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► To cite this version:

Sylvain Baumann. Protection and technology transfer against a terrorist threat. Economics Bulletin, 2009, 29, pp.3147 - 3154. hal-02311532

HAL Id: hal-02311532

<https://normandie-univ.hal.science/hal-02311532>

Submitted on 11 Oct 2019

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Volume 29, Issue 4

Protection and technology transfer against a terrorist threat

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Abstract

The aim of this paper is to analyze the decision-making process of a targeted country threatened by a terrorist group. This country has the choice between improving his arms or buying technologies from the border country. However, his resource is not unlimited. So the government has to do an arbitrage among the strategies. After determining the equilibrium, we analyze the impacts of each parameter.

1. Introduction

Since the September 11th attacks, countries have tried to protect themselves there but the solutions are not always effective. As a result, they undergo heavy losses. These terrorist networks are with difficulty localizable. The best solution or the solution of security stays the protection. The defensive strategies are multiple. It is possible to cooperate with certain countries in order to form an alliance and, therefore, have a common protection. Moreover, several authors analyzed the alliance within the framework of terrorist conflict: Olson and Zeckhauser (1966) and Lee (1988) focused on the phenomenon of the free riding in the alliances. Sorokin (1994) studied the optimal strategies of a country confronted with a terrorist threat. The country has the choice between having new weapons in order to improve the security, or to form an alliance to benefit from an outside help, or a combination of both. The alliance is not the only solution to limit the threat. The negotiation remains an important option, in particular within the framework of the hostage taking. This domain was the object of a precise analysis by Atkinson, Sandler, and Tschirhart (1987), Lapan and Sandler (1988), Selten (1988), Islam and Shahin (1989), Sandler and Scott (1987), Scott (1991), Shahin and Islam (1992) and Sandler and Enders (2002). In the continuity of the article of Sorokin, Baumann (2009) envisaged the fact that a country could become allied with a terrorist group. This alliance is characterized by a ransom to pay to the terrorists in order to stop their schemes.

However, the protection is not always effective. The terrorists use more and more cunning and undetectable means to manage their assaults. They specialize in precise types of attack. As a consequence, the protection is sometimes obsolete. In front of this specialization, the governments had to react and also had to specialize in some kinds of adapted protections. The development of technologies have had the expected effects. Even if they do not guarantee a total neutralization, they limit strongly the consequences. It is in this purpose that some countries joined the NATO. His purpose is to guarantee the safety of his members. In 1994, the Partnership for the Peace (PfP) was created. His objectives are to ease the threats, to establish a stability and tight relations between his partners. In a will to keep the peace in these countries, the NATO sets up the Action plan of the Partnership against the Terrorism during the summit of Prague in 2002. His role is to improve the safety on the borders, the cooperation and the sharing of information. In 2004, the summit of Istanbul led to the program elaboration of a work based on the development of new technologies. For example, France took charge of works in the detection, the protection and the defeat of the nuclear, biological and chemical weapons.

The member countries benefit from these new technologies. However, if a country is outside the alliance, he can decide to buy a part of this technology. It will improve the security acting on its probability to be attacked and consequently on the probability of the border country, holder of the technology. The purpose of this paper is to analyze the optimal value for the protection and the quantity of technology wanted by the country.

2. Transfer Technology Model

We consider a model of optimization under constraint where a country maximizes its utility subject to its budgetary constraint. Only the country 1 is threatened by a terrorist group k . The second country has developed a technology allowing him to increase its protection but especially to fight effectively against the terrorist threats. We suppose that only this country has the resources and the necessary capacities to invest in the research. This government is ready to send a part of its technology in exchange for a payment. We shall suppose that the cost of technological transfer is included in this payment. This innovation can take several forms: state-of-the-art technology transfer such as detectors of nuclear weapons or simply knowledge allowing to organize better the protection and to be able to produce much more sophisticated weapons.

The second country has many reasons to send his technology:

- First of all, he can want to help the country 1 in the anti-terror fight. He does not adhere to the terrorist ideology and wants to stabilize the peace in his border countries to avoid that the threat propagates until him.
- There is also an economic interest. Besides the fact of selling its technology, this one has probably trades with his nearby countries. Trade in a risked zone is not at its advantage. Furthermore, investing in the technology is expensive. Selling a part of the technology allows to make profitable this investment. Then, the cost of research will decrease.

The government has several strategies. He has the choice between having new arms or buying some quantities of technology. His protection function P_1 does not depend only of his cost C_1 , but also of the bought technology. The total technology developed by the other country is designated by T . However, if the cost to get all this innovation is too high, he can buy a part of

it: d is the degree of wanted technology, where $0 \leq d \leq 1$. We suppose that the protection function respects the hypotheses of growing and concavity concerning his cost: $\frac{\delta P_1}{\delta C_1} > 0$; $\frac{\delta^2 P_1}{\delta C_1^2} < 0$. To the contrary, this function is growing and convex with the technology, justifying that the technology is necessary in the conflict: $\frac{\delta P_1}{\delta T} > 0$; $\frac{\delta^2 P_1}{\delta T^2} > 0$. Indeed, lots of countries invest nowadays in the research and the development. It improves the protection but the cost is high. Nevertheless, the technology is an important key to protect himself from a terrorist attack. This threat is represented by M_k .

