

**AL QAEDA AND JIHADIST TERRORISM IN THE LIGHT OF CONTEST THEORY
A THEORETICAL NOTE AND EMPIRICAL EVIDENCE OVER THE PERIOD 2002-2007¹**

REVISE AND RESUBMIT, PUBLIC CHOICE

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Abstract: *This paper shows that the number of victims of al-Qaeda-style terrorist attacks is increasing in the number of victims of previous attacks so determining an upward trend in terrorist brutality. Given the existence of several jihadist groups in many countries, such evidence is interpreted in the light of contest theory as the outcome of a competition between them. To maximize their own probability of winning some 'prize' provided by al Qaeda, would-be terrorist groups maximize their efforts with the result of escalating brutality. In the presence of costless information each candidate group can easily observe the results of attacks of other groups. Therefore, each group tries to make attacks more destructive than the foregoing attacks. However, results also show that preconditions for terrorist activity have to be found within grievance for socio-economic conditions.*

Keywords: Terrorism, al Qaeda, Contest Theory, Tournament, Information, Negative binomial regression.

JEL CODES: D72, D74, J49, D8, D62, H4.

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1.Introduction

Terrorism has been becoming in the latest years a topic of growing interest for social scientists. There is no agreement between scholars and policy-makers on a common definition of terrorism. Drawing from Sandler et al. (1983) it is possible to espouse a very broad definition of terrorism as the “*premeditated, threatened or actual use of force or violence to attain a political goal through fear, coercion, or intimidation*”². Such a definition also encompasses the four characteristics of terrorist activity reported in Shugart (2006), namely (i) the use of violence (or its threat) for political effect; (ii) a planned and calculated course of action; (iii) a boundless behavior outside the context of legitimate conduct of warfare; (iv) the effort to induce a disproportionate fear and feeling of insecurity among people, especially civilians³.

Recent empirical studies focus in particular on economic determinants of terrorism activities. From a first point of view, some scholars emphasize the socio-economic roots of terrorism. This recalls the classical economic concept of opportunity cost. That is, the higher are the gains of an individual from participating into an ordinary productive activity the less he or she is willing to be engaged in terrorist activities. Therefore, better socio-economic scenarios would reduce the likelihood of terrorism. Moreover, would-be terrorists would also be motivated by grievance because of lack of civil liberties and existence of autocratic governments. This latter idea appears to be somehow challenged by several studies which tested the hypothesis that terrorist activity is positively related to the education and standard of living. That is, better educated individuals would become bloodier terrorists. This has been labelled ‘productivity argument’. In particular, since in poorest countries education and literacy levels are quite low, the productivity argument is also produced in order to rule out the opportunity cost argument.

The present work complements the existing literature. The paper is based on a different and complementary theoretical approach. That is, al Qaeda-style terrorist activity is interpreted in the light of contest theory. In this view, al Qaeda may be portrayed as a contest organizer providing a prize to the best terrorist group. In the eyes of economists, agents – namely the would-be terrorist groups – play à la Nash and maximize their efforts in order to win the prize provided by al Qaeda. In particular, in the presence of costless information each group observes the results of some previous attacks. Hence in order to maximize its own probability of winning the prize, each group maximizes its effort and tries to make attacks more destructive than the foregoing attacks perpetrated by competing groups. This theoretical hypothesis is eventually confirmed by means of an empirical analysis which shows that the number of victims of terrorist incidents is increasing in the number of victims of the previous incident in the same country.

In the light of contest theory, would-be terrorists are supposed to compete with each other to prove their commitment and ability⁴. This also falls within the idea of

² Sandler et al. (1983), p.37.

³ The four characteristics have been recognized by scholars as the fundamental components of terrorism. On the debate to define and conceptualize terrorism see Weinberg et al. (2004) and Schmid (2004).

⁴ This idea partly contrasts with Siqueira and Sandler (2010). The authors model a game-theoretic delegation game between a general terrorist organization and local terrorist groups. The current work and the cited paper share the idea that local groups can contribute to the general objective of spreading terror chosen by a terrorist leadership. The point of departure differs. In fact, a direct delegation of local groups contrasts with the idea of self-committed groups as they are assumed to be in the current work. Addison and Murshed (2005) believe that transnational terrorism is the

reinforcement of terrorist activity as expounded by Midlarsky et al. (1980) that explain why there is a recurrence of terrorist activity within the same country⁵. At the same time analogies can be drawn with political violence in Italy in the seventies. As explained by Della Porta (1992), competition between small groups contributed to radicalization of political violence. In particular, albeit grounded on very similar ideological basis, small groups were willing to improve “*their specific relevance within their environment*”.⁶ A similar explanation has been provided by Bloom (2004) with regard to suicide bombing by Palestinian militants.

The present work is not focused on terrorism in general⁷. It is focused on jihadist offspring of Al Qaeda. In particular, the study focuses on the plethora of would-be terrorist jihadist groups which emerged in the latest years in several countries. Such phenomenon has been also widely defined as ‘Global Jihadism’ or ‘Al Qaedaism’. These groups may have not been formally part of al-Qaeda but they share al-Qaeda’s vision and strategy⁸. Hence, in the following empirical application, the sample selection has been based upon a selection of attacks which fit the Al Qaeda’s *modus operandi* and ideology. In particular, the sample includes those countries where the Sunni radicalism of Al Qaeda emerged in the latest recent years. In some cases, would-be terrorists have been also effectively defined ‘self starters’, i.e., groups perpetrating terrorist attacks on their own initiative. This kind of phenomenon has been occurring in the last few years, thanks to the peculiar organization of Al Qaeda which had been defined as a ‘network’ or a ‘movement’, in order to highlight the nature of an entity less structured than traditional terrorist organisations. Therefore, assuming that the glue that binds the global ‘Jihadism’ is ideological, this study analyses terrorist events which must have been perpetrated by Sunni fundamentalists which embrace a Wahhabi version of Islam. This religious motivation has remarkable implications. Enders and Sandler (2000) show how the increase in religious-motivated terrorism also determined a change in strategy of terrorist groups. The authors argued that fundamentalists are engaged in fewer incidents with greater bloodshed. That is, the nowadays religious-motivated terrorism is more threatening than previous forms of political violence and terrorism. This marks a clear-cut distinction between jihadist terrorism and other forms of terrorism.

In the following empirical work, the composition of the sample is ‘global’ (mainly South Asian, Central Asian, Caucasian, African countries are included). The sample does not include countries or regions as Israel, Gaza Strip, or Iraq. In fact, in Israel, West Bank and Gaza, there is no need of a contest to select a terrorist champion. Shortly, Palestinian terrorist organisations are well-established and have been lasting for years. In Iraq, the scenario is puzzled. First, many observers agree that resistance

internationalization of a domestic dispute. Therefore they model a three three-way strategic interaction involving a government that faces armed opposition at home, which may spill over in the form of acts of terrorism by the state’s opponents against the government’s external sponsor. The external sponsor also uses deterrence against potential terrorists, which only lowers terrorism if terrorists are not intrinsically motivated. A rise in the external power’s preference for deterrence against terrorism may backfire in these circumstances. Increases in the government’s military efficiency are predicted to raise overall levels of violence.

⁵Midlarsky et al. (1980) maintain that the temporal and spatial distribution of terrorist incidents can follow four possible patterns: (1) randomness; (2) heterogeneity (3) contagion, and (4) reinforcement.

⁶ See Della Porta (1995) p. 110.

⁷ For a general discussion on modern terrorism from the Second World War to the beginning of twenty-first century see Shugart II (2006), Sandler (2003) and Intriligator (2010). For a comprehensive survey of the literature see Krieger and Meierrieks (2010). Another copious strand of literature on terrorism focuses on assessing the costs of terrorism. See among others Blomberg and Hess (2009), Frey et al. (2009), Frey et al. (2007), Crain and Crain (2006).

