Chapter 9

Preemptive Strikes, Can We Win the War on Terror?

9.1 Introduction

Although an absolutely essential counter-terror (CT) measure, security does not catch our imagination of war on terror, WoT, since it is defensive, hence inward. On the other hand, offensive measures like military crackdown to degrade the capability of terror groups by taking the war to the door of the enemy so to speak capture the spirit of WoT. In this chapter, we study how offensive CT measures work from an economic standpoint. Apart from military operations, financial controls that curb the flow of funds to terror organizations tend to weaken them too. Hence both military interventions and financial regulations are preemptive in that they tend to forestall terror groups from mounting attacks. In this and other chapters, we use the terms preemptive measures and preemption interchangeably.

In Chap. 8, we learned that security reduces the damage from terror in two ways. Even if terror organizations keep up terror attacks, enhanced security would reduce the damage from terror; this is a direct effect. Additionally, increased security discourages terrorists or terror groups from attacking: this is a deterrence effect, which is indirect in a sense. There is however no presumption that a direct effect is always stronger than an indirect effect. Realize that preemption exerts a deterrence effect only. It does *not* however imply that because preemption exerts only an indirect effect, its effectiveness is somewhat limited. In fact, preemptive measures constitute a frontal attack in the WoT and can deliver major blows to the production and propagation of terror.

How far a target country would step up its preemption in response to an increase in militancy or terrorism is a central question of interest in this chapter. Our analysis lends itself to formulate—and answer—the question of whether or under what conditions preemptive measures can help win the WoT. For simplicity, to focus on preemptive measures work, *we hold security measures fixed throughout this chapter.*

Section 9.2 conceptualizes preemption in a cost–benefit framework. In Sect. 9.3, we learn, in a one-organization and one-defending-state scenario, the terrorist organization's choice of the level of its production of terror and reaction to the state's

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preemptive measures. Taking into account the response of the terror organization, the state chooses the level of its preemptive measure; this is analyzed in Sect. 9.4.

Having characterized the choice behavior of the terrorist group and the state, the model will be able to frame the central question of whether preemptive measures can help win the WoT. Of course, this presupposes what we mean by winning the WoT. In Sect. 9.5, we define "winning or losing WoT" and then analyze whether or under what conditions, preemptive measures can or cannot deliver a win.

Like in Chap. 8, we also examine the interdependence among multiple target countries in regard to their choice of preemptive measures and compare the non-cooperative solutions with the cooperative solutions. This is explored in Sect. 9.6. An adverse side effect, so to speak, of using preemptive strikes is that it may lead to a backlash due to the collateral damage caused from such strikes. The ramifications of this are discussed in Sect. 9.7.

9.2 Preemptive Measures in an Economic Model

In an economic decision making setting, we can think of preemption in two ways: one is *static* where time does not play any role and the other *dynamic*. As in Chap. 8, we call a terror organization an Org and a target country a State.

9.2.1 Shift of the Marginal Cost Function of Producing Terror

This is a *static* view. Recall the terror cost function introduced in Chap. 8, which is a schedule of total costs associated with different levels of terror production. A decrease of a terror organization's capacity to produce terror can be viewed as an increase in the total and marginal costs of producing terror. Military strikes and financial controls tend to decrease the capability of terror groups in organizing attacks and thus affect both variable and fixed costs of producing terror. For our purpose, *we will regard preemptive measures as interventions that shift up a terror organization's marginal cost function, thus increasing the variable cost of producing terror.*

Let us divide the marginal cost (MC) of producing terror into two parts: one that is independent of the terror output and thus fixed from the perspective of the terror organization, and the other that varies with terror output, i.e.,

$$\text{MC of producing terror} = \underbrace{z + m}_{\text{fixed}} + \underbrace{v \cdot X}_{\text{variable}}, \; z + m > 0; \; v \geq 0. \tag{9.1}$$

In the above expression, X is the level of terror production, m denotes the level of preemptive measures, and thus an increase in preemption shifts up the marginal cost of producing terror, whereas z denotes that part of the marginal cost of producing terror which includes, among other components, the cost of equipment, hiring and training terrorists, and volunteering to join terror group. The "z" in the marginal cost function does not vary with the production of terror. Turning to the variable component, if $v > 0$, the marginal cost increases with terror output.

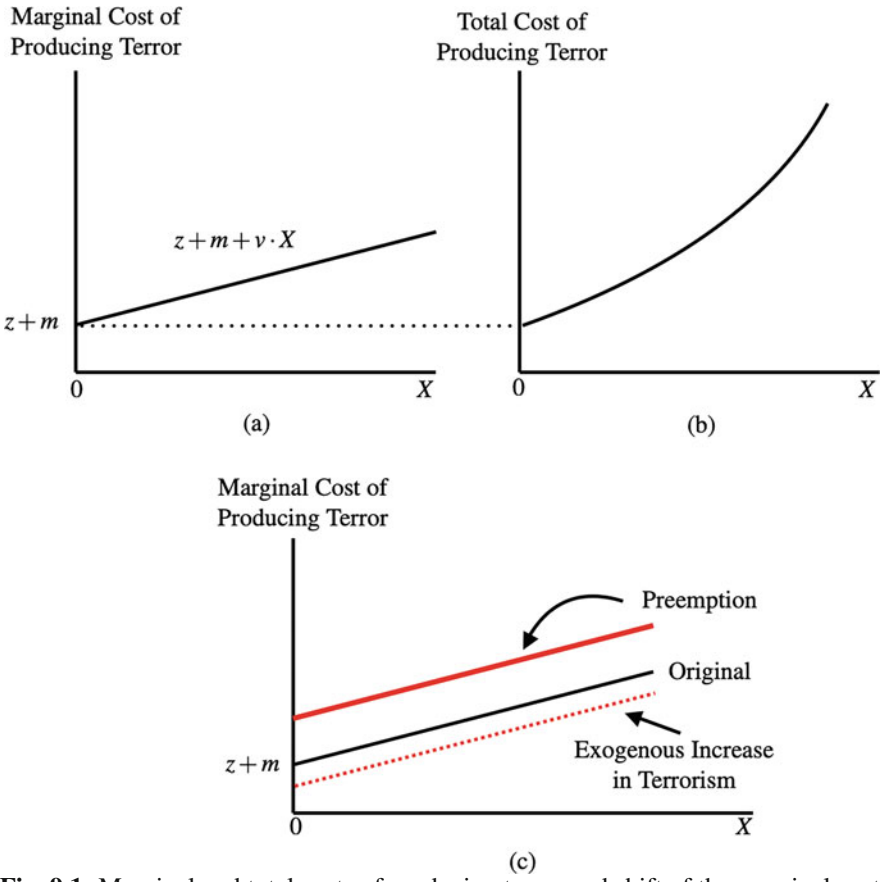

Fig. 9.1: Marginal and total costs of producing terror and shift of the marginal cost function . (**a**) Marginal cost function. (**b**) Targinal cost function. (**c**) Shift and marginal cost function

The total cost function, which gives rise to the marginal cost function in (9.1), is

$$C(X) = (z + m)X + \frac{1}{2}vX^2. \tag{9.2}$$

Check that $C_X(X) = \partial C/\partial X = z + m + vX$, which is the same as the expression (9.1).

Figure 9.1a illustrates the marginal cost function (9.1), whereas panel (b) exhibits the total cost function (9.2).[1] An increase in preemptive measures, via an increase in

[1] These are indeed the same terror cost functions shown in Fig. 8.7 in Chap. 8, except that these are more structured and thus less general so as to illustrate how preemption affects the cost function of a terror organization.

m, is illustrated in panel (c). Starting with middle line, which is the original marginal cost function, a higher level of preemption is associated with a higher marginal cost function such as the heavier line.

At any given level of preemption, an exogenous increase in terrorism or militancy is captured by a decrease in the exogenous component z and hence a downward shift of the marginal cost function, exhibited by the dotted line in panel (c).

Thus, z acts (inversely) as the parameter of the level of militancy. We shall refer to the sum, $z + m$, as the "level" of an Org's marginal cost function.

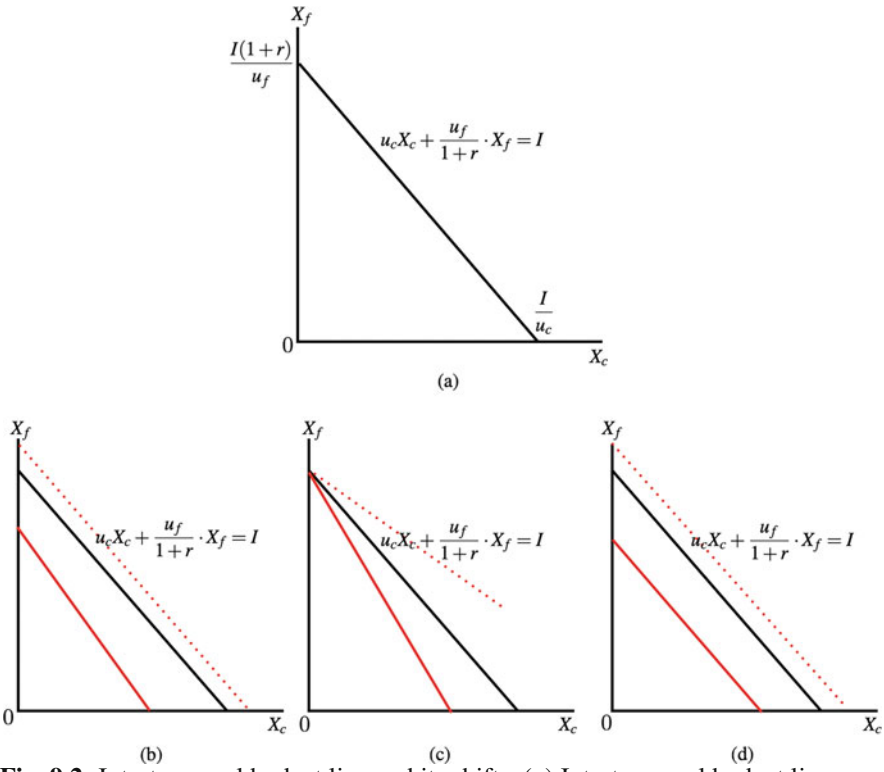

Fig. 9.2: Intertemporal budget line and its shifts. (**a**) Intertemporal budget line. (**b**) Preemptive strikes having a permanent effect. (**c**) Preemptive strikes having a temporary effect. (**d**) Financial controls

9.2.2 Shift of the Intertemporal Budget Line

This refers to a *dynamic* framework having an element of time, in which military strikes and financial controls can be discerned. Over time, money flows into the hands of terror groups, which organize attacks for the current as well as future periods. We

can imagine a terrorist organization planning its attacks over time subject to a budget constraint. For simplicity, suppose only two periods, say, present or current (c) and future (f). Let X_c and X_f denote an Org's production of the aggregate terror input in the present and in the future period, respectively. Assuming that an Org can borrow or lend at a given interest rate r, we can write its budget constraint as

$$u_c X_c + \frac{u_f}{1+r} \cdot X_f = I_c + \frac{1}{1+r} \cdot I_f \equiv I, \tag{9.3}$$

where u_c is the current period unit cost of producing X_c, I_c is the flow of funds to the Org in the same period, u_f is the *expected* unit costs of producing X_f and similarly I_f is the *expected* flow of funds in the future, and I is the discounted value of the flow of funds available to the Org in the current period.

