + O_T + MC, \{L_T + MC < C_A < L_T + O_T + MC\ C_E < C_D\}$

Simultaneous Game Solution

In the simultaneous, from solving the subgame between the government and terrorist, all four cases present feasible equilibrium provided the conditions are met. They are;

1. When the cost of attack is low ($C_A < min\{L_T + MC, L_T + O_T + MC\}$), and the cost of engaging the community to the government is high ($C_E > L_G + C_D - I_G$), the government will heighten security and terrorist will attack.
2. When the cost of attack is high ($C_A > max\{L_T + MC, C_A > L_T + O_T + MC\}$) and the cost of engaging the community to the government is high ($C_E > C_D$), the government will heighten security and terrorist will not attack.
3. When the cost of attack is low ($C_A < min\{L_T + MC, L_T + O_T + MC\}$) when the community supports either the government or the terrorist, and the cost of engaging the community to the government is low ($C_E < L_G + C_D - I_G$), the government will engage the community and terrorist will attack.
4. When the cost of attack is high ($C_A > max\{L_T + MC, L_T + O_T + MC$) and the cost of engaging the community to the government are low ($C_E < C_D$), the government will engage the community and terrorist will not attack.

Considering that this subgame is a simultaneous game where the terrorist is not aware of the government's moves before their move is selected, and both players select their moves at the same time. Similar to the sequential game, the most desirable outcomes for the government will be one that minimizes the impact of the damage to the community by the terrorist, and defends the community and nation as a whole. Hence, the most desirable equilibrium for the government will be [H, NA] and [EC, NA] where the terrorist does not attack provided the conditions in Table 4.3 for these cases are met. [EC, A] will not be a desirable equilibrium for the government since when the government

engages the community, the terrorist will prefer to attack to get a higher payoff than otherwise under the given conditions. [H, A] will not be a desirable equilibrium for the government since when the government heightens security, the terrorist will prefer to attack to get a higher payoff than otherwise under the given conditions.

For the terrorist, the most desirable equilibrium will be one where the most damage to the community is achieved. Hence, the equilibrium for the terrorist will be [H, A] and [EC, A] where the terrorist attacks provided the conditions in Table 4.*3* for these cases are met. [EC, NA] will not be a desirable equilibrium for the terrorist since if the government chooses to engage the community, the terrorist will prefer not to attack to receive a higher payoff than otherwise under the given conditions. [H, NA] will not be a desirable equilibrium for the terrorist since if the government chooses to heighten security, the terrorist will prefer not to attack to get a higher payoff than otherwise under the given conditions.

Comparing the Possible Equilibria for the Sequential and Simultaneous Subgame between the Government and Terrorist

Comparing the payoffs for both the sequential and simultaneous subgames between the government and terrorist, the conditions for possible equilibrium for cases 1 and 3 (the most desirable outcomes for the terrorists) are the same. However, for cases 2 and 4 (the most desirable outcomes for the government), there are more conditions in the sequential game than in the simulations game. This indicates that the government is more likely to reach their desired outcome in a sequential game than in a simultaneous game. Hence, we recommend that the government announce their strategy to the terrorists rather than keep their strategy unknown to the terrorist to better reach their desired outcome.

As seen in Figure 4.2.1, when $O_T \geq 0$, the cost of attack for the terrorist is low, and the cost of community engagement on the government when the terrorist attacks is

high, and might become detrimental to the government if engaging the community is not successful.

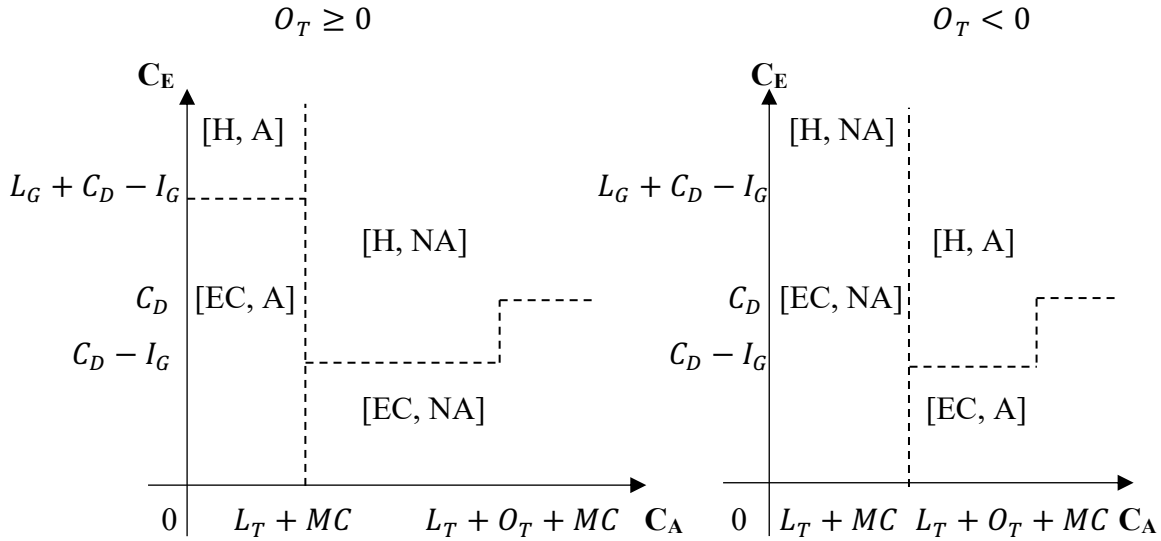

Figure 4.2.1. and Figure 4.2.2. Four Possible Equilibria (as specified in Table 4.3) for Subgame between Government and Terrorist as a Function of C_A and C_E. The Strategies in the Brackets are for the Government and Terrorist, respectively.

In Figure 4.2.2, when $O_T < 0$, the cost of attack for the terrorist is high, and the cost of community engagement for the government when the terrorist attacks is relatively low, the government has a higher chance of success with community engagement, while the terrorist will likely not attack when cost of attack is high.

Government and Community

Figure 4.3 shows the sequential game between the government and community. In this sequential game, the government makes the first move, and the community is aware of the government's move before their move is made. When the government heightens security (H), the payoffs are $-\mathrm{C_D}$ or $-\mathrm{J_G} - \mathrm{C_D}$ depending on if the community supports government or supports terrorist, respectively. When the government engages community (EC), the payoffs are $\mathrm{V_G} - \mathrm{C_E}$ and $-\mathrm{H_G} - \mathrm{C_E}$ depending on if the community supports

government or supports terrorist, respectively. On the other hand, the community payoffs are S_G or S_T depending on if they support government or support terrorist, respectively, when the government heightens security. Likewise, the terrorist payoffs are S_E or S_W depending on if they support government or support terrorist, respectively, when the government engages community.

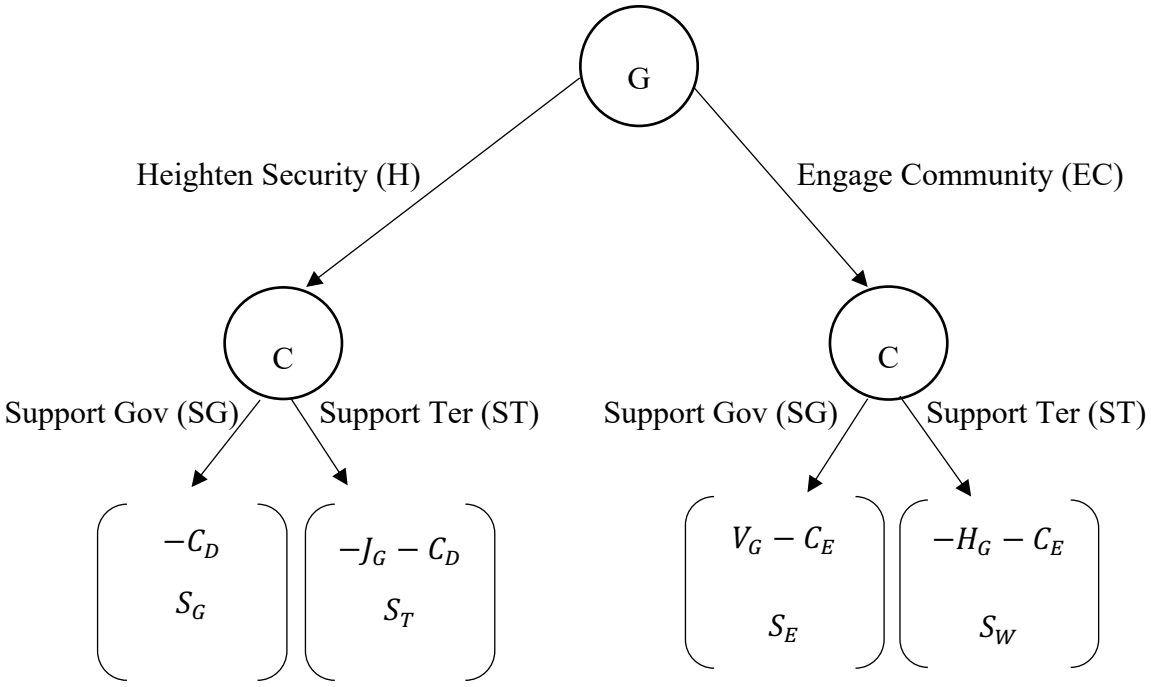

Figure 4.3. Game tree of the Sequential Subgame between the Government (G) and the Community (C).

Table 4.4
Possible Equilibria for Sequential Subgame between Government and Community

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[H, SG]	$[-C_D, S_G]$	$\{S_G \geq S_T, S_E \geq S_W, C_D \leq -V_G + C_E\}$ or $\{S_G \geq S_T, S_E < S_W, C_D \leq H_G + C_E\}$
2	[H, ST]	$[-J_G - C_D, S_T]$	$\{S_G < S_T, S_E \geq S_W, C_D \leq H_G + C_E - J_G\}$ or $\{S_G < S_T, S_E < S_W, C_D \leq -V_G + C_E - J_G\}$
3	[EC, SG]	$[V_G - C_E, S_E]$	$\{S_G \geq S_T, S_E \geq S_W, C_D > -V_G + C_E\}$, or $\{S_G < S_T, S_E \geq S_W, C_E < V_G + C_D + J_G\}$
4	[EC, ST]	$[-H_G - C_E, S_W]$	$\{S_G < S_T, S_E < S_W, C_D > H_G + C_E - J_G\}$ or $\{S_G > S_T, S_E < S_W, C_D > H_G + C_E\}$

Sequential Game Solution

From solving the sequential subgame between the government and community, all four cases present feasible equilibria provided the conditions are met. They are:

1. When the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G \geq S_T$), the impact to community for supporting the government when government engages the community is higher than that of supporting the terrorist ($S_E \geq S_W$), and when the cost of defense is low, and the cost of engaging the community to the government is high ($C_D \leq min\{-V_G + C_E, H_G + C_E\}$), the government heightens security and community supports the government.
2. When the impact to community for supporting government when government heightens security is low ($S_G < S_T$), the impact to community for supporting the terrorist when government heightens security is high ($S_E \geq S_W$), and when the

cost of defense is low, and the cost of engaging the community to the government is high ($C_D \leq min\{-H_G + C_E - J_G, -V_G + C_E - J_G\}$), the government will heighten security and community will support the terrorist.

3. When the impact to community for supporting government when government heightens security is high ($S_G \geq S_T$), the impact to community for supporting the terrorist when government heightens security is high ($S_E \geq S_W$), and when the cost of defense is high, and the cost of engaging the community to the government is low ($C_D \geq -V_G + C_E$), the government will engage the community, and the community will support the government.
4. When the impact to community for supporting government when government heightens security is low ($S_G < S_T$), the impact to community for supporting the terrorist when government heightens security is low ($S_E < S_W$), and when the cost of defense is high, and the cost of engaging the community to the government is low ($C_D \geq max\{-H_G + C_E - J_G, -H_G + C_D\}$), the government will engage the community and the community will support the terrorist.