⁸ See among others Rabasa et al. (2006) and Napoleoni (2005).

against U.S. military forces and terrorist activities must be disentangled. Moreover, the contextual rivalry between Shia and Sunni groups also makes the picture more complex.

All the foregoing points clearly make the empirical analysis peculiar. The dependent variable of the empirical application is the number of victims and not the incidence of terror in itself. In fact, the number of victims proxies contextually the productivity as well as the incidence of terror. As noted above, following the interpretation in the light of contest theory, the testable implication would be an upward trend in the number of victims. In particular, the point is whether the number of victims of jihadist attacks is increasing in the number of victims of previous attacks. Resulting evidence confirms the hypothesis. In addition, results show that al Qaeda-style jihadist terrorist activity depends also upon grievance for poverty and socio-economic conditions.

The paper is structured as follows: in a first paragraph we present a selection of recent empirical contributions. In a second section, a narrative theoretical argument is explained. In a third section, the empirical application is developed. Eventually, in the last section, results are summarised and some conclusions are presented.

2. A selection of empirical studies

Hereafter, we present a selection of empirical studies on the determinants of terrorism. A first argument in the recent literature refers to the classical economic argument of *opportunity cost*. That is, the larger is the set of economic opportunities for an individual the lower is the likelihood or the willingness for him to be involved in a terrorist activity. In simpler words, the higher is the level of well-being the lower is the probability of terrorist activity in some territories. Consequently, low-income and poorest countries would be the natural incubators of terrorism. A second argument which can be defined as a *productivity argument* stresses the positive relationship between education and terrorist activity. That is, better educated individuals would also become more productive and bloodier terrorists. Among scholars, opportunity cost and productivity arguments are commonly cited as opposite theories. In particular, since in poorest countries education and literacy levels are quite low, the productivity argument is also produced in order to rule out the opportunity cost argument. However, at a deeper reading, the two arguments are not necessarily on opposite sides. They can complement each other. In fact, the opportunity cost argument could determine the '*why*' whereas the productivity argument can determine the '*how*'. In addition, the opportunity cost argument is often complemented by a focus on institutional and political atmosphere where terrorist activities take place. In non-democratic countries, the lack of opportunities for political participation induces political grievances, fuelling terrorism. Hence, in many studies a linkage between democracy and terrorism is often investigated. In any case, they all can be considered *preconditions* for terrorism, namely «*factors that set the stage for terrorism over the long run*⁹», as explained in Crenshaw (1981).

In recent years, a well-known study is Krueger and Maleckova (2003). The authors – with a special focus on Israel - first estimate the likelihood that someone can become a Hezbollah affiliate. By means of a logistic estimation, the authors show that a higher level of education is positively associated with the likelihood of becoming a

⁹See Crenshaw (1981) p. 381.

Hezbollah militant. Eventually, the authors have estimated negative binomial regression models, where the dependent variable is the number of international terrorist events – defined as incidents involving citizens of more than one country. As noted above, albeit widely quoted by many other authors the study is not conclusive given that most of the coefficients are not statistically significant. The main and more robust finding shows that terrorists are more likely to originate from larger countries. The only other significant estimation shows that terrorists come from poorest countries (that is, the countries falling within the bottom quartile of world distribution of GDP per capita). However, it is significant in only one out of four regressions.

Blomberg et al. (2004) using the ITERATE database, analyse a panel of 127 countries over the period 1968-1991. By means of a bivariate Markov process, the authors investigate whether or not there is a relationship between emergence of terrorism and the state of a country's economy. Results show that periods of economic contractions increase the likelihood of terrorist activities. This result appears to be more robust for high-income and democratic countries. Such a relationship is also studied in Li (2005) which analyzes the incidence of terrorist events in 11 countries over the period 1975-1997 and stresses the negative association between terrorism and democracy. The dependent variable is the annual number of transnational terrorist events that occur in a country whereas the explanatory variables are a bundle of political variables and few some economic factors as economic inequality and GDP per capita. The econometric estimation is a negative binomial regression. The main results of the study show that democracy and terrorism are negatively associated. Such association is robust and statistically significant. Instead a negative association between terrorism and GDP per capita is only weakly significant. The emphasis on polity is also the core of Drakos and Gofas (2006) that analyse the incidence of terrorist events in 153 countries over the period 1985-1998. According to the authors polity affects press freedom in a country. Therefore, the actual number of terrorist activities can be misreported in the presence of severe limitations to freedom of the press. The empirical application shows that the incidence of terrorist events is positively associated with polity score (namely incidence of terrorism is more likely in the presence of non-democracies). As covariates, the authors apply lagged values of terrorist incidence. They find a positive association between current and past level of terror. Emphasis on the relationship between democracy, civil liberties and terrorism is also in Kurrild-Klitgaard et al. (2006). In this work, the results show that political rights and civil liberties are negatively related with the emergence of transnational terrorism. Interestingly, democracy and political rights variables are positive while their square terms are negative so suggesting that emergence of terrorist incidents is increasing with increasing degrees of democracy until a certain point after which the likelihood of terrorism decreases. In other words, the results suggest that countries at an intermediate level of democracy (or perhaps in transition from autocracy to democracy) are likely to experience higher levels of terrorist activity.

Piazza (2006) does not find any significant relationship between economic development and terrorism. In particular, this study employs alternatively as dependent variables the incidence of terrorist attacks and casualty rates. The data spans from the 1986 to 2002. The independent variables used in the analysis include a set of economic variables (HDI, GINI coefficient, GDP growth, inflation, unemployment), demographic variables (population and population growth, ethnic diversity), and political variables (number of parties, index of political repression). The results show that none of

economic variables exhibits a significant association with both the incidence and the casualty rate of terrorist activity. Abadie (2006) uses country level data for 2003-2004 and shows that an increase in per capita GDP is associated with a reduction of terrorism, even if after controlling for other country characteristics national income is no longer associated with terrorism. In particular, the author also shows that the effect of political freedom is remarkably non-linear. In fact, the lack of political rights variable squared shows a negative and significant association with the incidence of terrorism in spite of a weakly significant positive association in the absence of the power squared exponent. Eventually, instrumental variables estimates confirm the qualitative results of OLS regressions. Burgoon (2006), analyses the relationship between welfare policies and the emergence of terrorism. The author uses three different sources: the ITERATE database (for the period 1991-1998), the MIPT-RAND database (1998-2003) and the US State Department data (1996-2001). The study employs alternatively as dependent variables: (i) the total number of transnational terrorist incidents in a country; (ii) the total number of terrorist incidents in a country; (iii) the number of significant transnational terrorist incidents by country of perpetrator(s). The independent variables used in the analysis include first the total welfare spending on health, security and education and eventually a set of variables as: GDP per capita, trade openness, population, government capacity, left-wing government and index of democracy). Results show that total social welfare spending is negatively and significantly associated with all measures of terrorism. Braithwhite and Li (2007) analyse the phenomenon of contagion of terrorist activities. In particular, they study the spatial clustering of terrorist incidents. They apply local spatial statistics to identify whether or not countries located within terrorism hot spot neighbourhoods, are likely to experience terrorist attacks in the future. They find robust evidence in this respect under alternative definitions of geographical proximity.

