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Fakulta sociálních věd

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Dušková Martina

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Micro-economic analysis of international terrorism

Vypracovala: Dušková Martina
Vedoucí: PhDr. Martin Gregor, Ph.D.
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Prohlášení

Prohlašuji, že jsem bakalářskou práci vypracovala samostatně a použila pouze uvedené prameny a literaturu.

V Praze dne 28. 06. 2007

.....
Dušková Martina

Poděkování

Na tomto místě bych ráda poděkovala svému konzultantovi, PhDr. Martinu Gregorovi, Ph.D., za cenné připomínky a rady.

Všechny chyby a omyly jsou pak jen mé vlastní.

ABSTRACT

The objective of this work is to explore two different types of anti-terrorist policies and examine their reaction to distinct types of terrorists' motivation. We distinguish two types of terrorists' motivation. Firstly, we suppose that an individual becomes a terrorist to reach any feasible political goal. Secondly, we assume that individual starts a career of terrorist to harm her opponents by decreasing their income. Regarding anti-terrorism policies we differentiate two types. First type is called “deterrence”. This policy is the main tool in fighting with modern terrorism. It is based on the decreasing the welfare of terrorists or by increasing the costs of performing terrorist attack. Contrariwise, second type of anti-terrorism policy consists in increasing the opportunity costs of terrorism by raising available economic opportunities or in decreasing the benefit of terrorism. This is called “positive policy”. We examine both policies by the cost-benefit analysis and by the static game theory. This work argues that even if the positive policy is able to create higher aggregate payoff than deterrence its final effect can be highly influenced by types of terrorist motivation. This fact makes this policy hardly applicable in practice.

ABSTRAKT

Tato práce si klade za cíl porovnat dva rozdílné typy proti-teroristické politiky a jejich reakce na různé motivace teroristů. Rozlišujeme dva typy motivace teroristů. Za první předpokládáme, že jedinci se stávají teroristy, aby dosáhli reálného politického cíle. Za druhé uvažujeme, že jedinci se mohou stát teroristy i z toho důvodu, že se snaží ublížit svým protivníkům snížením jejich důchodu. Co se týče proti-teroristických politik, definujeme dva typy možných opatření. Prvním typem je hojně používaná politika “zastrašování”, která staví na snižování blahobytu teroristů na základě represe a na zvyšování nákladů na teroristické útoky pomocí zvýšených bezpečnostních opatření u pravděpodobných cílů útoku. Druhým typem proti-teroristické politiky je přístup prosazující takové metody, které zvýší buď náklady příležitosti terorismu v podobě více dostupných alternativních ekonomických možností, nebo sníží prospěch z teroristických útoků. Tato politika je nazývána “pozitivní politikou”. Oba typy proti-teroristických politik jsou analyzovány na základě užitku a nákladů vyplývajících z teroristické činnosti. Dále je pro analýzu použita teorie her. Tato práce ukazuje, že ačkoli může pozitivní politika vést k vyššímu agregátnímu výstupu než politika zastrašování, její finální efekty jsou ovlivněny typem motivace teroristů, což ji činí v praxi těžko aplikovatelnou.

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NOTATION AND ABBREVIATIONS

<i>D</i>	deterrence
<i>EU</i>	European Union
<i>FDI</i>	Foreign direct investment
<i>ITERATE</i>	International Terrorism: Attributes of Terrorist Events
<i>MB</i>	marginal benefits
<i>MC</i>	marginal costs
<i>NGO</i>	Non-governmental organization
<i>PD</i>	prisoner's dilemma
<i>PFLP</i>	Popular Front for the Liberation of Palestine
<i>PI</i>	positive incentives
<i>PIJ</i>	Palestinian Islamic Jihad
<i>SQ</i>	status-quo
<i>T</i>	amount of terrorism
<i>TB</i>	total benefits
<i>TC</i>	total costs
<i>US, USA</i>	United States of America

◆ Introduction

"Undoubtedly, a massive anti-terrorist campaign will reduce the overall level of terrorism. Nevertheless, an important strategic question remains, since some anti-terrorism policies are apt to be more successful than others."

Todd Sandler

After the events of 11 September the interest in terrorism seemed to be renewed. Terrorism appears to be a global challenge for the policy-makers of democratic countries and it becomes an issue of contemporary economics. The economics of terrorism is based on the rational choice approach. This approach offers to look at the terrorists as on the rational economic actors and thus to use classic economic tools as the decision-making calculus based on marginal utility or the cost-benefit analysis. We use these approaches to compare two totally different anti-terrorism policies - deterrence and positive policy. Deterrence has been a crucial way in fighting terrorism and it has been widely in recent years. On the contrary, the positive policy, also called "policy of benevolence", seems to be shadowed by negative policies. It is promoted mostly by Bruno S. Frey¹. He argues that such policies can produce Pareto-Dominant situations to the status-quo. His conclusions are based on assumption that terrorists want to reach a feasible political goal. We want to investigate how his conclusions can be changed when we take into account the fact that individuals become terrorists not to reach any feasible political goal but to cause damage to the opponents, for example by increasing their income.

As terrorism may seem to be far from the field of study of economists we show in *chapter 1* why terrorism may be an interested topic also for economists. We start with introducing economic areas influenced by modern terrorism. After that we briefly discussed main empirical methods used in research on terrorism and basic statistics about terrorist attacks are provided. Terrorism is not a modern way of reaching someone's goals and that is why we introduce some historical facts about terrorism. We also provide that terrorism has been favorite tools used both in warfare state and in peaceful time during whole human history.

For our analysis we need to define the key players, government and terrorists, and their utility function. In *chapter 2* we depicture both practical and academic definitions of

¹ Frey (2004), Frey and Luechinger (2003), Frey and Luechinger (2004)

terrorism. We use the distinction provided by Schnellenbach (2006) between terrorists who want to achieve a political goal and terrorists who try to harm their opponents. We state terrorists' utility function and we differentiate them according their motivation factors. Further, the decision-making calculus of prospective terrorists is discussed.

The objective of *chapter 3* is to define two different anti-terrorism policies - deterrence and positive incentives. We describe both policies separately to show what their effects are. Four main positive policies are defined discussed in details. We show that effects of these policies can differ widely according to terrorists' types of motivation.

In *chapter 4* we apply two models of static game theory to understand problem of terrorism. First model depict the interaction between government and terrorist and the joint effect of anti-terrorism policies. Second model illustrates the interaction of deterrence and positive policy. It is argued what are the conditions necessary for choosing positive policy if “competition” of anti-terrorism policies is possible.

1. Economic motivation for investigating terrorism and brief history of terrorism

Firstly, we pay attention to the economic areas influenced by terrorism. Secondly, we state basic statistics concerning terrorism and at the end the brief history and trends in modern terrorism are mentioned.

1.1. Economic areas influenced by terrorism

Tourism

The most recent terrorist attacks aimed at the touristy targets are the Luxor massacre in 1997, in which members of an Egyptian Islamic group shot dead 58 foreign tourists visiting the temple of Queen Hatshepsut in the Valley of the Queens and the bombing of the disco in Bali in 2002, causing almost 200 dead tourists.

There is a straight influence because individuals planning their holidays are less likely to visit a destination with a higher possibility of terrorist attack. Host countries are thus negatively influenced because they can be easily substituted. There is a literature investigating the impact of terrorist events in the touristy location by the number of tourists scared away, Sandler and Enders (1991), and also by the investigating the financial damaged caused to the host countries, Enders at al. (1992). These papers examine chosen country (or region) separately. However, according to the analysis of Drakos and Kutan (2003) there is a significant substitution effects. We can also find a contagion effects and negative externalities, Enders et al. (1992). They found that the continental Europe as a whole is more negatively affected by terrorism that the sum of the country-by-country effects would imply. Even if the results may differ among countries we can conclude that terrorism systematically influences tourists' choice of destination country and substantially negatively affect a host country. Even more importantly, the effect is a long-lasting and may affect the neighboring countries and the whole region as well.

Foreign direct investment (FDI)

As the foreigners usually have a larger spectrum of countries to invest in, even mild terrorist activities influence considerably the allocation decision of the firm investment and thus decrease the FDI in affected country. There are also the indirect effects because FDI is an important source of savings and so the investment and economic growth are negatively affected.

On the example of Spain Enders and Sandler (1996) showed that terrorism have reduced annual FDI inflow by 13.5% on average for the period 1975-1991. However, there was no impact of terrorism on FDI found for the France, West Germany and Italy.

As examined in paper of Abadie and Gardeazabal (2005) terrorism may have a large impact on the allocation of productive capital across countries, even if it represents a small fraction of the overall economic risk.

Savings and consumption

Consumption and hence savings may be influenced by terrorism in two opposite ways. Political violence increases perceived risk associated with savings. On the contrary, terrorism attacks force people to place their money in safe havens instead of buying goods. As mentioned above these two effects have opposite direction and thus the impact of terrorism on savings and consumption should be examined empirically. However, convincing empirical evidence has not been stated yet².

Investment

It is thought that the presence of political violence may increase the risks associated with long-term investments. Moreover, they may disrupt economic activity or distort factor allocation, reducing factor productivity and thus investment demand. This is examined on the case of Israel in paper Fielding (2003b). He investigated not only the impact of terrorism on the level of investment but also on the composition of investment. He found that the political violence has a significant impact on the investment³.

Stock markets

The stock prices have two main roles. They reflect the expected future gains of a company and the probability that these gains will be materialized. Further, they are potentially informative source. Increased political violence influences both the expected gains and the risk premium. However it is difficult to measure the impact of terrorism to the stock markets because it can be hardly separated from other factors influencing stock prices. For obtaining the empirical evidence Abadie and Gardeazabal (2003) analyzed the cease-fire the Basque ETA declared between 1998 and 1999. They found that “stocks of firms with a significant part of their business in the Basque Country showed a positive relative

² See Fielding (2003a)

³ Fielding (2003a) used two investment equations, one for non-traded capital goods and one for machinery and equipment, to analyze the impact on the composition of investment. He used the number of Jews killed and the number of Palestinian killed as the indicators of political instability.

performance when truce became credible, and a negative relative performance at the end of the cease-fire.” (pp.1).

Foreign trade

It is thought that terrorism influence foreign trade in several ways. Firstly, it increases the insecurity and thus the cost of doing business. Secondly, the transactional costs are increased by the additional security measures against terrorism. Thirdly, terrorism increases the risk of direct destruction of traded goods.

State budget

Even if the state budget is not directly influenced by the terrorists the government has to take into account the indirect expenditures of anti-terrorism policies. As an example of direct expenditures we use the data published by the US government⁴. US anti-terrorism expenditures are displayed in Table 1.1. It is visible that there was an overwhelming increase between 2002 and 2003 from 8.3 billion dollars to 62.2 billion dollars. Enacted anti-terrorism expenditures since 2007 have been 426.8 billion dollars.

Table 1.1 US anti-terrorism expenditures: 2001-2008

Increasing Support for Defense Operations in the Global War on Terror (in billion of dollars)										
		Enacted					Enacted To	Requested		Total
2001	2002	2003	2004	2005	2006	2007	Date	2007	2008	
9.3	8.3	62.2	62	100.5	114.5	70	426.8	93.4	141.7	661.9

Note: Funding levels exclude budget authority for Operation Noble Eagle that covers homeland defense and civil support missions in effect since the terrorist attacks on September 11, 2001. Levels include funding for the Intelligence Community.

Source: www.whitehouse.org

1.2. Basic statistics

Empirical methods are common tools used for analyzing terrorism in recent years⁵. But it is necessary to avoid potential traps. We mention the mostly implemented empirical methods and connected problems. After that we compute a few statistics connected to terrorism.

⁴ We use data from Department of Defense, retrieved www.whitehouse.org on 30.04.2007.

⁵ Recently, new way of measuring the impact of terrorism has appeared. It was introduced by Frey, Luechinger and Stutzer (2004a, 2004b). They propose to measure the consequences of terrorism also by using the life satisfaction approach or subjective well-being data.

