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The lone wolf terrorist: sprees of violence

Abstract: The purpose of this paper is to apply economic analysis to the opportunities and choices of single individual 'lone wolf' terrorists whose attacks are characterised by 'sprees' of violence, usually shooting sprees in public places, that last only for a relatively short period of time. The spree lone wolf also emerges suddenly. Having previously allocated no resources to terrorism, he suddenly and all at once allocates all of his resources, including time, to terrorism. The first step to providing guidance to governments and their law enforcement agencies is to encompass some important elements of the spree lone wolf's opportunities and choices within an economic analytical framework. The first steps towards this are undertaken in this paper by exploring the opportunities and choices of the spree lone wolf from a risk-reward perspective and a treatment of the spree lone wolf as an individual who, while attempting to maximise his expected utility, shuns the risk-reduction benefits of 'time diversification' and suddenly plunges all of his resources into terrorism within a single time period. The analysis shows that such behaviour can be explained within an economic model of choice and clears the way for further theoretical analysis and empirical analysis.

JEL Codes: D01, D81, H56, K42.

Keywords: lone wolf, terrorism, violence, shooting spree, expected utility, opportunities, choices, risk-reward, time diversification, resources, plunge.

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1 Introduction

Lone wolf terrorism has been described by governments and security agencies as the most significant terrorism threat. A lone wolf terrorist operates independently, alone, outside of a command structure. Some lone wolves have been

able to inflict greater amounts of human tragedy than some terrorist organisations. Because of their independence, the pre-emption of lone wolf terrorists by law enforcement is extremely difficult. Lone wolves are not a part of a terrorist organisation or a part of a terrorist network. There is nothing for law enforcement agents to infiltrate. Within the terrorism studies literature, lone wolf terrorists have usually been categorised according to their motivation or ideology. Within these broader types of categories, two types of lone wolf terrorist are observed. The first type is the 'serial' lone wolf terrorist who engages in a series of attacks over time, sometimes remaining active for more than a decade. The second type is the 'spree' lone wolf terrorist who engages in a sudden spree of violence, usually a shooting spree in a public place[1], which is concentrated within a very short period of time. In this paper, we are concerned with the behaviour of this second type of lone wolf terrorist.

Shooting sprees or other types of concentrated violence have been the attack method of choice for many of the lone wolf terrorists whose behaviour has been documented in both the United States and throughout Europe. Thirty cases of lone wolf terrorism are reported in the U.S. between 1968 and 2007. Nine cases are reported in Germany, seven in France, six in Spain and five in Italy over the same period[2]. In the United States between 1978 and 1999, 26 percent of the victims of terrorism were victims of lone wolf terrorism and the number of recorded incidences of lone wolf terrorism rose from just two during the 1960s to thirteen in the 1990s (Spaaij 2010, p.859-860). The dominant attack methods deployed by the lone wolves active in the United States have been bombing and armed attacks (Instituut voor Veiligheids en Crisismanagement 2007). Twenty-two of the lone wolves engaged in armed attacks. These armed attacks were predominantly either targeted shootings or single or multiple shooting sprees, with the latter being associated with a considerable number of injuries and fatalities.

The deadliest acts of lone wolf terrorism in the U.S. have been the shooting sprees attributed to Mark Essex (10 fatalities and 13 injuries), Joseph Paul Frank-

1 A shooting spree is the type of attack that immediately springs to mind. This is, no doubt, due to the popular usage of the word 'spree' in describing various acts of concentrated violence, especially those involving the use of firearms. However, a spree might involve bombing and the acts of violence may be continuous over a period of several days. If this definition is accepted, David Copeland is also an example of the 'spree' lone wolf. Copeland engaged in a 13-day bombing spree in London in 1999. He planted bombs in crowded areas on Saturday April 17, Saturday April 24 and Friday April 30. The bombs, laden with nails to maximise the number of injuries and fatalities, resulted in three fatalities and 129 injuries.