Freytag et al. (2008), present mixed results either confirming or contrasting the idea that terrorism is negatively associated with better socio-economic conditions. The analysis covers the period 1971-2005. The dependent variable is constructed as the number of terror incidents originating from a country during a five years span (ex. 1971-1975). The explanatory variables are clustered into three groups. (i) economic variables as – among others - GDP per capita, investment and trade openness; (ii) population characteristics as size and level of education; (iii) country specific effects related to institutional quality. The impact of GDP per capita on terror is significantly positive (except for European countries) but it turns to be significantly negative when GDP per capita is in quadratic form. The association between investment and terrorism is significantly negative with the exception of Islamic countries which show a positive association. Yet, human capital seems to be negatively associated terrorism with the exception of Islamic countries. The authors interpret such evidence as there is a significant threshold of development. As long as this threshold is not surpassed, better economic performance encourages terror. Instead, as the threshold is surpassed the usual interpretation of opportunity costs holds.

Berrebi (2007) and Benmelech and Berrebi (2007) with a specific focus on suicide attacks in Israel show that that both higher education and standard of living are positively associated with the incidence of suicide attacks. They produce a productivity argument. In short, better educated people would more productive terrorist, i.e., able to spread more terror by killing more people. In the first paper, both higher education and standard of living appear to be positively associated with membership in terror organizations such as Hamas or PIJ and with becoming a suicide bomber. The empirical

analysis is run by means of a logistic regression where the dependent variable equals 1 if the individual is member of Hamas or Palestinian Islamic Jihad (PIJ) and 0 otherwise. In the latter paper, the authors use a sample of 148 suicide attacks which represents 89% of the total number of suicide attacks between September 2000 and August 2005. The dependent variable is the number of people killed or injured in suicide attacks whereas the explanatory variables are given by age and education of suicide bombers and importance of target. In separate regressions, using a sub-sample of successful incidents (which reduces to the number of observations to 106) the authors show how the interaction terms (Age of suicide terrorist \times Target) and (Education \times Target) are positive and significant for the number of people killed. In their interpretation, older and better educated suicide bombers, when assigned to more important targets, are more effective killers. Jaeger and Paserman (2008) are intended to explain the cycle of violence between Israel and Palestinians. The sample period is from September 29, 2000, (when the Intifada began) to January 15, 2005, when Mahmoud Abbas assumed the presidency of the Palestinian Authority. Dependent variables in the empirical specification are given by fatalities of Palestinians and Israelis. In the period considered, the number of Palestinian fatalities is 3,244, whereas the number of Israeli fatalities reaches 994. By means of a VAR, the authors find evidence that the Israelis react in a significant and predictable way to Palestinian violence. However, there is no evidence that the Palestinians react to Israeli violence. It seems that Palestinian violence is pretty random. This contrasts the popular notion that the Israelis and Palestinians are engaged in a “tit-for-tat” cycle of violence. A complementary explanation is given (for the period 1991-2003) in Gupta and Mundra (2005). The authors show that Palestinian suicide attacks are the outcome of an interaction between Palestinian groups which is shaped by both cooperation and competition. For instance, previous PLO's incidents cause current attacks by Hamas and Islamic Jihad. Similarly, previous attacks by Hamas induce also attacks perpetrated by Islamic Jihad. However, Palestinian suicide attacks are also a reaction to Israeli attacks.

Another interesting recent study is Fielding and Shortland (2010). It is focused on Islamist violence in Egypt which is often cited as an important incubator of Islamist terrorism. The authors investigate the interactions between Islamist insurgent and Egyptian security force activity by means of several probit and tobit regressions and a new dataset on political violence in Egypt for the period 1990-2000. They found evidence that a cycle of violence does exist. Namely, increased activity on one side is followed by increased activity on the other. Interestingly, in order to test the opportunity cost argument the authors study the consequences of an increase in the price of bread on the number of casualties. As the price of bread increases the number of Egyptian civilians killed and wounded by other civilians also increases as well as the number of security forces casualties. Moreover, another interesting result is the negative spillover effect of Palestinian Intifada in Gaza. When the number of Intifada fatalities increases, Egyptian casualties also increase.

A recent study also focused on Palestinian suicide bombers is Sayre (2009). It studies the relationship between Palestinian suicide bombings and the labour market conditions as well as other political factors over the period 1993-2004. In the empirical model – estimated by means of a negative binomial regression – the dependent variable is the number of suicide bombings per quarter originating from a particular Palestinian sub-district and the explanatory variables are: (a) the mean daily wage; (b) the rate of unemployment and (c) the occurrence of some important political event. Results show

that the frequency of terrorist events is positively associated with a deteriorating economy. In short, it is in line with the opportunity cost argument.

TABLE 1 – SELECTION OF EMPIRICAL STUDIES.

AUTHOR(S)	JOURNAL	YEAR	PERIOD	REGIONS/COUNTRY	MODEL	DEPENDENT VARIABLE
Krueger and Maleckova	<i>Journal of Economic Perspectives</i>	2003	a) 1982-1994;b) 1997-2002	a) Israel/Lebanon; b) 148 countries	a) Logistic; b) Negative binomial regression	a) probability of becoming a Hizbollah affiliated; b) number of international terrorist events
Blomberg, Hess and Weerapana	<i>European Journal of Political economy</i>	2004	1968-1991	127countries	Bivariate Markov Process	Incidence of terrorism as average annual incidence
Li	<i>Journal of Conflict Resolution</i>	2005	1975-1997	11 countries	Negative binomial regression	annual number of trasnational terrorist events
Gupta and Mundra	<i>Terrorism and Political Violence</i>	2005	1991-2003	Israel/PLO	a) Poisson QMLE; b) SUR	a) Incidence of Suicide attacks; b) number of suicide attacks
Drakos and Gofas	<i>Journal of Conflict Resolution</i>	2006	1985-1998	153 countries	Negative binomial regression	annual number of transnational terrorist events
Piazza	<i>Terrorism and Political Violence</i>	2006	1986-2002	96 countries	OLS	a) incidence of terrorist attacks; b) casualty rate
Abadie	<i>American Economic review, Papers and Proceedings</i>	2006	2003-2004	186 countries	OLS	Index of Terrorist Risk (bounded between 10 and 100)
Burgoon	<i>Journal of Conflict Resolution</i>	2006	a) 1991-1998; b) 1998-2003; c) 1996-2001	100 countries	Negative binomial regression	(a) number of transnational terrorist incidents in a country; (b) number of terrorist incidents in a country; (c) the number of significant transnational terrorist incidents by country of perpetrator(s).
Kurrild-Klitgaard, Justesen, and Klemmensen	<i>Public Choice</i>	2006	1996-2002	121 countries	Logistic	Dichotomous variable, =1 if a country has experienced a terrorist incident in the period, = 0 if it has not.
Berrebi	<i>Peace Economics, Peace Science and Public Policy</i>	2007	1988-2002	Israel, West Bank and Gaza Strip	Logistic	probability for an individual to participate in Hamas or PIJ terrorist activities
Benmelech and Berrebi	<i>Journal of Economic Perspectives</i>	2007	2000-2005	Israel, West Bank and Gaza Strip	OLS	number of the people killed or injured in the attack
Braithwaite and Li	<i>Conflict Management and Peace Science</i>	2007	1975-1997	112 countries	Pooled time series	the annual number of transnational terrorist events that occur in a country
Freytag, Kruger and Schneider	<i>unpublished</i>	2008	1971-2005	95 countries	Poisson	number of terror incidents originating from a country during a five years span
Jaeger and Paserman	<i>American Economic review</i>	2008	2000-2005	Israel/PLO	VAR	fatalities of Palestinians and Israelis
Fielding and Shortland	<i>Journal of Peace Research</i>	2009	1990-2000	Egypt	Probit and Tobit	Civilians and Military Fatalities

Sayre	<i>Peace Economics, Peace Science and Public Policy</i>	2009	1993-2004	Israel/PLO	Negative binomial regression	number of suicide bombings per quarter
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3. Al Qaeda in the light of contest theory.