Considering that this subgame is a sequential game where the community is aware of the government's moves before their move is selected, the most desirable outcomes for the government will be the strategy where the community supports the government regardless of the government's move. Hence, the most desirable equilibrium for the government will be where the community supports the government [H, SG] and [EC, SG]. Additionally, [H, SG] and [EC, SG] will be desirable equilibria provided the conditions in Table 5 for these cases are met.

For the community, the most desirable equilibrium will be the one where the least damage to the community is achieved. Hence, the equilibrium for the community will be [H, SG], [H, ST], [EC, SG], and [EG, ST] where the community supports either the

terrorist or the government depending on how the decision of either player affects the community provided the conditions in *Table5* for these cases are met.

Then, we consider a simultaneous game as shown in Table 4.5 where neither player knows the moves of the other player, both players' moves are made simultaneously solely based on the best outcome for the individual player regardless of the other player's move. We use best response analysis to find the equilibrium. First, we evaluate the player's payoffs from the government's perspective. Then, we evaluate the payoffs from the community's perspective.

Table 4.5
Payoffs of the Simultaneous Subgame between the Government (G) and the Community (C)

G	**C**	
	Support Government (SG)	Support Terrorist (ST)
Heighten Security (H)	$[-C_D, S_G]$	$[-J_G - C_D, S_T]$
Engage Community (EC)	$[V_G - C_E, S_E]$	$[-H_G - C_E, S_W]$

Table 4.6
Possible Equilibria for Simultaneous Subgame between Government and Community

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[H, SG]	$[-C_D, S_G]$	$\{C_D \leq -V_G + C_E, S_G \geq S_T, S_E \geq S_W\}$
2	[H, ST]	$[-J_G - C_D, S_T]$	$\{C_D \leq H_G + C_E - J_G, S_G < S_T, S_E < S_W\}$
3	[EC, SG]	$[V_G - C_E, S_E]$	$\{C_D > -V_G + C_E, S_G \geq S_T, S_E \geq S_W\}$
4	[EC, ST]	$[-H_G - C_E, S_W]$	$\{C_D > H_G + C_E - J_G, S_G < S_T, S_E < S_W\}$

Simultaneous Game Solution

In the simultaneous game, from solving the subgame between the government and community, all four cases present feasible equilibrium provided the conditions are met (as shown Table 4.6 and 4.5).

1. When the impact to community for supporting government when government heightens security is high ($S_G \geq S_T$), the impact to community for supporting the government when government engages the community is high ($S_E \geq S_W$), and when the cost of defense is low, the cost of engaging the community to the government is high ($C_D < -V_G + C_E$), the government will heighten security and community will support the government.
2. When the impact to community for supporting government when government heightens security is low ($S_G < S_T$), the impact to community for supporting the terrorist when government engages the community is high ($S_E < S_W$), the cost of defense is low, and the cost of engaging the community to the government are

high ($C_D < H_G + C_E - J_G$, the government will heighten security and community will support the terrorist.

3. When the impact to community for supporting government when government heightens security is high ($S_G \geq S_T$), the impact to community for supporting the terrorist when government engages the community is low ($S_E \geq S_W$), the cost of defense is high, and the cost of engaging the community to the government are low ($C_D \geq -V_G + C_E$), the government will engage the community, and the community will support the government.
4. When the impact to community for supporting government when government heightens security is low ($S_G < S_T$), the impact to community for supporting the terrorist when government engages the community is high ($S_E < S_W$), the cost of defense is low, and the cost of engaging the community to the government are low ($C_D \geq -H_G + C_E - J_G$), the government will engage the community and the community will support the terrorist.

Considering that this subgame is a simultaneous game where the community is not aware of the government's moves before their move is selected, and both players select their moves at the same time. Similar to the sequential game, the most desirable outcomes for the government will be [H, SG], and [EC, SG] where the government takes an action to either heighten security or engage community provided the conditions in Table 4.6 for these cases are met. [EC, ST] is not a desirable equilibrium for the government since when the government engages the community, the community prefers to support the terrorist to receive a higher payoff than otherwise which is not desirable to the government under the given conditions. [H, ST] is not a desirable equilibrium for the government since when the government heightens security, the community prefer to support the terrorist to receive a higher payoff than otherwise under the given conditions.

For the community, the most desirable equilibrium will be the one where the least damage to the community is achieved. Hence, the desirable equilibrium for the community will be [H, SG], [EC, SG], and [EG, ST] where the community supports either the terrorist or the provided the conditions in Table 7 for these cases are met. [EC, ST] is not a desirable equilibrium for the government since when the government engages the community, the community prefer to support the terrorist to receive a higher payoff than otherwise which is not desirable to the government under the given conditions. [H, ST] is not a desirable equilibrium for the community since if the government chooses to heighten security, the community will be at a loss if they support the terrorist especially if the terrorist does not attack. Hence, the community will prefer to support the government to receive a higher payoff than otherwise under the given conditions.

Comparing the Possible Equilibria for the Sequential and Simultaneous Subgame between the Government and Terrorist

While comparing the payoffs for the sequential and simultaneous subgames between the government and community, we notice that the conditions for possible equilibrium for all cases exists under one set of conditions in the simultaneous game. However, there are two sets of conditions to achieve the given payoffs for all cases in the sequential game. This indicates that the both players, are more likely to reach their desired outcome in the sequential game than in the simultaneous game. Therefore, we recommend that the government announce their strategy to the community rather than keep their strategy unknown to the community to better reach their desired outcome vice versa.

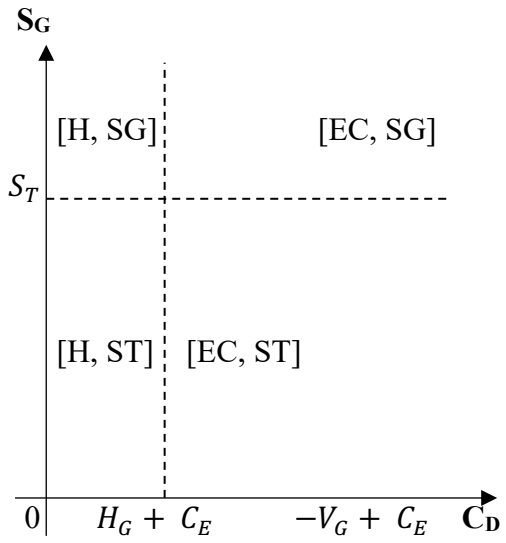

Figure 4.4. Four Possible Equilibria (as specified in Table 4.6) for subgame between Government and Terrorist as a Function of C_D and S_G

Community and Terrorist

In this sequential game, the community makes the first move, and the terrorist is aware of the government's move before their move is made. When the community supports government (SG), the payoffs are $-I_C$ or X_C depending on if the terrorist attacks or not, respectively. When the community supports terrorist (ST), the payoffs are T_C and $-P_C$ depending on if the terrorist attacks or not, respectively. On the other hand, the terrorist payoffs are $K_T - C_A$ or 0 depending on if they attack or not, respectively, when the community supports the government. Likewise, the terrorist payoffs are $B_T - C_A$ or 0 depending on if they attack or not respectively, when the community supports the terrorist.

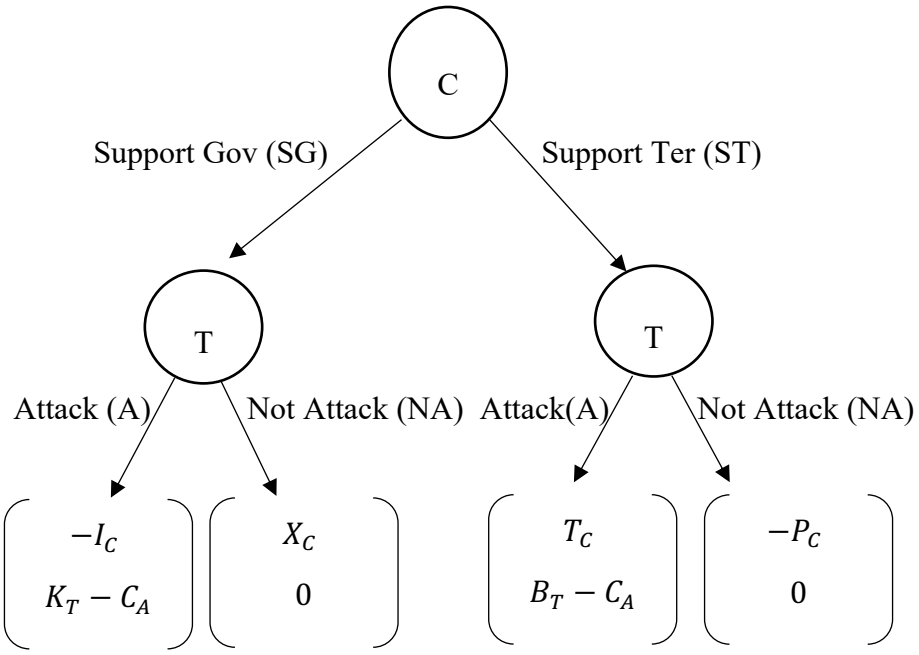

Figure 4.5. Game Tree of the Sequential Subgame between the Community (C) and the Terrorist (T).

Table 4.7
Possible Equilibria for Subgame between Community and Terrorist

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[SG, A]	$[-I_C, K_T - C_A]$	$\{C_A < min\{K_T, B_T\}, I_C < -T_C\}$ or $\{B_T \leq C_A < K_T, I_C < P_C\}$
2	[SG, NA]	$[X_C, 0]$	$\{K_T \leq C_A < B_T, X_C > T_C\}$ or $\{C_A \geq max\{K_T, B_T\}, X_C > -P_C\}$
3	[ST, A]	$[T_C, B_T - C_A]$	$\{\{C_A < max\{K_T, B_T\}, I_C > -T_C\}$ or $\{K_T \leq C_A < B_T, X_C < T_C\}$
4	[ST, NA]	$[-P_C, 0]$	$\{K_T > C_A \geq B_T, I_C > P_C\}$ or $\{C_A \geq max\{K_T, B_T\}, X_C < -P_C\}$

Sequential Game Solution

In the sequential game, from solving the subgame between the community and terrorist, all four cases present feasible equilibria provided the conditions are met. (as shown in Table 4.7 and Figure 4.5) They are:

1. When the cost of attack is low ($C_A < K_T$), and the impact to the community for supporting the government when terrorist attacks is low ($I_C < -T_C$), community will support government and terrorist will attack.
2. When the cost of attack is medium ($K_T \leq C_A < B_T$) and the impact to the community for supporting the terrorist when terrorist attacks is low ($X_C \geq T_C$), or when the cost of attack is high ($C_A \geq max\ \{K_T, B_T\}$), and the benefit to the community for supporting the government when terrorist does not attack is high ($X_C \geq -P_C$), community will support government and terrorist will not attack.
3. When the cost of attack is low ($C_A < K_T$), and the impact to the community for supporting the government when terrorist attacks is high ($I_C \geq -T_C$), community will support terrorist and terrorist will attack.
4. When the cost of attack is medium ($K_T > C_A \geq B_T$) and the impact to the community for supporting the government when terrorist attacks is high ($I_C \geq P_C$), or when the cost of attack is high ($C_A > max\ \{K_T, B_T\}$), and the benefit to the community for supporting the terrorist when terrorist does not attack is low ($X_C > -P_C$), community will support terrorist and terrorist will not attack.

