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Terrorism, Trade and Welfare: Some Paradoxes and a Policy Conundrum

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Abstract

We present a standard trade model and show that terrorism can be trade inducing, starting from autarky. In addition, terrorism can be shown to be welfare augmenting for a group of nations. Finally, we present some qualitative conditions that identify when a nation's trade volume may rise (or fall) in response to a greater incidence of terrorism. Our trade and welfare results point to potential difficulties in international coordination of counterterrorism policy because of terrorism's differential impact across nations.

Keywords: Terrorism; Trade; Welfare.

JEL codes: F11, F52, H56

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1. Introduction

A rise in terrorism may be expected to reduce trade and national welfare levels. Nitsch and Schumacher (2004) and Blomberg and Hess (2006), among others, find evidence that terrorism tends to depress trade. Recent empirical literature has shown more ambiguity.[1] On a related vein, Abadie and Gardeazabal (2008) and Bandyopadhyay et al. (2014) show that terrorism can reduce factor endowments by affecting FDI flows, while Bandyopadhyay and Sandler (2014) show that such changes in factor endowments can either raise or reduce trade. None of the existing literature, however, provides an analytical inquiry of international welfare implications of terrorism in a trading environment. Using a standard trade model, we first show that terrorism can be trade inducing where no other reason for trade exists. We then establish that while some nations must lose due to increased terrorism, other nations may actually be better off due to positive terms of trade externalities. For example, if terrorism in a targeted oil-producing nation reduces global oil supplies and raises oil prices, terrorism confers a positive terms of trade benefit to other terror-free, oil-exporting nations. Such differential welfare effects can pose a coordination problem because it may become harder to elicit international cooperation in counterterrorism efforts.[2] Section 2 presents the model and analysis. Section 3 concludes.

2. A Competitive Model of Trade and Terrorism

Consider two goods x_1 (good 1) and x_2 (good 2). Let the production of good 1 be more affected by terrorism than the production of good 2. For example, say, good 1 is a manufactured good, while good 2 is a primary product. The manufacturing sector tends to locate in more visible

[1] See for example, Egger and Gassebner (2015).

[2] In this example, oil importers lose due to adverse terms of trade effects. Therefore, they will not be averse to joining international counterterrorism efforts. It is the non-targeted oil exporters that can make cooperation more difficult.

urban or semi-urban areas attracting more attention from terrorist groups, rendering its production process relatively vulnerable to terrorism. For simplicity, assume that terrorism has no effect on the production of good 2.[3] We represent the aforementioned production environment by the following production function for good 1:

$$x_1 = \phi(T) F^1(L_1, K_1),\ 0 < \phi \leq 1,\ \phi'(T) < 0,\ \phi(0) = 1, \tag{1}$$

where $1-\phi(T)$ is a cost inflicted on good 1 due to the incidence of terrorism T in the nation, such that more terrorism results in a greater fraction of the good being destroyed. $F^1(L_1, K_1)$ is a standard constant returns to scale (CRS) production function in labor and capital. Good 2's production function is:

$$x_2 = F^2(L_2, K_2), \tag{2}$$

which is also a standard CRS production function. Let good 2 be the numeraire good, while the price of good 1 is p_1. If the wage rate is w and the rental rate is r, the first-order conditions for profit maximization of competitive firms in the two sectors require that:

$$p_1 \phi(T) F_L^1(L_1, K_1) = w = F_L^2(L_2, K_2), \tag{3a}$$

$$p_1 \phi(T) F_K^1(L_1, K_1) = r = F_K^2(L_2, K_2). \tag{3b}$$

Eqs. (3a) and (3b) may be written as:

$$P_1 F_L^1(L_1, K_1) = w = F_L^2(L_1, K_1),\ P_1 \equiv p_1 \phi(T) = P_1(p_1, T), \tag{4a}$$

$$P_1 F_K^1(L_1, K_1) = r = F_K^2(L_2, K_2). \tag{4b}$$

Eqs. (4a) and (4b) imply that the value of production of this economy may be represented through the standard revenue function R, which is the envelope function for the following