We presume that the Org has access to loan/credit markets in which it can freely borrow or lend, i.e., transfer funds between the two periods. This leads to a single budget constraint rather than one for each period. Equation (9.3) states that the discounted value of the costs of terror attacks equals the discounted value of the flow of funds to the Org. Of course, borrowing or lending is not an easy task for a non-state entity like a terrorist organization. We however abstract from the loan market problems facing a terrorist groups in order to highlight that they do have "some" access to the loan or credit market.

Notice that unit costs depend on technology as well as prices of various inputs like salaries of terrorists and personnel, cost of transport, training and equipment, etc. that enter the production of the aggregate terror input.

In sum, Eq. (9.3) is a simple intertemporal or "over time" budget constraint, which is illustrative of the tradeoff between current and future production of terror, given technology, input prices, flow of funds, and the interest rate. This is depicted in Fig. 9.2a. The shifts of this intertemporal budget line are exhibited in panels (b) to (d). Military interventions raise the unit costs through the destruction of facilities, personnel, etc. and thus shift the budget line inward. If they diminish both present and future capabilities, the inward shift occurs on both axes, as in panel (b). If they reduce only the current capabilities of a terror organization to produce terror, the budget line pivots on the horizontal axis that measures X_c—shown in panel (c). For example, damage caused by bombing certain roads that a terror organization uses can be rebuilt after some time.

The effect of financial controls is depicted in panel (d). These controls affect the current or the future flow of funds and will have similar qualitative effects as do military strikes: they lead to a parallel shift of the budget line. Notice that, in terms of consumer choice theory in microeconomics, preemptive strikes work like a price effect or an income effect, while financial controls are analogous to an income effect.

Comparing panel (b) to panel (d), we can see the similarity of shifts due to preemptive strikes that exert a permanent effect and financial controls. The implication is that

Result 9.1

Preemptive strikes that permanently reduce the capability of producing terror and controls on the flow of funds to terror organizations have similar implications toward the production of terror.

Result 9.1 underscores the importance of financial control as a means to combat terrorism.

An exogenous increase in terrorism can manifest in more participation and thus lower unit cost of producing terror or more funds supporting a terror organization. This is shown by the dotted lines in panels (b) to (d). Those in panels (b) and (d) illustrate more participation and/or more financial support, while the dotted line in panel (c) reflects more participation in the current period only. As in the static model, preemption and an exogenous increase in terrorism work in opposite directions.

It is important to note that the static and the dynamic versions of representing preemptive measures are *not* unrelated: the total cost of producing terror in the static model can be interpreted as money at disposal in the current period after the borrowing or lending is done. As an example, if the total cost of producing terror in the static model turns out to be 100 units (say in thousands of dollars), whereas the Org has 90 (respectively, 115) units, it then borrows 10 units (respectively, lends 15 units).

9.3 The Org's Choice of the Terror Input and the Impact of Preemption

9.3.1 The Static Model

In a timeless or one-period framework, the rational choice of terror production by the Org is guided by the principle that the marginal cost of terror production equals its marginal benefit in terms of damage caused to the target country. Assuming one target country, the State, recall the damage function for the State introduced in Chap. 8, namely $D(X, s)$, where X is the amount of terror produced and s stands for the security measures. If security is unchanged, we can ignore s and write (expected) damage as $D(X)$, the terror damage function. As in Chap. 8, let us assume positive but diminishing marginal effect of terror on damage inflicted upon the target country. Hence the Org's marginal benefit (MB) curve from terror is downward sloping.

A rational Org is assumed to maximize its surplus $D(X) - C(X)$, where $C(X)$ is the total cost of producing terror. The expression of the marginal cost $C_X(X)$ is

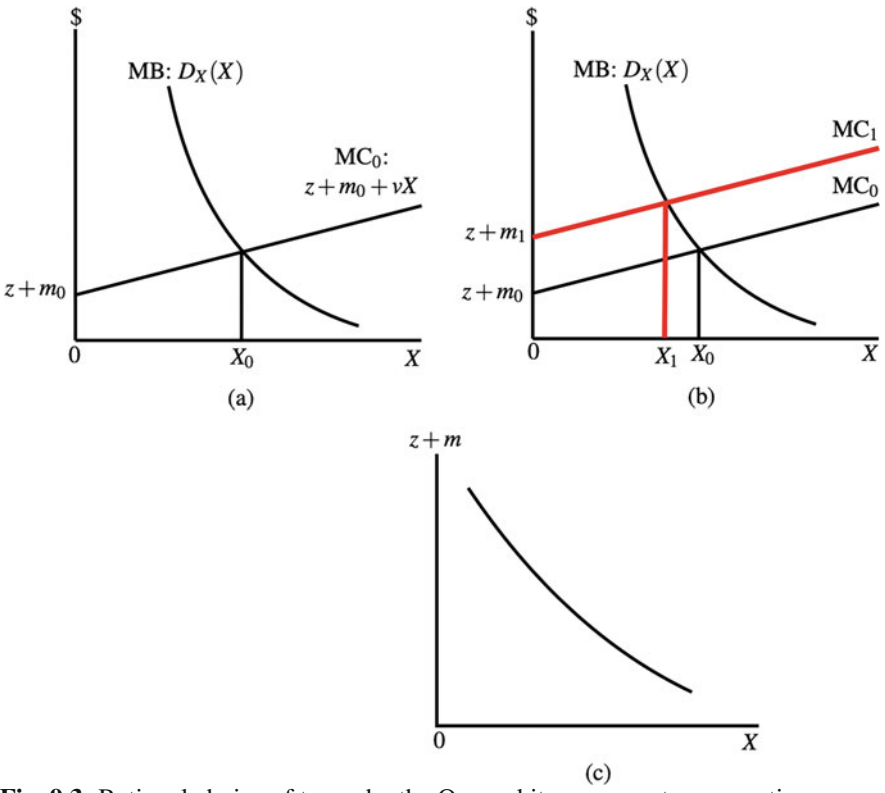

Fig. 9.3: Rational choice of terror by the Org and its response to preemptive measures in the static model. (**a**) Choice of production of terror. (**b**) Org's response to preemptive measures. (**c**) Best response function of the Org

given in (9.1). The first-order condition for the optimal choice of terror is thus

$$\underbrace{D_X(X)}_{\text{MB}} = \underbrace{C_X(X) = z + m + vX}_{\text{MC}}. \tag{9.4}$$

Figure 9.3a depicts the Org's marginal benefit function (the same as in Chap. 8) and, at a given level of preemptive measures, $m = m_0$, the marginal cost function. The intersection point is where the condition (9.4) is met. The corresponding X, that is X_0, is the optimal/rational choice of terror by the Org at the preemptive measures level m_0.

We can now see the Org's response to an increase in preemptive measures. Turning to panel (b), a higher level of preemption (m_1) implies a higher MC function for the Org and hence a lower equilibrium level of terror X_1. An increase in preemptive measures leads to a decline in the production of terror, as one would expect.

Recall the definition of the best response function, which states how one player's rational strategy varies with another player's strategy choice. Here X and m are the strategies of the Org and the State, respectively. From Fig. 9.3b, it follows that the best response function of the Org is downward sloping, as shown in Fig. 9.3c. It will be helpful to write this down algebraically:

$$X = X(z + m), \; X' < 0. \tag{9.5}$$

Figure 9.3c and the above equation summarize the impact of preemption on the behavior of the Org.

9.3.2 The Dynamic Model

We now consider the dynamic model of preemption, which differentiates between preemptive strikes and financial controls. Since there are two periods, present (c) and future (f), we can postulate two damage functions facing the State, $D^c(X_c)$ and $D^f(X_f)$, the functional forms of which may be the same or different. Let us now define a utility function of the Org from the terror-damage functions in the two periods:

$$U = \bar{U}(D^c(X_c), D^f(X_f)) = U(\underset{+}{X_c}, \underset{+}{X_f}), \tag{9.6}$$

which measures the overall benefit to the Org. In the static model, the damage $D(X)$ to the State spells the utility or benefit of the Org. In the same vein, the utility, $\bar{U}(D^c(X_c), D^f(X_f))$, to the Org here can be seen as an aggregate function of damage over the two periods caused to the State.

In this setup, it is natural to assume that the rational Org would choose X_c and X_f, the current and the future aggregate terror inputs, so as to maximize its total benefit $U(X_c, X_f)$, subject to the intertemporal budget constraint (9.3). A reader can immediately recognize that this is analogous to the household utility maximization problem studied in microeconomic theory. We can define an *iso-benefit curve* (IBC) or an *iso-damage curve* (IDC) as the locus of current and future terror production that generate the same level of total benefit to the Org or the same level of aggregate damage to the State. Henceforth, we will refer to this as an iso-damage curve or IDC.