Considering that this subgame is a sequential game where the terrorist is aware of the community's moves before their move is selected, the most desirable outcomes for the community will be the one that minimizes the impact of the damage to the community by the terrorist. Hence, the most desirable equilibrium for the community will

be [SG, NA] and [ST, NA] where the community supports either the government or terrorist provided the terrorist does not attack provided the conditions in Table 4.7 for these cases are met. [SG, A] will not be a desirable equilibrium for the community since when the community supports government, the terrorist will prefer to attack to obtain a higher payoff than otherwise which is not desirable to the community under the given conditions. [ST, A] will not be a desirable equilibrium for the community since when the community supports terrorist, the terrorist will prefer to attack to obtain a higher payoff than otherwise which is not desirable to the community under the given conditions.

For the terrorist, the most desirable equilibrium will be the one where the most damage to the community is achieved. Hence, the equilibrium for the terrorist will be [SG, A] and [ST, A] where the terrorist attacks provided the conditions in Table 4.7 for these cases are met. [SG, NA] will not be a desirable equilibrium for the terrorist since when the community supports government, the terrorist will prefer not to attack to obtain a higher payoff than otherwise which is not desirable to the terrorist under the given conditions. [ST, NA] will not be a desirable equilibrium for the terrorist since when the community supports terrorist, the terrorist will prefer not to attack to obtain a higher payoff than otherwise which is not desirable to the terrorist under the given conditions.

Next, we consider a simultaneous game, using the best response analysis to find the equilibrium. First, we evaluate the player's payoffs from the community's perspective then, we evaluate the payoffs from the terrorist's perspective.

Table 4.8
Payoffs of the Simultaneous Subgame between the Community and the Terrorist

C	**T**	
	Attack (A)	Not Attack (NA)
Support Government (SG)	$[-I_C, K_T - C_A]$	$[X_C, 0]$
Support Terrorist (ST)	$[T_C, B_T - C_A]$	$[-P_C, 0]$

The community chooses to support government if $-I_C \geq T_C$ and the terrorist chooses to attack if $K_T - C_A \geq 0$

The community chooses to support government if $X_C > -P_C$ and the terrorist chooses not to attack if $K_T - C_A < 0$

The community chooses to support terrorist if $-I_C < T_C$ and the terrorist chooses to attack if $B_T - C_A > 0$

The community chooses to support terrorist if $X_C < -P_C$ and the terrorist chooses not to attack if $B_T - C_A < 0$

Table 4.9
Possible Equilibria for Simultaneous Subgame between Community and Terrorist

Cases	**Strategies**	**Payoffs**	**Conditions**
1	[SG, A]	$[-I_C, K_T - C_A]$	$\{C_A < K_T, I_C < -T_C\}$
2	[SG, NA]	$[X_C, 0]$	$\{C_A \geq K_T, X_C \geq -P_C\}$
3	[ST, A]	$[T_C, B_T - C_A]$	$\{C_A < B_T, I_C \geq -T_C\}$
4	[ST, NA]	$[-P_C, 0]$	$\{C_A \geq B_T, X_C < -P_C\}$

Simultaneous Game Solution

In the simultaneous game, from solving the subgame between the community and terrorist above, all four cases present feasible equilibrium provided the conditions are met (as shown in Table 4.9 and Figure 4.8). They are:

1. When the cost of attack is low ($C_A < K_T$), and the impact to the community for supporting the government when terrorist attacks is low ($I_C > -T_C$), community will support government and terrorist will attack.
2. When the cost of attack is high ($C_A \geq K_T$) and the benefit to the community for supporting the terrorist when terrorist does not attack is high ($X_C \geq -P_C$), community will support government and terrorist will not attack.
3. When the cost of attack is low ($C_A < B_T$), and the impact to the community for supporting the government when terrorist attacks is high ($I_C \geq -T_C$), community will support terrorist and terrorist will attack.
4. When the cost of attack is high ($C_A \geq B_T$),), and the benefit to the community for supporting the terrorist when terrorist does not attack is low ($X_C < -P_C$), community will support terrorist and terrorist will not attack.

The most desirable equilibrium for the community will be [SG, NA] and [ST, NA] where the terrorist does not attack provided the conditions in Table 4.9 for these cases are met. [SG, A] will not be a desirable equilibrium for the community since when the community supports government, the terrorist will prefer to attack to obtain a higher payoff than otherwise which is not desirable to the community under the given conditions. [ST, A] will not be a desirable equilibrium for the community since when the community supports terrorist, the terrorist will prefer to attack to obtain a higher payoff than otherwise which is not desirable to the community under the given conditions.

For the terrorist, the most desirable equilibrium will be the one where the most damage to the community is achieved. Hence, the equilibrium for the terrorist will be [SG, A] and [ST, A] where the terrorist attacks provided the conditions in Table 4.9 for these cases are met. [SG, NA] will not be a desirable equilibrium for the terrorist since when the community supports government, the terrorist will prefer not to attack to obtain a higher payoff than otherwise which is not desirable to the terrorist under the given conditions. [ST, NA] will not be a desirable equilibrium for the terrorist since when the community supports terrorist, the terrorist will prefer not to attack to obtain a higher payoff than otherwise which is not desirable to the terrorist under the given conditions.

Comparing the Possible Equilibria for the Sequential and Simultaneous Subgame between the Community and Terrorist

While comparing the payoffs for the sequential and simultaneous subgames between the community and terrorist, we notice that the conditions for possible equilibrium for all cases exists under one set of conditions in the simultaneous game. However, there are two sets of conditions to achieve the given payoffs for all cases in the sequential game. This indicates that the both players, are more likely to reach their desired outcome in the sequential game than in the simultaneous game. Therefore, we recommend that the community make their strategy publicly available rather than keep their strategy unknown to the terrorist to better reach their desired outcome vice versa.

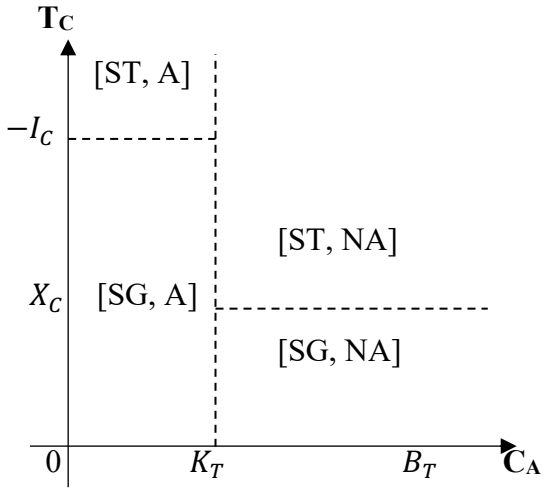

Figure 4.6. Equations of Community and Terrorist Sequential Game as a Function of C_A and T_C

Mixed Strategy Nash Equilibrium

Government and Terrorist

In the following section, we consider mixed strategies for the government and the terrorist.

Table 4.10
Payoff for the Simultaneous Subgame between the Government (G) and the Terrorist (T)

G (Player 1)	**T (Player 2)**	
	Attack (A)	Not Attack (NA)
Heighten Security (H)	$[-L_G - C_D, L_T + MC - C_A]$	$[-C_D, 0]$
Engage Community (EC)	$[-I_G - C_E,\ L_T + O_T + MC - C_A]$	$[-C_E, 0]$

An equilibrium support is a set of actions that occur with positive probabilities.

Assume the support is all of the actions: [H, EC] and [A, NA]. Given that support, the mixed strategy equilibrium is calculated. First, we assume that the terrorist attacks (A), with the probability P and does not attack with the probability $1 - P$. The rationale behind this probability is that the terrorist has chosen these probabilities in a way where the government is indifferent between their own actions [H, EC] regardless of the terrorist's decision. Equation (5) shows that the government's utility of heightening security equals the government's utility of engaging the community when the terrorist plays their mixed strategy with probabilities (P, 1 – P).

U_G [H, $(P, 1 - P)$] = U_G [EC, $(P, 1 - P)$] (6)

$$P(-L_G - C_D) + (1 - P)(-C_D) = P(-I_G - C_E) + (1 - P)(-C_E) \quad (7)$$

$$P = \frac{C_D - C_E}{I_G - L_G} \quad (8)$$

This implies that the only way the government can be indifferent about either heightening security or engaging community when the terrorist decides to play their mixed strategy is if $P = \frac{C_D - C_E}{I_G - L_G}$.

Similarly, the government must randomize to make the terrorist indifferent regarding their moves. We assume that the government heightens security (H) with the probability Q and the government engages the community (EC) with probability $1 - Q$. Equation (9) shows that the terrorist's utility of attacking equals the terrorist's utility of not attacking when the government plays their mixed strategy with probabilities (Q, 1 – Q).

U_T [(Q, 1 – Q), A] = U_T [(Q, 1 – Q), NA] (10)

$$Q\,(L_T + MC - C_A) + (1 - Q)\,(L_T + O_T + MC - C_A) = Q\,(0) + (1 - Q)\,(0) \quad (11)$$

$$Q = \frac{L_T + O_T + MC - C_A}{O_T} \quad (12)$$

This implies that the only way the terrorist can be indifferent between either attacking or not attacking when the government plays their mixed strategy is if $Q = \frac{L_T+O_T+MC-C_A}{O_T}$.

So, the mixed strategies $\left[\frac{L_T+O_T+MC-C_A}{O_T}, \frac{C_D-C_E}{I_G-L_G}\right]$ is the equilibrium.

Solving the Subgame between Government and Terrorist

For the terrorist, if P is greater than 1 – P, the terrorist is more likely to attack. When $C_D \geq C_E$, from Equation (13), if the defense cost (C_D) is high, then the probability of an attack by the terrorist is high since the government is less likely to invest in heightening security. On the other hand, when $C_D < C_E$, if the engagement cost (C_E) is high, then the probability of an attack by the terrorist is low since the government will more likely choose to heighten security. If the impact to the government for engaging the community when the terrorist attacks (I_G) is positive, then the probability of an attack by the terrorist will be low since the community will become allies of the government rather than allies to the terrorist. Likewise, if the loss from the terrorist attack (L_G) is high, the probability of an attack by the terrorist will be high because the terrorist aim to maximize damage.

For the government, if Q is greater than $1 - Q$, the government is more likely to heighten security. From Equation (14) for Q to have a definite value, $L_T + O_T + MC - C_A$ and O_T should be greater or less than zero simultaneously. If $L_T + O_T + MC - C_A$ is low then the probability Q of the government heightening security will be high which is somewhat counter intuitive since the government is more likely to engage the community if a terrorist attack will have the greater impact. If $L_T + O_T + MC - C_A \geq 0$, the terrorist will attack, and if $L_T + O_T + MC - C_A \leq 0$, the terrorist will not attack.

Community and Terrorist

In the following section, we consider mixed strategies for the community and terrorist.

Table 4.11
Payoff of the Simultaneous Subgame between the Community (C) and the Terrorist (T)

	T (Player 2)	
C (Player 1)	Attack (A)	Not Attack (NA)
Support Government (SG)	$[-I_C, K_T - C_A]$	$[X_C, 0]$
Support Terrorist (ST)	$[T_C, B_T - C_A]$	$[-P_C, 0]$

Assume the support is all of the actions: [SG, ST] and [A, NA]. Given that support, the mixed strategy equilibrium is calculated. First, we assume that the terrorist attacks (A) with the probability P and does not attack with the probability $1- P$. The rationale behind this probability is that the terrorist has chosen these probabilities in a way where the community is indifferent between their own actions [SG, ST]. Equation (15) shows that the community's utility (U_C) of supporting the government equals the community's utility of supporting the terrorist when the terrorist plays their mixed strategy with the probabilities $(P, 1 - P)$.