1.2.1. Methods of empirical research

The trends and consequences of terrorist activities are often captured by counting the number of incidents and casualties. However this approach could suffer from comparing terrorist activities with varying magnitude. So such method allows to capture the development of terrorism only if the structure of the events remains more or less unchanged. Hence the number of casualties is used to describe the varying intensity of terrorist attacks. But there is a problem with the inconsistency with the data because some data use only the number of person killed, while other data also take into consideration the number of people injured. Another problem is that only counts from the official statistics and in media are usually mentioned. As stated in Frey, Luechinger and Stutzer (2004a), relying only on the these sources can be misleading because the media pick up only those terrorist attacks occurring in the larger cities or the capital of the country and the official statistics can be bias. Besides the official statistics and the media information there exists a source file called ITERATE (International Terrorism: Attributes of Terrorist Events) created by the Edward Mickolus and extended by Mickolus, Sandler, Murdock and Fleming. It uses the information from publicly available resources and tries to quantify the data on the characteristics of transnational terrorist groups and their activities.

1.2.2. Look at the data

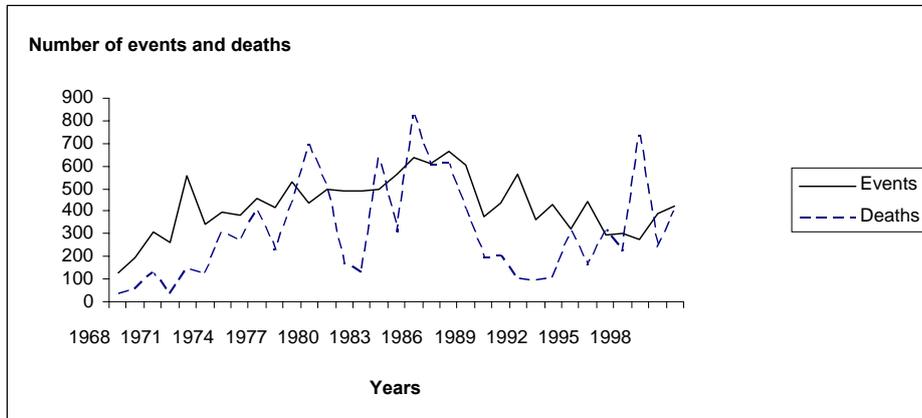
As mentioned above the most important indicator (and the most used) is the number of attack within a given period. We use the data from Sandler and Enders (2002a). Appendix 1 displays the annual number of terrorist events, the associated deaths and wounded and in the last column the number of attack against US people and/or property. From Figure 1.1 we can conclude that the annual number of events declines in time whereas the number of deaths is on the increase. The same fact is visible when we calculate the number of casualties per attack⁶. Enders and Sandler (2000) analyzed the terrorist events by the VAR regression and by the spectral analyses. They found that “each incident in post-cold war era is almost 17 percentage points more likely to result in death or injury compared with the previous decades.” pp. 329. But we need to emphasize that the trend is highly influenced by spectacular events. Hoffman (1999)⁷ analyses this effect and proposed two possible explanations. First, he supposes that some terrorists have increased the lethality because now it is harder to obtain attention by public and media. Second,

⁶ "casualties" means the sum of deaths and wounded per attack. Figure 1.2

⁷ Chapter 2 in paper Lesser, Hoffman, Arquilla, Ronfeldt, Zanini (1999)

terrorists profit from experience gained in the past and also they have access to the technically advanced weapons.

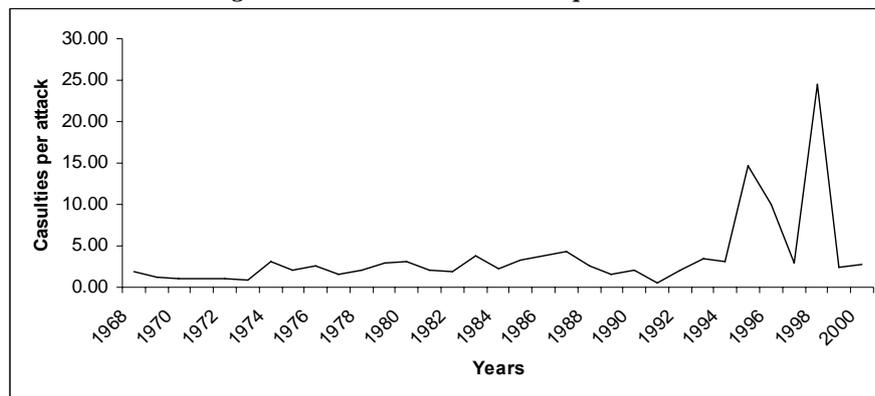
Figure 1.1 Transnational Terrorism: Events and Deaths 1968 - 2000



Source: Own calculation

Furthermore Enders and Sandler (2000) discovered by the spectral analysis that events with no injured civilians indicate no cycle whereas the attacks with more than one casualty display medium-term and long-term cycles. It means that logistically more complicated events have larger cycle than the others because of the fact that such events require more time of preparation and more resources available. Sandler and Enders (2002a) argue that an explanation could be the economies of scale and the attack-counterattack process between government and terrorists.

Figure 1.2 Deaths and Wounded per Attack



Source: Our calculation

1.3. Brief history and trends

Terrorism is not a modern invention. The word “terrorism” was coined in the guillotine days of the French Revolution, but the practice is much older. Where one side believed that the threat of violence might convince the counterpart to submit the requirement it usually did not hesitate to use such threats. We can say that terrorism of some kind become a standard course of action in many historical cultures.

As mentioned above terrorism is not a modern way how to achieve a stated goal. It was already used in Ancient Greek and in the Roman Empire. In Ancient Greek the assassination and tyrannicide were among the methods employed during conflicts between rival fractions in city states. As a terrorist attack influenced the history of Ancient Greek can be stated the assassination of Philip II of Macedon, father of Alexander the Great, in 336 B.C., in which the Alexander's involvement has never been ruled out. According to contemporary writers terror was a common tool of war used by government in the Roman Empire. The most popular terrorist attack is the assassination of Julius Caesar in 44 B.C.

During the Medieval Age the tactic of warfare changed on the basis of the Christian theology. According Christian approach the use of force was permissible only as part of process of obtaining justice. But this attitude did not change the level of terror used in the medieval warfare. On the contrary capturing of a knight was one of the incentives for common soldier to go to war. This is because of the fact that in that time the knights were more valuable to the enemy alive than dead. The soldiers thus could make a fortune from ransoming a valuable captive. For example when captured in 1356, John II of France paid the Black Prince, son of Edward III of England, three million gold coins in ransom. In this sense, terror remained a tool used to enforce or maintain the social order of the medieval world. A special case of medieval terror are the Assassins. They were a fanatical and murderous Muslim sect active in the Middle East from the eleventh century to the thirteen century. Simply the threat of assassination was often enough for Assassins to persuade the enemy to capitulate. Another example of specific terror is a use of Indian allies to terrorize civilian population by French and British during the Colonial wars, 1689-1760.

In history, terror was used not only by the enemies of state but also by governments. For example period of 1793-1794 is called the Reign of Terror conducted by the Committees of Public Safety and General Security. In that period the terror became the standard tool of state governance. Another example of state terror is a terror used by colonial powers in order to suppress resistance by natives.

A terrorist attack changing the history was the assassination of Archduke Franz Ferdinand in Sarajevo 1914. This event evoked the chain reaction among the Powers in Europe resulting in the World War I (1914 - 1918). The Archduke Franz Ferdinand was a target for many extremist nationalist groups from the Balkans. One of them was the conspiratorial organization Ujedinjenje Ili Smrt better known as the Black Hand. Even before the attack on the Archduke Franz Ferdinand this organization concentrated on the Austrian targets in Bosnia such as government buildings.

During the World War I (1914 - 1918) and World War II (1939 - 1945) terror was used a common tool of warfare strategy, especially by Germany. For example at the beginning of World War I Germany adopted the terror policy called Schrecklichkeit (dreadfulness). These state terrors together with the state terror in Russia during the governance of Josif Stalin (1928 - 1953) are the most inhuman in history.

New terrorism is originated after the World War II. Terror has been using during the national liberalizations, guerrillas or campaigns of decolonization. But most of all the modern terrorism is focused on public as a target. Thus, the beginning of modern type of terrorism might be stated in 1968 when the Popular Front for the Liberation of Palestine (PFLP) hijacked an El Al airliner en route from Tel Aviv to Rome. This was the first time that the nationality of the carrier (Israeli) and its symbolic value was a specific operational aim. Also this was a first deliberate use of the passengers as hostages for demands made publicly against the Israeli government. Both aspects made this attack an international event with high media attention.

Terrorism can also differ widely according to the environment of operation (rural or urban) or according to the origin of their resources. We should differentiate terrorist organizations supported by state from the organizations gaining their resources from the illegal activities. Generally, state-sponsored terrorist organizations have better access to large amounts of weapons, ready cash and transport. The U.S. Department of State identified five states supporting terrorism (Table 1.2.). Such states are defined as “states providing repeatedly support for acts of international terrorism”⁸.

⁸ www.state.gov

Table 1.2 States sponsoring terrorism

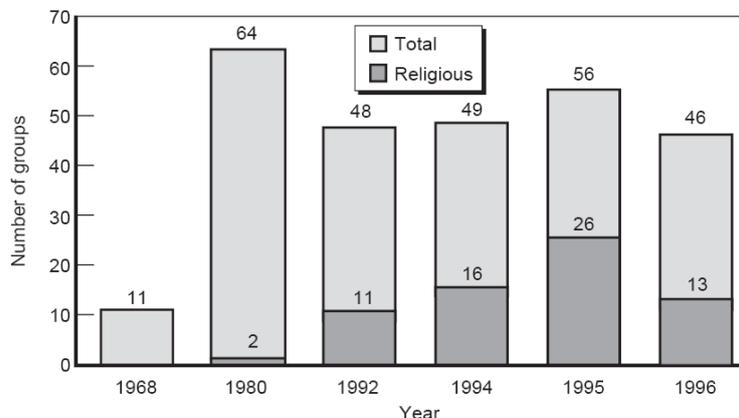
Country	Designation Date
Cuba	March 1, 1982
Iran	January 19, 1984
North Korea	January 20, 1988
Sudan	August 12, 1993
Syria	December 29, 1979

Source: www.state.gov

Concerning the trends in trends we identify three main changes in time. The first regards the change in weapons used by terrorists. Terrorists have an access to technologically advanced weapons permitting higher number of casualties per attack. Biological and chemical weapons belong to such weapons. On the other hand, the favorite terrorist technique has always been bombing.

Another important trend in modern terrorism is the increase of religious terrorist groups. According Hoffman (1999)⁹ while in 1980 there were only two groups with a strong religious aspect as dominant characteristic in 1996 there were 13 religious terrorist groups. The expansion of the religious terrorism between 1968 and 1996 is visible in Figure 1.3.

Figure 1.3 Religious terrorist groups



Source: Hoffman (1999)

Finally, terrorism became international because attacks in one country involve the citizens or institutions of another country. This internalization also means the cooperation between the extremist organizations in conducting terrorist operations. Motives of such cooperation range from the ideological to financial where the experts from one group may help to organize an attack other terrorist groups.

⁹ Chapter 2 in paper Lesser, Hoffman, Arquilla, Ronfeldt, Zanini (1999).

2. Classification of key players and our assumptions

In our analysis we have two different types of players: terrorists and government. In this chapter we describe both players and their main characteristics. As the government is commonly used term we focus more on terrorists. We state the basis definition of both players and after that we define their utility functions and show how individuals decide whether become terrorists or remain peaceful. We also analyze the cost connected to terrorism.