Given the utility function $U(\cdot)$, IDC is downward sloping. Let us further assume that like a standard indifference curve it is convex to the origin. Figure 9.4a shows the Org's rational choice of current and future production of terror, defined by the point of tangency E_0 along with X_{0c} and X_{0f} as the optimal solutions. In general, the optimal choice of terror production for the present and the future depends on the position and slope of the budget line and the shape of IDCs that depend on the per-period terror damage functions and the aggregate damage function $\bar{U}(\cdot)$.

We are ready now to analyze the implications of preemptive measures. A higher level of preemptive measures shifts the budget line in (see panels (b)–(d) of Fig. 9.2),

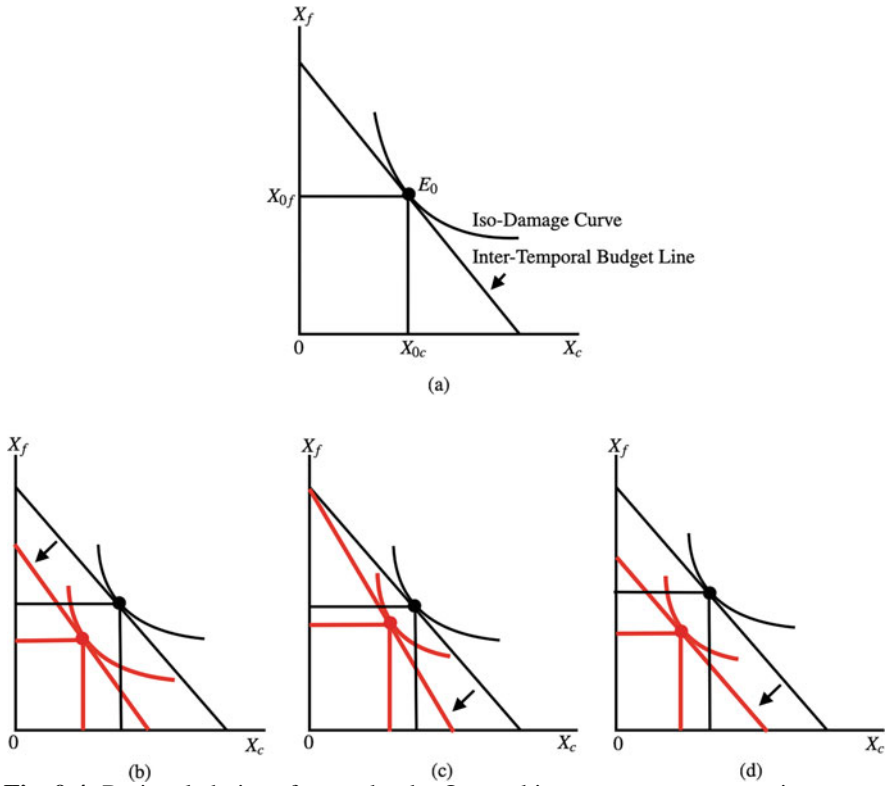

Fig. 9.4: Rational choice of terror by the Org and its response to preemptive measures: The dynamic model. (**a**) Choice of terror for present and future. (**b**) Preemptive strikes having a permanent effect. (**c**) Preemptive strikes having a temporary effect. (**d**) Financial controls

whereas the nature of the shift depends on the type of the preemptive measure, already discussed in Sect. 9.2. The impacts on X_c and X_f individually are ambiguous, however. But, an inward shift of the budget line implies that the terror production for at least one of the two periods would decline; that is,

Result 9.2

Preemptive measures in terms of either military strikes or financial controls lead to a decline in aggregate damage associated with a decrease in the current or/and future production of terror.

Specifically, if the current and future damage functions are similar and preemptive strikes that damage present *and* future capability of the terror organization in similar magnitudes, we can deduce the following from Fig. 9.4:

Result 9.3

(i) Preemptive measures that have permanent effects tend to reduce both present and future productions of the aggregate terror input.
(ii) In response to preemptive measures that reduce only the current capability, the current production of terror falls, while the future production of terror may increase or decrease.
(iii) Present *or* future financial controls tend to reduce present *and* future production of the aggregate terror input.

Part (i) of Result 9.3 follows from the implications shown in panel (b) of Fig. 9.4. Part (ii) is derived from panel (c). Whether funds are available in the present period or will be generated in the future, as long as borrowing and lending allow fund transfer between present and future, part (iii) of Result 9.3 follows in view of panel (d) of Fig. 9.4. An upshot is that

Is That So? 9.1: Equivalence between Military Strikes and Financial Controls

Financial controls are as potent as military measures to contain or degrade the capability of terror organizations.

The dynamic model is richer than, yet consistent with, the earlier static approach. Both approaches lead to the same broad conclusion that *preemptive measures directly discourage the production of terror.*

9.4 The State's Choice of Preemptive Measures: A Sequential Game

For now on, we shall suppress security-deterrence measures and focus on the choice of preemptive measures by the State. Furthermore, for simplicity of exposition, we will use *the static model of the Org's behavior*, because it delivers, in a simple way, the prediction that an increase in preemptive measures induces the Org to reduce the production of terror.

Recall that in Chap. 8, we employed the concept of one-shot, simultaneous-move Nash equilibrium to study security measures. But we cannot do the same here, because, unlike security measures, there is no (direct) effect of preemption on damage from terror (if the Org keeps the level of its terror production unchanged). Put differently, if the terror output is unaffected, there is no benefit to the State from preemptive actions and thus a simultaneous-move Nash equilibrium where a player optimizes over his actions given the strategy of other players would imply zero preemptive measures (i.e., $m = 0$). This does not make sense.

Instead, because preemption (the State's strategy) works *only* through its impact on terror production (the Org's strategy), we must use a *sequential game* (see General Appendix A, Sect. A.6) to study the choice of preemption. In a two-player sequential game, one player moves first and chooses an action, and the other player moves next and chooses his action after observing the action of the first player. In other words, the second player has a prior knowledge of the strategy of the first player but not vice versa. The game is "solved" by backward induction. We first characterize the second player's choice of action conditional upon the first player's action. Factoring in this behavior of the second player, we then solve the behavior of the first player in stage 1. There is a refined concept of Nash equilibrium used here called the *sub-game perfect equilibrium*, requiring that the strategies be such that a Nash equilibrium holds *at each stage of the game.*[2]

In our context, it is natural to assume a two-stage sequential game in which the State moves first and chooses the level of preemption in stage 1, and, in stage 2, the Org chooses the level of production of terror after observing the level of preemption selected by the State.

We are ready to "solve" the game, beginning with stage 2 and working backward. In stage 2, it is the Org's turn. Realize that we have already characterized the Org's choice of terror, given the level of preemptive measures chosen by the State. In other words, we already have the solution of the game in stage 2: it is the best response function of the Org defined in Eq. (9.5) and illustrated in Fig. 9.3c. We proceed to characterize the State's choice of preemption in stage 1 of the game.

It should be clear now why this sequential game—where the State chooses its action (preemption) first and the Org chooses its action (production of terror) next—is the appropriate game model. The level of preemption in stage 1 fixes the marginal cost function facing the Org. Having observed this function, the Org chooses its level of terror in stage 2—which determines the expected damage facing the State. This is the mechanism of benefit to the State from the preemptive measures. To be more specific, an increase in preemption leads to less production of terror, which, in turn, implies less damage from terror. Connecting the chain effects,

$$\boxed{D(X) = D(X(z+m)) = \bar{D}(z+m).} \tag{9.7}$$

We call this the *damage-deterrence function*, as it capsules that preemption delivers benefits to the State by deterring the Org from attacking the State.

The negative (beneficial) impact of preemptive measures on damage means $\bar{D}_m(z+m) \equiv \partial \bar{D}/\partial(z+m) < 0$, the magnitude of which is $-\bar{D}_m(z+m)$. We assume that the marginal benefit diminishes with m, i.e., $-\bar{D}_{mm}(z+m) < 0$, that is,

$$\boxed{\bar{D}_{mm}(z+m) > 0.} \tag{9.8}$$

[2] Since in a sequential game only one player "moves" at any given stage of the game, at the sub-game perfect equilibrium, each player chooses its optimal strategy whenever her/his turn comes.

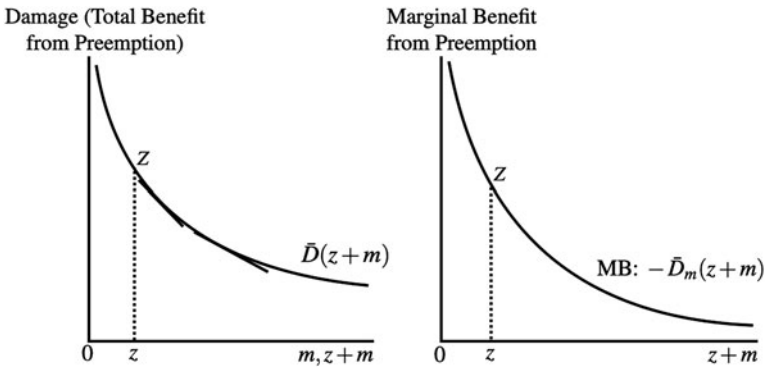

Fig. 9.5: The State's total and marginal benefit functions from preemption

The total and marginal benefits to the State from preemption are illustrated in Fig. 9.5 at some given level of z. The absolute value of the slope of the $\bar{D}(z+m)$ curve (equal to MB) decreases in conformity with condition (9.8). In both panels, m is measured along the horizontal axis from z to the right and the total and marginal benefits on the vertical axis from Z to the right.

Turning now to the costs associated with preemptive actions, there are direct costs of military engagement. Injury and death of soldiers entail their opportunity costs as well as the cost of pain and suffering of relatives and the nation at large. Furthermore, there are collateral damages. If terrorists and facilities are located in populous areas, there would be civilian casualties and loss of property. These are direct costs to the population where the terrorists reside but at the same time impose implicit costs to the State in terms of increased hostility and loss of goodwill. Let $H(m)$, with $H_m > 0$, denote the total cost function of preemptive measures. In view of the preceding discussion, it is compelling to assume *increasing* marginal cost of preemptive measures: $H_{mm}(m) > 0$.[3] However, for the sake of understanding the implications of increasing marginal cost of preemption, we need to consider constant marginal cost of preemption as a benchmark. Thus, for analytical purposes, we shall assume constant or increasing marginal cost of preemption, that is,

$$\boxed{H_m(m) \geq 0.}$$

Figure 9.6 depicts the graphs of the preemption cost functions.