U_C [SG, (P, 1 – P)] = U_C [ST, (P, 1 – P)] (16)

$$P(-I_C) + (1 - P)(X_C) = P(T_C) + (1 - P)(-P_C) \quad (17)$$

$$P = \frac{P_C + X_C}{I_C + T_C + P_C + X_C} \quad (18)$$

This implies that the only way the community can be indifferent between either supporting the government or supporting the terrorist when the terrorist decides to play their mixed strategy is if $P = \frac{P_C+X_C}{I_C+T_C+P_C+X_C}$.

Similarly, the community must randomize to make the terrorist indifferent regarding their moves. We assume that the community supports the government (SG) with the probability Q and the community supports the terrorists (ST) with probability $1 - Q$. Equation (19) shows that the terrorist's utility of attacking equals the terrorist's utility of not attacking when the community plays their mixed strategies with the probabilities $(Q, 1 - Q)$.

U_T [(Q, 1 – Q), A] = U_T [(Q, 1 – Q), NA] (20)

$Q(K_T - C_A) + (1 - Q)(B_T - C_A) = Q(0) + (1 - Q)(0)$ (21)

$Q = \frac{C_A-B_T}{K_T-B_T}$ (22)

This implies that the only way the terrorist can be indifferent between either attacking or not attacking regardless of the community's decision, is if $Q = \frac{C_A-B_T}{K_T-B_T}$. The equilibrium exists under that probability condition.

So, the mixed strategies $\left[\frac{C_A-B_T}{K_T-B_T}, \frac{P_C+X_C}{I_C+T_C+P_C+X_C}\right]$ is the equilibrium.

Solving the Subgame between Community and Terrorist

For the terrorist, if (P) is greater than (1 – P), the terrorist is more likely to attack. From Equation (23), when the loss to the community for supporting the terrorist when the terrorist does not attack (P_C) is high, then the probability of an attack by the terrorist is high since the terrorist will prefer to attack to gain the support of the community, and cause maximum damage to the government. On the other hand, when the loss to the community for supporting the terrorist when the terrorist does not attack (P_C) is low, then the probability of an attack by the terrorist is low. Likewise, the probability of an attack *P*

will be high provided, the impact to the community for supporting the terrorist when the terrorist attacks (T_C) is positive.

For the community, if Q is greater than $(1 - Q)$, the community is more likely to support the government. From Equation (24), when $C_A \geq B_T$, the attack cost (C_A) is high, then the probability of the community supporting the government will be high since the terrorist will be less likely to attack. On the other hand, when $C_A < B_T$, when the attack cost (C_A) is low, the probability of the community supporting the government will be low since the terrorist will be more likely to attack. Likewise, if the impact on the terrorist when the community supports the government and the terrorist attacks (K_T) is high ($K_T > B_T$,), the probability of an attack by the terrorist will be low, and the community will support the government.

Government and Community

In the following section, we consider mixed strategies for the government and community.

Table 4.12
Payoff for the Simultaneous Subgame between the Government (G) and the Community (C)

	C (Player 2)	
G (Player 1)	Support Government (SG)	Support Terrorist (ST)
Heighten Security (H)	$[-C_D, S_G]$	$[-J_G - C_D, S_T]$
Engage Community (EC)	$[V_G - C_E, S_E]$	$[-H_G - C_E, S_W]$

Assume the support is all of the actions: [H, EC] and [SG, ST]. Given that support, the mixed strategy equilibrium will be calculated. First, we assume that the community supports government (SG), with the probability K and the community supports terrorist (ST) with the probability $1- K$. The rationale behind this probability is that the terrorist has chosen these probabilities in a way where the government is indifferent between their own actions [H, EC] regardless of the community's decision. Equation (25) shows that the government's utility (U_G) of heightening security equals the government's utility of engaging community when the community plays their mixed strategy with probabilities (K, 1 – K).

$$U_G [H, (K, 1 – K)] = U_G [EC, (K, 1 – K)] \quad (26)$$

$$K(-C_D) + (1 - K)(-J_G - C_D) = K(V_G - C_E) + (1 - K)(-H_G - C_E) \quad (27)$$

$$K = \frac{H_G + C_E - J_G - C_D}{-J_G + V_G - H_G} \quad (28)$$

This implies that the only way the government can be indifferent between either heightening security or engaging community when the community decides to play their mixed strategy is if $K = \frac{H_G + C_E - J_G - C_D}{-J_G + V_G - H_G}$. Similarly, the government must randomize to make the community indifferent regarding their moves. We assume that the government heightens security (H) with the probability R and engages community (EC) with probability $1 - R$. Equation (29) shows that the community's utility of supporting the government equals the community's utility of supporting the terrorist when the government plays their mixed strategies with the probabilities $(R, 1 - R)$.

$$U_C [(R, 1 – R), SG] = U_C [(R, 1 – R), ST] \quad (30)$$

$$R(S_G) + (1 - R)(S_E) = R(S_T) + (1 - R)(S_W) \quad (31)$$

$$R = \frac{S_W - S_E}{S_G - S_E - S_T + S_W} \quad (32)$$

This implies that the only way the terrorist can be indifferent between either supporting the government or supporting the terrorist, is if $R = \frac{S_W - S_E}{S_G - S_E - S_T + S_W}$. The equilibrium exists under that probability condition.

So, the mixed strategies $\left[\frac{S_W - S_E}{S_G - S_E - S_T + S_W}, \frac{H_G + C_E - J_G - C_D}{C_G - J_G + V_G - H_G}\right]$ is the equilibrium.

Solving the Subgame between Government and Community

For the community, if K is greater than $1 - K$, the community is more likely to support the government. When $C_E \geq C_D$, from Equation (33), the cost of community engagement is high, so the community is less likely to support the government. On the other hand, when $C_E < C_D$, the cost of community engagement is low, so the community is more likely to support the government. Likewise, the probability of supporting the terrorist, $1 - K$ will be high provided the loss to the government when the government engages community and the community supports the terrorist (H_G) is low.

For the government, if R is greater than $(1 - R)$, the government is more likely to heighten security. From Equation (34) when $S_W > S_E$, if the impact to the community when the government engages community (S_W) is high, then the probability of the government heightening security will be low, and the community will support the government. On the other hand, when $S_E > S_W$, the impact to the community when the government engages community (S_W) is low, then the probability of the government heightening security will be high. Likewise, if the impact to community for supporting the government when government heightens security (S_G) is high, the probability of the community supporting the government will be low.

Three Player Game

The three-player game will be solved using backward induction. Hence, we begin solving from the terrorist's decision to attack or not attack in stage 3 to followed by the decision of the community in stage 2 to support the government or support the terrorist then, the decision of the government in stage 1 to either heighten security or engage community. See Figure 4.7

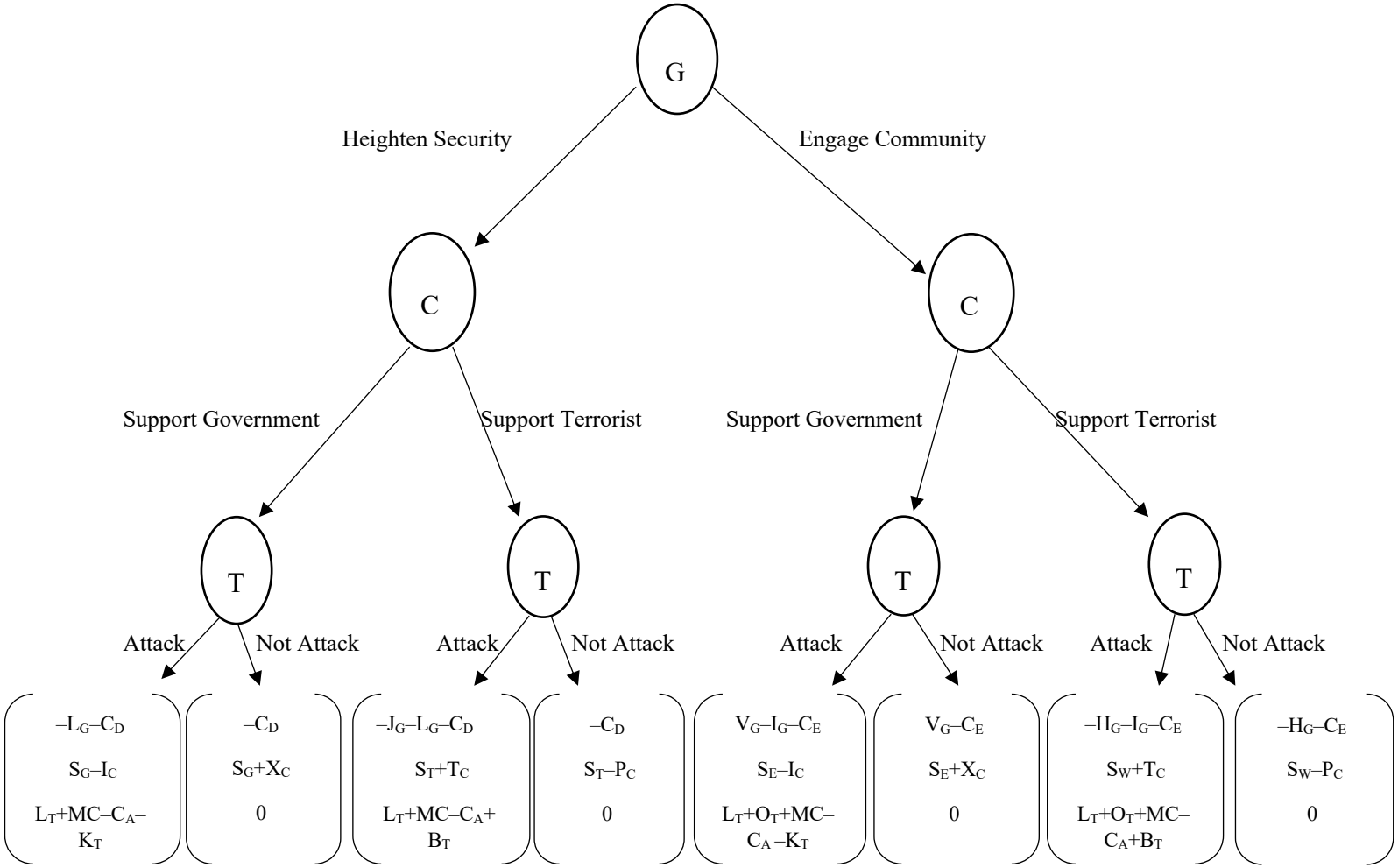

Figure 4.7. Three-Player Game Tree

Table 4.13
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
1	H – SG – A	$[-L_G - C_D, S_G - I_C, L_T + MC - C_A - K_T]$	[$C_A \leq \min$ {L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T}, $S_G >$ S_T+T_C+I_C, $S_W < S_E$–I_C–T_C, $C_D <$ – V_G+I_G+C_E–L_G], [$C_A \leq$ min{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T}, $C_A \geq$ L_T+O_T+MC+B_T, $S_G > S_T$+T_C+I_C, $S_W < S_E$– I_C+P_C, $C_D <$ –V_G+I_G+C_E–L_G], [$C_A \leq$ min{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC+B_T} and $C_A \geq$ L_T+O_T+MC–K_T, $S_G > S_T$+T_C+I_C, $S_W < S_E$+X_C–T_C, $C_D <$ – V_G+C_E–L_G], [$C_A \leq$ min{L_T+MC–K_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T}, and $C_A \geq$ L_T+MC+B_T, $S_G > S_T$–P_C+I_C, $S_W < S_E$–I_C–T_C, $C_D <$ –V_G+I_G+C_E–L_G], [$C_A \leq$ min{L_T+MC– K_T, L_T+MC+B_T}, $C_A \geq$ max{L_T+O_T+MC– K_T, L_T+O_T+MC+B_T}, $S_G < S_T$+T_C+I_C, $S_W \leq$ S_E+X_C+P_C, $C_D <$ –V_G+C_E–L_G], [$C_A \leq$ min{L_T+MC–K_T, L_T+O_T+MC–K_T}, and C_A $\geq$ max{L_T+O_T+MC+B_T, L_T+MC+B_T}, $S_G \geq$ S_T–P_C+I_C, $S_W < S_E$–I_C+P_C, $C_D <$ –V_G+I_G+C_E– L_G], [$C_A \leq$ min{L_T+MC–K_T,