2.1. Rationality

We assume both players to be rational in the sense that they make rational expectations and rational choices¹⁰. Formally, the rationality can be expressed as following¹¹:

1. The individual realizes all available alternatives and she denies taking into account each alternative that is not feasible.
2. The individual have in mind all accessible information and tries to reach this information to consider the outcome of any available alternative.
3. According her preferences the individual sorts the accessible alternatives on the bases of their outcomes. This configuration has to meet several assumptions:
 - A. *Completeness*:
for all couples x' and x'' is $x' \prec x''$ or $x' \succ x''$ or $x' \sim x''$
 - B. *Transitivity*:
if $x' \prec x''$ and $x'' \prec x'''$, then $x' \prec x'''$
 - C. *Reflexivity*:
is $x' \preceq x'$ it means that $x' \preceq x' \wedge x' \succeq x' \Rightarrow x' \sim x'$
 - D. *Non-saturation (Monotonous preferences)*¹²:

¹⁰ “Even if one is not willing to attribute individual rationality to each and every suicide bomber, one can still argue that the leaders of terrorist groups who guide and encourage the suicide bombers are rational individuals, so that the phenomenon of terrorism as a whole remains a reasonable subject for rational choice approaches”, Schnellenbach (2006), pp. 301.

¹¹ Translation from the prof. Koubek’s script of undergraduate course of micro-economics on IES (section „Teorie spotřebitele“- pp.8-12 and section „Povaha a předmět mikroekonomie“ – pp3). , not published but available in the IES library.

$$(x' \geq x'' \wedge x' \neq x'') \Rightarrow x' \succ x''$$

E. *Continuity of preferences:*

$$\forall x' \in \text{Int}R_{+,0}^n, \forall x^1, x^2 \in R_{+,0}^n : x^1 \prec x', x^2 \succ x'$$

is that

$$\exists k' \in (0,1) : \bar{x} = k'x^1 + (1-k')x^2 \in I_{x'}, \text{ where } I_{x'} = \{x : x \sim x'\} \subset R_{+,0}^n$$

F. *Convex preferences*

4. The individual chooses the alternative that is on the highest position in her configuration.

2.2. Definition of key players

2.2.1. Government

As the term of government is more frequently used and its definition does not contain possible traps we do not go into the details for defining this term. In this paper “government” means the national or local government that has the power to decide about the anti-terrorism policy¹³.

The general government’s utility function is hard to define because it is determined by many different factors. For the purposes of this paper we will assume that the government’s utility function is defined by the standard economics indicators such as GDP, inflation, unemployment rate, foreign trade balance, etc¹⁴.

The government’s strategy depends on the chosen policy and thus it is explained in more details in the appropriate sections.

¹² This assumption may be too strong and thus we can use the weaker assumption (e.g. the assumption of „Weak non-saturation“) and it is stated as:

$$x = (x_1, x_2, \dots, x_n) \in R_{+,0}^n$$

$\forall x \exists \varepsilon > 0$ for which is true $\exists i \in \{1, \dots, n\}$ such that for

$$\forall x' : \forall j \in \{1, \dots, n\}, j \neq i, x'_j = x_j \wedge x_i + \varepsilon > x'_i > x_i, \text{ is } x' \succ x$$

¹³ Because of the fact that this paper examines the international terrorism (not the special cases of local terrorism) in most cases “the government” means the national government.

¹⁴ The GDP can be seen as the opponents’ income in the terrorists’ utility function.

2.2.2. Terrorists

For the purposes of this paper we follow the classification of the types of terrorist activity distinguished in most literature of terrorism: transnational and domestic. “Transnational terrorist groups either pursue international goals or move beyond their own frontiers to achieve national goals”, Crettez and Deloche (2007), pp. 2. In other words terrorism is transnational when an attack in one country involves the citizens or institutions of another country.

Practical definitions used by political leaders change dramatically together with the changes in form of terrorist attacks or in structures in terrorist organizations. However, some stable attributes can be found. One of them is a perception of terrorism as an attack on the non-fighting civilians. To show what is understood under the term of terrorism by the public we use the research made among 20 biggest newspaper agencies, TV and radio stations in Western Europe. Researchers asked the question: “What kind of attack do you label as terrorism?” Results are displayed in Table 2.1. The answers show agreement in labeling only some acts of violence as terrorism.

Table 2.1 Common perception of terrorism

Type of attack	% of editors using label "terrorism"
Hostage-taking	80%
Assassination	75%
Indiscriminate Bombing	75%
Kidnapping	70%
Hijacking for Coercive Bargaining	70%
Urban Guerrilla Warfare	65%
Sabotage	60%
Torture	45%
Hijacking for Escape	35%

Source: Sharpe (1997)

Scholar definitions of terrorism differ widely and it is therefore difficult to find a single definition that covers all existing aspects of terrorism. Most of them are limited by

the assumption that terrorism is way how the individuals want to achieve a feasible political goal by using the fear and intimidation.¹⁵

As one of the most suitable definitions we see the one cited by Berrebi (2003) and originally mentioned in Deluxe Black's Law Dictionary¹⁶. It defines terrorism as "An activity that involves a violent act or an act dangerous to human life that is a violation of a criminal laws...and appears to be intended – (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion, or (iii) to affect the conduct of a government by assassination or kidnapping." This definition is wide enough to cover all different aspects of terrorism mentioned in this paper.

Within this framework we will distinguish different types of terrorist actions - active and passive - and types of terrorists' motivation - nihilist and non-nihilist¹⁷. Concerning terrorist actions, the active terrorists are the ones participating on the terrorist attacks and belonging to terrorist groups while the passive terrorists are the civilians that sympathize with active terrorists and support them by financial aid or only by their sympathies for terrorist attacks. We distinguish two main factors of terrorists' motivation:

- Terrorism is a use for reaching feasible political goal. This motivation factor is used in the literature on terrorism as the most usual one.
- The second one is nihilism. The main source of this approach is the paper of Schnellenbach (2006) where nihilism means "a doctrine or belief that conditions in the social organization are so bad as to make destruction desirable for its own sake independent of any constructive program or possibility"¹⁸. In other worlds nihilism corresponds to a desire to decrease opponent's income because the social differences are so high that it is easier to decrease the gap by attacking the opponent than try to raise the individual's income. Nihilism is very close to other concepts of interdependent preferences - namely to the envy. Generally, the envy

¹⁵ E.i.: the definition used by Sandler and Enders (2002a), pp. 1 – "Terrorism is the premeditated use, or threat of use, of extra normal violence to obtain a political objective through intimidation of fear directed at a large audience. "

¹⁶ Berrebi (2003), pp 10.

Originally Black's Law Dictionary, 6th Edition, p. 1473.

¹⁷ The religious motivation can be seen as other important motivation. According Hoffman (1999) the religious motivations are the most constant of all motivation. Thus, even if expect that the religious motivation does not change the rationality of terrorist we can conclude that the change of terrorists' preferences is expensive and long-lasting but could be long-lasting.

¹⁸ Schnellenbach (2006), pp. 302

means that the first partial derivative of individual's utility function with regard to opponent's income is negative.

Terrorists with both types of motivation are rational with standard preferences. We assume that nihilism does not change the terrorists' rationality and the characteristics of their preferences. We consider nihilists as "moderate nihilists"¹⁹.

2.3. Terrorists' utility functions

Firstly, we define aspects influencing terrorists' general utility function. Secondly, we study the decision-making process of individuals under what condition she becomes a terrorist or remains peaceful civilian. After that we specify the expected utility for terrorists concerning the situation when the individual has already decided to become a terrorist.

2.3.1. Parameters of utility function

The motivation of terrorists changes dramatically their decision-making process and also their reaction to the anti-terrorism policies. While the difference between the nihilist and non-nihilist preferences is visible in the utility function the disparity between the active and passive terrorist is noticeable during the decision-making process and not in the utility function. We assume that even if the utility functions of nihilist and non-nihilist can be influenced by different factors they are both still standard continuous and differentiable. Thus, this section is divided into two groups based on the differentiation of motivation types.

Utility function with the factor of nihilism²⁰

Suppose that the individual's utility function takes the form

$$U_1 = u(Y_1, Y_0, \rho, \mathcal{G})$$

¹⁹ This distinction is used because the extreme case of nihilist has the lexicographic preferences, Schnellenbach (2006).

²⁰ Concept of nihilism is taken over from Schnellenbach (2006) but he uses the opponent's utility as a factor of nihilism. Instead of opponent's utility we use the opponent's income as a factor of nihilism. This approach allows us to argue that the government's utility function is defined by standard economics indicators such as GDP, inflation, unemployment rate or foreign trade balance and that the GDP is the opponent's income in the terrorists' utility function. Moreover, if we use the opponent's income instead of utility we avoid the situation when one nihilist player faces another nihilist player and their utility functions are interdependent which leads to the infinite changes in utilities.

where Y_1 is the own household income
 Y_0 is the opponent's income
 ρ is earthly reputation
 \mathcal{G} is an expected ethereal reward

In this utility function nihilism is captured by the factor Y_0 . And we assume that

$$\frac{\partial U_1}{\partial Y_0} < 0, \quad \frac{\partial U_1}{\partial Y_1} > 0, \quad \frac{\partial U_1}{\partial \rho} > 0, \quad \frac{\partial U_1}{\partial \mathcal{G}} > 0$$

Utility function without the factor of nihilism

Suppose that the individual's utility function takes the form

$$U_2 = u(Y_2, \alpha, \rho, \mathcal{G})$$

where Y_2 is the own household income
 α is a degree of reaching defined goal
and $\alpha \in (0,1)$
 ρ is earthly reputation
 \mathcal{G} is an expected ethereal reward

We suppose that

$$\frac{\partial U_2}{\partial Y_2} > 0, \quad \frac{\partial U_2}{\partial \rho} > 0, \quad \frac{\partial U_2}{\partial \mathcal{G}} > 0, \quad \frac{\partial U_2}{\partial \alpha} > 0$$

The α takes the value between zero and one. The situation when $\alpha = 0$ means that the terrorist do not reach their feasible political goal while the $\alpha = 1$ signifies that the terrorists do reach their defined objective. When $0 < \alpha < 1$ the terrorists have achieved a certain degree of compromise. It is obvious that the utility function increases when α rises.

According Frey and Luechinger (2004) terrorists tries to achieve their main goal through three tactic goals. They choose these goals to impose the maximum possible costs on the country under attack:

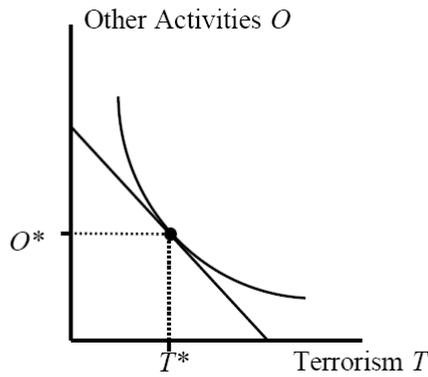
- Terrorists seek the attention of the media in order to make their cause more visible and more known. Terrorists are aware of the fact that their attack must attract the media attention and they know that to undertake attacks which the press and other media do not report is a waste of time.
- Terrorists seek to destabilize the polity. If the government loses its power and political system's legitimacy is eroded terrorists improve their chances to achieve the goal.
- Terrorists seek to damage the economy. They want to impose material costs on the population. They know that under such pressure or threat the public can change its opinion based on a never-to-negotiate approach.

2.3.2. Become terrorist or remain peaceful

Combining the types of terrorist action and types of motivation we can define three stages of terrorism: peaceful civilian, passive terrorist and active terrorist. In this section we will study how an individual decides to become a terrorist (active or passive) or remain peaceful. Firstly, we answer this question generally using the indifference curves and budget constraint. After that, we specify the decision-making process for types of motivations and terrorists attacks.

Generally, the individual compares two utility functions with different incomes and different levels of Y_0 , α for the nihilists and the non-nihilists, respectively. She faces the decision-making shown on Figure 2.1. The budget constraint depends on the expected costs of terrorism and all other activities. Formally speaking, the slope of the budget constraint is a negative ratio of the expected costs of terrorism and all other activities. Costs of terrorism consist of material, financial and human resources, collecting information, time needed for preparation as well as the danger connected to undertaking the act. The shape of indifference curve depends on terrorist's preferences and motivation but it is also determined by the effectiveness of terrorism in promoting a political goal. The equilibrium amount of terrorism is defined by the tangency between the indifference curve and the budget constraint.