Having understood the benefits and costs associated with preemption, we move on to the State's rational choice of preemption. Assume that the State chooses preemptive measures m in order to minimize the sum of total terror-damage cost and the total cost of preemption, i.e., its objective is to

$$\boxed{\text{Minimize} \quad \bar{D}(z \underset{-}{+} m) + H(\underset{+}{m}) \text{ with respect to } m.} \tag{9.9}$$

[3] See Bueno De Mesquita (2005), who also assumes increasing marginal cost of preemption.

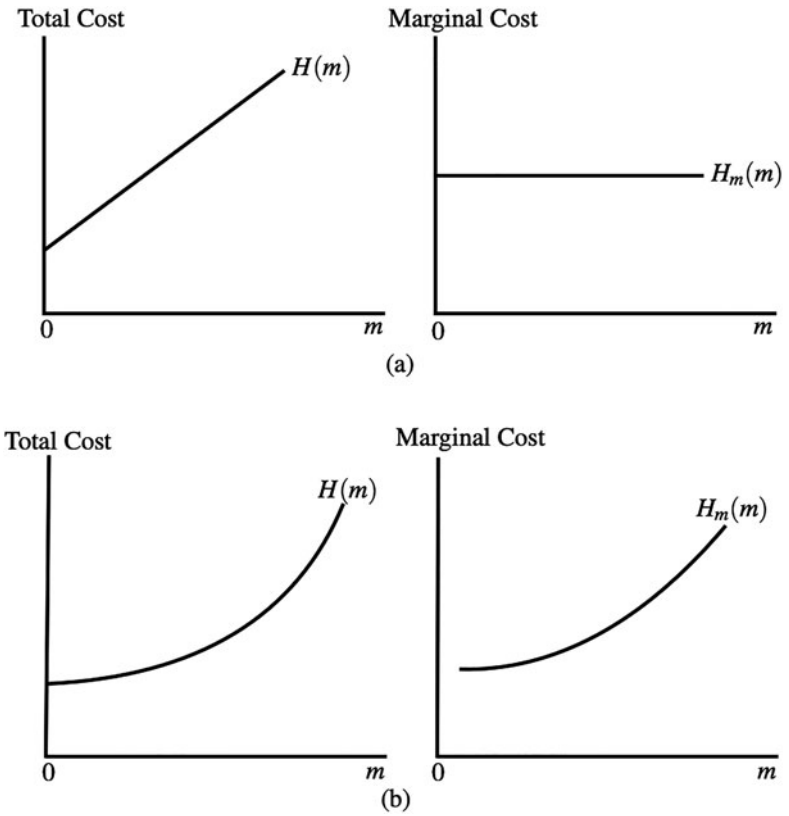

Fig. 9.6: Preemption cost functions. (**a**) Constant marginal cost of preemption. (**b**) Increasing marginal cost of preemption

The tradeoffs are clear from the signs underneath. The first-order condition for the rational choice of m is

$$\bar{D}_m(z+m) + H_m(m) = 0 \Leftrightarrow \underbrace{-\bar{D}_m(z+m)}_{\text{State's MB}} = \underbrace{H_m(m)}_{\text{State's MC}}. \tag{9.10}$$

Figure 9.7 illustrates this, where the exogenous level of militancy is given at z_0.

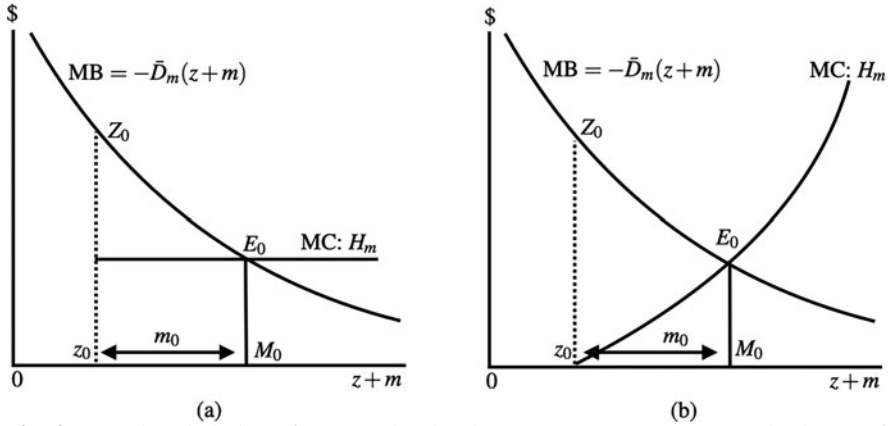

Fig. 9.7: Rational choice of preemption by the State . (**a**) Constant marginal cost of preemption. (**b**) Increasing marginal cost of preemption

Notice that the State's MB depends on the level of the marginal cost function facing the Org, $z+m$, which is measured on the horizontal axis. If $z = z_0$, we read MB from the point Z_0 on the curve. The MC of preemption depends on m only, and thus the MC function is drawn from z_0. Panels (a) and (b) depict the constant-preemption-marginal-cost and increasing-preemption-marginal-cost situations, respectively. The intersection point between the MB and the MC curves (E_0) locates where the first-order condition (9.10) is met. The optimal solution of $z_0 + m$ is M_0 and the optimal level of preemption is m_0. Of course, since the two panels graph different MC functions of preemption, E_0, M_0, and m_0 in the two panels represent different points and magnitudes.

Given the solution of m, the optimal production of terror is determined from Fig. 9.3c. The "solution" of the model is complete.

9.5 Can the State Win the War on Terror?

We are in a position now to pose and answer some fundamental questions. First, how would the Org and the State respond to an increase in militancy? Technically, it boils down to a comparative statics with respect to a decrease in the militancy parameter z. Interestingly, this leads to an answer for another fundamental question: can we win the WoT?

We first define winning or losing WoT. Start with an initial level of militancy say z_0. Given z_0, the State chooses a level of preemption, say m_0. Given z_0 and m_0, the level of the Org's marginal cost function is $z_0 + m_0$. In turn, in Stage 2, let the corresponding level of Org's rational production of terror be X_0. From this initial situation, consider an increase in militancy, i.e., a decline in z from z_0 to, say, z_1. We expect that the State would respond with more preemptive measures, say $m_1 (> m_0)$. Now, if m_1 is high enough such that the Org produces a level of terror, say X_1, which

is less than how much terror it produced before (that is X_0), we say that the State has successfully overcome the problem of terrorism by preemptive measures, i.e., the State has won WoT. If $X_1 = X_0$, we would say that the State has weakly won WoT. But if $X_1 > X_0$, the State is losing WoT: its response in terms of preemptive measures is not strong enough to turn the rising tide of terror attacks. Hence, we have the following definition:

Definition of Winning or Losing the WoT

The State loses WoT if, following an exogenous increase in militancy or terrorism and the State's response in terms of CT measures, the Org still produces more terror than earlier. Otherwise, the State wins.

We next argue that winning or losing WoT depends on the nature of the State's marginal cost of preemptive measures. Refer to Fig. 9.8, which has two panels: one for constant marginal cost of preemption and the other for increasing marginal cost of preemption. Each panel has two quadrants. The upper one depicts the marginal benefit and marginal cost functions for the State. The lower quadrant graphs the best response function of the Org, which is the same as in Fig. 9.3c but drawn upside down.

In both panels, z_0 and z_1, respectively, denote the original and the new level of militancy. We first analyze the case of constant marginal cost of preemptive measures.

9.5.1 Constant Marginal Cost of Preemption

In panel (a), at the original level of militancy z_0, the MB curve of preemptive measures for the State starts from Z_0 in the top quadrant. The MC curve of preemptive measures is the flat line "MC: H_m." The original equilibrium point for the State is E_0 where the State chooses the level of preemption equal to m_0. The level of the Org's marginal cost function is $z_0 + m_0$, which marks the point M_0. In the bottom quadrant, we read the equilibrium production of terror corresponding to M_0. It is X_0.[4]

Now suppose there is an increase in militancy such that z falls from z_0 to z_1. How do the Org and the State respond? The MB curve for the State begins from Z_1. However, notice that its intersection with the MC curve occurs at E_0 as before, and thus the equilibrium $z + m$ is at M_0. This means that the State responds to the increase in militancy by increasing preemption from m_0 to m_1. The point is that, despite the increase in militancy, this response by the State leaves the level of Org's marginal cost function unchanged. As a result, the equilibrium production terror remains unchanged at X_0. The increase in militancy is neutralized by the State's preemptive actions. Per our definition, the State has won WoT, albeit in the weak sense! Since the marginal cost of preemptive measures is constant, the economically rational response for the State is to increase preemption that exactly offsets the

[4] Note that the best response function of the Org in the bottom quadrant is implicit in the MB curve in the top quadrant. They are drawn separately to show the equilibrium responses.