As noted above, al Qaeda-style terrorist activity is analysed in the light of contest theory. This interpretation has been also partly expounded in Caruso and Locatelli (2004/2008/2009). A contest is commonly defined as a game in which players compete for a prize by making irreversible outlays. In other words, contests are situations in which rational agents spend resources in order to win a prize. The characteristic feature of this interaction is that resources are spent irreversibly¹⁰. In this view, al Qaeda may be portrayed as a contest organizer providing an indivisible prize to the best terrorist group. Bin Laden and his fellows may start a competition among different would-be terrorist groups which are only loosely related to terrorist network. The prize could be assumed to be an honourable membership as well as an economic reward¹¹. Hence, these candidate cells compete with each other. Agents – namely the would-be terrorist groups – play à la Nash and maximize their efforts. In particular, all candidate groups may believe to be involved in a contest made by multiple rounds.

How such interpretation could be defended? It has always been broadly acknowledged that al Qaeda does not retain a clear hierarchical line of command. In particular, this flexibility allows for a novel recruitment system. Even some recent works suggest that the recruiting process may now resemble a kind of voluntary application to join the organization¹². In this view, new groups are involved in the organization as the result of a selection process amongst different volunteers (Sageman, 2004). The rise of the so-called “self starters” is taken as evidence of this, i.e., groups with little or no affiliation with the network perpetrating terrorist attacks on their own initiative (Kirby 2007; Sageman 2008). In particular, attacks in Istanbul (November 2003), Madrid (March 2004), London (twice in July 2005) seemed to confirm the emergence of such phenomenon. This allows al Qaeda to extend its membership almost infinitely, simply because new groups can be affiliated at any time without an institutionalized recruitment procedure. It has also at least two significant advantages for al Qaeda. Firstly, there is no need for bin Laden and his fellows to invest resources in any recruitment mechanism. Secondly, and most importantly, such an abundance of applications would allow al Qaeda to be very selective in granting membership.

As noted above, contests are situations in which rational agents irreversibly spend resources in order to win a prize. This does constitute the main difference with auctions, in which agents do not bear the cost of the bids entirely by themselves. This is also the rationale for labelling contests as all-pay auctions. Literature on contests implies the concept of non-cooperative Nash equilibrium. Simple examples of contests can be drawn from sports. In a race, athletes cannot coordinate their actions and in the presence of an indivisible prize they will put in their maximum effort to win the prize.

¹⁰Traditional contest models are formally grounded on Tullock (1980), and found seminal explanations in O’Keeffe, Viscusi, Zeckhauser (1984); Rosen (1986); Dixit (1987). Recent excellent contributions are Moldovanu and Sela (2001) and Moldovanu et al. (2007). A comprehensive and recent study on contest theory is Konrad (2009).

¹¹ It is established that al Qaeda has given grants to local groups that devised promising plans for attacks.

¹²Cozzens (2005).

The optimal level of the effort exerted by every agent is strictly correlated to the value of the ‘prize’ – i.e., the higher the evaluation of the ‘prize’, the higher the commitment to put the maximum effort into the contest. Second, each agent knows that the probability of winning the contest is increasing in its own effort and decreasing in other players’ efforts. That is, in the simplest case of two agents, say A and B, the probability of agent A of winning the contest is higher when it makes a bigger effort than agent B. Therefore, the only feasible strategy for both A and B will be exerting the maximum possible effort. In a multi-agent scenario, however, the theory also predicts that total effort decreases in the number of contestants. That is, when agents are aware that the contest is joined by more agents, individual effort will decrease. In fact, the higher is the number of agents the lower is the probability for each agent to win the prize.

Of course, these general predictions about agents’ behaviour can be considered as *ceteris paribus* conditions. In general, these properties hold even when other factors impact the effectiveness of efforts. We can say that it is possible to indicate two candidate subsets of interacting factors: (a) individual characteristics; (b) exogenous characteristics. As individual characteristics, consider first the existence of different talents and abilities. Individuals as well as groups differ widely in terms of abilities. The idea of ability is ‘somehow’ *technological*. If you consider that a contest can be considered nothing but a production function of a monetary reward, then the efforts do constitute the ‘inputs’, whilst the abilities do constitute a technology translating a certain level of efforts into the probability of success. The impact of different abilities is clearer in the presence of a winner-take-all contest. Take again the example of the race. Since athletes are expected to put their maximum effort into the race, and given that their level of effort depends upon the value of the prize, they would exert the same effort. In such a case, the outcome of the contest will be determined – everything else being equal – by abilities.

Of course, the design of the contest matters. That is, the agent providing the ‘prize’ of the contest can somehow modify the architecture of the contest in order to influence the total effort exerted. The simplest case is that of providing different prizes. This is commonly the case with sport contests where prizes are offered for the winner but also for the runner-up. Moldovanu and Sela (2001) offer a brilliant theoretical contribution in this respect. They show that in the presence of concave cost functions, only one prize is the optimal design which maximizes efforts. By contrast, in the presence of convex cost functions, different prizes may constitute an optimal design. In fact, even if agents are aware that they cannot win the contest, they also expend the maximum effort to get the other prizes. This is the case in sports such as cycling, where different prizes are provided by organizers and then the total efforts of participants is maximized. By contrast, when the cost function is not convex only one prize leads to the best design. In such a case, the designer’s objective is also maintained. The level of total effort is maximized. Offering only one prize guarantees that no player will give up. This is true in particular when players do not have information about other contestants’ abilities.

A crucial point is also represented by information. The simplest case refers to asymmetry in the evaluation of the prize. That is, without any public disclosure of information, agents can evaluate the ‘prize’ of a contest differently. Since the level of effort is positively correlated to the value of the prize, different evaluations of the stake lead to different levels of effort made by agents. Nti (1999) analyses the case of a contest where participants evaluate the ‘prize’ differently. The common result of this

analysis is that high-evaluation agents exert a bigger effort than low-evaluation participants. Hillman and Riley (1989) show that asymmetric evaluation deters participation by low-evaluation agents. Consider a contest with only two players, A and B, with identical abilities. If A retains a higher evaluation of the prize, it will exert itself more, and as a consequence will be the favorite. Agent B, the ‘Underdog’, will exert itself less. Therefore, increasing the favourite’s valuation increases its effort, but decreases the effort of the underdog. This result may hold even if Agent B (the low-evaluation agent) has superior abilities.

Another crucial piece of information which is not publicly available is the number of contestants. Namely, participants do not know (at least not exactly) the number of contestants. As noted in Muenster (2006) this also increases the total level of efforts exerted. Eventually, all the participants are privately informed about their abilities – in other words, each group knows how much it can achieve, but is unaware of the others’ potential. This, in turn, creates a favourable condition for the contest designer, since all participants have to maximize their efforts. This point is crucial even in the presence of a multi-stage contest, namely a tournament. In fact, in the first round of a tournament the competing groups can signal their commitment and ability to other participants. This also increases the aggregate level of efforts exerted. This is modelled in Amegashie (2006) and Amegashie et al. (2006) that analyses elimination contests where all players do not save efforts in the first stage in order to signal their own ability to the other contestants.