[3] This assumption is not critical, and can be easily relaxed.

maximization problem (noting that $p_2 = 1$):

$$\text{Maximize } P_1 F^1\left(L_1, K_1\right) + F^2\left(L_2, K_2\right), \text{ subject to } L_1 + L_2 = \bar{L}, \text{ and } K_1 + K_2 = \bar{K}, \tag{5}$$

where $\bar{L}$ and $\bar{K}$ are the national labor and capital endowments, respectively. Suppressing the factor endowments, the envelope function corresponding to Eq. (5) is:

$$R = R\left(P_1, p_2 = 1\right), \text{ where } R_1\left(\cdot\right) = F^1\left(L_1, K_1\right),\ R_2\left(\cdot\right) = F^2\left(L_2, K_2\right). \tag{6}$$

The relative supply of good 1 is:

$$\frac{x_1}{x_2} = \frac{\phi(T) F^1\left(\cdot\right)}{F^2\left(\cdot\right)} = \frac{\phi(T) R_1\left(P_1, 1\right)}{R_2\left(P_1, 1\right)} = \phi(T)\rho\left[P_1\left(p_1, T\right)\right], \text{ where } \rho\left(P_1\right) \equiv \frac{R_1\left(P_1, 1\right)}{R_2\left(P_1, 1\right)}. \tag{7a}$$

Thus, the relative supply of good 1 may be represented as:

$$X\left(p_1, T\right) \equiv \phi(T)\rho\left[P_1\left(p_1, T\right)\right]. \tag{7b}$$

Standard properties like homogeneity of the revenue function of degree one in prices and also convexity in prices imply that $\rho'\left(P_1\right) > 0$. Using Eqs. (4a) and (7b), we have

$$X_{p_1} = \phi^2 \rho'\left(P_1\right) > 0 \text{ and } X_T = \phi'(T)\left[\rho + \phi p_1 \rho'\left(P_1\right)\right] < 0. \tag{8}$$

Eqs. (7b) and (8) yield a relative supply curve for good 1 that is positively sloped and shifts to the left with a greater incidence of terrorism. Given a representative consumer and homothetic preferences, the nation's expenditure function is $E\left(p_1, 1, u\right)$, where u denotes the nation's utility. Using this function, the relative Hicksian demand, *RD*, for good 1 is:

$$\frac{E_1\left(p_1, 1, u\right)}{E_2\left(p_1, 1, u\right)} = \frac{E_1\left(p_1, 1, 1\right)u}{E_2\left(p_1, 1, 1\right)u} = \frac{E_1\left(p_1, 1, 1\right)}{E_2\left(p_1, 1, 1\right)} \equiv RD\left(p_1\right), \tag{9}$$

where $RD'\left(p_1\right) < 0$ from standard concavity properties of the expenditure function.

2.1 Effect of Terrorism on Trade

Consider two nations, *A* and *B*, such that they are identical except for having different potential levels of terrorism. Let the incidence of terrorism in nation *j* be T^j. Given identical preferences and technology between nations, the two nations' demand and supply may be represented by a common functional form. Thus, the autarky equilibria for *A* and *B* are, respectively,

$$X\left(p_1, T^A\right) = RD\left(p_1\right), \tag{10a}$$

$$X\left(p_1, T^B\right) = RD\left(p_1\right). \tag{10b}$$

Proposition 1

Starting from perfect symmetry, a rise in terrorism in one of two terrorism-afflicted nations induces trade. The nation experiencing the rise in terrorism will import the good that is susceptible to terrorism-related production disruptions, and export the other good.