2 Though when Europe is considered as a whole, there were 38 lone wolves active during the period throughout Europe.

lin (18 fatalities and 5 injuries), Joseph Christopher (5 fatalities and 1 injury) and Colin Ferguson (6 fatalities and 19 injuries). However, the archetypal modern example of the spree lone wolf is almost certainly Anders Behring Breivik. In Norway in July 2011 Breivik engaged in a bombing and shooting spree that resulted in the deaths of 77 people. The attacks were undertaken in two parts. First, a car bomb was left outside the government building that housed the offices of the Prime Minister. The bomb was detonated and killed eight people. Breivik then travelled approximately 40 kilometres to a youth camp where he murdered another 69 people in an hour-long shooting spree. This attack has highlighted the threat of lone wolf terrorism to European governments and their security agencies and became the most deadly incidence of lone wolf terrorism, overshadowing the 18 fatalities attributed to the actions of Joseph Paul Franklin in the U.S. in the 1970s.

In this paper, we wish to determine whether this type of 'spree' behaviour can be encompassed within an economic framework. That is, can sudden sprees of violence concentrated in a short space of time perpetrated by individuals who were hitherto uninvolved in terrorist activity be explained by an economic model of choice? Once this model has been constructed, we use empirical data to determine whether the predictions of the model are more or less consistent with the patterns of behaviour that we have observed to characterise lone wolf terrorists. In particular, we are interested in whether a model of attack method choice that explains 'spree' behaviour also predicts the use of 'armed attacks', which has been the attack method of choice for lone wolf terrorists involved in sudden sprees of violence. We shall also see what the model can say about the possibility that the 'spree' lone wolf terrorist will choose another type of attack method as his means of perpetrating an act of violence. This paper represents a step towards an economic analysis of terrorism that provides operationally relevant conclusions that may be used by law enforcement in the investigative process.

2 The Lone Wolf's Opportunities and Choices

The economic model of choice that underlies this analysis is the mean-variance expected utility model (Phillips 2009, 2011 & 2012). This model simplifies the analysis of terrorism by reducing the lone wolf's opportunities and choices to 'risk-payoff pairs'. Each attack method that the lone wolf may choose is associated with an expected payoff and a risk that the actual payoff may be different from what was expected. Given the words and deeds of terrorists, Phillips (2009) uses fatalities as the unit of payoff. This approach comes with the additional

advantage of associating the terrorist's optimal or rational choice with his most dangerous choice. If the lone wolf terrorist has quadratic utility[3] or if the payoffs to terrorism are normally distributed, the mean-variance analysis will be consistent with the von Neumann and Morgenstern axioms for rational behaviour. If these two conditions do not apply, mean-variance analysis will still produce preference orderings for attack methods that approximate those computed with a 'full' expected utility analysis (Elton et al. 2003, p.232; Kroll, Levy and Markowitz 1984; Levy and Markowitz 1979).

The complete opportunity set of the lone wolf terrorist can be computed by determining all of the risk-payoff pairs that may be obtained given the available attack methods. We measure expected payoffs by the historical average (mean) fatalities per attack per year and we measure the risk of those payoffs by the historical standard deviation or variance that characterises the fatalities per attack per year. This opportunity set tells us every possible combination of expected fatalities and risk that the terrorist can obtain using the available attack methods. The rational terrorist, however, will only be interested in those attack methods that have the highest expected number of fatalities at each level of risk. He will only be interested in the 'efficient' opportunity set (Phillips 2009). Because the payoffs to different attack methods are not perfectly correlated with each other, the efficient set will display convexity when the means and standard deviations of each possible attack method combination are plotted. Although there will be different opportunity sets for different levels of resource allocation to terrorism, we are interested in the case where the lone wolf suddenly allocates all of his resources, including time, to terrorism. Hence, the opportunity sets depicted in our diagrams are implicitly '100 percent resource allocation' opportunity sets.

The lone wolf's optimal choice from this opportunity set is a choice that maximises his expected utility. It is also his most dangerous choice. When working with geometry rather than equations, the lone wolf's preferences are represented by an indifference curve map. Points of tangency between the efficient opportunity set and his highest indifference curve are points where utility is maximised given the available opportunities. For a risk-averse lone wolf terrorist with concave indifference curves, optimal choices may be represented as figure 2.

We are interested in whether we can identify a type of utility maximising lone wolf – a particular representation of the indifference curve map – who exhibits

3 It must also be noted that quadratic utility, while somewhat restrictive, approximates a broader class of utility functions. The well-known criticisms of mean-variance analysis and quadratic utility come with several qualifications and counter-arguments. Furthermore, Phillips (2009 & 2011) uses a normalised 'fatalities per attack per year' rather than a 'raw' fatalities count.