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
1	H – SG – A	$[-L_G - C_D, S_G - I_C, L_T + MC - C_A - K_T]$	$L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E-L_G]$, $[C_A \leq L_T+MC-K_T$, and $C_A \geq \max \{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G > S_T-P_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E-L_G]$
2	H – SG – NA	$[-C_D, S_G + X_C, 0]$	$[C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+MC-K_T$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E]$, $[C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E]$, $[; C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max\{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E]$, $[C_A \leq \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E]$, $[C_A \leq L_T+MC+B_T$, and

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
2	H – SG – NA	$[-C_D, S_G + X_C, 0]$	$C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E$], [$C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E$], [$C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E$], [$C_A \geq \max\{L_T+MC-K_T, L_T+MC-B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T-P_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E$]
3	H – ST – A	$[[-J_G - L_G - C_D, S_T + T_C, L_T + MC - C_A + B_T]$	$L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq L_T+O_T+MC+B_T$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G-J_G+C_E-L_G$], [$C_A \leq \min\{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+O_T+MC-K_T$, $S_G < S_T+T_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$], [$C_A \leq \min\{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
3	H – ST – A	$[[-J_G - L_G - C_D, S_T + T_C, L_T + MC - C_A + B_T]$	$C_A \geq L_T+MC+B_T$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D > H_G+I_G+C_E$], [$C_A \leq$ min {L_T+MC+B_T, $L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, and $C_A \geq L_T+MC-K_T$, $S_G < S_T+T_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D < H_G+I_G+C_E-J_G-L_G$], [$C_A \leq$ min {L_T+MC-K_T, L_T+MC+B_T}, $C_A \geq$ max {$L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, $S_G \geq S_T+T_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D < H_G-J_G+C_E-L_G$, [$C_A \leq$ min {L_T+MC+B_T, $L_T+O_T+MC-K_T$, and $C_A \geq$ max {L_T+MC-K_T, $L_T+O_T+MC+B_T$}, $S_G < S_T+T_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G-J_G+C_E-L_G$], [$C_A \leq$ min {L_T+MC+B_T, $L_T+O_T+MC+B_T$}, and $C_A \geq$ max {$L_T+O_T+MC-K_T$, L_T+MC-K_T}, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$], $C_A \leq L_T+MC+B_T$, and [$C_A \leq$ min {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C-T_C$, $C_D < H_G+I_G+C_E-J_G-L_G$],

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
3	H – ST – A	$[[-J_G - L_G - C_D, S_T + T_C, L_T + MC - C_A + B_T]$	[$C_A \leq \min\{L_T+MC-K_T, C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G-J_G+C_E-L_G$]
4	H – ST – NA	$[-C_D, S_T - P_C, 0]$	[$C_A \leq \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq L_T+MC+B_T$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$], [$C_A \leq \min\{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC-B_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G+C_E$], [$C_A \leq \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W \geq S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$], [$C_A \leq \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \{L_T+MC-K_T, L_T+MC-B_T\}$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D < H_G+I_G+C_E$], [$C_A \leq L_T+MC-K_T$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G+C_E$],

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
4	H – ST – NA	$[-C_D, S_T - P_C, 0]$	[$C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq$ max {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC+B_T$}, $S_G < S_T-P_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G+C_E$], [$C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq$ max {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC-K_T$), $S_G < S_T-P_C-X_C$, $S_W \geq S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$], [$C_A \geq$ max {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, $S_G < S_T-P_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G+C_E$]
5	EC – SG– A	$[V_G - I_G - C_E, S_E - I_C, L_T + O_T + MC - C_A - K_T]$	[$C_A \leq$ min {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E-L_G$], [$C_A \leq$ min {L_T+MC-K_T, L_T+MC+B_T, $L_T+O_T+MC-K_T$}, $C_A \geq$ max $L_T+O_T+MC+B_T$, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C+P_C$, $C_D > -V_G+I_G+C_E-L_G$], [$C_A \leq$ min {L_T+MC-K_T, $L_T+O_T+MC-K_T$, $L_T+O_T+MC+B_T$}, and $C_A \geq$ max L_T+MC+B_T, $S_G > S_T-P_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E-L_G$],

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
5	EC – SG– A	$[V_G - I_G - C_E, S_E - I_C, L_T + O_T + MC - C_A - K_T]$	[$C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+MC–K_T$, $S_G \geq S_T+T_C–X_C$, $S_W < S_E–I_C–T_C$, $C_D > –V_G+I_G+C_E$], [$C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC–K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T, L_T+MC–B_T\}$, $S_G \geq S_T–P_C+I_C$, $S_W < S_E–I_C+P_C$, $C_D > –V_G+I_G+C_E–L_G$], [$C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC–K_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, $S_G \geq S_T+T_C–X_C$, $S_W < S_E–I_C+P_C$, $C_D > –V_G+I_G+C_E$], [$C_A \leq \min \{L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC–K_T, L_T+MC+B_T\}$, $S_G \geq S_T–P_C–X_C$, $S_W < S_E–I_C–T_C$, $C_D > –V_G+I_G+C_E$], [$C_A \leq L_T+O_T+MC–K_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $S_G \geq S_T–P_C–X_C$, $S_W < S_E–I_C+P_C$, $C_D > –V_G+I_G+C_E$]
6	EC – SG– NA	$[V_G - C_E, S_E + X_C, 0]$	[$C_A \leq \min \{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq L_T+O_T+MC–K_T$,

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
6	EC – SG– NA	$[V_G - C_E, S_E + X_C, 0]$	$S_G > S_T+T_C+I_C$, $S_W < S_E+X_C–T_C$, $C_D > –V_G+C_E–L_G$], [$C_A \leq$ min $\{L_T+MC–K_T, L_T+MC+B_T\}$, $C_A \geq$ max $\{L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C+I_C$, $S_W \leq S_E+X_C+P_C$, $C_D > –V_G+C_E–L_G$], [$C_A \leq$ min $\{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$ max $\{L_T+MC+B_T, L_T+O_T+MC–K_T\}$, $S_G \geq S_T–P_C+I_C$, $S_W < S_E+X_C–T_C$, $C_D > –V_G+C_E–L_G$], [$C_A \leq$ min $\{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$ max $\{L_T+O_T+MC–K_T, L_T+MC–K_T\}$, $S_G \geq S_T+T_C–X_C$, $S_W < S_E+X_C–T_C$, $C_D > –V_G+C_E$], [$C_A \leq L_T+MC–K_T$, and $C_A \geq$ max $\{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC–K_T\}$, $S_G > S_T–P_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D > –V_G+C_E–L_G$], [$C_A \leq L_T+MC+B_T$, and $C_A \geq$ max $\{L_T+MC–K_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C–X_C$, $S_W < S_E+X_C+P_C$, $C_D > –V_G+C_E$], [$C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq$ max $\{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T$), $S_G \geq S_T–$

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

6	EC – SG– NA	$[V_G - C_E, S_E + X_C, 0]$	$P_C - X_C$, $S_W < S_E + X_C - T_C$, $C_D > -V_G + C_E$], [$C_A \geq \max\{L_T + MC - K_T, L_T + MC - B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$, $S_G > S_T - P_C - X_C$, $S_W < S_E + X_C + P_C$, $C_D > -V_G + C_E$]
7	EC – ST– A	$[-H_G - I_G - C_E, S_W + T_C, L_T + O_T + MC - C_A + B_T]$	[$C_A \leq \min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$, $S_G < S_T + T_C + I_C$, $S_W > S_E - I_C - T_C$, $C_D > H_G + I_G + C_E - J_G - L_G$], [$C_A \leq \min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\}$, $C_A \geq L_T + O_T + MC - K_T$, $S_G < S_T + T_C + I_C$, $S_W > S_E + X_C - T_C$, $C_D > H_G + I_G + C_E - J_G - L_G$], [$C_A \leq \min\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$, and $C_A \geq L_T + MC - K_T$, $S_G < S_T + T_C - X_C$, $S_W \geq S_E - I_C - T_C$, $C_D > -H_G + I_G + C_E - J_G - L_G$], [$C_A \leq \min\{L_T + MC - K_T, L_T + O_T + MC + B_T\}$, and $C_A \geq \max\{L_T + MC + B_T, L_T + O_T + MC - K_T\}$, $S_G < S_T - P_C + I_C$, $S_W \geq S_E + X_C - T_C$, $C_D > H_G + I_G + C_E$], [$C_A \leq \min\{L_T + MC + B_T, L_T + O_T + MC + B_T\}$, and $C_A \geq \max\{L_T + O_T + MC - K_T, L_T + MC - K_T\}$, $S_G < S_T + T_C - X_C$, $S_W > S_E + X_C - T_C$, $C_D > H_G + I_G + C_E - J_G - L_G$],

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	**Equilibrium**	**Payoffs**	**Conditions**
7	EC – ST– A	$[-H_G - I_G - C_E, S_W + T_C, L_T + O_T + MC - C_A + B_T]$	[$C_A \leq \min$ {L_T+O_T+MC–K_T, L_T+O_T+MC+B_T}, and $C_A \geq \max$ {L_T+MC–K_T, L_T+MC+B_T}, $S_G < S_T$–P_C–X_C, $S_W \geq S_E$–I_C–T_C, $C_D > H_G$+I_G+C_E], [$C_A \leq$ L_T+O_T+MC+B_T, and $C_A \geq \max$ {L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T), $S_G < S_T$–P_C–X_C, $S_W \geq S_E$+X_C–T_C, $C_D > H_G$+I_G+C_E]
8	EC – ST– NA	$[-H_G - C_E, S_W - P_C, 0]$	[$C_A \leq \min$ {L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T}, $C_A \geq L_T$+O_T+MC+B_T, $S_G < S_T$+T_C+I_C, $S_W > S_E$–I_C+P_C, $C_D > H_G$–J_G +C_E–L_G], [$C_A \leq \min$ {L_T+MC–K_T, L_T+MC+B_T}, $C_A \geq \max$ {L_T+O_T+MC–K_T, L_T+O_T+MC+B_T}, $S_G < S_T$+T_C+I_C, $S_W >$ S_E+$X_C$$-P_C$, $C_D > H_G$–J_G +C_E–L_G], [$C_A \leq \min$ {L_T+MC–K_T, L_T+O_T+MC–K_T}, and $C_A \geq$ $\max$ {L_T+O_T+MC+B_T, L_T+MC+B_T}, $S_G <$ S_T–P_C+I_C, $S_W > S_E$–I_C+P_C, $C_D > H_G$+C_E], [C_A $\leq \min$ {L_T+MC+B_T, L_T+O_T+MC–K_T}, and $C_A \geq \max$ {L_T+MC–K_T, L_T+O_T+MC+B_T}, $S_G < S_T$+T_C–X_C, $S_W > S_E$–I_C+P_C, $C_D > H_G$–J_G +C_E–L_G], [$C_A \leq L_T$+MC–K_T,

Table 4.13, cont'd
Possible Equilibria for the Three-Player game between the Government (G), the Community (C), and Terrorist (T)

Cases	Equilibrium	Payoffs	Conditions
8	EC – ST– NA	$[-H_G - C_E, S_W - P_C, 0]$	and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G+C_E$], [$C_A \leq L_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G-J_G+C_E-L_G$], [$C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D > H_G+C_E$], [$C_A \geq \max\{L_T+MC-K_T, L_T+MC-B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G+C_E$]