Figure 2.1 Decision calculus



Source: Frey and Luechinger (2003)

Next, we suppose that income of active terrorist is smaller than the civilian income. Formally stated as: $\underline{Y} < \bar{Y}$. This assumption is based on the fact that terrorists have lower economic opportunities.

In the case that the individuals decides between civilian life and active terrorism the \underline{Y} represents the income of active terrorism (supposing that she is member of a terrorist organization the terrorist's income is represented by the salary paid by this organization). If the individual decides to become a passive terrorist we suppose that he decides whether to pay an amount D as a financial support for the active terrorists. Thus the income of passive terrorist \underline{Y}' can be stated as:

$$\underline{Y}' = \bar{Y} - D$$

We assume that income of passive terrorist is not necessary equal to the income of active terrorist ($\underline{Y}' \neq \underline{Y}$).

In the presence of nihilism, an individual faces the binary choice by comparing two utility functions:

$$\bar{U} = U(\bar{Y}, Y_0, \rho, \vartheta)$$

$$\underline{U} = U(\underline{Y}, Y_0^*, \rho, \vartheta)$$

where \bar{Y} is the individual's income gained in civil job
 \underline{Y} is the terrorist's income (active or passive)
 Y_0 is the income of the opponent

Y_0^* is the level to which any single terrorist wants to depreciate the opponent's income

Y_0^* is taken exogenous for passive terrorists. This is not true for active terrorists because often terrorist organizations rely on the support of individuals who are not active terrorists but have the sympathy for the goals of these organizations. These individuals, passive terrorists, support them with financial resources and thereby enable them to become full-time active terrorists. Thus, we can conclude that both income of active terrorist \underline{Y} and targeted level of opponent's income Y_0^* depends on the magnitude of support from passive terrorists.

For the individuals without nihilism the decision-making is given by the choosing between these two utility functions:

$$\bar{U} = U(\bar{Y}, \bar{\alpha}, \rho, \mathcal{G})$$

$$\underline{U} = U(\underline{Y}, \alpha^*, \rho, \mathcal{G})$$

where \bar{Y} is the individual's income gained in civil job

\underline{Y} is the terrorist's income (active or passive)

$\bar{\alpha}$ represents a degree of reaching stated goal when individual decides not to become a terrorist and thus the situation when there is no terrorist attack and $\bar{\alpha} = 0$.

α^* is a degree of reaching the goal that an individual wants to achieve. We suppose that terrorists want to achieve fully their goal so $\alpha^* = 1$.

Both for the nihilist and the non-nihilist holds that if $\bar{U} > \underline{U}$ she decides to stay peaceful and if $\bar{U} < \underline{U}$ she wants to become a terrorist²¹. As the income and the motivation (Y_0 or α) are the main factors of the individuals' utility function the decision-making process can be influenced by the lowering/raising the individual's income or by decreasing/increasing the Y_0 or α .

²¹ If $\bar{U} = \underline{U}$ the individual is indifferent.

To prevent individual to become a terrorist the government can either increase the civil income \bar{Y} by the wealth transfers²² and thus increase the civil utility function \bar{U} or decrease the terrorist's income \underline{Y} and hence lower the \underline{U} , the later can be done by the deterrence policy. Another possibility is to decrease the Y_0 or α by the positive incentives. It means that the government finds a policy that would persuade the individual not to become a terrorist not on the financial base but on the motivation-base. In case of the non-nihilist terrorist who wants to achieve feasible political goal the government must either accept terrorists' goal or convince them to stop trying reaching this goal and to start living peacefully.

2.3.3 Expected utility

We consider three states of the world: the terrorist attack does not occur, terrorist attack occurs but fails and terrorist attack occurs and is successful.

If the terrorists decide not to undertake the terrorist attack their utility is given by $U^N \leq 0$. If the terrorists decide to undertake the terrorist attack the expected utility is uncertain and is given by

$$U^T = \pi U^S + (1 - \pi)U^F$$

Where π is terrorist's subjective estimates of probability of a successful terrorist attack and $\pi \in (0;1)$

$(1 - \pi)$ is terrorist's subjective estimates of probability that the terrorist attack fails

U^S is an expected utility of successful attack

U^F is an expected utility if the attack fails

and $U^S > U^F$

The terrorist will attempt to undertake a terrorist attack if the expected utility of this action is higher than the expected utility of the situation with no attack (status-quo):

$$U^N < U^T = \pi U^S + (1 - \pi)U^F$$

From this equation we can conclude that anything that increases the U^N or decreases the U^T lower that probability of terrorist attack.

²² Wealth transfer can be both financial and material and their pros and cons are discussed later in this paper.

Given that $U^S > U^F$ the same result can be achieved by the change in subjective estimate of probability of successful attack which will increase the expected utility of terrorist attack U^T :

$$\frac{\partial U^T}{\partial \pi} = U^S - U^F > 0$$

According Sandler and Enders (2002b) the magnitude of final effect of changing π is influenced by the value of difference between U^S and U^F . The smaller difference is, the less effect such policy has. In special example when $U^S = U^F$ the modification of π has no effect at all. One of the factors affected the gap between U^S and U^F is a degree of fanaticism because fanatical terrorist has higher U^F and it makes the attack more likely. Thus, “the fanatical terrorists must be apprehended or killed for attacks to stop.” Sandler and Enders (2002b), pp. 7.

Among other things π depends on the size of terrorist group because the numerous terrorist groups can collect more resources than an individual terrorist and thus have higher influence by for example attacking more important targets. Another factor affecting the probability of success is the protection degree of possible targets.

The U^S and U^F are influenced by the same factors and they differ only in their final values. As was said above we assume that $U^S > U^F$ for all types of terrorists.

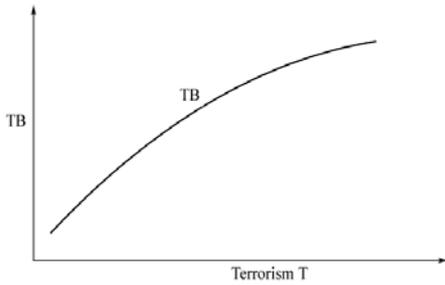
2.3.4 Costs and Benefits of Terrorism

To show the effects of anti-terrorism policies we will use the cost-benefit analysis and that is why we define the concept of total and marginal benefits and costs.

Total benefits (TB) are an increasing concave function of total number of terrorist attacks (Figure 2.2). They do not increase in linear way which means that an additional attack brings lower benefit than the previous ones. This results from the fact that terrorists undertake the attacks producing the greatest benefits and afterwards they have to choose the targets with lower benefits.

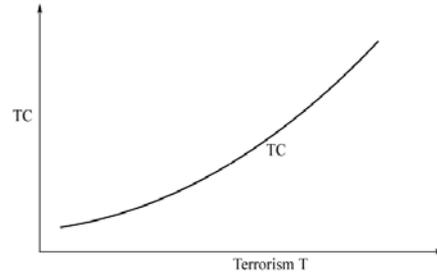
Total costs (TC) are decreasing convex function of number of terrorist attacks (Figure 2.3). Its convexity reflects the fact that the costs of additional attack are higher than costs of previous ones. The logic is analogous to the total benefits because terrorists choose attacks with the lowest costs at the first place and afterwards they attack targets with higher costs. The costs of committing an attack consist of material, financial and human resources, collecting information, time needed for preparation as well as the danger connected to undertaking the act.

Figure 2.2 Total benefits



Source: Frey (2004)

Figure 2.3 Total costs



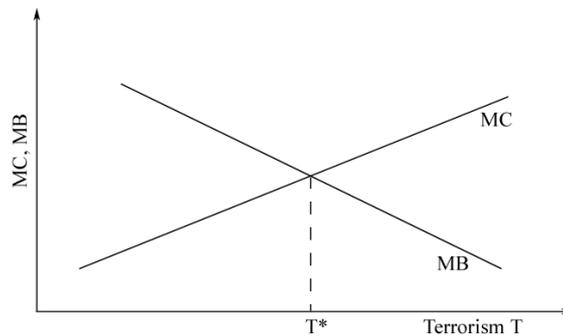
Source: Frey (2004)

Marginal benefits (MB) are decreasing linear function of number of attacks and signify the benefit from undertaking additional terrorist attack. They slope downward if the additional attack has less and less effect on targeted country. Marginal costs (MC) reflect the costs of undertaking the additional terrorist attack and slopes upwards as the terrorists commit attacks with lowest costs in first place and thus costs of any additional attack are higher²³.

$$\frac{\partial MC}{\partial T} > 0 \quad \frac{\partial MB}{\partial T} < 0$$

The equilibrium amount of terrorism is given by the point where the MC and MB are equal (Figure 2.4). This equilibrium should correspond to the number of terrorist attack observed in reality.

Figure 2.4 Equilibrium amount of terrorism



Source: Frey (2004)

²³ Marginal benefits are steeper with increasing level of extremism and in that case the anti-terrorism policy increasing MC has less effect.

3. Anti-Terrorism Policies

Even though the deterrence is in recent period a crucial element of the way how to fight terrorism and is the most used anti-terrorism policy in practice there are some attempts by the scholars to offer another possibilities how to increase the number of terrorist events. Deterrence tries to reduce the terrorist activity by raising the costs of terrorism both ex ante and ex post. On the other hand the policy proposed by Frey and Luechinger (2003, 2004) and summarized by Frey (2004) reduces the benefit of terrorism by increasing the opportunity costs. We call this policy "positive incentives" or "positive policy". These policies are dramatically different in their costs both to citizens and terrorists. In this section we explore each of them separately, using the cost-benefit analysis and terrorists' utility function and state their pros and cons.

To describe the effects of both policies the cost-benefit analysis and the analysis based on terrorists' preferences will be used.

3.1. Deterrence

There is no exact definition of deterrence policy used in economics. As deterrence we see the policy that decreases the terrorists' welfare by increasing the costs of terrorism or by the elimination of the terrorists' finance resources. The deterrence is mostly connected with the employing the military and police enforcement or with the negative sanctions. It seeks to raise the future costs of terrorist acts by making them more difficult to undertake and by punishing the actors more severely. An increase in the cost of terrorist activities can also be achieved indirectly by eliminating terrorists' resource base when they are at least to some extent state sponsored.

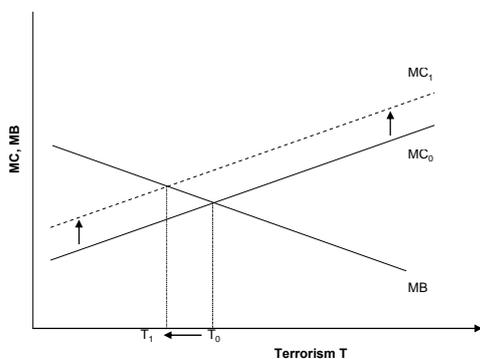
The deterrence can be either active or passive. The active deterrence is based on the eliminating terrorists' resources, infrastructure or personnel while the passive policy concerns the protective measures of potential targets to divert the attack or to decrease its consequences.

The deterrence policy decreases the terrorist's income \underline{Y} and thus increases the gap between utility gained from civilian life and terrorists' utility. The income factor influences both the utility function of nihilist and utility function of non-nihilist it has the same effect regardless the fact whether the terrorist has nihilist or non-nihilist motivation.

Generally, the deterrence policy shifts the marginal costs curve upwards. As a result, there will be smaller equilibrium amount of terrorism (Figure 3.1.). This effect can

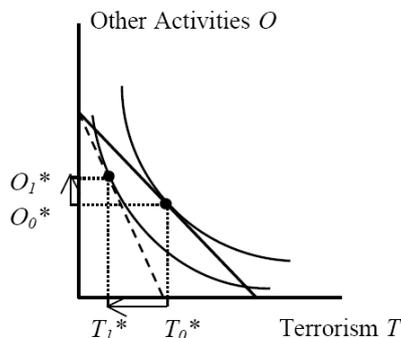
be also shown by means of utility function and decision calculus (Figure 3.2). The increased cost of an attack evokes the rotation of budget constraint inwards along the terrorism-axes and again this results in a smaller equilibrium amount of terrorism.