This introduces a proper and necessary distinction between contests and tournaments. As noted, in fact, a tournament is a multi-stage contest. However, it has some implications with respect to the availability of information. As analysed in Morgan and Vardy (2007), in a sequential tournament, it is the effectiveness of the first-movers effort that is revealed to the second mover, rather than the effort itself. That is, the second long jumper gets to observe the distance jumped by the first, but not the underlying effort that produced the jump. By contrast, in a sequential contest it is effort that is observable, while its ultimate effectiveness remains unobservable until the very end of the contest. In our context, the second terrorist candidate observes the outcome of the first terrorist candidate. Once the efforts are exerted information becomes costless. When it comes to terrorist attacks, monitoring and information costs are close to zero: in fact, when a terrorist group bombs an embassy or a trade centre with dozens of casualties somewhere in the world, the event is extensively covered by international mass media¹³. In the presence of costless information acquisition, Dixit (1987) points out that modelling difference between contests and tournaments makes no sense. In the presence of costless information there is no difference between a contest and a tournament. Hereafter, given the costless information emerging after a terrorist attack, equivalence between contest and tournament can be assumed in our context. Therefore, henceforth the terms ‘contest’ and ‘tournament’ will be used alternatively. Let us consider the jihadist tournament. Within this context, let us assume that each group – before perpetrating its own attack – observes the results of some previous attacks. Hence in order to maximize its own probability of winning the prize, each group

¹³In the context of our study, this is related to the relationship between terrorism and media. The media, in fact, can minimize the cost of information acquisition about terrorism. In a recent article Rohner and Frey (2007) demonstrated empirically that media attention and terrorism do mutually Granger cause each other. Interestingly, Cowen (2006) also made an effective analogy between terrorism and the production of some cultural goods as theatre.

maximizes its effort and tries to make attacks more destructive than the foregoing attacks.

4. Testable implications and empirical strategy.

4.1 The data

On the basis of the theoretical insights presented above, the testable implication is that: *the number of victims of jihadist attacks is increasing in the number of victims of previous attacks.* That is, an upward trend in the number of victims would confirm the basic hypothesis of this work. Put differently, an increase of victims would be the outcome of competition between groups. The additional limiting assumption is that if a tournament takes shape, it does at a national level. In such a way, the feasible interpretation is that al Qaeda would work in order to organise some ‘national’ champions. It is also possible that some terrorist groups behave spontaneously as they were in a national contest.

Hence, in the empirical specification, the dependent variable is the number of victims of Al Qaeda-style terrorist attacks which occurred in the sampled countries. The number of victims is computed as the sum of killed and wounded people. The main explanatory variable would be the number of victims of previous Al Qaeda-style terrorist attack in the same country. The years considered span from 2002 to 2007. We examine the main hypothesis of this work by using a panel data model. In particular, since the dependent variable is event count, a negative binomial model is applied.

Data on terrorist incidents have been extracted from Global Terrorism Database GTD dataset¹⁴. The dataset is very detailed. Each record reports different characteristics of the incident. Then, it had been possible to filter the dataset in order to in order to consider only incidents fitting with al Qaeda’s *modus operandi*. Therefore the records have been filtered according the following steps:

- (1) Each record had to report the Islamic extremist as perpetrator. In particular, only Sunni extremism has been considered;
- (2) Incidents occurred in Israel, Gaza Strip, West Bank, Iraq and Afghanistan have been excluded;
- (3) Each incident had to involve explosive devices (in particular IED, Improvised explosive device);
- (4) Attacks to facilities have been excluded¹⁵. For example, attacks to pipelines have been excluded;
- (5) Assassinations of political leaders have been excluded even if an involvement of Islamist extremists has been reported;
- (6) Attacks to shops, groceries and small business facilities have been excluded.

In order to understand the criteria used to select the data, it is useful to refer to the ‘Manchester Manual’ which is considered as a ‘handbook’ for jihad. It was first found by British police in a raid in Manchester. It is currently available on line at the website

¹⁴The dataset is downloadable at the address <http://www.start.umd.edu/gtd/> (last access January 2010).

¹⁵For precise definition of ‘facilities’ please refer to GTD codebook available at www.start.umd.edu/gtd/downloads/Codebook.pdf (accessed on December 2010)

of US Department of Justice ¹⁶. Reading this document it is clear what must be the main targets of a terrorist cell and in particular among others (see p. 13 of the manual): (i) blasting and destroying the places of amusement, immorality and sin; (ii) blasting and destroying the embassies and attacking vital economic centres; (iii) assassinating enemy personnel as well as foreign tourists. In the manual, there is no mention of assassination of political leaders. At the same time, reading the manual it is clear that attack to shops and small business facilities are not included as well as the attacks to facilities as pipelines.

Eventually, even on the basis on (1)-(6) and of (i), (ii) and (iii), the categories (as coded by GTD) of targets included in the sample are: (a) diplomat; (b) foreign business; (c) indiscriminate civilians/non combatants; (d) international; (e) US business; (f) US Diplomat; (g) US indiscriminate civilians/non-combatants; (h) US transportation; (i) US other.

The empirical application covers the period 2002 – 2007. The sample includes countries where the Sunni radicalism of Al Qaeda emerged in the latest recent years. As explained in the introduction the sample does not include countries as Israel, Gaza Strip or Iraq. In fact, as noted above, in Israel, West Bank, Gaza, there is no need of a tournament to select a national champion. National champions already exist. Palestinian terrorist organisations are well-established and have been lasting for years. In fact, Hamas, PIJ or Hezbollah do not need to be involved in any tournament. They are already the ‘best teams’. Hamas has been founded in 1978 and launched the Jihad against Israel in 1988. The Palestine Islamic Jihad (PIJ) has been formed by militant Palestinians in Gaza during the 1970s. Therefore, it is reasonable to assume that the theoretical approach of the tournaments does not apply to this scenario.

Iraqi scenario is also puzzled. First, the main problem about Iraq is represented by available data. In many cases, no group claimed responsibility of attacks. Therefore, it is difficult to select the cases which could fit the model because the database does not report the necessary definitions. For example, many events could be alternatively attributed to either Sunni or Shia groups. Secondly, in Iraq, Al Qaeda operations have been led by Al Zarqawi. However, Al Zarqawi has been officially recruited by Al Qaeda in 2002. That is, the recruitment process was held before the period considered. In this case, it also seems that a jihadist tournament as a recruitment process did not take place. However, even the role and the tasks of Al Zarqawi in Iraq are debated and controversial¹⁷. Third, moreover, in Iraq, resistance to U.S. occupation forces and terrorism should be disentangled. There is evidence that many attacks depend upon the presence of U.S. occupation forces (Blank et al. 2008).

Table 2 reports the countries included in the sample. Moreover, table 2 reports the groups which are active in those countries. The main source has been the GTD, which reports the groups that claimed responsibility for attacks. The list has been also enriched including information about active groups available in Rabasa et al. (2006), and in the list of foreign terrorist organizations provided by US Department of State.

TABLE 2 – COUNTRIES, ACTIVE GROUPS

Country	Groups*, **, ***
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¹⁶The Manchester Manual is available at http://www.usdoj.gov/ag/manualpart1_1.pdf (last access December 2010).

¹⁷ The most comprehensive study on Al Zarqawi is Napoleoni (2005).