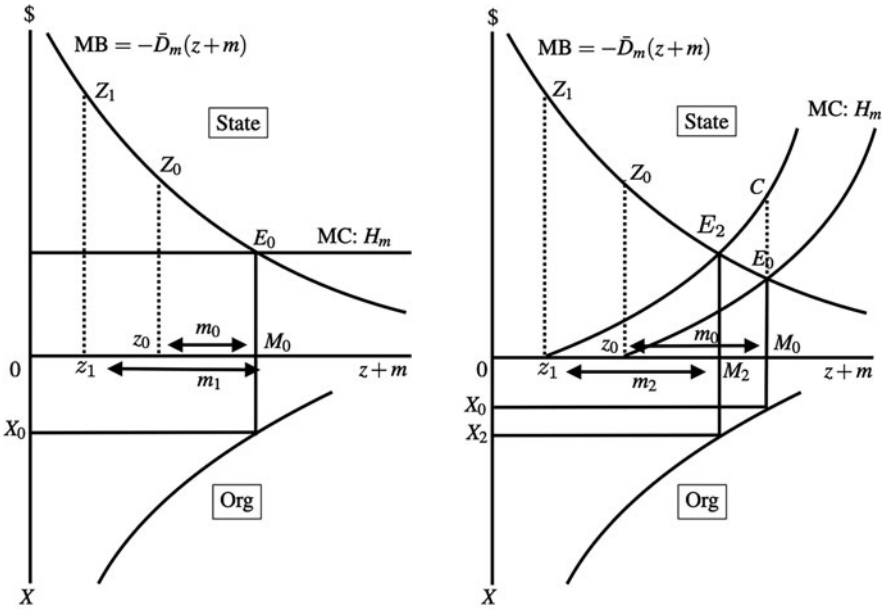

Fig. 9.8: Increase in militancy. (**a**) Constant marginal cost of preemption. (**b**) Increasing marginal cost of preemption

decrease in z due to the increase in militancy. Consequently, increased militancy does not translate into an increase in the capability of the Org. There is no increase in terror production, and the State wins.

9.5.2 Increasing Marginal Cost of Preemption

This is shown by the upward sloping MC function facing State in panel (b) of Fig. 9.8. We will now see that the implications are vastly different if the marginal cost of preemption to the State is increasing—which, as we have argued, is more realistic.

Consider the initial level of militancy z_0. The upward sloping curve starting from z_0 is the marginal cost function and reflects increasing marginal cost of preemption. The MB and the MC curves intersect at E_0. The initial optimal level of preemption is m_0 and the initial level of terror production is X_0.

Starting from z_0, m_0, and X_0, if the level of militancy increases so that $z = z_1$, the MB curve starts from Z_1, while the (same) MC curve starts from z_1 instead of z_0. The two curves intersect at E_2, implying the new level of preemption m_2. Although it is not evident from the diagram, one can show that $m_2 > m_0$. That is, the State responds to an increase in militancy by increasing the preemptive actions. However, the key point is that the increase in preemption from m_0 to m_2 does *not* fully offset the decrease in z. *The new level of marginal cost facing the Org is M_2, which is less than M_1 even after the State's response.* In the bottom quadrant, the associated new level of terror production is X_2, which is *higher* than X_0. The State loses the WoT.

The underlying reason is that if the marginal cost of preemption is increasing, it is too costly for the State to enhance preemption to fully neutralize the increase in militancy. Notice that if the State did so (such that the marginal cost to the Org remains unchanged at M_0), its MC would be at the point C in panel (b), which exceeds its MB. The State would not maximize its surplus. This is why the State does *not* fully offset the exogenous increase in militancy or terrorism and thus (rationally) loses the WoT. The State willingly accepts a higher level of terror.

This may appear odd at first but not at all unrealistic. Just think about why the USA did not engage in a full-scale military operation to defeat Taliban, although, undoubtedly, it has the military capability to obliterate Taliban soldiers and their strongholds. It is the prospect of huge collateral damage that withheld the USA from engaging in a full-scale attack on Taliban, which is the equivalence of increasing marginal cost of preemption. It explains why the USA could not win over Taliban.

Here is our model's prediction.

Is That So? 9.2: Winning/Losing WoT

Preemptive actions can help the State to win WoT if the marginal cost of preemption is constant but cannot win WoT if the marginal cost of preemption is increasing.

One would think that if preemptive measures are not enough, it can be combined with more security measures and win. Well, it is possible but not for sure—because a rational state would substitute between security and preemptive measures: if the State enhances security, its response with respect to preemption may be less than otherwise from a cost–benefit standpoint. Hence it is unclear that the State would win WoT: *winning is highly unlikely if the marginal costs of both preemption and security are increasing*. The same logic applies.

It is worth noting that if the State were not a liberal democracy and did not care about the cost of preemption and security measures, it can simply "go after" terrorists and terror organizations and suppress the problem effectively. But as long as the State is a liberal democracy—as most of the developed western nations, Japan, Australia, India, and some others are—it would care about the loss of civil liberty and collateral damage. This would constrain the State from unleashing enough preemptive actions required to win the WoT as long as the marginal costs of preemption are increasing.

Our analysis thus suggests that military intervention alone may not be sufficient to mitigate the problem of terrorism. In Chap. 13, we examine how it may be combined with other measures to tame terrorism.

9.6 Interdependence Among Target Countries

We now relax the assumption of one target country and consider a scenario where multiple target countries face the threat of terrorism from the same terror organizations. In Chap. 8, we analyzed the interdependence of security measures by target countries, whereas here we examine preemption. Our objective is to understand the

nature and implications of interdependence of preemptive measures by the target countries that arises because of a *common-enemy situation*. For simplicity, assume two target countries, a and b (the results are generalized to many target countries). Security measures are kept unchanged so as to focus on preemptive measures. As in Chap. 8, in order to understand the interaction between the target countries, we keep the behavior of a terror organization implicit: it is not treated as a separate entity. Thus, we have a two-player game with State a and State b.

Remember that an increase in security by one target country exerts a terror diversion effect and a negative externality on other target countries. In contrast, *preemptive measures entail a positive the externality effect*. If country a (say the USA) steps up its attack on the facilities of terror organizations that plan attacks on the USA as well as country b (say Britain) and raises their marginal cost, it is good news for country b, Britain. Hence,

Is That So? 9.3: Preemptive Measures Have a Positive Externality Effect

In the context of multiple target countries, an increase in the preemption by one target country acts as a positive externality for other target countries.

The implication is that if target countries choose their preemptive measures individually, i.e., non-cooperatively, they do not factor in the positive externality effect. Hence they *under-provide* preemptive measures compared to what may be the best for them jointly. Another way to look at it is that one target country tends to free-ride on another's preemptive measures and thus undertakes less preemptive measures compared to a cooperative arrangement. For instance, if France bombs ISIS, there is less incentive for the USA to do so and vice versa.

The model below is based on Sandler and Siqueira (2006).

9.6.1 The Model

9.6.1.1 Damage-Deterrence and Cost Functions

Let m^i denote country i's measure of preemption, where $i = a, b$.

Assumption 9.1. *Preemptive actions m^a or m^b shift up the terror organizations' marginal cost function, reducing their terror producing capabilities. As a result, they unleash less terror attacks on both countries.*

It essentially says that *preemptive actions by either country reduce terror damage received by both countries.* Accordingly, let us define more general terror-deterrence functions $D^a(m^a, m^b)$ and $D^b(m^a, m^b)$:

$$D^a = D^a(\underline{m}^a, \underline{m}^b); \quad D^b = D^b(\underline{m}^a, \underline{m}^b). \tag{9.11}$$

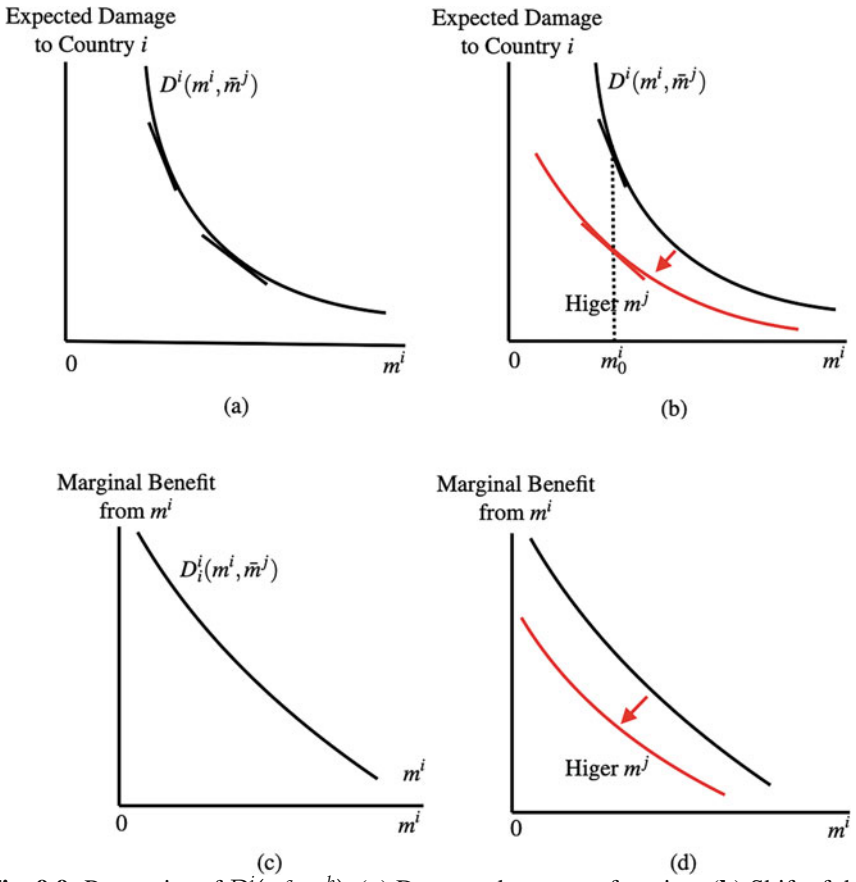

Fig. 9.9: Properties of $D^i(m^a, m^b)$. (**a**) Damage deterrence function. (**b**) Shift of the damage deterrence function. (**c**) Marginal benefit function. (**d**) Shift of the marginal benefit function

We impose the following conditions:

Assumption 9.2. *(i) The marginal damage-reducing effect of own preemptive measures is subject to diminishing returns. (ii) The marginal damage-reducing effect of own preemptive measures falls as other country steps up its preemptive actions.*

The positive externality effect is reflected by the negative marginal effect of m^b on D^a and m^a on D^b in the damage-deterrence functions as well as part (ii) of Assumption 9.2. Assumptions 9.1 and 9.2 are illustrated in Fig. 9.9. The convex curvature of the damage-deterrence functions implies that the absolute value of its slope falls with own preemption. This is reflective of diminishing returns ((i) of Assumption 9.2). Given m_0^i, an increase in m^j by country j implies less damage for country i and hence leftward shift of the damage-deterrence function. In panel (b),

note that, at any given m_0^i, the slope of the damage-deterrence function falls with an increase in m^j. This is part (ii) of Assumption 9.2.