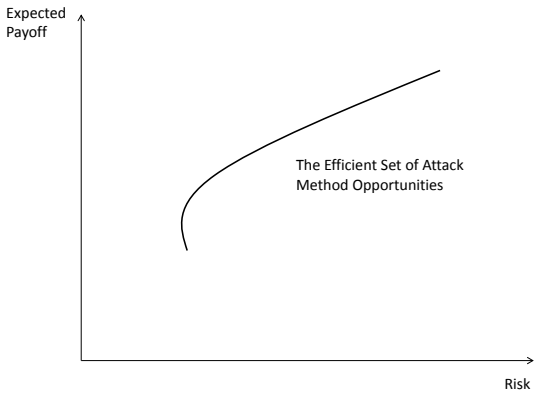

Figure 1: The Lone Wolf's Efficient Opportunity Set

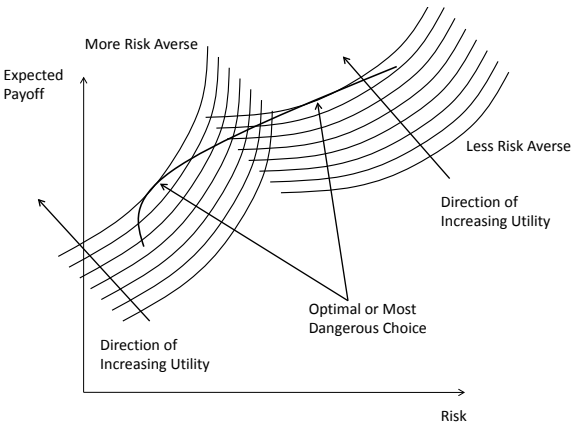

Figure 2: Optimal Choices of the Risk-Averse Lone Wolf

'spree' type behaviour. That is, no resource allocation to violent terrorism then, suddenly, 100 percent allocation to violent terrorism. This type of lone wolf is willing to absorb additional risk in return for increases in expected payoffs. At higher levels of risk he requires very little additional expected payoff in order to be enticed to bear an additional increment of risk. At very high levels of risk, it will take only a very small increase in expected payoff to entice this lone wolf to bear a lot more risk. When the expected payoffs to terrorism increase, this type of lone wolf will be observed to suddenly switch all of his resources into the attack methods that are available to him where previously all of his resources were devoted to other, non-violent activities. All at once he will 'plunge' all of his resources into the available attack methods. All at once he will engage in a spree. Such behaviour is encompassed by indifference curves that are upward

sloping in expected payoff-risk space to reflect the special property that Tobin (1958) calls 'plunging'. In our context: no resources allocated to the violent terrorism then, following a change in the risk-reward trade-off, all resources 'plunged' into violent terrorism.

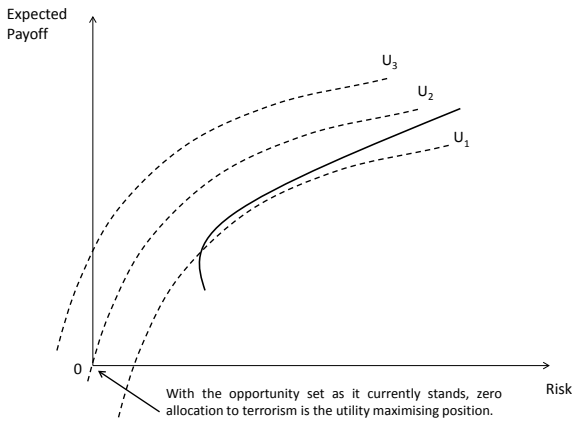

Figure 3: Optimal Choices of the Plunging Lone Wolf

With the opportunity sets as they stand in Figure 3, the utility maximising position for the lone wolf is initially a zero allocation of resources to violent terrorism because U_2 is his highest feasible indifference curve. If he chose to engage in terrorism, he would be on a lower indifference curve with lower utility. His optimal choice is not to engage in terrorism given the current risk-reward trade-offs. However, if he were to perceive an innovation in the risk-reward trade-offs available to him such that the efficient opportunity set moves upwards such that it intersects an indifference curve higher than U_2, the lone wolf will 'plunge' all of his resources into terrorism. The plunging of all resources, including time, into terrorism may manifest itself as a spree. Where law enforcement had been previously unaware of the existence of a potential lone wolf threat because of his avoidance of terrorist actions, the spree lone wolf now emerges suddenly. He does not emerge as an individual who allocates some resources to terrorism and some resources to other activities. The spree lone wolf suddenly and all at once plunges all of his resources, including time, into violent terrorism.