1) Algeria	Salafist Group for Call and Combat (GSPC)*,**,***, Armed Islamic Group (GIA)*,**,***, Essedik Katibat*, Dhamat Houmet Daawa Salafia***, AQLIM*
2) Bangladesh	Tablig Jamaat*, Islami Chhatra Shibir*, Jagrata Muslim Janata Bangladesh (JMB)*, Jama'atul Mujahideen Bangladesh (JMB)*
3) Egypt	Tawhid Islamic Brigades*; Jamaah al-Islamiya organization (JI)*; the Battalions of the Martyr Abdullah Azzam*, Sinai Martyr's Group*, Al-Tawhid Wal-Jihad (Unity and Jihad Group in Egypt)*, Al-Jihad ***
4) Ethiopia	Al-Itihaad al-Islami (AIAI)***, Mujahideen Youth Movement (MYM)*
5) India	Hizbul-Mujahedin*, Jaish-e-Mohammed (JEM)*, Jammu and Kashmir Islamic Front (JKIF)*, Harakat ul Mujahidin (HUM)*, Lashkar-e-Tayyiba (LT)*, Harakat ul-Jihad-I-Islami/Bangladesh (HUJI-B)*
6) Indonesia	Jemaah Islamiya Organization (JI), Tanzim Qai'dat al-Jihad**, Majelis Mujahideen Indonesia (MMI)**
7) Iran	Jundullah (Soldiers of God)*
8) Jordan	Tanzim Qa'idat al-Jihad fi Bilad al-Rafidayn (QJBR) (al-Qa'ida in Iraq)
9) Kenya	Al Qaeda*, Al-Shabaab*,
10) Lebanon	Asbat al-Ansar, Jund al-Sham, Fatah al-Islam
11) Morocco	Salafia Jihadia*, Moroccan Islamic Combatant Group**
12) Nigeria	Boko Haram, Salafist Group for Call and Combat (GSPC)
13) Pakistan	Harakat ul Mujahidin (HUM), Lashkar i Jhangvi, Sipah-I-Sahaba/Pakistan (SSP), Qari Zafar Group, Tehrik-i-Taliban
14) Philippines	Moro Liberation Front (MLF), Abu Sayyaf Group (ASG), Jemaah Islamiyah (JI), Al Khobar*
15) Russian Federation	Riyad us-Saliheyn Martyrs' Brigade*, Caucasus Emirate*, Shariah Jamaat*, Mojahedin of Karbada*, Special Purpose Islamic Regiment (SPIR)***
16) Saudi Arabia	Gama'a al-Islamiyya (IG)***, Al-Jihad***
17) Somalia	Mujahideen Youth Movement (MYM)*, Al-Shabaab*, Al-Itihaad al-Islami (AIAI)**

18) Thailand	Jemaah Islamiyah (JI)**, Kumpulan Mujahedin Malaysia (KMM)***, Muslim separatists*
19) Turkey	Abu Hafs al-Masri Brigades*, Kurdistan Freedom Hawks (TAK)*, Islamic Great Eastern Raiders-Front (IBDA-C)***
20) United Kingdom	Abu Hafs al-Masri Brigades*, the Secret Organization of al-Qaeda* in Europe, Al-Jihad (AJ)***

Sources: * GTD, ** Rabasa et al. (2006), *** US Department of State, List of foreign terrorist organizations (2007)

4.2 The empirical specification

Henceforth, we examine the main hypothesis of this work by using a panel data model. In particular, since the dependent variable is event count, a negative binomial model is applied. The Negative Binomial regression, is the model used to deal with event count data exhibiting over-dispersion. In particular, the negative binomial distribution is a generalization of the Poisson distribution allowing for the variance exceeding the mean. The panel models for count data have been introduced in Hausman et al. (1984) and deepened in Cameron and Trivedi, (1986:1998). Let y_{it} be the nonnegative dependent count variable for country i at time t . When y_{it} follows a negative binomial distribution, following Hausman et al. (1984) the mass function can be written as:

$$f(y_{it} | \lambda_{it}, v_i) = \frac{\Gamma(y_{it} + \lambda_{it})}{\Gamma(y_{it} + 1)\Gamma(\lambda_{it})} \left(\frac{v_i}{v_i + 1}\right)^{y_{it}} \left(\frac{1}{v_i + 1}\right)^{\lambda_{it}} \quad (1)$$

The dispersion parameter v_i is assumed to be constant over time for each individual i while λ_{it} depends on explanatory variables. Eventually $\Gamma(\cdot)$ is the gamma function. The mean and the variance are given respectively by:

$$E[y_{it}] = v_i \lambda_{it} = v_i e^{X_{it}\beta}, \quad (2)$$

$$VAR[y_{it}] = v_i(1 + v_i)\lambda_{it} = v_i(1 + v_i)e^{X_{it}\beta} \quad (3)$$

where β is a vector of unknown parameters and X_{it} is a set of explanatory variables. The exponential function adopted ensures non-negativity of the mean. It is clear that the variance exceeds the mean. This is property which is commonly referred as over-dispersion. In particular, the ratio of the variance to the mean is $(1 + v_i)$, which is constant over time but can vary across individuals. The log-likelihood is then obtained from the function above and estimation is by maximum likelihood. For a random effects model we have to allow v_i to vary randomly across countries by assuming that $1/(1 + v_i) \sim Beta(a, b)$. The joint probability which is the basis for maximum likelihood estimation for the i^{th} country is:

$$Pr[y_{i1}, \dots, y_{iT}] = \left(\prod_{t=1}^T \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)}\right) \times \frac{\Gamma(a+b)\Gamma(a + \sum_{t=1}^T \lambda_{it})\Gamma(b + \sum_{t=1}^T y_{it})}{\Gamma(a)\Gamma(b)\Gamma(a+b + \sum_{t=1}^T \lambda_{it} + \sum_{t=1}^T y_{it})} \quad (4)$$

For the fixed effects model the joint probability of the counts for each country is conditional on the sum of the counts for the country, namely the observed $\sum_{t=1}^{T_i} y_{it}$. This yields:

$$Pr[y_{i1}, \dots, y_{iT} | \sum_{t=1}^{T_i} y_{it}] = \left(\prod_{t=1}^T \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)} \right) \times \frac{\Gamma(\sum_{t=1}^{T_i} \lambda_{it})\Gamma(\sum_{t=1}^{T_i} y_{it} + 1)}{\Gamma(\sum_{t=1}^{T_i} \lambda_{it} + \sum_{t=1}^{T_i} y_{it})} \quad (5)$$

Specifications (4) and (5) are implemented in the STATA statistical software which has been used in the present work¹⁸. The maximum likelihood estimators of β maximize the log-likelihood function based on (4) and (5).

As noted above, the main hypothesis of the present work is that the number of victims of jihadist attacks is increasing in the number of victims of previous attacks. This hypothesis necessarily relaxes the assumption of independence between events. Therefore, the event count dependent variable would be associated with its lagged value so determining a trend. As discussed in Cameron and Trivedi (1998: ch.7), Brandt et al. (2000) and Brandt and Williams (2001), a feasible approach is to include a lagged dependent event count as a regressor in the mean function of the negative binomial model. That is, this would take the shape of an autoregressive model. Then, in the current specification, we include a lagged dependent event count as regressor, and the mean turns to be conditional on current X_{it} and past value of the dependent variable, say y_{t-1} . Therefore we can specify¹⁹ the conditional mean as:

$$E[y_t | y_{t-1}, X_{it}] = v_i \lambda_{it} = v_i \exp(\beta X_{it} + \rho y_{it-1}) \quad \text{with } \rho > 0. \quad (6)$$

The conditional mean specified in (6) can be substituted into (4) and (5). Therefore, the procedure for the non-dynamic negative binomial panel case can be easily adapted to the autoregressive model.

Finally, the dependent variable y_{it} is the aggregate number of killed and wounded people in any Islamist terrorist attack occurred in each country considered. The dataset is an unbalanced panel of 631 jihadist incidents occurred in 20 countries. The number of attacks per country varies from 2 to 158 with a total number of attacks of 631. The number of victims for incident varies from 0 to 317. Then, the dependent variable y_{it} varies over countries ($i = 1, 2, \dots, 20$), and is indexed by time (t). In particular, the time of incident is an exact date. In particular, incidents are ordered by date. Henceforth we refer to the dependent variable as ‘victims’. Needless to say, the number of incidents differs widely across years. The lagged event count (y_{it-1}) is the number of victims of the previous terrorist attack in the same country. Henceforth we refer to it as ‘pastvict’. An example would clarify. On 17th august 2005, the group Jama'atul Mujahideen Bangladesh bombed several targets across Bangladesh killing two people and wounding

¹⁸ It must be noted however that there are several specifications of negative binomial models. In general, as pointed out in Cameron and Trivedi (1986), different negative binomial regression models can be generated by linking λ_{it} and v_i to the explanatory variables in different ways. The one outlined here is usually referred as Negative Binomial 2 or NB2. Negative Binomial 1 (NB1) has the same expected count as NB2, namely $E[Y_t] = \lambda_{it} = e^{X_i\beta}$. The difference comes in terms of the variance. In the NB1 model, the variance is $VAR(Y) = (\lambda_{it} + \alpha\lambda_{it})$. Greene (2008) discusses the differences between two models, then developing an encompassing model which nests both of them.