Figure 3.1 Deterrence changes the equilibrium amount of terrorism



Source: Our calculation

Figure 3.2 Increasing the costs of terrorism



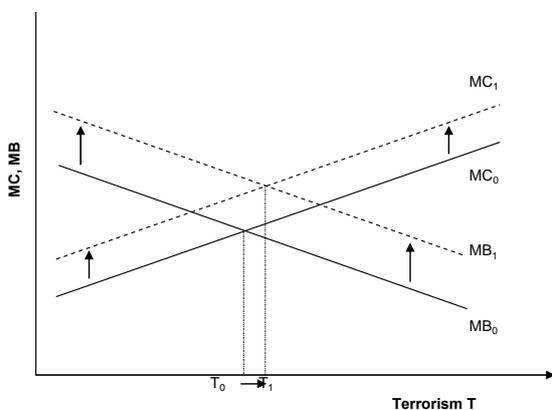
Source: Frey and Luechinger (2004)

Besides the general effect Frey (2004) identified two other effects of deterrence:

- He argues that the coercive deterrence has less effect (or is ineffective) if it is offset by rewards. This would be the case if prospective terrorists interpret a larger punishment as a signal that their cause is particularly worthy and will be rewarded accordingly in the afterlife. In this case the deterrence will increase the MC but also the MB. The final effect thus is not sure and depends on the fact how much the MC and MB were increased (i.e. the deterrence can be both effective or ineffective or counterproductive). However, we suppose that in equilibrium the government would never choose an anti-terrorism policy increasing the final level of terrorism. Thus, we may conclude that effect from increasing MB is smaller than the effect from increasing MC and the final level of terrorism will be still smaller than SQ.
- The second possibility is influenced by the fact that the deterrence policy has a secondary effect. By implementing the counter-terrorism policy based on deterrence the government increase the political and economic centralization. In that case more decision-making power is concentrated into one location, making it more vulnerable to terrorist attack. Such a deterrence policy not only shifts the terrorists' cost curve (MC) upwards but, at the same time, also shifts their benefit curve (MB) upwards. These two effects are countervailing, and it remains open whether the equilibrium amount of terrorist activity actually falls, as is generally

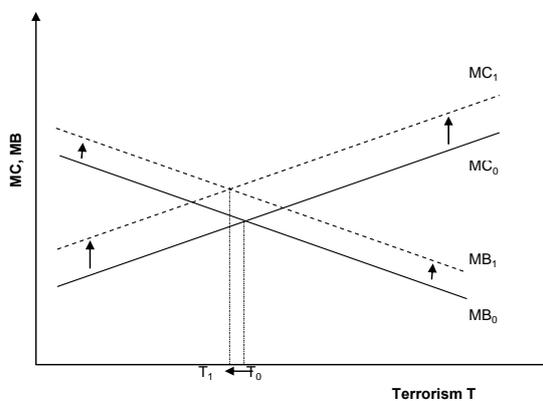
expected. But again we can argue back that this would not be the equilibrium point and that in final the level of terrorism will be lower than it would be in SQ (Figure 3.3 and Figure 3.4).

Figure 3.3 Effect of deterrence - Frey version



Source: Frey 2004

Figure 3.4 Effect of deterrence - our version



Source: Own calculation

Regarding the costs it is useful to distinguish costs falling directly on the initiator of the deterrence policy from those induced in response by the terrorists, as well as more general costs. As a framework we use the categorization introduced by Frey (2004), pp 30.

Among the direct costs of terrorism we may include budgetary costs, political costs, and costs in terms of reduced human and political rights.

State's budget is influenced by costs connected to the board control, scientific research in the area of new weapons (nuclear and biological), collection and interpretation of information undertaken by intelligence agencies and last but not least the military and police costs.

Political costs are zero or even negative if the public is a main proponent of the deterrence. Political costs become visible when the economic costs in the form of budget deficiencies and restricted labor force for this purposes and public starts to be against this policy. Another political cost may arise from international agreement if the coalition partners do not agree with the policy. This was the case of the US Invasion to Iraq when France as a partner of USA expressed its disagreement of the action.

There is also a risk that the deterrence policy involving the use of force may resolve to repressive means. For example some groups and actions may be found guilty on the basis of "ethic profiling" instead of unlawful activity. This concern was fully discussed in connection with the anti-terrorism measures undertaken by the USA after the attack of

September 11, 2001, especially the "Patriot Act" passed through US Congress shortly after the event.

As the main goal of the government is to remain in power it is tempted by the opportunity of abusing terrorism to their own advantage. This was suggested many times, Congleton (2002) that the President Bush uses terrorism to evoke the "rally around the flag".

Frey and Luechinger (2004) argued that the deterrence decrease the level of political decentralization and thus its effect can be countervailing using the USA as an example of this effect. However, they specified the measures undertaken by US government that increase political centralization but they do not prove that the final effect of such policy is negative. We have to emphasize that even if there exist this theoretical possibility of inverse effect of deterrence, government minimizing the volume of terrorism would never undertake steps increasing equilibrium level of terrorism.

Among indirect costs we include the induced substitution, increased vulnerability and costs of failed delivery.

As will be discussed later in more details deterrence may induce substitution effect. Terrorists can substitute not only differently secured targets but also countries with different level of anti-terrorism policies. Countries can decrease the substitution among states by introducing the same level of deterrence but the substitution concerning different targets is impossible since it would require full deterrence and thus the infinite costs.

Media attention may increase the marginal benefit of terrorist attack and thus it may increase final level of terrorism. The government needs to identify the adversaries to adopt an effective deterrence policy and this focuses media attention to the terrorists' existence and causes.

If the coercive action undertaken by government is not successful it may become unpopular and consecutively induces higher political costs. According to Frey and Luechinger (2004) a natural reaction of the government is to use more force against terrorists.

Concerning the benefit of deterrence we can mention the fact that the deterrence has same effects regardless the motivation of terrorism. This is important because the factor of motivation is very hard to distinguish in population and even if the government is able to divide the society into two or more groups with different motivation factors it is difficult to aim the right anti-terrorism policy to specified part of the society. Moreover, the deterrence imposes high costs on terrorists or equally decreases their available resources.

3.2. "Carrot policy"

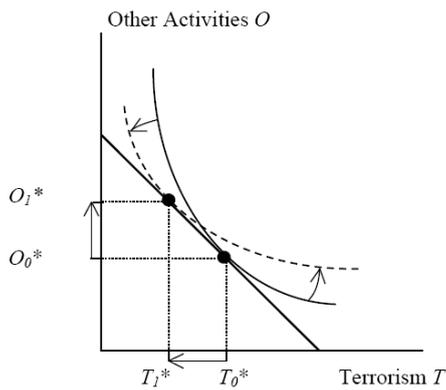
Frey (2004) argues that an effective anti-terrorism policy can be designed around the idea of positive-sum game. According to this theory an anti-terrorism policy should be proposed such that it leads to Pareto-superior situation than is status-quo. It has to increase the welfare for the terrorists and the prospective terrorists if they give up terrorism as well as for those who suffer from terrorism. On the other hand the pure deterrence policy tends to decrease the welfare of the terrorists (or potential terrorists) using the money of the civilian people (victims or prospective victims of terrorism). This is called negative-sum game.

We can distinguish two level of positive policy (PI). The first one is the PI applied to prospective terrorism and the second one is PI used to discouraged actual terrorists from their violent activities by providing them superior alternatives or by reducing the benefits they derive from terrorist attack. The alternative of proposing superior alternatives means the increasing of opportunity costs.

As mentioned above the positive policy tends to convince both potential and actual terrorists not to incline to terrorist attacks. This can be reached either by increasing the benefits connected to terrorism or by increasing the opportunity costs. The alternative of decreasing the marginal benefit of terrorism means that it becomes less attractive and thus reduces the marginal rate of substitution of all other activities for terrorism (Figure 3.5). As an example of this approach we can mention the political and economic decentralization when the single target becomes less interesting for terrorists because the system as a whole is less sensitive to destruction of separate target. Another policy with same effect is a lower media attention to terrorist attacks and terrorism as a whole.

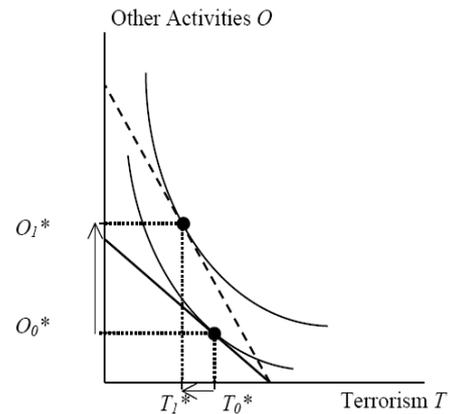
Opportunity costs can be raised by opening up alternatives to terrorism. Opportunity costs consist of utility that could be gained by not becoming a terrorist. This approach differs widely from the deterrence that decreases the material costs of terrorism. Higher opportunity costs or, equivalently, lower costs of all other activities reduces the individual's willingness to commit an attack. The budget constraint rotates upwards along the axis indicating "other activities" and the equilibrium amount of terrorism is lower (Figure 3.6). As an examples suggested by Frey (2004) of such policy we can mention political integration and dialogue with terrorists, higher education or visiting foreign countries by the scholars.

Figure 3.5 Reducing the benefits of terrorism



Source: Frey and Luechinger (2003)

Figure 3.6 Increasing the opportunity costs



Source: Frey and Luechinger (2003)

Analyzing general benefits and costs of positive policy we start from the classification used by Frey (2004) and Frey and Luechinger (2003)²⁴. According Frey and Luechinger (2003) positive policy has following general advantages:

First, exit from the terrorist organization is facilitated because many other opportunities outside of terrorism are now more accessible and the individual's dependence on the terrorist group is reduced.

Second, as the opportunities outside terrorist groups are available they represent the rival or competitor to the terrorist activity. Thus they create the conflict between them and terrorism. This situation produces the tensions within the terrorist group because the exit becomes more attractive. This argument is supported by Wintrobe (2003). He argues that deterrence encourages the solidarity among terrorist group members.

Third, the interaction between the terrorist and the rest of the society creates the positive-sum game. It means that everyone “benefits”. Government and society in general by the decrease of terrorism and terrorists by better opportunities they can achieve.

In our opinion one of the main general costs of positive policy is the fact that one positive policy can have different effect on terrorists with different motivation factors. Positive policies influencing the factor α have no effect on nihilist terrorists. However, this conclusion cannot be done for all positive policies because policies increasing the individual's income can influence both nihilist and non-nihilist terrorists.

²⁴ Both costs and benefits are discussed only on general level and they are analyzed in more details in next subsections for each concrete positive policy separately.

We should also mention that the positive policy applied to actual terrorists may induce the perverse incentives and thus the moral hazard. If in the first period the government offers to actual terrorists a positive sanction if they become peaceful it may in second period attract the civilians to become a terrorists because they would have an experience that for leaving terrorist's organization they will be offered with the same positive sanction.

Last but not least another problem may arise when we take into account practical implementation. This is connected to the political and economic considerations. Even if the positive policy leads to superior aggregate income for the targeted society as a whole, the government may prefer a deterrence strategy based on threats. If the government chooses the positive policy there is no accurate information regarding the benefits and costs of positive policy before its implementation. Further, interests of most well organized groups are clearly against the positive policy. Two major organizations being against the positive policy are the army and police. In case of application of positive policy both they would receive fewer funds and they cannot profit from deterrence anymore because the positive policy does not build on their services. Moreover, the benefits of positive policy are not directly attributed to the government in power because they may arise in the long run. Finally, the “benevolence” strategy reduces the decision power of the government, especially if such policy requires the anticipation of NGOs.