3 The Optimality of Plunging: Empirical Data

Having established the possibility of encompassing spree type behaviour within an economic model of terrorist choice, we now turn our attention to determining whether the model of choice predicts 100 percent resource allocations to bombing and armed attacks. Both serial lone wolves and spree lone wolves have generally chosen armed attacks or bombing as their preferred attack methods (Instituut voor Veiligheids en Crisismanagement 2007). To make this determination, we use the transnational terrorism data contained in the RAND-MIPT database for the period 1968 to 2006 to identify efficient[4] resource allocations to individual attack methods at different levels of risk. Using the RAND-MIPT transnational terrorism database has the advantage of being 'independent' of any specifically lone wolf data series. What we are after is a data set that provides a good indication of the average fatalities and injuries that may be expected to be generated by particular attack methods. The RAND-MIPT data for transnational terrorism provides this. The identification of efficient resource allocations at different levels of risk involves solving the quadratic programming problem:

$$\max E(R_i) = \sum_{i=1} w_i E(R_i) = R^* \tag{1}$$

Where R^* is maximum expected payoff to attack method i at a target level of return variance (risk), σ^{2*}. The percentage of resources, w_i, allocated to attack method i will be 1.00 or 100 percent when there is complete specialisation and some fraction between 0.00 and 1.00 when specialisation is less than complete. The target levels of risk σ^{2*} at which this quadratic programming problem was solved are: 0.1, 0.2, 0.3, 0.5, 1.0, 1.5, 2.0 ...42.5. The degrees of specialisation and attack methods that correspond to the solution of the quadratic programming problem at these levels of risk are presented in Table 1 below.

At very low levels of risk, the lone wolf terrorist will allocate some of his resources to assassination. In equation (1), w_i will be greater than 0.00 but less than 1.00. His optimal level of specialisation in assassination increases as the level of risk he wishes to bear increases but he never becomes a complete specialist—100 percent resource allocation—in assassination because at increasing levels of risk higher degrees of specialisation in assassination become dominated by lower degrees of specialisation in bombing. Granting assassination a $w_i = 1.00$ never solves equation (1) because before that point is reached a $w_i < 1.00$ accorded to bombing begins to solve equation (1) as risk increases and as we move from left

4 That is, resource allocations that yield maximum expected payoffs at each given level of risk.

Risk (Standard Deviation)	Degree of Specialisation	Attack Method	Expected Payoff
0.1	0.143	Assassination	0.22
0.2	0.286	Assassination	0.441
0.3	0.429	Assassination	0.66
0.4	0.572	Assassination	0.883
0.5	0.715	Assassination	1.10
1.0	0.166	Bombing	0.97
1.5	0.249	Bombing	1.46
2.0	0.333	Bombing	1.96
2.5	0.416	Bombing	2.45
3.0	0.499	Bombing	2.94
3.5	0.582	Bombing	3.43
4.0	0.666	Bombing	3.92
4.5	0.749	Bombing	4.41
5.0	0.832	Bombing	4.90
5.5	0.915	Bombing	5.39
6.0	0.999	Bombing	5.88

Table 1, Part 1: The Lone Wolf's Optimal Choice: Varying Specialisation Level

to right along the efficient set depicted in Figure 1. Assassination no longer solves equation (1) at these higher levels of risk. The terrorist becomes a specialist in bombing at levels of risk (standard deviation) approaching 6.00. At higher levels of risk, bombing is superseded by hijacking, in which near specialisation may be observed, and at even higher levels of risk hijacking is superseded by armed attacks. At levels of risk (standard deviation) that approach 15.00 the lone wolf becomes a specialist in and allocates all of his resources to armed attacks. At the appropriate levels of risk both bombing and armed attacks represent solutions to the spree lone wolf's utility maximisation problem.