Three Player Game Solution

In the sequential game, from solving the three-player game between the government, community, and terrorist, all eight cases present feasible equilibria provided the conditions are met. They are:

1. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC+B_T, L_T + O_T + MC-K_T, L_T + O_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + MC+B_T, L_T + O_T + MC-K_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T +$

$MC+B_T, L_T + O_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + O_T +$ $MC- K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > \{S_T + T_C + I_C, S_T - P_C + I_C\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government $\left(S_W < \{S_E - I_C - T_C, S_E - I_C + P_{C,} S_E+X_C - T_C\}\right)$, and the cost of defense is low ($C_D < \{-V_G + I_G + C_E- L_G, -V_G + C_E- L_G\}$), and when the cost of attack is medium ($L_T + O_T + MC- K_T, L_T + O_T + MC + B_T \leq$ $C_A \leq L_T + MC + B_T, L_T + MC- K_T$), and ($L_T + O_T + MC + B_T, L_T + MC+B_T \leq$ $C_A \leq L_T + MC - K_T, L_T + O_T + MC - K_T$), and ($L_T + O_T + MC - K_T, L_T +$ $MC+B_T \leq C_A \leq L_T + MC - K_T, L_T + O_T + MC + B_T$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G \geq S_T - P_C + I_C$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < S_E - I_C + P_C$), and the cost of defense is low ($C_D < \{-V_G + I_G + C_E- L_{G,}- V_G + C_E- L_G\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC+B_T, L_T + O_T + MC- K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > S_T - P_C + I_C\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < S_E+X_C + P_C\}$), and the cost of defense is low ($C_D <- V_G + C_E- L_{G,}$), the government will heighten security, the community will support the government, and terrorist will attack.

2. When the cost of attack is low ($C_A \leq min\{L_T + MC+B_T, L_T + MC+B_T, L_T +$ $O_T + MC- K_T\}$) the impact to community of supporting government when

government heightens security is higher than that of supporting the terrorist ($S_G > S_T + T_C - X_C$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < S_E - I_C - T_C$), and the cost of defense is low ($C_D < -V_G + I_G + C_E - L_G$), and when the cost of attack is medium ($L_T + MC - K_T, L_T + MC + O_T + B_T \leq C_A \leq L_T + O_T + MC - K_T, L_T + MC + B_T$), and ($L_T + MC - K_T, L_T + MC + O_T - K_T \leq C_A \leq L_T + O_T + MC + B_T, L_T + MC + B_T$), and ($L_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + O_T + MC + B_T, L_T + MC + O_T - K_T$), and the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > S_T + T_C - X_C, S_T - P_C - X_C$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < S_E + X_C - T_C, S_E - I_C - T_C$), and the cost of defense is low ($C_D < \{-V_G + C_E, -V_G + C_E + I_{G,}\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC + B_T, L_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > \{S_T + T_C - X_C, S_T - P_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < \{S_E + X_C + P_C, S_E - I_C + P_C, S_E + X_C - T_C\}$), and the cost of defense is low ($C_D < \{-V_G + C_E, -V_G + C_E + I_{G,}\}$), the government will heighten security, the community will support the government, and terrorist will not attack.

3. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T$), and ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T$), and ($C_A \leq min\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T$), and ($C_A \leq min\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < \{S_T + T_C + I_C, S_T - P_C + I_C, S_T + T_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E - I_C - T_C, S_E - I_C + P_C, S_E + X_C - T_C$), and the cost of defense is low ($C_D < H_G + I_G + C_E - J_G - L_G, H_G + C_E - J_G - L_G, H_G + I_G + C_E$), and when the cost of attack is medium ($L_T + O_T + MC - K_T, L_T + MC + O_T + B_T \leq C_A \leq L_T + MC - K_T, L_T + MC + B_T$), and ($L_T + MC - K_T, L_T + MC + O_T + B_T \leq C_A \leq L_T + MC + O_T - K_T, L_T + MC + B_T$), and ($L_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + MC + O_T + B_T, L_T + MC + B_T$), and the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T + T_C - X_C$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E - I_C + P_C, S_E + X_C - T_C\}$), and the cost of defense is low ($C_D < H_G + C_E - J_G - L_{G,} H_G + I_G + C_E - J_G - L_G,$), and when the cost of attack is high ($C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T + T_C - X_C$), the impact to community of supporting the terrorist when government engages the community is

higher than of supporting the government ($S_W > S_E + X_C + P_C$), and the cost of defense is low ($C_D < H_G + I_G + C_E - J_G - L_G$), the government will heighten security, the community will support the terrorist, and terrorist will attack.

4. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T - P_C + I_C$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > S_E + X_C - T_C$), and the cost of defense is low ($C_D < H_G + I_G + C_E$), and when the cost of attack is medium ($L_T + MC + O_T + B_T, L_T + MC + B_T \leq C_A \leq L_T + MC - K_T, L_T + O_T + MC - K_T$), and ($L_T + MC + O_T - K_T, L_T + MC + B_T \leq C_A \leq L_T + MC - K_T, L_T + O_T + MC + B_T$), and ($L_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + O_T + MC - K_T, L_T + O_T + MC + B_T$), and the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T - P_C - X_C$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E + X_C - T_C, S_E - I_C - T_C\}$), and the cost of defense is low ($C_D < \{H_G + C_E, H_G + I_G + C_E\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T - P_C - X_C$), the impact to community of supporting the

terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E - I_C + P_C, S_E + X_C - T_C, S_E + X_C + P_C\}$), and the cost of defense is low ($C_D < \{H_G + C_E, H_G + I_G + C_E\}$), the government will heighten security, the community will support the terrorist, and terrorist will not attack.

5. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \leq min\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > \{S_T + T_C + I_C, S_T + T_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < \{S_E - I_C - T_C, S_E - I_C + P_C\}$), and the cost of defense is low ($C_D < \{-V_G + I_G + C_E - L_G, -V_G + I_G + C_E\}$), and when the cost of attack is medium ($L_T + MC + B_T, L_T + O_T + MC + B_T \leq C_A \leq L_T + O_T + MC - K_T, L_T + MC - K_T$), and ($L_T + O_T + MC + B_T, L_T + MC - K_T \leq C_A \leq L_T + MC + B_T, L_T + O_T + MC - K_T$), and ($L_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + O_T + MC - K_T, L_T + O_T + MC + B_T$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G \geq \{S_T - P_C + I_C, S_T + T_C - X_C, S_T - P_C - X_C,\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < \{S_E - I_C + P_C, S_E - I_C - T_C\}$), and the cost of defense is high ($C_D > \{-V_G + I_G + C_E - L_{G,} - V_G +$

$C_E - L_G$, $- V_G + I_G + C_E$}), and when the cost of attack is high ($C_A \geq max\{L_T + MC + B_T, L_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > S_T - P_C - X_C$}), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < S_E - I_C + P_C$), and the cost of defense is low ($C_D < - V_G + I_G + C_E$), the government will engage the community, the community will support the government, and terrorist will attack.

6. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > \{S_T + T_C + I_C\}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < \{S_E + X_C - T_C\}$), and the cost of defense is low ($C_D < \{- V_G + C_E - L_G, - V_G + I_G + C_E\}$), and when the cost of attack is medium ($L_T + O_T + MC - K_T, L_T + O_T + MC + B_T \leq C_A \leq L_T + MC + B_T, L_T + MC - K_T$), and ($L_T + MC + B_T, L_T + O_T + MC - K_T \leq C_A \leq L_T + MC - K_T, L_T + O_T + MC + B_T$), and ($L_T + MC - K_T, L_T + O_T + MC - K_T \leq C_A \leq L_T + MC + B_T, L_T + O_T + MC + B_T$), the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist ($S_G > \{S_T + T_C + I_C, S_T - P_C + I_C, S_T + T_C - X_C, \}$), the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government ($S_W < \{S_E + X_C + P_C, S_E + X_C - T_C\}$), and the cost of defense is high ($C_D > \{- V_G + C_E - L_{G,} - V_G + C_E\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq$

$max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\})$, and $(C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + MC + B_T\})$, and $(C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\})$, the impact to community of supporting government when government heightens security is higher than that of supporting the terrorist $(S_G \geq \{S_T - P_C - X_C, S_T + T_C - X_C\})$, the impact to community of supporting the terrorist when government engages the community is lower than of supporting the government $(S_W < \{S_E + X_C + P_C, S_E + X_C - T_C\})$, and the cost of defense is high $(C_D > -V_G + C_E - L_G, -V_G + C_E\})$, the government will engage the community, the community will support the government, and terrorist will not attack.

7. When the cost of attack is low $(C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T)$, and $(C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\})$, and $(C_A \leq min\{L_T + O_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T)$, and $(C_A \leq min\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T)$, the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist $(S_G < \{S_T + T_C + I_C, S_T + T_C - X_C, \})$, the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government $(S_W > \{S_E - I_C - T_C, S_E + X_C - T_C, \})$, and the cost of defense is high $(C_D > \{H_G + I_G + C_E - J_G - L_G, \})$, and when the cost of attack is medium $(L_T + O_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + MC - K_T, L_T + O_T + MC + B_T)$, and $(L_T + MC - K_T, L_T + MC + O_T - K_T \leq C_A \leq L_T + MC + O_T + B_T, L_T + MC + B_T)$, and $(L_T + MC - K_T, L_T + MC + B_T \leq C_A \leq L_T + MC + O_T - K_T, L_T + O_T + MC + B_T)$, and the impact to community of supporting government when government heightens security is lower than that of supporting

the terrorist ($S_G < \{S_T - P_C + I_C, S_T + T_C - X_C, S_T - P_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W \geq \{S_E + X_C - T_C, S_E - I_C - P_C, S_E - I_C - T_C\}$), and the cost of defense is high $C_D > H_G + I_G + C_E, H_G + I_G + C_E - J_G - L_G,$) ($C_D < \{H_G + C_E - J_G - L_{G,} H_G + I_G + C_E - J_G - L_G\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < S_T - P_C - X_C$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > S_E + X_C - T_C$), and the cost of defense is low ($C_D < H_G + I_G + C_E$), the government will engage the community, the community will support the terrorist, and terrorist will attack.

8. When the cost of attack is low ($C_A \leq min\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < \{S_T + T_C + I_C\}$) ($S_G < \{S_T + T_C + I_C, S_T + T_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E - I_C + P_C,\}$), and the cost of defense is high ($C_D > \{H_G + C_E - J_G - L_G\}$), and when the cost of attack is medium ($L_T + O_T + MC - K_T, L_T + O_T + MC + B_T \leq C_A \leq L_T + MC - K_T, L_T + MC + B_T$), and ($L_T + MC + B_T, L_T + MC + O_T + B_T \leq C_A \leq L_T + MC + O_T - K_T, L_T + MC - K_T$), and ($L_T + MC - K_T, L_T + O_T + MC + B_T \leq C_A \leq L_T + MC + O_T - K_T, L_T + MC + B_T$), and the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < \{S_T + T_C + I_C,\ S_T - P_C + I_C, S_T + T_C - X_C,\}$), the impact to

community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E + X_C - P_C, S_E - I_C + P_C\}$), and the cost of defense is high ($C_D > H_G + C_E - J_G - L_G, H_G + C_E\}$), and when the cost of attack is high ($C_A \geq max\{L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC + B_T\}$), and ($C_A \geq max\{L_T + MC - K_T, L_T + MC + B_T, L_T + O_T + MC - K_T, L_T + O_T + MC + B_T\}$), the impact to community of supporting government when government heightens security is lower than that of supporting the terrorist ($S_G < \{S_T - P_C + I_C, S_T + T_C - X_C, S_T - P_C - X_C\}$), the impact to community of supporting the terrorist when government engages the community is higher than of supporting the government ($S_W > \{S_E + X_C + P_C, S_E - I_C + P_C\}$), and the cost of defense is low ($C_D < \{H_G + C_E, H_G + C_E - J_G - L_G\}$), the government will engage the community, the community will support the terrorist, and terrorist will attack.