Frey (2004) proposed the concrete anti-terrorism policies designed as the positive-sum game²⁵. We will discuss following policies:

- Education and higher income
- Political integration
- Political and economic decentralization
- Positive sanctions

3.2.1. Education

According Frey (2004) one of those policies increasing the opportunity costs is improved education and higher income. This implies to provide better education for the masses and thereby increase their economic opportunities. One of the main arguments is that people with higher education can evaluate and compare the alternatives of becoming a terrorist or not and that the higher education offers higher income in future. This argues

²⁵ In most cases these policies do not have a form of an explicit contract because it can lead to the new problems of surveillance and enforcement.

that the education can besides others change the factor of motivation no matter the types of motivation.

Human capital is one of the main factors influencing the individual's production function. Education increases the human capital and thus the production function. This means that the higher level of education an individual achieves the higher income in future can earn. This means that the education can raise the civil income \bar{Y} . Traditional theory of crime, Bergstrom et al. (1986), argues that people compare the marginal benefit of committing crime with its marginal costs and individuals with fewer opportunities in legal (civil) life are more likely to commit a crime. When we use the parallel with terrorism we can say that according this theory people who have nothing to loose would be more likely to join a terrorist organization. Additional education raises the opportunities available in civil life and thus gives decrease the incentive to become a terrorist. These conclusions correspond with conventional wisdom.

The scholars use the empirical research to answer the question whether the conclusions mentioned above are really applicable to the problem of terrorism. Berrebi's (2003) research is based on the data of Hamas and Palestinian Islamic Jihad (PIJ). The results suggest that "if there is a link between income level, education and participation in terrorist organization it is either very weak or in the opposite direction of what one intuitively might have expected", pp. 38. But these results do not mean that we should not deal with the connection between the education and terrorism. We should only focus on the content of education and not only on the achieved level of education. The problem is that not all education plans are identical and sometimes the education is burden by a particular political or religious belief. In such situation the additional education exposes people to this belief and may increase the tensions to become a terrorist²⁶.

A seemingly opposing findings was introduces by Blomberg, Hess and Weerapana (2004). They argue that terrorism increases with the worse economic situation.

These two conclusions were put together by Bueno de Mesquita (2005). He presents the theoretical model of interaction between government, a terrorist organization and potential terrorists that is consistent with the empirical findings mentioned above. He

²⁶ Berrebi (2005) states other possible explanations why the higher education may increase terrorism but he does not states any supporting literature. First, "individuals with more education may be better equipped to understand moral and religious justifications invoked by such groups", pp. 17. Second, "highly educated individuals may be more aware of situations of injustice and discrimination, and may be more aggrieved by their implications, inducing them to participate in terrorist activities", pp. 17. Third, "education may contribute to the development of a sense of social responsibility and highly educated people may feel the need to contribute to particular causes", pp. 18.)

shows that the lack of economic opportunity and education are the factors of mobilization of terrorism and that the terrorists choose the potential terrorists from the lowest socioeconomic group. Terrorists are not indifferent to the ability of the operatives and they select the volunteers according to their ability and education. This means that the terrorists becoming from such selection are the most educated and able individuals in the given socioeconomic group.

To solve the problem with "educated terrorists" the government fighting against terrorism can offer the foreign students the scholarship on universities in the country. In terms of utility function this policy changes the "factor of motivation" and can have long lasting effects. It is based on the fact that the education plan in the democratic country is not burden by any ideological or religious belief and confrontation with liberal ideas could moderate their terrorist inclinations. The second argument is support by the theory of Hardin (2002). He states that the interaction between groups is likely to reduce extremist view. He argues that individual's knowledge depends on costs and benefits allied to acquiring this knowledge and after that with its application. As marginal costs of receiving information are relatively high people usually rely on the authorities of their society. People also do not have a need to gain information and knowledge that are beyond common belief of their society. This involves that the extremism is more likely to prosper in isolated society of like-minded individuals. Further, the extremism is sometimes a norm for an exclusion of an individual or group. These two conclusions implicates that the extremism reinforces the segregation and vice versa.

Even if this proposal of combining the additional education and social integration seems to be without any problems there are several questions that should be answered. One of them is how the government chooses these students and how it insures that they really belong to group endangered by terrorism. The government needs to have this inflow of human capital under control. This could be provided by the selection of talented youth from the countries with high rate of originating terrorists. However, as the most talented students were selected in the first place we assume that the marginal benefit will decrease in time as less and less talented people will be available. Another problem is that such radical change of environment and culture could evoke feeling of separateness and such individual is a perfect potential member of any extremist group.

3.2.2. Positive sanctions

Persons engaged in terrorism may be offered incentives such as money, reduced punishment or a secure future life if they are prepared to leave the terrorist organization

they are involved and if they want to talk about it and its projects. Such incentives increase the opportunity costs of being terrorists.

Frey and Luechinger (2003) argue that this policy was already used in case of the Brigade Rose in Italy and the Rote Armee Fraktion in Germany. They state that it was a brilliant success and it provided much important information to the leaders. They also propose to use this policy to discourage potential terrorists. Frey (2004), pp. 99 argues that “if the government promises terrorists a reward for abstaining from violence, it is more probable that the terrorists will respond in similar ways. If the government uses negative sanctions, the terrorists are more likely to respond with violence”.

We think that it is better to provide people with the rewards in kind instead of offering the money. Even if the traditional economic theory says that the money are preferable to rewards in kind because money are more fungible than goods or services the terrorist would usually refuse such offer because it could be seen as a morally unacceptable bribe. Another reason is that if we offer the money directly we can not influence how it will be used by the terrorists (or potential terrorists) because even if we stated the conditions for receiving such financial reward it would be impossible (or too costly) to control the use of money. For example we can provide terrorists (or potential terrorists) the physical capital as the instruments, machines or vehicles to start their economic independence. They will use them for production activity and thus they can increase their income. Hence, by using the term "wealth transfer" we mean the providing of non-financial supports increasing future civil income.

Using the utility function of terrorists, positive sanctions increase civil income \bar{Y} which is included in utility function of both non-nihilist and nihilist terrorists. Thus, this anti-terrorism policy has same effect regardless types of terrorists' motivation.

Frey (2004) uses the theory of transaction costs to proof the correctness of his theory. The theory of transaction costs argues that the economic subject choose between the market and contract. If the costs connected to the contract are higher that the costs of preparing and performing the transaction through the market then they prefer the market. But if the overall costs connected to the bargaining, monitoring and implementing of the contract are lower than the transaction costs of the market the market fails. The transaction costs are low when the behavior of economic actors can be observed and enforced. As the behavior of terrorists is hard to observe the transaction costs are extremely high. However,

he argues that if some conditions are stated the transaction costs are reduced to such level that they are low enough for establishing the contract between government and terrorists²⁷.

He proposed following possibilities to establish a credible commitment, pp 101-102:

- Both government and terrorists can voluntarily offer verifiable information about their behavior. In practice, journalists could be allowed to observe the camps and the government could invite a representative of the terrorist and let her survey the police and army whether they observe the agreement.
- The government could deposit the agreed reward with some organization, under the condition it be paid out to the terrorists if they indeed honor the agreement. The terrorist group could deposit their arms with another country, where they remain if the government meets its obligations. If, however, the government does not respect the commitment, the arms would be returned to the terrorists.
- Both government and terrorists may involve international organizations to monitor their behavior and to enforce the contract. Such organization has to be considered neutral by both sides.
- Both actors take positions imposing high costs on themselves when not following the agreement. This separates them from making unreliable commitments and enforces them to engage only with the credible ones.

We think that these conditions may be fulfilled by the terrorists with non-nihilist preferences because it can be one way how to achieve their goals. But if we consider terrorists to be nihilist we can conclude that these conditions are not enough to make this policy effective.

Another problem rises when we take into account that such "wealth transfers" are offered to the population with high fraction of passive terrorists with nihilist preferences. The results from the literature on voluntary contributions to public goods show that an increase in the overall wealth or income of this population will increase both the consumption of private goods and public goods²⁸. This means that an increasing of population's income will lead, *ceteris paribus*, to higher resources available to active terrorists. Formally speaking, government decided to provide the population with high terrorist potential with the material wealth transfer that increases the civil income from the level Y_1 to Y_2 , where $Y_1 < Y_2$. This population has a big fraction of passive terrorists with

²⁷ However, they are not low enough to let the market be effective.

²⁸ Bergstrom, Blume and Varian (1986)

nihilist preferences. Assume that the passive terrorist pays a certain amount of the financial support to active terrorists and individual's income after the payment of such support can be generally stated as $\hat{Y} = Y - D$. Before the wealth transfer the sympathizer paid the support in the amount of D_1 ($\hat{Y}_1 = Y_1 - D_1$). After the receipt of the transfer the individual pays the support in the amount of D_2 with unchanged final income $\hat{Y}_2 = Y_2 - D_2$. Using the idea that the higher income implicates higher contribution to the public goods we can conclude that $D_1 < D_2$.

Total effect of positive sanctions depends on the size of the nihilist faction in the population. “For a population that is characterized by a sufficiently small fraction of individuals with nihilist preferences, a combined appeasement strategy may therefore be successful that (i) raises civil incomes high enough so that a career as an active terrorist becomes uninteresting and (ii) strikes a compromise over the disputed matter that leads to a substantial decline of voluntary contributions from civilian supporters of terrorism. If, on the other hand, the faction of nihilists in the population is sufficiently large, then (i) raising civil incomes will backfire because voluntary contributions by nihilist civilian supporters increase and (ii) attempts to strike a compromise are futile, since the nihilist faction of the population is only interested in doing harm to the opposing population, but not in reaching a political agreement” Schnellbach (2003), pp. 310. Neither the nihilist preferences nor the voluntary supporters of active terrorists are easily observable in the population. Hence, the wealth transfers cannot be targeted only to those individuals with the non-nihilist preferences.

Moreover, if we prolong our analysis from one-period to the more-periods this theory leads to the problem that in the long run the offering positive incentives may be seen as an indirect reward of terrorist activity. And as mentioned above this may induce the moral hazard and change individual's behavior in a wrong way.

These strategies may also not work because the incentives are insufficient to attract terrorists. This may be true especially for strongly motivated or fanatical terrorists. Another problem is that the positive incentive may be considered immoral by the public and therefore be rejected.

3.2.3. Political and economic decentralization

Basic idea is that the society with many different centers is difficult to destabilize. The single centre is less essential for the polity and economy and has lower symbolic value. The logic of this proposal is that if one centre is hit by a terrorist attack, other

centers can take over its tasks. Thus, attacking one centre in decentralized society has less effect on the political stability. This concept was introduced by Frey and Luechinger (2004) and discussed in details in Frey (2004). Both the economic and political decentralization reduce the benefits derived from terrorism and terrorism is made less attractive to potential terrorists.

Political decentralization can take two forms. First type is a division of power among different political actors. The modern system of power distribution between government, legislature and courts fulfils this requirement. In many countries, there are also other actors that are independent. Most prominent is the central bank that can pursue the goals concerning the monetary policy. But there are other regulatory bodies with some degree of independence from other political decision-makers. Even though the reasons for such independence are far from the threat of terrorism this could be an effective means of decreasing the system vulnerability to terrorist attack.

Second form is a distribution of political power between different levels of governments. The federalism can be an example of this decentralization. This kind of decentralization is called "spatial" and concerns not only different levels of government but also the spatial decentralization of population. This is important in case where terrorists use the chemical and biological weapons²⁹.

Economic decentralization is fully represented by the market economy. Market economy with high decentralization of decision-making and implementation is less vulnerable to terrorist attack than regulated or monopolized economy. Under competition conditions, the suppliers are able to substitute for each other. If one supplier is hit by the terrorist attack she can be easily replaced by the others. Most economic sectors are not perfectly competitive but the requirement of economic decentralization does not require perfect competition and only some extend of decentralization can secure that there are always actual or potential suppliers who can take over with no steps undertaken by government. Another aspect of economic decentralization is that in such economy terrorist attack is likely to cause less harm than in monopolistic or oligopolistic sectors of economy.