If a lone wolf can choose just one single attack method, his optimal opportunities become an efficient set characterised by a single attack method and a particular level of specialisation in terrorism at particular levels of risk. For the most part, complete specialisation emerges as an optimal choice only at small number of points. It is far more usual to find $w_i < 1.00$ for some attack method at most levels of risk. At very low levels of risk, complete specialisation is not expected at all. At the mid-range of risk, we do observe complete specialisation in terrorism – 100 percent allocation of resources to terrorist attack methods—with 100 percent resource allocation to bombing being a constituent of the efficient set of attack method opportunities at a level of risk or standard deviation of 6.00. At the mid-

Risk (Standard Deviation)	Degree of Specialisation	Attack Method	Expected Payoff
6.5	0.609	Hijacking	2.38
7.0	0.655	Hijacking	2.56
7.5	0.702	Hijacking	2.74
8.0	0.749	Hijacking	2.93
8.5	0.796	Hijacking	3.11
9.0	0.843	Hijacking	3.29
9.5	0.890	Hijacking	3.47
10.0	0.936	Hijacking	3.66
10.5	0.983	Hijacking	3.84
11.0	0.743	Armed Attacks	3.95
11.5	0.777	Armed Attacks	4.13
12.0	0.810	Armed Attacks	4.31
12.5	0.844	Armed Attacks	4.49
13.0	0.878	Armed Attacks	4.67
13.5	0.912	Armed Attacks	4.85
14.0	0.945	Armed Attacks	5.03
14.5	0.979	Armed Attacks	5.21

Table 1, Part 2: The Lone Wolf's Optimal Choice: Varying Specialisation Level

to-high ranges of risk we observe almost complete specialisation in hijacking and complete specialisation in armed attacks at a level of risk or standard deviation approaching 15.00. A plunging spree lone wolf who can only choose bombing or armed attacks will find that these attack methods do solve his utility maximisation problem at their respective levels of risk. If he is willing to bear this risk and if he perceives an innovation in the risk-reward trade-off such that expected payoffs are higher at every level of risk, he will shift his resources completely into terrorist activity.

4 Conclusions and Implications

There are several implications for law enforcement. First, the spree lone wolf will be very sensitive to changes in the risk-reward trade-off. A risk-seeking lone wolf will already (and always) be at the point of maximum risk and maximum expected payoff. He is most likely planning or engaging in the riskiest attack methods: hostage-taking and 'unconventional' attacks. A risk averse serial lone wolf will adjust to changes in the risk-reward trade-off by increasing or decreasing his engagement in terrorism or choosing different attack methods but he will never 'plunge' or engage in a spree of violence in response to changes in the risk-reward trade-off. Second, a spree must necessarily be a very violent action. A spree occurs when the lone wolf suddenly and all at once plunges all of his resources into terrorism. This is precipitated by a change in the risk-reward trade-off that characterises terrorism. If the lone wolf's perception is matched by a real upward shift in the efficient opportunity set, every attack method and combination now is expected to inflict a higher amount of human tragedy. Third, armed attacks and bombing represent utility maximising solutions for the spree lone wolf. This is consistent with the empirically observed attack method choices of lone wolf terrorists.

Although the challenges presented to law enforcement by lone wolf terrorism are substantial, the analysis shows that the spree lone wolf's actions must be precipitated by an upward movement in the efficient opportunity set (increase in the risk-reward ratio). Effective actions by law enforcement agencies serve to increase the risk and decrease the rewards of terrorism (decrease the risk-reward ratio). Effective law enforcement and vigilant security at public locations serve to ensure that the rewards available to terrorism do not rise more than proportionately to the risks. This represents the most effective check on the spree lone wolf. What must be guarded against is the unfavourable rebalancing through some security initiative of the deterrence-substitution effects that characterise terrorism. Defence economists have shown that security initiatives deter but also encourage substitution (Landes 1978; Sandler, Tschirhart and Cauley 1983; Enders and Sandler 1993; Sandler and Enders 2004). In the case of spree lone wolf terrorism, the most dangerous implication is that a targeted security initiative shifts law enforcement resources such that a particular type of terrorist action at a particular location becomes riskier without increasing the associated rewards (decrease in the risk-reward ratio) whilst simultaneously the risk-reward ratio of an alternative attack method is increased. If the spree lone wolf senses this set of circumstances and perceives additional expected payoffs to be available at a given level of risk, the potential consequences are clear. He may suddenly and all at once plunge all of his resources into this attack method.

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