Proof: If $T^A = T^B = \overline{T}$, the two nations are perfectly symmetric, and therefore the autarky prices coincide, leaving no scope for any gains from trade. Now suppose that terrorism in *A* rises above $\overline{T}$, while that in *B* remains the same. In this case, $T^A > T^B$, and $X\left(p_1, T^A\right)$ must be less than $X\left(p_1, T^B\right)$ at any p_1 [see Eq. (8)]. This is shown in Figure 1, where the autarky price of good 1 in nation *A* must exceed the corresponding price in nation *B*. Thus, after the rise in terrorism there is reason to trade, and nation *A* will export good 2 and import good 1.

Comment: When terrorism in *A* rises, it disproportionately affects the production of good 1 relative to good 2. This fall in the relative supply of good 1 raises the autarky price of good 1 in

A above that in *B*. This price difference leads to trade, which means that terrorism is trade inducing in this environment.

2.2 The Trading Equilibrium

Under free trade, the market-clearing condition for good 1 is:

$$\phi\left(T^A\right)R_1\left[P_1\left(p_1,T^A\right),1\right]+\phi\left(T^B\right)R_1\left[P_1\left(p_1,T^B\right),1\right]=E_1\left(p_1,1,u^A\right)\quad E_1\left(p_1,1,u^B\right), \tag{11}$$

where u^A and u^B are the respective utility levels in the two nations. Let exp_i^j be the net export of good i (i=1,2) of nation j, which is represented by the difference between the nation's supply and demand of good i. Accordingly, we have:

$$exp_1^j=\phi\left(T^j\right)R_1\left[P_1\left(p_1,T^j\right),1\right]\quad E_1\left(p_1 1,u^j\right), \tag{12a}$$

$$exp_2^j=R_2\left[P_1\left(p_1,T^j\right),1\right]\quad E_2\left(p_1 1,u^j\right). \tag{12b}$$

If nation j is an exporter (importer) of good i, then exp_i^j is positive (negative). Now, the trade balance condition for each nation requires that

$$E\left(p_1,1,u^j\right)=R\left[P_1\left(p_1,T^j\right),1\right],\ j=A,B. \tag{13a}$$

Under homotheticity, we can express (13a) as:

$$u^j=\frac{R\left[P_1\left(p_1,T^j\right),1\right]}{E\left(p_1,1,1\right)}\quad u^j\left(p_1,T^j\right),\ u_{p_1}^j=\frac{exp_1^j}{E\left(p_1,1,1\right)}>0,\ \text{iff}\ exp_1^j>0,\ \text{and,}$$

$$u_{T^j}^j=\frac{p_1R_1\left[P_1\left(p_1,T^j\right),1\right]\phi'\left(T^j\right)}{E\left(p_1,1,1\right)}\quad 0,\ j=A,B. \tag{13b}$$

When Eqs. (13a)-(13b) are substituted into (11), the market-clearing price of good 1 is implicitly defined as:

$$p_1 = p_1\left(T^A, T^B\right),\ \frac{\partial p_1}{\partial T^j} > 0,\ \ j = A, B.^4 \tag{14}$$

Therefore, a rise in terrorism in any of the nations must improve the terms of trade of the nation exporting good 1. Let us now assume that *A* is the relatively terror-prone nation, such that $T^A > T^B$. In the light of Proposition 1, this implies that *A* imports good 1 from *B*, while *A* exports good 2 to *B*.

Proposition 2

A rise in terrorism in either of two trading nations must reduce the relatively terror-prone nation's (i.e., *A*) welfare. The relatively terror-free nation (i.e., *B*) gains when terrorism rises in *A*, but may lose when terrorism rises in its homeland.