However, considering that this subgame is a sequential game where the terrorist is aware of the government, and community's moves before their move is selected, the most desirable outcomes for the government will be the one that minimizes the impact of the damage to the community by the terrorist, and gains the community's support, and defends the nation as a whole. Hence, the most desirable equilibrium for the government will be [H, SG, NA], and [EC, SG, NA] where the terrorist does not attack, and the community supports the government provided the conditions in Table 4.13 for these cases are met. [H, ST, A] will not be a desirable equilibrium for the government since when the government heightens security, the community prefers to support the terrorist, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the

given conditions. [H, SG, A] will not be a desirable equilibrium for the government since when the government heightens security, the community prefers to support the government, but the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions. [EC, ST, A] will not be a desirable equilibrium for the government since when the government engages the community, the community prefers to support the terrorist, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions. [EC, SG, A] will not be a desirable equilibrium for the government since when the government engages the community, the community prefers to support the government, but the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions.

The most desirable equilibrium for the community will be [H, SG, NA], [H, ST, NA], [EC, SG, NA], and [EC, ST, NA] where the community supports the government or terrorist, and the terrorist does not attack provided the conditions in Table 4.13 for these cases are met. [H, SG, A] will not be a desirable equilibrium for the community since when the government heightens security, the community will prefer to support the government, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions. [H, ST, A] will not be a desirable equilibrium for the community since when the government heightens security, the community will prefer to support the terrorist, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions. [EC, SG, A] will not be a desirable equilibrium for the community since when the government engages the community, the community will prefer to support the government, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions. [EC, ST, A] will not be a desirable equilibrium for the community since when the engages the community, the community

will prefer to support the terrorist, and the terrorist will prefer to attack to obtain a higher payoff than otherwise under the given conditions.

For the terrorist, the most desirable equilibrium will be the one where the most damage to the community is achieved. Hence, the equilibrium for the terrorist will be [H, ST, A], [H, SG, A], [EC, ST, A], and [EC, SG, A] where the terrorist attacks provided the conditions in Table 4.13 for these cases are met. [H, SG, NA] will not be a desirable equilibrium for the terrorist since when the government heightens security, the community prefers to support the government, and the terrorist will prefer not to attack to obtain a higher payoff than otherwise under the given conditions. [H, ST, NA] will not be a desirable equilibrium for the terrorist since when the government heightens security, the community prefers to support the terrorist, and the terrorist will prefer not to attack to obtain a higher payoff than otherwise under the given conditions. [EC, SG, NA] will not be a desirable equilibrium for the government since when the government engages the community, the community prefers to support the government, and the terrorist will prefer not to attack to obtain a higher payoff than otherwise under the given conditions. [EC, ST, NA] will not be a desirable equilibrium for the government since when the government engages the community, the community prefers to support the terrorist, and the terrorist will prefer not to attack to obtain a higher payoff than otherwise under the given conditions.

CHAPTER V:

RECOMMENDATIONS AND FUTURE RESEARCH DIRECTION

While studying the two-player sequential and simultaneous subgames games, the results show that all three players have more conditions to reach possible equilibrium in the sequential game rather than in the simultaneous game. This leads to the first conclusion that the government, make their strategy publicly available to the community, and terrorist in order to receive their desired outcomes rather than keeping it undisclosed.

From the results of the three-player game, it is gathered that when the cost of attack, C_A is medium, the terrorist decision to attack or not attack depends on the decision of the community to either support the government or terrorist in stage 2 using backward induction. Likewise, the community's decision to either support the government or terrorist depends on the decision of the government. This further confirms the first-mover advantage from previous literature, and the importance of the government to reveal their strategy to the community.

Although this paper focuses on studying the interaction of the players, and tackling terrorism under a set of two decisions variables per player, future studies may further explore multiple decision variables, in different orders (i.e., Government – Terrorist – Community, Community – Government – Terrorist, Community – Terrorist – Government). The research methodology can be applied in different scenarios in engineering management including; organizational management, enterprise resource planning, and operations management among others. It can be used by employers to determine if new policies will be beneficial to customers and/or employees, or to determine how customers and/or employees might react to specific organizational changes before they are adapted.

CHAPTER VI:

CONCLUSION

In this research, game theory was used as a means to analyze the interactions between the government, terrorists and the community with regards to terrorism mitigation. Three subgames between the government and terrorist, government and community, and community and terrorist, respectively were developed and solved. For all subgames, sequential and simultaneous games are compared. We identified possible equilibria and their leading conditions for both subgames in both orders of moves. We also analyzed the most desirable equilibria for all subgames.

We compared the sequential and simultaneous games and confirmed the first mover advantage in both the sequential game between the government and terrorist (when the government moves first) and that between the government and community (when the government moves first) supporting previous research (Zhuang and Bier 2007). While studying the two-player sequential and simultaneous subgames games, the results show that all three players have more conditions to reach possible equilibrium in the sequential game rather than in the simultaneous game. In both the first and second subgame between the government and terrorist, and government and community comparing the conditions in the sequential game to those in the simultaneous game for when the equilibrium for the government which were [H, NA], [EC, NA], and [H, SG], [EC, SG], the government had more conditions to be met in the sequential game than in the simultaneous game Likewise, in the final two-player subgame between the community and terrorist, the community is more likely to meet their desired equilibrium [SG, NA] or [ST, NA] under the given conditions. This leads to the conclusion that the government, make their strategy publicly available to the community, and terrorist in order to receive their desired outcomes rather than keeping it undisclosed.

The results from the three-player game further confirmed the first mover advantage since in stage 3, when the cost of attack, C_A is low, medium or high, the terrorist's decision to attack or not attack ultimately depends on the decision of the community to either support the government or terrorist in stage 2 using backward induction. Also, the community's decision to either support the government or terrorist depends on the decision of the government to either heighten security or engage community.

This topic is relevant for mitigating terrorism since terrorism is a growing world challenge which endangers innocent citizens, increases crime rates, and deteriorates the economy of concerned nations. The community being the most vulnerable sub-unit of the nation has experienced high displacement into already relatively saturated communities due to terrorism in some countries. The rise of lone wolf terrorist acts suggests the importance of engaging the community so that they are likely to support the terrorist or becoming a terrorist. Therefore, it is important to find efficient ways to stop the community from supporting terrorists out of necessity to survive.

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APPENDIX A:

THREE PLAYER GAME BACKWARD INDUCTION

STAGE 3: Terrorist payoff

There are four terrorist subgames, and eight terrorist decision nodes in stage 3.

We use backward induction to solve for the payoffs, under 16 conditions.

Condition 1- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+MC-C_A+B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A-K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A+B_T$ will be their payoff.

Condition 2- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, and $C_A \geq$

$L_T+O_T+MC+B_T$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+MC-C_A+B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A-K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 3- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq$

$L_T+O_T+MC-K_T$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+MC-C_A+B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A-K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A+B_T$ will be their payoff.

Condition 4- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC+B_T

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A - K_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A -K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A+B_T$ will be their payoff.

Condition 5- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC-K_T

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+ B_T > 0$, the terrorist will attack, and $L_T+MC-C_A+ B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A - K_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A -K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A+B_T$ will be their payoff.

Condition 6- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max \{L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+ B_T > 0$, the terrorist will attack, and $L_T+MC-C_A+ B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A - K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 7- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T > 0$, the terrorist will attack, and $L_T+MC-C_A-K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A - K_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A -K_T$ will be their payoff.

4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 8- $C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC–K_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T > 0$, the terrorist will attack, and $L_T+MC–C_A–K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A – K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A+B_T$ will be their payoff.

Condition 9- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC–K_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T > 0$, the terrorist will attack, and $L_T+MC–C_A+ B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A – K_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A –K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 10- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC–K_T, L_T+MC–K_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T > 0$, the terrorist will attack, and $L_T+MC–C_A+ B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A – K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A+B_T$ will be their payoff.

Condition 11- $C_A \leq \min \{L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC–K_T, L_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A–K_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A–K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A+B_T$ will be their payoff.

Condition 12- $C_A \leq L_T+MC–K_T$, and $C_A \geq \max \{L_T+O_T+MC+B_T, L_T+MC+B_T,$

$L_T+O_T+MC–K_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T > 0$, the terrorist will attack, and $L_T+MC–C_A–K_T$ will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 13- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+O_T+MC–K_T,$

$L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T > 0$, the terrorist will attack, and $L_T+MC–C_A+ B_T$ will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 14- $C_A \leq L_T+O_T+MC–K_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC–C_A+ B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC–C_A–K_T > 0$, the terrorist will attack, and $L_T+O_T+MC–C_A–K_T$ will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC–C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

Condition 15- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+MC+B_T,$

$L_T+O_T+MC–K_T$)

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC–C_A–K_T < 0$, the terrorist will not attack, and 0 will be their payoff.

2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A-K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T > 0$, the terrorist will attack, and $L_T+O_T+MC-C_A+B_T$ will be their payoff.

Condition 16- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$

1. In terrorist subgame 1, comparing terrorist nodes 1 and 2, when $L_T+MC-C_A-K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
2. In terrorist subgame 2, comparing terrorist nodes 3 and 4, when $L_T+MC-C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.
3. In terrorist subgame 3, comparing terrorist nodes 5 and 6, when $L_T+O_T+MC-C_A-K_T < 0$, the terrorist will not attack, and 0 will be their payoff.
4. In terrorist subgame 4, comparing terrorist nodes 7 and 8, when $L_T+O_T+MC-C_A+B_T < 0$, the terrorist will not attack, and 0 will be their payoff.

STAGE 2: Community Payoff

The community's subgames and nodes in stage 2 are dependent on the terrorist's payoff in stage 3. There are two community subgames, and four community nodes in stage 2. We use backward induction to solve for the payoffs, under 32 conditions.

Condition 1- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G \geq S_T+T_C+I_C$, $S_W < S_E-I_C-T_C$

1. In community subgame 1, comparing community decision nodes 1 and 2, when $S_G-I_C \geq S_T+T_C$, the community will support the government, and S_G-I_C will be the payoff.
2. In community subgame 2, comparing community decision nodes 3 and 4, when $S_E-I_C > S_W+T_C$, the community will support the government, and S_E-I_C will be the payoff.

Condition 2- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C < S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 3- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq L_T+O_T+MC+B_T$, $S_G \geq S_T+T_C+I_C$, $S_W \leq S_E-I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C \geq S_T+T_C$, the community will support the government, and $S_G–I_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C \geq S_W–P_C$, the community will support the government, and $S_E–I_C$ will be the payoff.

Condition 4- $C_A \leq \min \{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC–K_T\}$, $C_A \geq$

$L_T+O_T+MC+B_T$, $S_G > S_T+T_C+I_C$, $S_G < S_T+T_C+I_C$, $S_W > S_E–I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C < S_W–P_C$, the community will support the terrorist, and $S_W–P_C$ will be the payoff.

Condition 5- $C_A \leq \min \{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq$

$L_T+O_T+MC–K_T$, $S_G \geq S_T+T_C+I_C$, $S_W < S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C \geq S_T+T_C$, the community will support the government, and $S_G–I_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W+T_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 6- $C_A \leq \min \{L_T+MC–K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq$

$L_T+O_T+MC–K_T$, $S_G < S_T+T_C+I_C$, $S_W \geq S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C < S_T+T_C$, the community will support the terrorist, S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 7- $C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC+B_T, $S_G > S_T–P_C+I_C$, $S_W < S_E–I_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C > S_T–P_C$, the community will support the government, and $S_G–I_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C > S_W+T_C$, the community will support the government, and $S_E–I_C$ will be the payoff.