¹⁹ An alternative specification, labeled as linear feedback model, is in Blundell et al. (2002).

more than 100 others. In such a case, the dependent variable would be $y_{Bangladesh,17\text{ august }2005} = 102$. The lagged event count is the number of victims of the previous incident occurred in Bangladesh, namely the number of victims occurred on 13th august 2005 when one worshipper was killed and 80 others were injured when 10 to 12 bombs detonated simultaneously in the Shah Peer Kalla Shaheed shrine in Akhaura, say $y_{bangladesh,13\text{ august }2005} = 81$.

Two further points require attention. First, we have to consider different time intervals. That is, we assume that terrorist groups behave as they were in a tournament but it is unclear what could be the exact reaction time of each group. Namely, after what time interval a competitor group would attack to respond to an attack perpetrated by another group. In this respect, it is reasonable to assume a tournament takes place in a limited period of time. Therefore, the previous incident should have occurred within a short period of time. To deal with this, we apply alternatively as independent variable the number of victims of previous incidents occurred within: (i) an indefinite period of time; (ii) two months; (iii) three months. That is, in a first set of regressions we consider as explanatory variable only the number of victims of the previous incident whatever the interval between the two attacks. Eventually, we consider as explanatory variable the number of victims in the previous incident if and only if it took place within a period of two or three months before. The latter interval in particular is applied following Gupta and Mundra (2005).

A second point relates to the target choice²⁰. In fact, target choice is a characteristic feature of any terrorist activity. That is, terrorist groups may believe that they will be differently evaluated on the basis of the targets chosen and the consequent victims. For instance, western or US casualties could be supposed to be worth more than local citizens. In order to capture this, incidents considered include as target the categories (as coded by GTD): (a) diplomat; (b) foreign business; (c) indiscriminate civilians/non combatants; (d) international; (e) US business; (f) US Diplomat; (g) US indiscriminate civilians/non-combatants; (h) US transportation; (i) US other. Eventually, a second set of regressions includes only civilian targets (c) indiscriminate civilians/non combatants; (g) US indiscriminate civilians/non-combatants.

The control variables are drawn from the literature on determinants of terrorism. In order to capture the opportunity cost argument, we consider GDP per capita and consumer price index. Data on GDP per capita have been extracted from the Penn World Tables²¹. CPI denotes the average annual change in consumer price index and it is extracted from IMF/WEO. The CPI proxies changes in purchasing power of individuals which can affect the standard of living so modifying their opportunity cost. In addition, the CPI also proxies the expectations of individuals about future economic growth. That is, the higher is the CPI, the higher is the expected future economic growth rate. In order to avoid endogeneity problems, both GDP per capita and CPI are lagged one year. GDP per capita has been also squared in order to deal with potential non-linearity.

²⁰Brandt and Sandler (2010) analyze in depth the changes in target choices which took shape in the latest forty years so highlighting four target regimes. (i) the rise of modern transnational terrorism starting around 1968; (ii) the era of technological barriers beginning in 1973; (iii) the age of state-sponsored terrorism ensuing in late 1979 and ending around 1990; and (iv) the post-Cold War era and the dominance of Islamic fundamentalist terrorists starting around 1990.

²¹The Penn World Tables are available at http://pwt.econ.upenn.edu/php_site/pwt_index.php. Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.3, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, August 2009.

The institutional regime has been captured through the polity index developed in Polity IV project. The actual polity-index is based on a subtraction of a value on the autocracy scale from a value on the democracy scale. Thus it results in values ranging from -10 (very autocratic) to +10 (very democratic). The Education and the Gini index of income inequality have been drawn from UNDP²². Moreover, we included a dummy variable denoting whether an attack has been launched by suicide bombers or not. It takes the value of unity in the case of suicide bombing and zero otherwise. The full set of variables are listed in Table 3 below with descriptive statistics for the full sample.

TABLE 3- VARIABLES, DESCRIPTIVE STATISTICS AND SOURCES

	Description	Source	Obs.	Mean	Std. Dev.	Min	Max
<i>Victims</i>	Number of Victims of current incidents	GTD	631	17.96	34.15	0	317
<i>Pastvict</i>	Number of Victims of previous incident in the same country	GTD	631	17.68	33.92	0	317
<i>Gdppc</i>	GDP per capita (logged),	Penn World Tables	631	8.31	0.713	6.14	10.35
<i>Gdppc square</i>	GDP per capita squared (logged)	Penn World Tables	631	69.557	11.532	37.684	107.05
<i>Polity</i>	Polity IV project index, bounded between -10 and 10.	Polity IV Project	633	3.92	5.39	-10	10
<i>Education</i>	Education index (logged)	UNDP	630	-.399	.257	-.968	-.010
<i>CPI</i>	average annual change in consumer price (logged)	IMF/WEO	627	1.592	.725	-.494	4.23
<i>Suicide</i>	Dummy variable (yes=1)	GTD	631	0.09	0.28	0	1
<i>Gini Index</i>	Gini index of income inequality (logged)	UNDP	631	3.619	.124	3.40	3.795

TABLE 4 . PAIRWISE CORRELATIONS

	<i>Vict</i>	<i>pastvict</i>	GDP per capita (t-1)	GDP per capita (t-1) square	education index	Polity	Gini index	CPI	Suicide
<i>Vict</i>	1								
<i>Pastvict</i>	.3315	1							
GDP per capita (t-1)	.0670	.0711	1						
GDP per capita (t-1) squared	.0712	.0755	.9964	1					
education index	.0395	.0388	.6925	.7090	1				
Polity	.0723	.0863	.0122	-.0070	.2357	1			
Gini index	-.0851	-.0801	.3193	.3381	.7627	.2630	1		
CPI	.0249	.0294	.3664	.3319	.1131	.1151	-.1533	1	
Suicide	.386	.1137	.1186	.1258	-.0075	-.0841	-.1118	-.0226	1

²² The GINI index (as adopted by UNDP) is multiplied by 100, so lying between 0 and 100. A value of 0 represents absolute equality and 100 absolute inequality. Please see <http://hdrstats.undp.org/en/indicators/161.html> (last access December 2010).

4.3 Results

Table 5 reports the results of the regressions. Both random (denoted by RE) and fixed effects (denoted by FE) estimations are presented²³. As noted above columns 1 and 2 do not assume an exact interval for consequent incidents whereas columns 3,4,7 and 8 assume an interval of two months and columns 5,6,9 and 10 assume an interval of three months. Moreover, columns 1-6 reports results for specifications which include as target the categories (as coded by GTD): (a) diplomat; (b) foreign business; (c) indiscriminate civilians/non combatants; (d) international; (e) US business; (f) US Diplomat; (g) US indiscriminate civilians/non-combatants; (h) US transportation; (i) US other. Columns 7-10 report results for specification which includes only civilian targets (c) indiscriminate civilians/non combatants; (g) US indiscriminate civilians/non-combatants.