²⁹ Glaeser and Shapiro (2001) suggest that there is a statistical link between terrorism and urbanization. But they were able to isolate only a weak relationship.

3.2.4. Political integration

Intensifying contacts and social integration can be also stated as one of those policies. Concretely we can talk about the reintegrating of the terrorists³⁰. This can be done in many different ways - the terrorist can be involved in the discussion process or they can be involved in the institutionalized political process. An example can be provided by a terrorist campaign in Switzerland in 60's. But in this particular case terrorism was a tool for reaching political goal.

This approach brings also some questions. General question is how far we can go in integrating the extremists and what are the most extremist opinions to which we should allow the participation in political discussion. This problem concerns the Europe, mainly with the right extremism. For example after the World War II, in the Federal Republic of Germany, there was no possible entry on the coalition regional market for the successive extreme right parties³¹. On the other hand the example of Austria is totally opposite to the German one. The integration of extreme right is total and it is present in the regional parliaments since 1948.

3.3. Income Effect and Substitution Effect

Each anti-terrorism policy can influence the terrorists by affecting their resources or by increasing the costliness of different types of attack. This is called income effect and substitution effect, respectively.

The income effect influences the overall level of terrorists' resources - reducing their assets will decrease their ability to commit an attack. The increase in particular action costs motivates the terrorists to find other type of attack with the similar effect but lower costs - this is called substitution effect. The substitution among the types of attack can be caused not only by increase in relative price but also by increase in the probability of success of particular attack or increase in the payoff of other type of tactic. Moreover, substitution effect concerns not only different types of terrorist tactics but also target countries. A decrease in probability of success, an increase in costliness or a decrease in the payoff of terrorist attack will reduce the number of terrorist events in a particular country and will increase number of terrorist attacks in similar, relatively less-protected country.

³⁰ Interaction between groups tends to reduce extremist views (Takács, 2001)

³¹ Godmer and Kestel (2001)

However, an increase in relative price of all terrorist tactics by a particular anti-terrorist policy actually means the decrease in terrorists' overall resources and thus has the income effect.

As Sandler and Enders (2002b) showed an evidence of the substitution across attack modes: "A government policy aimed at a single type of terrorist event adversely changes its relative price and results into now less expensive mode of attack." ,pp 12³². Shuhgart (2006) observes that the terrorists substituted kidnapping and assassination of foreign-service personal for embassy bombing in time when the government made an arrangement to protect the embassies.

In our analysis by the static game theory we focus on the substitution effect among different countries. This type of substitution effect can be also described as a transfer of negative externality from one country to another. This negative effect is connected to the deterrence policy and to the appearance of the global terrorists' networks. "Globalization of terrorism" decreased the effectiveness of countries' efforts to face terrorism. The externalities are maximized through countries' uncoordinated decisions. Obviously, the transnational terrorists will seek the weakest country. Apparently the simplest solution could be the cooperation among the states. But according to Sandler and Enders (2002a) the problem of the autonomy occurs. Governments do not allow losing their independence in decision-making concerning the home security. Wilkinson (1987) proposed the solution in the form of "piecemeal" policy where the countries would share the intelligence but the security decision-making would stay independent. The problem is that this proposal requires all countries to participate in this policy. If only few countries follow this rule they create the negative externality for all other countries. This could simply imply the "transference race" which may worsen the situation of countries sharing the intelligence.

³² The evidence of substitution effect was shown also by Sandler and Enders (1993) by the vector auto-regression (VAR) on the data from the USA and the UK.

4. Static game theory models

In this section we show two examples of using the game theory for comparing different anti-terrorist policies.

In the first part we examine the interaction between the government and the terrorists. We study the case where the government can choose between SQ and deterrence. Here, terrorists are active players assessing game equilibrium directly by their decision-making.

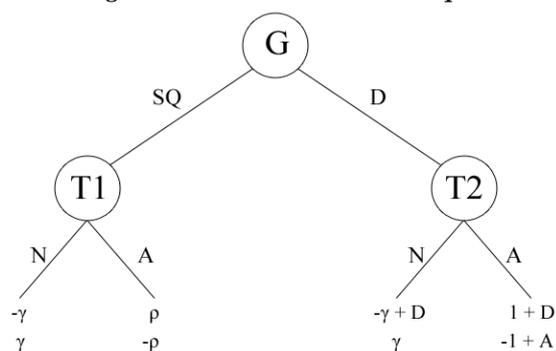
In the second part we use the static game theory to describe the joint effects of two different types of chosen anti-terrorism policies, taking into account different terrorists' motivation. We study how this motivation may change the results of anti-terrorism policies and what the implication to the joint effects is. In this model, terrorists are passive players. They influence the result of the game indirectly by their reactions to concrete anti-terrorist policy because their expected reaction by government influenced the amount of benefits.

4.1. Interaction between government and terrorists

Crettez and Deloche (2006) asked the question whether the government should protect key assets and critical infrastructures against the terrorist attack or whether it should be repaired after the attack. He modeled the non-cooperative interaction between the terrorists and the government where the government has to make a priori decision whether or not to protect these key assets. We use this model to analyze the situation when the government can choose before SQ and D. We want to show under which conditions the deterrence discourages terrorists from the attack.

As was said above the deterrence has the same effect no matter what the terrorists' motivation is. In this model the terrorists are now the active players (together with the government). Payoffs of this game in extensive form are displayed in Figure 4.1. The first figures of the payoffs at the terminal nodes correspond to the losses of government, second ones correspond to the losses of terrorists.

Figure 4.1 Deterrence or Status-quo



Source: Crettez and Deloche (2006)

Government has to decide first whether it will deter (D) or not (SQ). After that the terrorists can choose between the attack (A) and status-quo (N). We consider that the terrorists want to weaken the government by diminishing its public support. If the terrorists do not attack they are assumed to be defeated and they loose. On the other hand if there is an attack it is always a success for them and failure for the government. For the simplicity we suppose the zero-sum game. Both players minimize their losses.

Further, we assume that deterrence is costly and this adds the loss in amount of D to the government but deterrence also imposes higher costs on terrorists and this adds the loss in amount of A to terrorists. These costs concerns for example better security measures for expected targets.

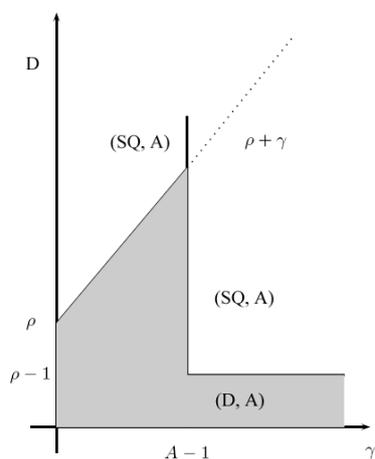
The variable ρ describes the government's loss in case if it chooses SQ and there is an attack. The assumption $\rho > 1$ means that the loss of the government in case that there is an attack are higher when it chooses SQ than when it prefer to deter. Moreover we assume that $\rho > \gamma$ which implies that the loss of terrorists is in absolute value higher when they do not attack than when they attack (and there is no deterrence).

Nash equilibriums of this game are as following:

- If $A < 1 + \gamma$, than if $D \leq \rho - 1$, the Nash equilibrium is (SQ, A), if not, the equilibrium is (D, A).
- If $A \geq 1 + \gamma$, than if $D \geq \rho + \gamma$, the Nash equilibrium is (SQ, A), if not, the equilibrium is (D, N)³³.

³³ Crettez and Deloche (2006), pp.5.

Figure 4.2 The equilibria of the game



Source: Crettez and Deloche (2006)

In other words if the costs of deterrence are relatively low and the loss of terrorists caused by the deterrence are relatively high the government chooses the deterrence and the terrorists are discouraged from undertaking an attack. If not, the government chooses not to deter or the terrorists seen the attack as their best choices. This conclusion is illustrated in Figure 4.2.

4.2. Join effect of deterrence and positive incentives

In the previous section we used the cost-benefit analysis to show the general effect of the deterrence and the positive incentives. They were analyzed separately without including the possible joint effect. Now, we would like to examine how these policies are influenced by each other and what is the impact of their cohabitation. For this purposes we used the static two-player model³⁴ and the theory of substitution and income effect of anti-terrorism policies³⁵. In this model there are two active players (the USA and the EU) who decide simultaneously among three strategies (deter - D, propose positive incentives - PI or do nothing - SQ). There is also one passive player (the terrorists) that chooses the weaker active player; if neither player is weaker it chooses one of them randomly.

Firstly, we assume that the terrorists have non-nihilist preferences and after that we adjust this assumption and examine the changes in the model. For the purposes of our analysis we specify the following terms:

B - benefits of positive incentives

³⁴ Sandler and Arce (2004)

³⁵ Sandler and Enders (2002b)

C - costs of positive incentives

b - benefits of deterrence

c - costs of deterrence

4.2.1. Terrorists with non-nihilist preferences

In case of non-nihilist preferences we assume that the positive incentives present pure public benefit because it prevent from the terrorist attack by increasing the overall opportunity costs to terrorists. This means that positive incentive implemented by one country lowers the total amount of terrorism for all countries (in our case both players). Other countries doing nothing can thus benefit from application of positive policy by one state. Thus this strategy creates positive incentives.

Concerning the deterrence policy it implies the costs imposed on the nation that deters an attack as well as the costs caused by the increased likelihood of having the attack deflected to the other country. Deterrence spending is paid regardless of the outcome but when the terrorist attack occurs the expected damage is lower than in the situation with no policy. If the deterrence is applied only by one country the substitution effect occurs. Thus, the deterrence creates a negative externality. Payoffs are illustrated in Figure 4.3.

Figure 4.3 Payoff matrix: non-nihilist preference

		EU		
		<i>Positive Inc.</i>	<i>Status quo</i>	<i>Deterrence</i>
USA	<i>Positive Inc.</i>	(2B-C)	(B-C)	(B-C-c)
	<i>Status quo</i>	B	0	-c
	<i>Deterrence</i>	(B+b-c)	(b-c)	(b-2c)
		(2B-C)	B	(B+b-c)
		(B-C)	0	(b-c)
		(B-C-c)	-c	(b-2c)

Source: Arce and Sandler (2004)

To start we examine the positive incentives game and the deterrence game separately.

The positive incentives game is captured by the north-west 2x2 bold-border matrix. In case that one player does nothing and chooses SQ and the second one chooses PI the first player has no costs and has the benefit in the amount of B . The second one bears the costs of C and has benefit B . If both players use the PI their benefits are $2B$ because the PI implies the public benefits and the cost is C . So the net benefit for each player is $(2B-C)$.

We assume that the payoff from PI-PI is higher than the payoff from SQ-SQ, $2B - C > 0$. We can suppose that $C > B$ or $C < B$:

- $C > B$

This assumption implies that

$$B - C < 0$$

$$2B - C < B$$

$$2B > C > B$$

This game is a prisoner's dilemma (PD) with the Nash equilibrium SQ-SQ (0, 0). It means that neither USA nor EU will act because it is their dominant strategy. But the equilibrium is not the Pareto dominant because both players could reach higher payoff if they would mutually act (PI-PI). Even if the PI implies the positive externality and the players choose doing nothing because the costs are higher than benefits.

- $C < B$

Under this assumption it holds that

$$B - C > 0$$

$$2B - C > B$$

$$2B > B > C$$

Obviously this game results in the Nash equilibrium in the point PI-PI with the pay-offs (2B-C) for both players. The deterrence strategy is dominant for both players.

Now we move to the deterrence game that is captured by the south-east 2x2 bold-border matrix. Now there is no free-rider because the player choosing no deterrence has to face the additional cost caused by the increased probability of becoming the target of the terrorist attack. Formally, it can be described by the presence of the substitution effect and the absence of the overall income effect allowing the advantage of free-riding. For simplicity we stated these additional costs connected to the substitution effect of deterrence in the amount of c . If one player chooses the D and the second one the SQ the first has thus costs in the amount of " c " and the benefit in the amount of b and the second one has no benefit and the cost of substitution effect c . On the other hand if both players choose D their pay-offs are $(b-2c)$. We assume that the D-D implies lower payoff than SQ-SQ, $b - 2c < 0$ Again we can distinguish two different situations: $c > b$ and $c < b$:

- $c > b$

This condition evokes that

$$b - c < 0$$

$$b - 2c < -c$$

$$2c > c > b$$

The solution of this PD game is a Nash equilibrium SQ-SQ. In this case the deterrence has both higher costs than benefits and negative externality.