The utility function is the difference between the protection of the country and the damages caused by a terrorist attack. It represents the undergone losses if the attack succeeds. The utility of the country is given by:

$$U_1 = P_1 - M_k$$

The government is constrained by its budget B_1 , supposed positive. The unit price to acquire a unit of technology is designated by p . Knowing that the country will buy dT , this one will thus have to pay pdT . Consequently, the budget for the country 1 will consist of the amount assigned to the protection C_1 and the bought technology pdT .

$$B_1 \geq C_1 + pdT$$

The aim of the government is to maximize his utility under its budgetary constraint. in order to determinate his optimal strategies :

$$\max_{C_1, d} U_1 = P_1 - M_k \text{ with respect to } B_1 \geq C_1 + pdT$$

We specify the protection function:

$$P_1 = (\gamma_1 + dT)^\omega C_1^a, \quad \text{where } \gamma_1 \geq 1, \omega > 1 \text{ and } 0 < a < 1$$

The parameters γ_1 , ω and a are exogenous. γ_1, ω and a represent the coefficients linked to the protection. They guarantee the previous hypothesis.

To solve this constrained maximization problem, we use the Lagrangian function:

$$L_1(C_1, T, \lambda_1) = (\gamma_1 + dT)^\omega C_1^a - M_k + \lambda_1(B_1 - C_1 - pdT) \quad (1)$$

At the equilibrium, we have the following optimal values given by the equations (2) and (3):

$$d^* = \frac{B_1 - \frac{a}{\omega} p \gamma_1}{pT(\frac{a}{\omega} + 1)} \quad (2)$$

$$C_1^* = \frac{a}{a + \omega}(B_1 + p\gamma_1) \quad (3)$$

From these equations, we deduct the optimal values of the other endogenous variables:

$$P_1^* = \left(\frac{p\gamma_1 + B_1}{p(\frac{a}{\omega} + 1)} \right)^\omega \left(\left(\frac{a}{a + \omega} \right) (B_1 + p\gamma_1) \right)^a \quad (4)$$

$$U_1^* = \left(\frac{p\gamma_1 + B_1}{p(\frac{a}{\omega} + 1)} \right)^\omega \left(\left(\frac{a}{a + \omega} \right) (B_1 + p\gamma_1) \right)^a - M_k \quad (5)$$

3. Analysis

Through the variations of the various parameters, we shall determine their effects on the optimal strategies of the government.

3.1 Effects of sale price of the technology

If the sale price to acquire a unit of technology is higher, then the government will increase its spending in armament. It is due to the fact that the bought part will decrease. Consequently, the utility will decrease also caused by a less effective protection. Indeed, the government will have less technology. The effects are represented in the table 1.

	d^*	C_1^*	P_1^*	U_1^*
p	-	+	-	-

Table 1: Effects of sale price

3.2 Effects of the budget

It is obvious that an increase of the resources will improve the utility of the government. It will be possible to him to acquire more weapons while increasing its degree of cooperation with the other country. His protection will be thus strengthened because he will have a more important technological quantity.

	d^*	C_1^*	P_1^*	U_1^*
B_1	+	+	+	+

Table 2: Effects of the budget

3.3 Effects of the protection parameters

These coefficients have the same effects on the variables of the model [Table 3]. If one of both increases, it will improve logically the protection. If this one becomes more and more efficient, the appeal to the technology will make lesser, without giving up it. It will always remain necessary as long as the protection does not allow it to neutralize the attacks. The degree of acquisition of technology is weaker so giving more resources to the government to buy more weapons. The amount resulting from the difference between these degrees will thus be transferred towards the cost of protection: $p(d^1 - d^0) = +\Delta C_1$

	d^*	C_1^*	P_1^*	U_1^*
γ_1, a	-	+	+	+

Table 3: Impacts of the protection coefficients

Now, if the technology is more and more successful [Table 4], the government will decide to have it much more to the detriment of its protection. With a minimum of protection but a high technology, this one will be able to counter the threat thanks to a more effective security. The coefficient ω is directly connected to the technology.

	d^*	C_1^*	P_1^*	U_1^*
ω	+	-	+	+

Table 4: Impacts of the protection parameter linked to the technology

3.4 Impacts of the technology

The technology acts directly only on the degree of acquisition [Table 5]. Indeed, for a quantity of technology, if this one increases, then the degree will decrease, all other things being equal, in order to keep the same quantity: $d^1T^1 = d^0T^0$.

	d^*	C_1^*	P_1^*	U_1^*
T	-	0	0	0

Table 5: Impacts of the technology

4. Conclusion

This paper gives us preliminary results on the effects of a transfer technology on the decision-making process of a country. It is the first step of the analysis. The second country will have to choose its level of technology that he wants to develop. By helping the poor country, he will be threatened too by the terrorists. Consequently, a probability of being attacked will be integrated in this model.

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