The main hypothesis of this work is confirmed. The number of victims of terrorist incidents is significantly increasing in the number of victims of the previous incident in the same country. In particular, it shows an upward trend. For one-unit increase in the *pastvict* variable the expected number of victims increases approximately by 0.4 per cent²⁴. That is, coefficient on the lagged value of the number of victims can be interpreted as a growth rate. In fact, following Cameron and Trivedi (1998) for any model with exponential conditional mean the coefficient equals the change in the conditional mean if the regressor changes by one unit. This follows from $\frac{\partial E[y_{it}|y_{it-1}, X_{it}\beta]}{\partial y_{it-1}} = \rho E[y_{it}|y_{it-1}, X_{it}\beta]$. That is, the coefficient of the lagged count ρ can be interpreted as the change in the expected count induced by a unit change in y_{it-1} . Brandt et al. (2000) show that including a lagged count in the exponential function of an event count model estimates a linear exponential growth rate. This determines a dynamic model with an upward trend.

The covariates also present the expected signs. A positive significant association between polity and terrorist brutality emerges. In fact, since the level of press freedom is highly correlated with regime type, democratic countries are likely to have a superior reporting propensity. That is, democratic regimes safeguard press freedom, and thereby underreporting of terrorism is likely to be minimized. This point has been confirmed in Drakos and Gofas (2006). In all regressions the association between lagged GDP per capita and the number of victims is negative but it is significant only in specifications 4,7,8,9, and 10. In particular, such association is not significant when the larger sample of targets is applied. Instead, when considering only the indiscriminate terror against civilians the negative relationship between GDP per capita and brutality is significant. Moreover, such negative association appears to be even stronger when the fixed effect estimator is used. When considering also the quadratic form of lagged GDP per capita, the association turns out to be positive and it is significant in columns 3,4 and from 6 to 10. This suggests a non-linear relationship between terrorist brutality and socio-economic environment. Even in this case, such association is (weakly) significant when the smaller sample of targets is applied whereas it is more robust when the fixed effect estimator is used. Specifically, the estimated coefficients suggest that an increase of

²³ Allison and Waterman (2002) and Guimaraes (2008) show that the fixed effects negative binomial only control for individual specific effects under a set of specific assumptions.

²⁴ We would like to thank an anonymous referee who suggested us to highlight this point.

GDP per capita decreases brutality of terrorism when a country is at a relatively lower level of per capita income.

Table 5 – Dependent variable: victims by event (Panel Negative Binomial Regression)

	(a) diplomat; (b) foreign business; (c) indiscriminate civilians/non combatants; (d) international; (e) US business; (f) US Diplomat; (g) US indiscriminate civilians/non-combatants; (h) US transportation; (i) US other.						(c) indiscriminate civilians/non combatants; (g) US indiscriminate civilians/non-combatants.			
	indefinite reaction period		reaction time=2 months		reaction time =3 months		reaction time=2 months		reaction time = 3 months	
	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE
	1	2	3	4	5	6	7	8	9	10
Pastvict	.003*** (.001)	.003*** (.001)	.003*** (.001)	.003** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)
GDP per capita(t-1)	1.025 (.920)	1.231 (1.056)	-1.79 (1.26)	-2.57* (1.56)	-1.32 (1.176)	-2.14 (1.429)	-1.99* (1.173)	-3.20** (1.504)	-1.75* (1.099)	-3.31** (1.488)
GDP per capita(t-1) squared	-0.62 (.057)	-0.77 (.066)	.129* (.080)	.181** (.100)	.099 (.074)	.155* (.091)	.136** (.074)	.218*** (.095)	.119* (.069)	.221*** (.094)
Polity	.023*** (.010)	.022** (.011)	.038*** (.013)	.037** (.014)	.038*** (.012)	.038** (.013)	.032*** (.0128)	.032*** (.0141)	.031*** (.012)	.03** (.014)
Education	-0.005 (.404)	-0.075 (.447)	-.845 (.590)	-1.35** (.708)	-.805 (.554)	-1.42** (.653)	-.837 (.626)	-1.60** (.767)	-.63 (.57)	-1.19 (.715)
Gini	-1.37** (.671)	-1.22* (.741)	-1.05 (.925)	-.307 (1.156)	-1.03 (.874)	-.156 (1.074)	-.246 (1.05)	.693 (1.31)	-.559 (.974)	-.033 (1.238)
CPI	-.308*** (.075)	-.378*** (.076)	-.318*** (.0904)	-.37*** (.100)	-.32*** (.087)	-.38*** (.097)	-.165* (.101)	-.235** (.113)	-.177** (.096)	-.256*** (.113)
Suicide	.858*** (.128)	.791*** (.135)	.63*** (.151)	.598*** (.159)	.718*** (.142)	.67*** (.151)	.776*** (.154)	.723*** (.165)	.821*** (.146)	.752*** (.156)
Const	.373 (4.575)	-7.33 (5.22)	9.117 (6.152)	9.21 (7.94)	7.22 (5.82)	6.87 (7.46)	7.21 (6.024)	7.96 (8.27)	7.60 (5.585)	11.622 (8.053)
Obs	626	626	537	534	566	563	494	494	514	514
Groups	19	19	18	17	19	18	16	16	16	16
Log Likelihood	-2290.12	-2160.28	-1957.55	-1839.61	-2057.01	-1931.17	-1826.31	-1720.64	-1888.14	-1784.91

Notes: *** significant at 1%, ** significant al 5%, * significant at 10%. For sake of readability statistically significant coefficients are in bold.

The idea according to which terrorist activity depends also upon grievance for poverty and socio-economic conditions seems to be confirmed (at least for low-income countries). This is also confirmed by the negative association between the CPI and the number of victims. Since CPI is assumed to be a proxy for a growing economic scenario, the brutality of terrorists decreases so confirming the opportunity cost argument. That is, the higher is the CPI, the higher are the expectations of individuals about future economic growth. Finally, the opportunity cost argument has to be

confirmed even if in the presence of a non-linear relationship between GDP per capita and terror. By contrast, there is no way to defend the ‘productivity argument’. In fact, the association between education and the dependent variable appears to be negative. That is, the higher is the education index, the lower is the number of victims of terrorist incidents. Such negative association is significant only applying the fixed effects estimator in columns 4, 6 and 8. Inequality in income distribution also comes out to be insignificant. Eventually, brutality of incidents increases in the suicide attacks. Put differently, in the presence of a suicide attack the number of victims is likely to be higher.

5. Summary and conclusion

This work interpreted the emergence of Jihadist terrorism in the light of contest theory. The empirical analysis has shown that the number of victims of Al Qaeda-style terrorist attacks significantly increase in the number of victims of past attacks in the same country. This seems to confirm that would-be terrorist groups behave as they were in a tournament. In short, they observe the results of past attacks and maximize their efforts in order to make attacks more destructive than foregoing attacks. Therefore an upward trend in terrorist casualties turns to be the outcome of competition between groups. This does constitute a novel empirical result which enriches the existing literature on terrorism. In particular, it sheds new light upon the ‘production’ and ‘brutality’ of terror. Moreover, what we would also claim as novelty is the peculiar focus on jihadist offspring of Al Qaeda. In particular, the empirical analysis is based upon a selection of attacks which fit the Al Qaeda style and approach. This makes the analysis peculiar. Consequently, it cannot be compared with foregoing empirical studies which do not disentangle behaviour of would-be Al Qaeda cells from the complex and heterogeneous universe of terrorism.

The policy implications descending from the findings of this study are somehow puzzled. A general improvement of standard of living appears to have the potential to reduce the likelihood (and even the brutality) of terrorist attacks. In fact, results show a negative association between number of victims and GDP per capita. Secondly, an additional prescription is related to funding. Needless to say, since reward to would-be terrorist groups may also be expected of a monetary nature, tracking financial flows of terrorist organization becomes a critical task. The argument for an international cooperation on regulating financial flows is thus strengthened.

6. References

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