- $c < b$

$$b - c > 0$$

$$b - 2c > -c$$

$$2c > b > c$$

This PD game results in a Nash equilibrium D-D. The deterrence evokes negative externality in the form of public costs it is a dominant strategy for both players and this negative externality is exceeded by the fact that the costs are lower than benefits. The Nash equilibrium is not the Pareto-dominant state because both players can reach the higher payoffs by not acting (SQ, SQ).

Finally, we examine the situation when players can choose from all three strategies. We have to complete the payoff matrix with the situation PI-D and vice-versa. If the USA chooses to deter and the EU positive policy the USA gain the public benefit of PI in the amount of B and their net pay-off is $(B+b-c)$. While the EU bears the costs of substitution effect of D in the amount of C and its net pay-off is $(B-C-c)$. The other payoffs remain the same as in the previous examples. Once again we assume that $2B - C < 0$ and $b - 2c < 0$.

Now we can combine the relationships between B and C and between b and c . Table 4.1 shows the outcomes in all four combinations. The results in two first cases (where the individual's net outcomes are symmetrical) are something expectable and intuitive. In third case the PI strategy has two "advantages" against the deterrence in the form of positive individual's net benefit ($B-C > 0$) and positive externality. Hence, the positive policy is a dominant strategy for both players.

The most interesting is the last example showing that if the positive incentive loses its advantage of positive net benefit of individual it is not the dominant strategy any more even if the deterrence implies the negative externality. The positive externality of PI

is not able to outweigh the negative net benefit for individual. In Table 4.1 we can see that in such case the equilibrium of the game is in the point D-D. This means that players prefer to lower their private costs rather than lowering the public costs. Table 4.1 also displays that players choose the positive incentives only in case that its benefits are higher than costs ($B > C$). In case that also the benefits of deterrence are higher than its costs (i.e. $b > c$) the positive policy is chosen if its net benefits are higher than net benefits of deterrence ($B - C > b - c$). Hence, we can conclude that the positive incentives are chosen only if their net “private” benefits are positive regardless the fact that it can imply the positive externality. Once again, players prefer to maximize their benefits, not the aggregate benefits of the society.

Table 4.1 Summary of outcomes in PI-D game

$B > C$ $b > c$	if $(B - C) > (b - c) \rightarrow$ PI-PI
$B < C$ $b < c$	if $(B - C) < (b - c) \rightarrow$ D-D
$B < C$ $b < c$	SQ - SQ
$B > C$ $b < c$	PI - PI
$B < C$ $b > c$	D - D

Source: Own calculation

The most important conclusion from this game is that the positive externality of positive incentives cannot outweigh its negative net benefits. Conversely, positive net benefits of deterrence may easily exceed its negative effect for the society as a whole in form of imposed negative externality.

4.2.2. Terrorists with nihilist preferences

This situation differs from the one where terrorists' motivation is non-nihilist in the fact that we cannot judge the effects of positive incentives globally. Each specific positive policy may have different effect on nihilist terrorists³⁶. Let us recall main facts. Individual make their decision whether to become a terrorist or remain peaceful comparing two utility functions, Table 4.2.

³⁶ Effects of concrete positive policies are described in more detail in appropriate sections (3.2.1. - 3.2.4.).

Table 4.2 Decision calculus of prospective terrorists

<i>Non-nihilist terrorists</i>	<i>Nihilist terrorists</i>
civil utility function:	civil utility function:
$\bar{U} = U(\bar{Y}, \bar{\alpha}, \rho, \vartheta)$	$\bar{U} = U(\bar{Y}, Y_0, \rho, \vartheta)$
terrorist's utility function:	terrorist's utility function:
$\underline{U} = U(\underline{Y}, \alpha^*, \rho, \vartheta)$	$\underline{U} = U(\underline{Y}, Y_0^*, \rho, \vartheta)$

Source: Our calculation

Generally, positive anti-terrorism policies can be divided into two groups regarding the fact what factor of utility function they influence. If they influence the civil or terrorist's income their effects are independent on types of motivations. However, policies changing the amount of α have no effect on nihilist terrorists. Same is true for changes in Y_0^* and non-nihilist preferences.

For example education may increase the future expected income and also may change the factor of terrorist's motivation. Increase in future income implies growth of civil income \bar{Y} . Changing the factor of motivation means the affection of α^* or Y_0^* depending on types of motivation. In extreme case Y_0^* can be removed totally for nihilist terrorists. This shows that the education increasing only the civil income may have same impact no matter the types of terrorists' motivation. Same effect can be observed for the positive sanctions changing the civil income \bar{Y} . Again, this positive policy has same effect for both nihilist and non-nihilist terrorists.

It is obvious that an offer of political dialogue has no impact on final level of terrorism if terrorists are nihilist. This means that such positive incentive does not represent sufficient motivation for leaving the career of terrorist because the nihilist terrorists are interested only in increasing the opponent's utility. Benefit from such kind of policy is lower than benefit of this policy in the case of non-nihilist preferences. This is caused by the fact that offering of political integration is a policy that increases the factor α in the terrorists' utility function. But if the terrorists are nihilist the factor α does not influence their utility function.

All this shows that if the positive policy influence the factor included in both nihilist and non-nihilist terrorists' utility function it has same effect and the equilibriums of all games mentioned above are not changed (Table 4.1). However, if positive policy

changes the factor α its benefit in case of nihilism is zero. Payoffs mixed PI-D game if $B=O$ are displayed in Figure 4.4. If $c < b$ the equilibrium is SQ-SQ and the governments decide to do nothing. If $c > b$ players choose deterrence and the D-D is the equilibrium of the game. This conclusion is equal to the one of the game with non-nihilist terrorists. It is evident that the governments never choose the positive policy because it brings only costs and no benefits.

Figure 4.4 Payoff matrix: nihilist preferences

		EU		
		<i>Positive Inc.</i>	<i>Status quo</i>	<i>Deterrence</i>
USA	<i>Positive Inc.</i>	- C	- C	(-C-c)
		- C	0	(b-c)
	<i>Status quo</i>	0	0	-c
		- C	0	(b-c)
	<i>Deterrence</i>	(b-c)	(b-c)	(b-2c)
		(-C-c)	-c	(b-2c)

Source: Own calculation

Our analysis shows that nihilism may decrease the influence of PI and the PI becomes less attractive than the deterrence. We show that the decision what kind of positive policy will be applied is essential because nihilist terrorist may have different reaction to such policy than non-nihilist terrorists. To make such decision the government should know the range of nihilist fraction in population. But this information is unlikely to be obtained prior to policy application. Only those positive policies increasing the civil income have a chance to be effective also for nihilist preferences. Our model shows that the positive policy having same effect on all types of terrorists will be applied only in case that its net benefits are positive and higher than net benefit of deterrence.

◆ Conclusion

Recent attacks on civil population in democratic countries have renewed the interest of many scholars in terrorism. As it influences many economic areas it becomes an interesting subject also for economists.

This work tries to analyze anti-terrorism policies with respect to different motivations of terrorists. For this purposes we distinguish two different types of terrorists' motivation - nihilist and non-nihilist. We define the economic effects of terrorism in *chapter 1* together with the basic statistics concerning terrorism. In *chapter 2* we state terrorists' utility functions. We discuss the decision-making process of prospective terrorists along with the ways how this process can be influenced.

In *chapter 3* we describe both policies and present their general effects. After that, we focus on four main positive policies. We illustrate changes in their effects with respect to nihilist and non-nihilist motivation. We also show their pros and cons based both on theoretical framework and on the empirical research. We argue that positive policies influencing a factor included in utility functions of both nihilist and non-nihilist preferences have same effect regardless the types of motivation. On the contrary, positive policy influencing the factor of non-nihilist's utility function has no effect on nihilist and vice versa.

Increasing the level of education is the most popular positive incentives. It is argued that focusing only on the level of educational attainment could be misleading and according to many empirical researches has not the expected effects. It is supposed that this situation could be improved by offering the scholarship to the most talented students from countries with relatively high rate of new terrorists. This approach combines intensified social integration together with higher future income.

Besides the problems of concrete policies we see identify few general disadvantages of positive incentives. First one concerns those policies applied to actual terrorists. It is argued that policy based on offering positive sanctions for actual terrorists if they leave their organization induces moral hazard and create adverse incentives. Second problem regards the fact that it is impossible to obtain the information concerning its costs prior to the implementation. This aspect becomes more important if we take into account the nihilist motivation. The information about the extent of nihilist fraction in population is hard to be obtained prior to the policy application.

On the other hand, correctly applied positive policy can implicate higher aggregate payoff than deterrence. Moreover, it can have long-lasting effect based on changes in terrorists' motivation and it is able to create positive externality for the society as a whole. But it is argued in chapter 4 that if we examine the joint effect of both anti-terrorism policies we derive that the positive policy is selected by both players only if its net private benefits are positive and higher than net private benefit of deterrence.

APPENDIX 1 - Transnational Terrorism: Events 1968 - 2000

Year	Number of Events	Deaths	Wounded	Attacks on US Interests
2000	423	405	791	200
1999	392	233	706	169
1998	273	741	5 952	111
1997	304	221	693	123
1996	296	314	2 652	73
1995	440	163	6 291	90
1994	322	314	663	66
1993	431	109	1 393	88
1992	363	93	636	142
1991	565	102	233	308
1990	437	200	675	197
1989	375	193	397	193
1988	605	407	1 131	185
1987	665	612	2 272	149
1986	612	604	1 717	204
1985	635	825	1 217	170
1984	565	312	967	133
1983	497	637	1 267	199
1982	487	128	755	208
1981	489	168	804	159
1980	499	507	1 062	169
1979	434	697	542	157
1978	530	435	629	215
1977	419	230	404	158
1976	457	409	806	164
1975	382	266	516	139
1974	394	311	879	151
1973	345	121	199	152
1972	558	151	390	177
1971	264	36	225	190
1970	309	127	209	202
1969	193	56	190	110
1968	125	34	207	57

Source: Sandler and Enders (2002a)

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U.S. Department of State	www.state.gov
The World Bank	www.worldbank.org
Wikipedia, The Free Encyclopedia	www.wikipedia.org

Teze bakalářské práce

Student:	Dušková Martina
Obor:	Ekonomie
Konzultant:	PhDr. Martin Gregor, Ph.D.

Předpokládaný název BP:

Mikroekonomická analýza mezinárodního terorismu

Charakteristika tématu:

Cílem této práce bude podrobná analýza moderního mezinárodního terorismu pomocí mikroekonomické teorie her.

Práce bude rozdělena do tří částí. První část bude věnována teoretickému základu, použitým analytickým nástrojům a popis vlastnímu modelu. V druhé části budou definovány užtkové funkce jednotlivých hráčů a popsány jejich zvolené strategie (v tomto případě teroristé a národní vlády). V třetí části budou analyzovány jednotlivé vládní strategie při potírání terorismu a jejich možné dopady na základě definovaných užtkových funkcí a zvoleného herního prostředí.

Struktura BP:

1. Základní pojmy a vymezení použité teorie

- 1.1 Základní pojmy
- 1.2 Vymezení aplikovaného modelu

2. Hráči a jejich užtkové funkce

- 2.1 Definice a stručných popis jednotlivých hráčů
- 2.2 Definice užtkových funkcí hráčů

3. Aplikace modelu na vládní strategie proti terorismu

- 3.1 Popis jednotlivých vládních strategií
- 3.2 Analýza dopadu vládních strategií
- 3.3 Srovnání zvolených strategií

4. Závěr

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