Proof:

Using Eqs. (13a), (13b), and (14), and noting that *A* is an importer of good 1 (i.e., $exp_1^A < 0 \Rightarrow u_{p_1}^A < 0$), we have that *A*'s welfare change, with respect to increases in terrorism in *A* and *B*, respectively, may be written as:

$$\frac{\partial u^A}{\partial T^A} = u_{p_1}^A \frac{\partial p_1}{\partial T^A} + u_{T^A}^A < 0;\ \text{and}\ \frac{\partial u^A}{\partial T^B} = u_{p_1}^A \frac{\partial p_1}{\partial T^B} < 0. \tag{15a}$$

Thus, regardless of whether terrorism rises in *A* or *B*, *A*'s welfare necessarily falls. Noting that *B* is the exporter of good 1 ($exp_1^B > 0 \Rightarrow u_{p_1}^B > 0$), we have:

$$\frac{\partial u^B}{\partial T^A} = u_{p_1}^B \frac{\partial p_1}{\partial T^A} > 0,\ \text{and}\ \frac{\partial u^B}{\partial T^B} = u_{p_1}^B \frac{\partial p_1}{\partial T^B} + u_{T^B}^B > 0\ \text{iff}\ u_{p_1}^B \frac{\partial p_1}{\partial T^B} > \left|u_{T^B}^B\right|. \tag{15b}$$

[4] Proof is available on request.

Thus, *B* necessarily gains when there is more terrorism in *A*, but it may gain or lose when it suffers more terrorism at home.

Comment: A rise in terrorism in *A* adversely affects *A* in two ways. First, there is the direct loss in income due to terror attacks at given terms of trade. Second, *A* suffers from a rise in its import price due to a fall in the supply of the terror-susceptible good. Nation *B*, however, must gain when terrorism rises in *A*, because it suffers no direct loss, while at the same time enjoying a terms of trade benefit as the price of good 1 (its export good) rises. Following similar logic, we can conclude that if, instead, *B* were to experience a rise in terrorism, it will have conflicting direct and terms of trade effects, rendering its aggregate welfare effect ambiguous. However, even in this case, *A* must lose, because the only effect on it is an adverse terms of trade effect.

2.3 Multicountry Analysis

The previous analysis can be easily extended to a multicountry context. If nations are indexed by *A*, *B*, *C*,.., the equation corresponding to Eq. (14) is:

$$p_1 = p_1\left(T^A, T^B, T^C, ...\right),\ \frac{\partial p_1}{\partial T^j} > 0,\ \ j = A, B, \mathrm{C}, \ldots \tag{16}$$

Following Proposition 1, the nation with the highest (lowest) terror index must be an importer (exporter) of good 1. Nations in between these two extremes may either be exporters or importers of good 1.

2.4 Small Open Economy Equilibrium and Volume of Trade

For a sufficiently large number of relatively symmetric nations (except for some differences in their terrorism levels), we can assume that each nation is "small" in the sense that the

international terms of trade is not affected by a rise in terrorism in that nation alone. In this case, results of the previous subsections continue to hold, with the caveat that $\frac{\partial p_1}{\partial T^j} = 0$. Trade balance for nation *j* requires that the sum of the value of its net exports equal zero, so that

$$exp_2^j = p_1 exp_1^j \quad p_1 imp_1^j, \tag{17}$$

where imp_i^j is the volume of net import of good *i* for nation *j*. Given p_1, we can use either exp_2^j or imp_1^j as a measure of the volume of trade. Now,

$$exp_2^j = R_2\left[P_1\left(p_1, T^j\right), 1\right] \quad E_2\left[p_1, 1, u^j\left(p_1, T^j\right)\right]. \tag{18}$$

Differentiating (18) and using Eqs. (1b) and (13b), we get:

$$\frac{dexp_2^j}{dT^j} = R_{21} p_1 \phi'\left(T^j\right) - E_2\left(p_1, 1, 1\right) u_{T^j}^j > 0, \text{ because } R_{21} < 0.^5 \tag{19}$$

Proposition 3

If the nation experiencing more terror is a net exporter of good 2, then its trade volume will increase. If it is a net importer, its trade volume will decrease.

Proof:

If *j* is a net exporter of good 2, $exp_2^j > 0$, then $\frac{dexp_2^j}{dT^j} > 0$ so that its exports of good 2 and hence its imports of good 1 both must rise. If, on the other hand, it is a net importer, then $exp_2^j = imp_2^j \quad 0$, and $\frac{dexp_2^j}{dT^j} > 0 \Rightarrow \frac{dimp_2^j}{dT^j} < 0$. The last inequality establishes the second part of the proposition.