Damage-deterrence functions describe the States' benefits from preemptive measures. The marginal benefit from own preemptive measures falls with own or the country's preemptive measures (Assumption 9.2). These are shown, respectively, by the downward slope of the MB function in panel (c) and the leftward shift of the same in panel (d).

In the cost side, we continue to assume constant or increasing marginal cost of preemptive measures. However, there is no qualitative difference in implications here between the constant and increasing marginal cost situations. To fix ideas, we will suppose increasing marginal cost of preemption, as shown in Fig. 9.6b.

9.6.1.2 Rational Choice of Preemptive Measures and Nash Equilibrium

Since in the present context, preemptive measures by any country have their own direct impact on terror damage when the levels of preemptive measures by other target countries remain unchanged, we can work with a simultaneous-move Nash game, where countries a and b simultaneously choose m^a and m^b, respectively. Each country's objective is to minimize the sum of terror damage costs and the costs of preemption, i.e.,

$$\text{Minimize} \quad C^i = D^i(m^a, m^b) + H^i(m^i), i = a, b.$$

Recall that Nash equilibrium is where each player has no incentive to deviate from his strategy given the strategies of other players. Thus, each country minimizes its total cost with respect to its own preemptive measures, i.e., C^i is minimized with respect to m^i, given m^j. That is, each country chooses the level of its preemptive measures optimally on its own. The first-order conditions are

$$m^a : \; D_a^a(m^a, m^b) + H_m^a(m^a) = 0 \Leftrightarrow \underbrace{-D_a^a(m^a, m^b)}_{\text{MB}_a} = \underbrace{H_m^a(m^a)}_{\text{MC}_a} \tag{9.12}$$

$$m^b : \; D_b^b(m^a, m^b) + H_m^b(m^b) = 0 \Leftrightarrow \underbrace{-D_b^b(m^a, m^b)}_{\text{MB}_b} = \underbrace{H_m^b(m^b)}_{\text{MC}_b}. \tag{9.13}$$

In Fig. 9.10a, the intersection of the respective marginal benefit and marginal cost curves defines the respective optimal choice of preemptive actions.

How does the choice of preemption by one country affect that of the other? It is shown in panel (b). Assumption 9.2(ii) implies that a higher m^j by country j leads to a lower level of the MB curve from preemption for country i. The equilibrium or optimal level of m^i is thus lower. This implies, in turn, that the best response functions are downward sloping, shown in panel (c). The positive externality effect is the underlying reason: if one country steps up preemption, the other country

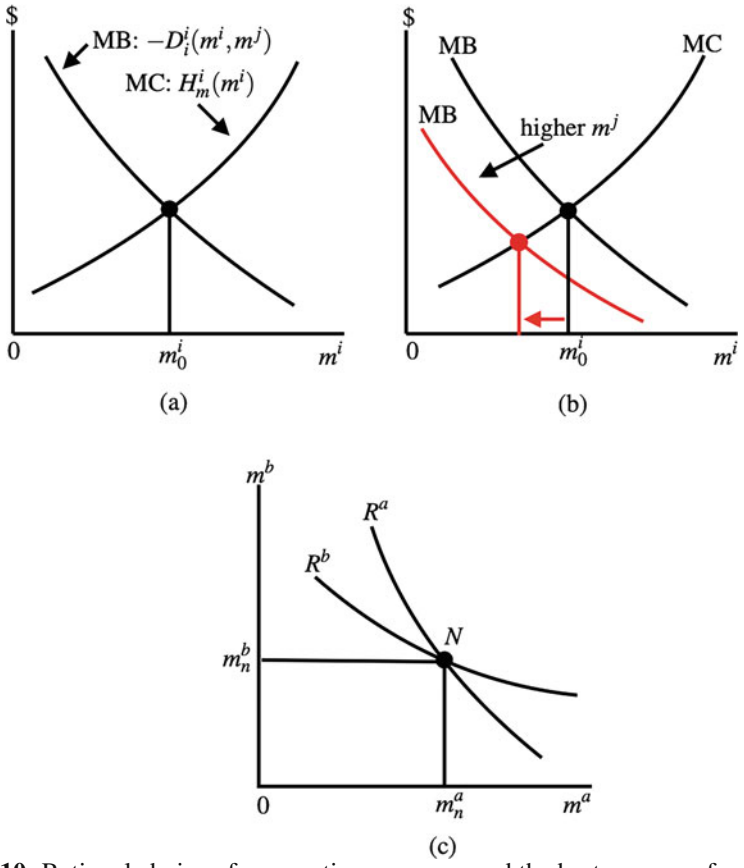

Fig. 9.10: Rational choice of preemptive measures and the best response functions. (**a**) Choice of m^i, given m^j. (**b**) Effect of an increase in m^j on m^i. (**c**) Best response functions and the Nash equilibrium

benefits and hence has an incentive to free ride and reduce its preemptive actions. The intersection point N of the best response functions locates the Nash equilibrium choice of preemption strategies (m_n^a and m_n^b).[5]

9.6.1.3 Comparative Statics

In economic terms, preemptive measures work like a common fund for a common purpose, to which every member contributes. Here, the common purpose is to defeat the common enemies that target them, and contributions to the fund are akin to preemptive measures. Which target country will "contribute" more and which will

[5] Using some other assumptions, it can be established that the R^a curve is steeper than the R^b curve.

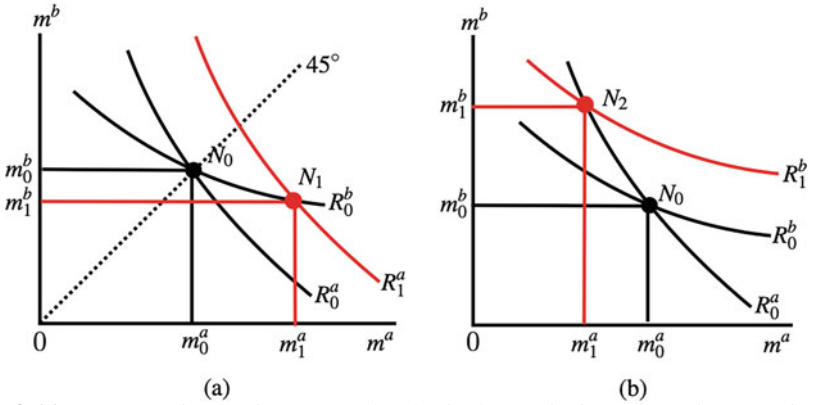

Fig. 9.11: Comparative statics. (**a**) Technological superiority. (**b**) An increase in the valuation of damage from terrorism

"contribute" less? Difference in technological capabilities is one of the factors. Suppose country a is technologically superior to country b in delivering preemptive measures. All else the same, we should expect country a to use more preemptive measures. Our model predicts this indeed.

Let us start with a situation where the damage and cost functions are the same for the two countries. Their best response functions will be mirror reflections of each other and the Nash equilibrium will lie on the 45° line like the point N_0 in Fig. 9.11a. The equilibrium preemptive measures are m_0^a and m_0^b, where $m_0^a = m_0^b$. Now, suppose country a develops a superior technology of attack. One could think of more powerful aircrafts or drones, more rigorously trained armed forces, etc. This amounts to a lower marginal cost of preemptive measures for country a. It will tend to deploy more preemptive measures, which will shift its best response function out to the right. There is no shift of country b's best response function. The new Nash equilibrium will be at a point like N_1 in panel (a). We have $m_1^a > m_0^a = m_0^b > m_1^b$. More preemptive actions are undertaken by the technologically superior country. Particularly notable is the outcome that as country a employs more preemptive measures, country b free-rides on it and scales down its preemptive measures—thanks to the positive externality effect of country a's initiative. This explains, for instance, why the USA is the natural leader in the war against terror.

Turning to our next comparative statics, whenever there is a successful terror attack causing fatalities and injuries to several people it is a big news, heightening public fear. Imagine that country a, but not country b, has experienced such a terror attack in the recent past. All else equal, another terror attack would cause greater fear among the people in country a. In other words, the damage valuation of country a is now greater. In Chap. 8, we modeled this via an increase in a multiplicative parameter α in the terror-damage function. Following the same approach, let us modify country a's damage-deterrence function as $\alpha D^a(m^a, m^b)$, where an increase in α represents a proportional increase in the valuation of damage from terror. The comparative statics question is how does an increase in the valuation of damage from

terror by country a (i.e., an increase in α) affect the choice of preemption by both countries?

Note that an increase in α shifts up not just the total damage-deterrence function but also the marginal benefit function of country a's preemptive measures. At any given m^b, country a will choose a higher m^a. As shown in Fig. 9.11b, starting with an initial Nash equilibrium at N_0, the best response function of country a will shift out. The new equilibrium will be at point like N_2. Country a chooses a higher level of preemptive measures. Country b scales down. The positive externality effect is the key again, because of which country b tends to free ride on preemptive strikes by country a and chooses a lower level of preemption.

9.6.1.4 Cooperation

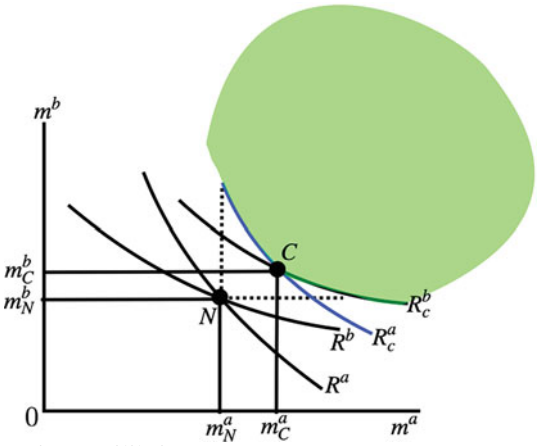

Fig. 9.12: Cooperative equilibrium

Because the positive externalities associated with preemption are not internalized at the Nash equilibrium, there is a scope for a better outcome through a joint cooperative decision making by target countries in attacking terror groups militarily and financially. It amounts to forming a coalition on terror. The question is how does the cooperative solution compare with the non-cooperative Nash solution?