Condition 8- $C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC+B_T, $S_G < S_T–P_C+I_C$, $S_W \geq S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C < S_T–P_C$, the community will support the terrorist, and $S_T–P_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 9- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC-K_T, $S_G \geq S_T+T_C-X_C$, $S_W < S_E-I_C-T_C$.

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C \geq S_T+T_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C > S_W+T_C$, the community will support the government, and S_E-I_C will be the payoff.

Condition 10- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC-K_T, $S_G < S_T+T_C-X_C$, $S_W \geq S_E-I_C-T_C$.

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 11- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max \{L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W \leq S_E+X_C+P_C$.

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C > S_T+T_C$, the community will support the government, and S_G-I_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C \geq S_W-P_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 12- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max \{L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G \geq S_T+T_C+I_C$, $S_W < S_E+X_C+P_C$.

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C \leq S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C < S_W-P_C$, the community will support the terrorist, and S_W-P_C will be the payoff.

Condition 13- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E-I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C \geq S_T-P_C$, the community will support the government, and S_G-I_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C > S_W-P_C$, the community will support the government, and S_E-I_C will be the payoff.

Condition 14- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E-I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C < S_T–P_C$, the community will support the terrorist, and S_T+P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C < S_W–P_C$, the community will support the terrorist, and $S_W–P_C$ will be the payoff.

Condition 15- $C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC–K_T\}$, $S_G \geq S_T–P_C+I_C$, $S_W < S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C \geq S_T–P_C$, the community will support the government, and $S_G–I_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W+T_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 16- $C_A \leq \min \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC–K_T\}$, $S_G < S_T–P_C+I_C$, $S_W \geq S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G–I_C < S_T–P_C$, the community will support the terrorist, and $S_T–P_C$ will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 17- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC–K_T$, and $C_A \geq \max \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C–X_C$, $S_W < S_E–I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C > S_T+T_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C > S_W–P_C$, the community will support the government, and $S_E–I_C$ will be the payoff.

Condition 18- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC–K_T\}$, and $C_A \geq \max \{L_T+MC–K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C–X_C$, $S_W > S_E–I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E–I_C < S_W–P_C$, the community will support the terrorist, and $S_W–P_C$ will be the payoff.

Condition 19- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC–K_T, L_T+MC–K_T\}$, $S_G \geq S_T+T_C–X_C$, $S_W < S_E+X_C–T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C \geq S_T+T_C$, the community will support the government, and S_G+X_C will be the payoff.

2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W+T_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 20- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C < S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 21- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C \geq S_T-P_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C > S_W+T_C$, the community will support the government, and S_E-I_C will be the payoff.

Condition 22- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E-I_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T-P_C$, the community will support the terrorist, and S_T-P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 23- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max \{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G > S_T-P_C+I_C$, $S_W < S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C > S_T-P_C$, the community will support the government, and S_G-I_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W-P_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 24- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max \{L_T+O_T+MC+B_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G-I_C < S_T-P_C$, the community will support the terrorist, and S_T-P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C < S_W-P_C$, the community will support the terrorist, and S_W-P_C will be the payoff.

Condition 25- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C > S_T+T_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W-P_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 26- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T+T_C$, the community will support the terrorist, and S_T+T_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C < S_W-P_C$, the community will support the terrorist, and S_W-P_C will be the payoff.

Condition 27- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C \geq S_T-P_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C > S_W-P_C$, the community will support the government, and S_E-I_C will be the payoff.

Condition 28- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E-I_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T-P_C$, the community will support the terrorist, and S_T-P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E-I_C < S_W-P_C$, the community will support the terrorist, and S_W-P_C will be the payoff.

Condition 29- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E+X_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C \geq S_T-P_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W+T_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 30- when the terrorist attacks in subgame 4, but does not attack in subgames 1, 2 and 3, and the community supports the terrorist, $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E+X_C-T_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T-P_C$, the community will support the terrorist, and S_T-P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C \leq S_W+T_C$, the community will support the terrorist, and S_W+T_C will be the payoff.

Condition 31- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T-P_C-X_C$, $S_W < S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C > S_T-P_C$, the community will support the government, and S_G+X_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C > S_W-P_C$, the community will support the government, and S_E+X_C will be the payoff.

Condition 32- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E+X_C+P_C$

1. In community subgame 1, comparing community nodes 1 and 2, when $S_G+X_C < S_T-P_C$, the community will support the terrorist, and S_T-P_C will be the payoff.
2. In community subgame 2, comparing community nodes 3 and 4, when $S_E+X_C < S_W-P_C$, the community will support the terrorist, and S_W-P_C will be the payoff.

STAGE 1: Government Payoff

The government's subgames and nodes in stage 1 are dependent on the terrorist's payoff in stage 3, and the community's payoff in stage 2. There is one government subgame, and two government nodes in stage 1. We use backward induction to solve for the payoffs, under 64 conditions.

Condition 1- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-I_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 2- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 3- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 4- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C-T_C$, $C_D > -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$ will be the payoff.

Condition 5- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq L_T+O_T+MC+B_T$, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-I_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 6- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq L_T+O_T+MC+B_T$, $S_G > S_T+T_C+I_C$, $S_W < S_E-I_C+P_C$, $C_D > -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-I_G-C_E$, the government will engage community, and $-V_G-I_G-C_E$ will be the payoff.

Condition 7- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq \{L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C+I_C$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff

Condition 8- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $C_A \geq L_T+O_T+MC+B_T$, $S_G > S_T+T_C+I_C$, $S_G < S_T+T_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D > H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 9- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq L_T+O_T+MC-K_T$, $S_G > S_T+T_C+I_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 10- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$ and $C_A \geq$

$L_T+O_T+MC-K_T$, $S_G > S_T+T_C+I_C$, $S_W < S_E+X_C-T_C$, $C_D > -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 11- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+O_T+MC-$

K_T, $S_G < S_T+T_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff

Condition 12- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+O_T+MC-$

K_T, $S_G < S_T+T_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D > -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$ will be the payoff.

Condition 13- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max$

L_T+MC+B_T, $S_G > S_T-P_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-I_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 14- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC+B_T, $S_G > S_T-P_C+I_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 15- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq$

L_T+MC+B_T, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$, $C_E > -H_G-I_G+C_D$ H-ST-

NA

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > H_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 16- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max$

L_T+MC+B_T, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C-T_C$, $C_D > H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < H_G-I_G-C_E$, the government will engage community, and $H_G-I_G-C_E$ will be the payoff.

Condition 17- $C_A \leq \min\{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+MC-K_T$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 18- $C_A \leq \min\{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $C_A \geq L_T+MC-K_T$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 19- $C_A \leq \min\{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq L_T+MC-K_T$, $S_G < S_T+T_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 20- $C_A \leq \min\{L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq L_T+MC-K_T$, $S_G < S_T+T_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D > -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$ will be the payoff.

Condition 21- $C_A \leq \min\{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max\{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W \leq S_E+X_C+P_C$, $C_D < -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 22- $C_A \leq \min\{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max\{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C+I_C$, $S_W \leq S_E+X_C+P_C$, $C_D > -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 23- $C_A \leq \min\{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \max\{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G \geq S_T+T_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D < H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 24- $C_A \leq \min \{L_T+MC-K_T, L_T+MC+B_T\}$, $C_A \geq \{L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G \geq S_T+T_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D > H_G-J_G+C_E-L_G$, $C_E < -H_G+J_G$

$+C_D+ L_G$ EC-ST-NA

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 25- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E-L_G$,

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-I_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 26- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E-I_C+P_C$, $C_D > -V_G+I_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 27- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 28- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+O_T+MC+B_T,$

$L_T+MC+B_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E-I_C+P_C$, $C_D > H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 29- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 30- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G \geq S_T-P_C+I_C$, $S_W < S_E+X_C-T_C$, $C_D > -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 31- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W \geq S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 32- $C_A \leq \min \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W \geq S_E+X_C-T_C$, $C_D > H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$ will be the payoff.

Condition 33- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 34- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D > -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 35- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 36- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC-K_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D > H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 37- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 38- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G \geq S_T+T_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D > -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-C_E$, the government will engage community, and $-C_D$ will be the payoff.

Condition 39- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C-T_C$, $C_D < -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 40- $C_A \leq \min \{L_T+MC+B_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+O_T+MC-K_T, L_T+MC-K_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C-T_C$, $C_D > -H_G+I_G+C_E-J_G-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$ will be the payoff.

Condition 41- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D < -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 42- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C-T_C$, $C_D > -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 43- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D < H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 44- $C_A \leq \min \{L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, and $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E-I_C-T_C$, $C_D > H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-I_G-C_E$, the government will heighten security, and $-H_G-I_G-C_E$ will be the payoff.

Condition 45- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G > S_T-P_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D > V_G-C_E$, the government will heighten security, and $-L_G-C_D$ will be the payoff.

Condition 46- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G > S_T-P_C+I_C$, $S_W < S_E+X_C+P_C$, $C_D > -V_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-L_G-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 47- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 48- $C_A \leq L_T+MC-K_T$, and $C_A \geq \max\{L_T+O_T+MC+B_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T\}$, $S_G < S_T-P_C+I_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 49- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 50- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G > S_T+T_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D > -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 51- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D > -H_G-C_E$, the government will heighten security, and $-J_G-L_G-C_D$ will be the payoff.

Condition 52- $C_A \leq L_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+O_T+MC-K_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T+T_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G-J_G+C_E-L_G$

1. In government subgame 1, comparing government nodes 1 and 2, when $-J_G-L_G-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 53- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D < -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 54- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G \geq S_T-P_C-X_C$, $S_W < S_E-I_C+P_C$, $C_D > -V_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-I_G-C_E$, the government will engage community, and $V_G-I_G-C_E$ will be the payoff.

Condition 55- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D < H_G+C_E$, $C_E > -H_G+C_D$ H-ST-NA

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 56- $C_A \leq L_T+O_T+MC-K_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E-I_C+P_C$, $C_D > H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.

Condition 57- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T$), $S_G \geq S_T-P_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D < -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 58- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \max\{L_T+MC-K_T, L_T+MC+B_T,$

$L_T+O_T+MC-K_T$), $S_G \geq S_T-P_C-X_C$, $S_W < S_E+X_C-T_C$, $C_D > -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 59- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-$

K_T), $S_G < S_T-P_C-X_C$, $S_W \geq S_E+X_C-T_C$, $C_D < H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-I_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 60- $C_A \leq L_T+O_T+MC+B_T$, and $C_A \geq \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T)$, $S_G < S_T-P_C-X_C$, $S_W \geq S_E+X_C-T_C$, $C_D > H_G+I_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-I_G-C_E$, the government will engage community, and $-H_G-I_G-C_E$, will be the payoff.

Condition 61- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T-P_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D < -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > V_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 62- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G > S_T-P_C-X_C$, $S_W < S_E+X_C+P_C$, $C_D > -V_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < V_G-C_E$, the government will engage community, and V_G-C_E will be the payoff.

Condition 63- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D < H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D > -H_G-C_E$, the government will heighten security, and $-C_D$ will be the payoff.

Condition 64- $C_A \geq \max \{L_T+MC-K_T, L_T+MC+B_T, L_T+O_T+MC-K_T, L_T+O_T+MC+B_T\}$, $S_G < S_T-P_C-X_C$, $S_W > S_E+X_C+P_C$, $C_D > H_G+C_E$

1. In government subgame 1, comparing government nodes 1 and 2, when $-C_D < -H_G-C_E$, the government will engage community, and $-H_G-C_E$ will be the payoff.