[5] Convexity and homoegeneity properties of the revenue function ensure that $R_{21} < 0$.

Comment: Terror disproportionately hurts good 1, so that more resources flow to good 2. An increase in production of good 2, coupled with a fall in demand for good 2 due to income losses, augment the export of good 2. If good 2 is an import good, a rise in its production and a fall in its demand reduce imports, shrinking the volume of trade.

3. Conclusion

The paper establishes that terrorism may have surprising effects on trade flows and welfare of trading nations. Among other results, we show that welfare effects of terrorism differ between different trading nations, some of which may actually gain from terrorism. These effects can make international coordination in counterterrorism policy more difficult to achieve.

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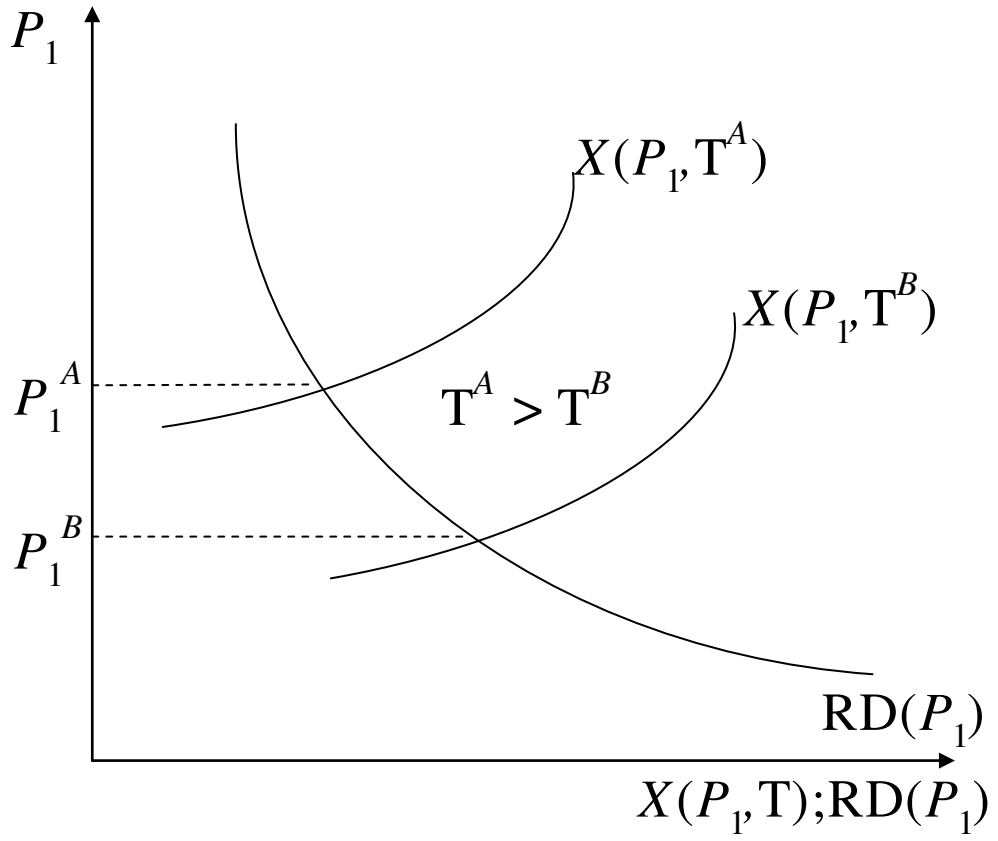
Figure 1


P_1
$X(P_1, \mathrm{T}^A)$
$X(P_1, \mathrm{T}^B)$
P_1^A
$\mathrm{T}^A > \mathrm{T}^B$
P_1^B
$\mathrm{RD}(P_1)$
$X(P_1, \mathrm{T}); \mathrm{RD}(P_1)$