Assuming that the objective of the coalition is to minimize the unweighted sum of total costs facing all target countries, in our two-target country model, countries a and b jointly decide m^a and m^b so as to minimize

$$D^a(\underset{-}{m^a}, \underset{-}{m^b}) + H^a(\underset{+}{m^a}) + D^b(\underset{-}{m^a}, \underset{-}{m^b}) + H^b(\underset{+}{m^b}).$$

The trade-offs are clear. An increase in m^i tends to reduce expected terror damage to and hence enhance the benefit of both countries, while it imposes an increase in

costs for country i only. The first-order conditions are

$$m^a: \underbrace{-D_a^a(m^a,m^b)\underbrace{-D_a^b(m^a,m^b)}_{\text{+ve externality}}}_{\text{SMB of } m^a} = \underbrace{H_m^a(m^a)}_{\text{MC of } m^a} \tag{9.14}$$

$$m^b: \underbrace{-D_b^b(m^a,m^b)\underbrace{-D_b^a(m^a,m^b)}_{\text{+ve externality}}}_{\text{SMB of } m^b} = \underbrace{H_m^b(m^b)}_{\text{MC of } m^b}, \tag{9.15}$$

where SMB stands for social or collective marginal benefit, which includes own marginal benefit as well as the positive externality effect. These equations spell the respective cooperative response functions, shown as R_c^a and R_c^b in Fig. 9.12. Parallel to the social marginal cost introduced in Chap. 8, here

$$\underset{\text{of preemption}}{\text{Social Marginal Benefit}} = \underset{\text{of preemption}}{\text{Private Marginal Benefit}} + \underset{\text{of preemption}}{\text{Positive Externality}}.$$

The main point is that, compared to the first-order conditions defining the non-cooperative Nash equilibrium spelled out in Eqs. (9.12) and (9.13), under cooperation, the positive externalities are internalized, and thus the social marginal benefits of preemptive measures are higher. At any given m^b, the collectively optimal or the cooperative choice of m^a will be higher. Similarly, at any given m^a, the cooperative choice of m^b will be greater.

Figure 9.12 depicts the cooperative solution vis-à-vis the non-cooperative Nash solution. The cooperative response functions R_c^a and R_c^b must lie to the right of R^a and R^b, respectively, since the positive externalities are internalized and the social marginal benefit of m^a and m^b are higher than the individual or private benefit. The cooperative equilibrium point must lie in the shaded area (and beyond), which is to the right or both R^a and R^b lines.

Looking at the shaded area, the most likely cooperative equilibrium point will be like the point C where the solutions, m_C^a and m_C^b, are higher than the respective solutions at the Nash equilibrium point N. That is, compared to no cooperation, every target country is expected to undertake more preemptive measures. But it need not be the case. The intersection point of R_c^a and R_c^b may not lie to the north east of point N, if the two countries differ greatly in terms of cost or damage functions. The reason behind why all countries may not necessarily be called upon to engage in more preemptive strikes under cooperation is that preemptive measures by target countries are substitutes of one another. Thus

Result 9.4

Compared to non-cooperation, under cooperation at least one country chooses a higher level preemptive actions. If both countries are not too dissimilar, both would have to choose higher levels of preemptive actions.

We can generally say that the aggregate preemptive actions by the two countries together will be greater, and hence the terror organizations will be under more pressure if the target countries act collectively. Reversing the sequence,

Result 9.5

Compared to what is collectively or cooperatively the best for a group of target countries, there will be an ***under-provision of preemptive measures*** when they (non-cooperatively) choose preemption on their own (at the Nash equilibrium).

9.7 Side Effects

There are side effects of preemptive strikes that tend to encourage terrorists and terror production. One is a backlash effect arising out of resentment and anger, and the other is a negative economic externality that preemptive strikes create when economic assets of affected areas are damaged. This does not however apply to financial controls as preemptive actions.

9.7.1 Backlash

Collateral damages generate anger, vengeance, and thus more hostility toward the attackers. Such concerns have been voiced by many leaders and experts, who do not support heavy-handed military intervention as a general strategy to address the problem of terrorism. How do we think of the backlash effects in our model? There are two (generic) ways: anger and vengeance

(1) Lead to more support for terror organizations in terms of finance and willingness to join terror organizations

(2) Translate into more satisfaction to a terror organization from the same level of damage it causes to the target country that has carried out the preemptive strikes.

The first is physical and tangible, while the second is psychological. Both lead to a change in the behavior.

9.7.1.1 Greater Support for Terrorism

Sympathy and anger from crackdown and collateral damage can motivate more support to terror organizations in the form of more financial support and/or more recruitment opportunities for terror groups. We view this as a decrease in the marginal

cost of producing terror *induced by preemption*. Algebraically, we can write the Org's marginal cost function as

$$\boxed{\text{MC of producing terror} = z + m - \gamma m + v \cdot X,\ \gamma > 0,} \tag{9.16}$$

which is a generalization of (9.1) and where $\gamma > 0$ represents the backlash coefficient. Note that the backlash effect depends on preemptive actions (m); notice that it is 0 when $m = 0$. If $\gamma \geq 1$, then preemptive measures have no benefit to the State and thus totally ineffective as CT measures. This is highly unrealistic. It is reasonable to suppose $0 < \gamma < 1$. Hence, without the backlash effect, a unit increase in m leads to a unit increase in the MC facing the Org, whereas with a backlash effect, the marginal impact is less than unity ($= 1 - \gamma$). Two conclusions follow immediately.

Result 9.6

(i) Collateral damage-induced backlash effects tend to reduce the impact of preemption on the Org's marginal cost function and therefore reduce the effectiveness of preemption as a CT measures. (ii) However, this does not imply that preemptive measures are ineffective. WoT can still be weakly won if the marginal cost of preemption is constant. Of course, compared to the case of no backlash, a higher level of preemption will be necessary for the purpose. But, if, more realistically, the marginal cost of preemption is increasing, the backlash effect further diminishes the role of preemptive measures in limiting the problem of terrorism.

9.7.1.2 Preference Shift

Backlash may breed of a sense of intense hatred, such that the same amount of damage caused to the State engenders more satisfaction to the terrorists. We can modify the utility function of the Org as $U_D = \beta(m)D(X)$, where β increases with m and captures the backlash-induced shift in preferences of the Org. The Org maximizes the surplus $\beta(m)D(X) - C(X)$, the first-order condition of which is

$$\boxed{\beta(m)D_X(X) = z + m + vX.} \tag{9.17}$$

Notice that an increase in preemption increases the MC of as well as the MB from producing terror. While the former tends to reduce the production of terror, the latter tends to encourage the production of terror and captures the backlash effect. In symbols,

$$\boxed{X = \bar{X}(z + \underset{-}{m}, \underset{+}{m}).} \tag{9.18}$$

Similar to the increasing-support argument effect, the preference shift effect also implies a diminished effectiveness of preemptive measures.

9.7.1.3 Targeted Backlash Effect: A Third Aspect

Another kind of backlash effect arises in the context of multiple target countries. It can be argued that if, for example, country a takes more preemptive actions, it would incur the wrath of the terror organization more so compared to other target countries. As a result, in terms of carrying out terror attacks, the preference of the Org would shift away from country b to country a.

We can capture this by augmenting the damage-deterrence functions. For countries a and b, we can define them as

$$\underset{-}{D^a}(\underset{-}{m_a}, \underset{-}{m_b}) + \underset{+}{L^a}(\underset{+}{m_a}, \underset{-}{m_b}); \quad \underset{-}{D^b}(\underset{-}{m_a}, \underset{-}{m_b}) + \underset{-}{L^b}(\underset{-}{m_a}, \underset{+}{m_b}). \tag{9.19}$$

where $D^a(m_a, m_b)$ and $D^b(m_a, m_b)$ are the earlier damage-deterrence functions, and, $L^a(m_a, m_b)$ and $L^b(m_a, m_b)$ are the respective targeted backlash effects. The backlash effect is such that, all else the same, preemption actions by one country tend to invite more damage to that country and less to other target countries. There are two implications.

Result 9.7

In the presence of targeted backlash effect, (a) the preemptive actions chosen by the partner country remaining unchanged, a given target country will use less preemptive actions—because the terror organization becomes more focused on this country, and (b) there is an additional positive externality effect of one country's use of preemption on another target country's welfare or payoff: that is, as a country steps up its preemptive actions, the Org shifts its attention away from other target countries.

Result 9.7b implies that in Nash equilibrium, preemption will be under-provided because of two positive externality effects, and hence, cooperation would improve the joint welfare of all target countries more strongly than otherwise.[6]

9.7.1.4 Evidence on Backlash Effects

Estimating backlash effects is not an easy task. Scholars like Walsh (2013) and Gill (2015) have attempted to correlate the number of drone attacks or the civilian causalities from drone attacks in Afghanistan and Pakistan between mid-2000s and early 2010s one hand and insurgent violence in terms of terror attacks within the same or succeeding periods. They find no systematic relationship, i.e., drone strikes did not appear to have any significant deterrence effect. It means, albeit indirectly, that backlash effects cancel out *short-term* deterrence effects of drone strikes, a rather strong backlash effect. However, it does *not* say anything about the long-run deterrence effects.

[6] For a detailed analysis of this point, see Siqueira and Sandler (2007).

In terms of regression analysis, strong evidence of backlash effects is reported by Santifort-Jordan and Sandler (2014). They analyzed panel data on suicide terrorism at the global level from 1998 to 2010, covering 48 countries. Controlling for country-specific variables that may explain suicide attacks (e.g., per-capita income, unemployment, whether a country has a democratic system of government, etc.) and attack-specific variables like whether attackers belong to a secular or religious fundamentalist group, whether targets are business, official, or military, the authors use a time dummy variable, assuming value 0 for 1998 to 2001 and 1 for 2002 to 2010, to represent WoT that began in late 2001.

With other plausible determinants of suicide terrorism accounted for, the authors interpret the coefficient of WoT as the backlash effect.[7] Among other results, the authors find that, at the margin, WoT resulted in an *increase* of the number of transnational suicide attacks by 70%. The effect was particularly strong for suicide-attack-prone countries like Afghanistan and Iraq. Overall, "... this war created a deadlier world by enhancing grievances and expanding the use of suicide attacks by terrorists against hardened targets."

9.7.2 Negative Economic Externality

Bueno De Mesquita (2005) has argued that military crackdown on terrorists and terror facilities that produce collateral damages of economic assets like factories, infrastructure, and so on can reduce economic opportunities in the marketplace and force young people to join terror organizations. This side effect results from purely economic consideration rather than through an elevated psychological sense of anger, resentment, or ideology. This point can be understood more precisely in a simplified version of Bueno de Mesquita's self-selection model of choice in which an individual decides between working in an economy and volunteering for a terror group.

Assume an eligible workforce in a geographic area prone to preemptive strikes by a State. Individuals in the workforce differ in their ability to earn based on innate and/or education-enhanced skill. Let a denote a unidimensional index of ability that varies across individuals over an interval say from $\underline{a}$ to $\bar{a}$. Let the earning potential of an a-level-ability person be $W(a)$, where W increases with a.

Crackdown or preemption reduces economic opportunities when economic assets providing employment are damaged or destroyed. Thus, actual earnings, say w, will depend also on the level of preemption. Define $w = (1 - \mu m)W(a)$, where μ is a fraction such that $\mu m < 1$. Thus an increase in preemption reduces the earnings of all individuals irrespective of their abilities. Figure 9.13 graphs w against ability a at two levels of preemption, m_0 and m_1, where $m_1 > m_0$. The earnings lines are upward sloping, drawn as a straight lines for simplicity, and the higher the level of preemption, the flatter is the earnings line.

Suppose that all individuals are sympathizer of the cause of terror organizations. If some of them decide to volunteer for a terror organization, they receive some utility,

[7] Suicide terrorism is measured by the number of suicide missions, casualties from and the likelihood of these attacks, and the authors differentiate between domestic and transnational suicide terror attacks.

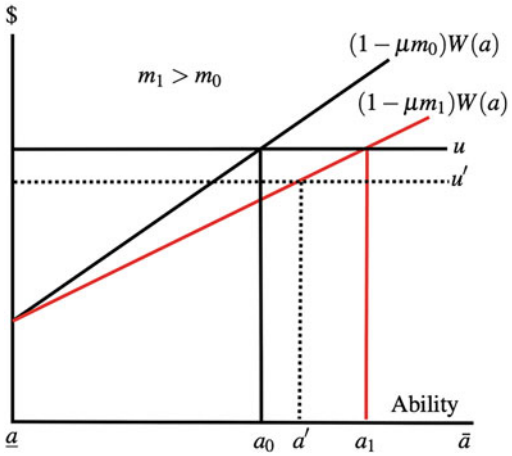

Fig. 9.13: Choice of terrorism: Self-selection

say, $u > 0$. It can be argued that u decreases with preemption, because degrading a terror organizations' capabilities reduces the chance of success and fulfillment as a terrorist. On the other hand, higher preemption can also increase u by increasing resentment—which we have already discussed. A person's ideological sentiments would also affect the magnitude of u. But, in order to isolate the effect of economic options, suppose that the net effect of preemption on u is zero. In Fig. 9.13, this is depicted as the flat line labeled u.

An individual in the labor force faces a binary choice: either work or join a terror group. Thus he/she weighs $w = (1 - \mu m)W(a)$ against u. He works or volunteers for terror organizations according to $(1 - \mu m)W(a) \gtrless u$. This comparison can be seen in Fig. 9.13. At the preemption level m_0, individuals with ability in the range $(\underline{a}, a_0)$ join terror organizations and those with ability higher than a_0 prefer to work in the economy. It is a self-selection mechanism that yields an expected outcome: those who have relatively higher ability work in the economy and those with relatively lesser ability and lesser earnings potential choose to join a terrorist group.

Beginning with the preemption level of m_0, if the State escalates it to m_1, the earnings line shifts down: all potential workers face the prospect of lower earnings because of the negative economic externality effect of preemptive strikes. At the margin, this affects the composition of individuals who opt to work and who opt to become or remain as a terrorist. We see that the new cut-off point is a_1, which implies a greater number of terrorists: those with ability in the range $(\underline{a}, a_1)$. Individuals in the ability range (a_0, a_1) become fresh entrants to terror groups. This is the main point: that is, the negative economic externality effect associated with preemptive strikes creates more terrorists.

It is not an unqualified outcome, however. By damaging the ability of terror organizations to carry out attacks, preemptive strikes may very well lower the utility from being a terrorist. If $u'(< u)$ is the new utility level from terrorism associated with $m = m_1$, the cut-off point is a'. A smaller number of people freshly join terror

organization. It is, of course, possible that if the capability of the terror organizations is sufficiently degraded so that utility from terrorism falls by a sufficiently large magnitude, some may leave terror organizations and hence participation in terrorism falls. Hence the outcome depicted in Fig. 9.13 assumes that the negative economic externality effect outweighs the capability-damaging effect of preemption. However, even then the point remains that, all else the same, reduced economic opportunity, i.e., the negative economic externality (shown by the downward shift of the earnings line) is, in and of itself, a push factor toward greater participation in terrorism.

Returning to our assumption that the negative economic externality effect is dominant, there is another important and interesting implication. Observe that the new entrants to terror organizations, whose abilities range from a_0 to a_1 in Fig. 9.13, are more skilled than the existing members. This would tend to increase the *quality* of terrorism as well. Thus

Result 9.8

If preemptive strikes reduce economic infrastructure of areas that are affected by these strikes, they would tend to reduce job opportunities in those areas and encourage participation in terror organization, especially by relatively more skilled workers, thereby increasing the *quantity and quality of terrorism.*

9.8 Take-Aways

- Preemptive measures can be viewed as shift parameters of the marginal cost function of a terror organization that produces terror.
- Preemptive strikes that permanently reduce the capability of producing terror and control of funds flow to a terror organization have similar implications toward the production of terror. That is, preemptive strikes and financial controls are equivalent to some extent.
- In a game-theory setup, preemption can be studied as a sequential game where the State first chooses the level of preemptive actions, followed by the Org's choice of the level of terror production.
- Losing or winning WoT is defined such that the State loses WoT, if after an exogenous increase in militancy or terrorism and the State's response in terms of CT measures, the Org is induced to produce more terror; otherwise, the State wins.
- Preemptive measures can help the State to win WoT if the marginal cost of preemption is constant but cannot win WoT if the marginal cost of preemption is increasing.
- In the context of many target countries, an increase in the preemptive measures by one target country exerts a positive externality effect on other target countries.

- When there are two or more target countries, compared to non-cooperation among them, under cooperation at least one country must choose higher level preemptive measures, and the equilibrium level of terror is lower. If target countries are highly dissimilar among one other in terms of the cost-efficiency of counter-terror measures, relatively inefficient target countries may be called upon to scale down their preemptive actions under cooperation than under no cooperation.
- Compared to what is collectively or cooperatively the best for a group of target countries, there will be an ***under-provision of preemptive measures*** when they (non-cooperatively) choose preemption on their own (at the Nash equilibrium).
- Collateral damage induced backlash effects tend to reduce the impact of preemption on the Org's marginal cost function and therefore weaken the effectiveness of preemption as CT measures. However, this does not imply that preemptive measures are ineffective. WoT can still be weakly won if the marginal cost of preemptive measures is constant. Of course, compared to the case of no backlash, a higher level of preemption will be necessary for the purpose. But, if the marginal cost of preemption is increasing—which is more realistic—the backlash argument further diminishes the potency of preemptive measures, on their own, to contain the problem of terrorism.
- In a multiple target country scenario and targeted backlash effects, (a) the preemptive measures chosen by the partner country remaining unchanged, a given target country will use less preemptive actions—because the terror organization becomes more focused on this country, and (b) there is an additional positive externality effect of one country's use of preemption on another target country's welfare or payoff; that is, as a country steps up its preemptive actions, the Org shifts its focus away from other target countries.
- If preemptive strikes reduce infrastructure of areas that are affected by these strikes, it would tend to reduce job opportunities in those areas and encourage participation in terror organization, especially by relatively more skilled workers, thereby improving the quantity and quality of terrorism.

Questions

9.1 How would you differentiate between an exogenous and an endogenous change in terrorism or militancy?

9.2 Which of the following preemption cost functions, $H(m)$, satisfy the assumption of increasing marginal cost and why?

(i) $10 + \sqrt{m}$
(ii) $10 + m^2$
(iii) $10 - 2m + 5m^2$?

9.3 Consider the two-period model in which a terrorist group chooses the level of terror attacks in the current period and the future period. The present value of its resources in the two periods is $340,000. Assuming that all attacks are of the same magnitude in either period, the unit costs of organizing terror attacks (cost per one attack) in the present and future periods are $20,000 and $33,000. The interest rate is 10%. If the Org chooses 5 terror attacks in the current period, how many terror attacks can it plan for the future period?

9.4 Describe in words why preemptive measures may fail to ensure a win in the war on terror if the marginal cost of such measures is increasing.

9.5 In multiple target country preemption game, the damage function for country i ($i = a, b$) is given by

$$D^i = 10 - \ln(m_a + m_b).$$

You may check that this function satisfies the relevant assumptions. Let the preemption cost function be $H^a(m_a) = m_a/100$ for country a and $H^b(m_b) = m_2^b/4000$ for country b.
(a) Derive the Nash solutions, m_a^n and m_b^n, and compare the two.
(b) Set up the cooperative or coalition problem and find the cooperative solutions, m_a^c and m_b^c.
(c) Compare m_a^c with m_a^n, m_b^c with m_b^n, and $m_a^c + m_b^c$ with $m_a^n + m_b^n$, and interpret.

9.6 "Backlash against preemptive actions causing collateral damage may fully neutralize the effect of such measures in degrading terrorist organizations." Defend or refute.