

# Terrorism, Trade, and Welfare

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For a standard competitive trade model, the authors show that the incidence of terrorism in different nations can affect the pattern of trade. Nations with a greater incidence of terrorism will export goods that are more immune to terrorism-related disruptions, while importing more terrorism-impacted goods. In addition, terrorism can be welfare augmenting for some nations because of terms-of-trade externalities. Finally, the authors present some qualitative conditions that identify when a nation's trade volume may rise (or fall) in response to a greater incidence of terrorism. Given the differential impact across nations, these trade and welfare results point to potential difficulties in international coordination of counterterrorism policy. (JEL F11, F52, H56)

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## 1 INTRODUCTION

Terrorism is the premeditated use of or threat to use violence by individuals or subnational groups to obtain a political or social objective through the intimidation of a large audience beyond that of the immediate victims (Enders and Sandler, 2012). Civil wars or internal conflicts may, but need not, involve terrorism as a tactic (Sambanis, 2008). Moreover, terrorism typically occurs in the absence of a civil war—e.g., terrorism campaigns by the Italian Red Brigade, Direct Action, and the Red Army Faction in the 1970s and 1980s. Civil wars kill many more people than terrorism, which usually involves relatively few deaths and injuries each year.<sup>1</sup> To be classified as a civil war, a death threshold of at least 1,000 must be reached, while there is no such threshold for terrorism. Civil wars and interstate wars are shown to have much larger economic impacts than terrorism because these wars destroy much more infrastructure, capital, and lives. Empirical studies by Blomberg, Hess, and Orphanides (2004) and Gaibullov and Sandler (2009, 2011) indicate that internal and external wars have a much greater impact on per capita income growth and other macroeconomic aggregates for samples that include the world, Asia, and Africa.<sup>2</sup> In a recent study, Gaibullov and Younas (2016)

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find that civil wars, unlike terrorism, have a robust negative impact on domestic bank lending, which funds investment and development in developing countries.

In contrast to civil wars, terrorism is usually more sector specific, aimed at tourism, the export sector, or foreign direct investment (FDI) (Sandler and Enders, 2008). Many of these sectors also tend to be more capital intensive than other sectors so that terrorism does not impact all productive factors equally. This sector specificity of terrorism arises, among other reasons, from the publicity that terrorist organizations seek for their attacks. This publicity helps these organizations advertise their strength and recruit sympathetic individuals who share their grievances. If a terrorist organization kills two people working in a sugar plantation in India, the attack is unlikely to garner a lot of international press. On the other hand, if two American tourists perish in an attack at an Indian hotel, the terrorist incident will likely lead to a lot of press coverage—both nationally and internationally. This attention is what the terrorist organization seeks, raising the potential value to them of sectors such as tourism. Similarly, multinational firms employing citizens of different nationalities in their plants or dealerships will be relatively high-value targets. This terrorist asymmetric targeting of different productive sectors of an economy differentiates terrorism from less-targeted disruptions such as the current Syrian civil war, which makes all productive sectors vulnerable. When certain sectors are impacted more than other sectors of an economy, this targeting strategy changes the pattern of general equilibrium production and consumption. The resulting asymmetric effects on the nation's relative supply and demand of different goods (and services) will affect the nation's pattern of trade. A recent paper by Bandyopadhyay, Sandler, and Younas (2016) addresses some of these issues by building a heterogeneous-firm, monopolistic-competitive model of trade. These authors estimate the theoretical implications of their analysis by considering the effects of terrorism on trade using a sample of 151 nations. They find that terrorism tends to affect different sectors unevenly, with the greatest harm being experienced by manufacturing, compared with primary (non-manufactured) goods. Within manufacturing, they find that effects of terrorism are more damaging to high-skilled production than low-skilled production. These asymmetric effects on different sectors are also critical to the competitive model of trade that we present in this paper.

Recent high-profile terrorism attacks in France, Turkey, Belgium, Germany, and elsewhere indicate how terrorism remains a security concern that must be addressed worldwide. This threat raises questions about its economic implications, not only within a targeted nation, but also among trading partners. For the latter, terrorism may affect trade and welfare in ways that transcend the immediate loss of life and property. After the World Trade Center attacks on 9/11, terrorism-related threats have come under greater scrutiny in terms of U.S. policy. Beyond the immediate loss of life and property, there are longer-term economic consequences stemming from terrorist attacks. For example, if a country is perceived as particularly vulnerable to such attacks, foreign investors are more likely to shy away from investing in that country (Enders and Sandler, 1996); in turn, this can reduce the country's FDI, with a concomitant drop in employment opportunities. Abadie and Gardeazabal (2008), Enders, Sachsida, and Sandler (2006), and others find that terrorism can cause substantial reductions in FDI for a terrorism-afflicted nation. This FDI reduction may stem from higher risks or an FDI diversion

to safer venues abroad. Terrorism can also divert government expenditures toward security activities, which may compromise other important allocations such as expenditures on a nation's infrastructure. In turn, this can affect a country's economic growth as well as its exports and imports (see Blomberg, Hess, and Orphanides, 2004; Blomberg and Hess, 2006).

Terrorism can impact international trade through various channels. For instance, it can increase the costs of transportation by raising insurance premiums for goods shipped to higher-risk nations. In turn, such higher costs augment prices of imported goods, working effectively as import tariffs to reduce trade. Terrorism can also lead to destruction of productive capacity of certain sectors of an economy, making these sectors more reliant on imports, which has the counterintuitive implication that terrorism may actually increase trade. Empirical works such as Nitsch and Schumacher (2004), Blomberg and Hess (2006), and Mirza and Verdier (2014), among others, find evidence that terrorism tends to depress trade. A recent empirical article finds that transnational terrorist attacks had virtually no short-run impact on trade.<sup>3</sup> This null finding suggests that the effect of terrorism on trade may be driven by factors other than transaction costs. The absence of a trade effect may be reconciled when one recognizes that terrorism can destroy capital or labor endowments unevenly in targeted sectors, thereby twisting the production possibility frontier and impacting the pattern of trade. For example, Abadie and Gardeazabal (2008) and Bandyopadhyay, Sandler, and Younas (2014) show that terrorism can reduce capital stocks by reducing FDI flows, while Bandyopadhyay and Sandler (2014b) show that such changes in factor endowments can either increase or decrease trade. The current paper differs from Bandyopadhyay and Sandler (2014b) in a few ways. First, the current paper does not use factor abundance in a Heckscher-Ohlin model to investigate terrorism-induced trade changes. Terrorism is now viewed as sector specific rather than factor specific. Second, we now abandon the small-country assumption so that there can be terrorism-induced changes to the terms of trade. Third, unlike Bandyopadhyay and Sandler (2014b), the current paper allows welfare effects that do not have to be negative in light of terrorism—i.e., there may be gainers and losers.

The existing literature, however, does not provide an analytical inquiry of international welfare implications of terrorism in a trading environment. Using a standard competitive trade model, we first identify how terrorism may affect trade patterns. Next, we show that, while some nations must lose due to increased terrorism, other nations may actually be better off due to positive terms-of-trade externalities. Finally, we provide a qualitative condition under which terrorism increases trade. Section 2 presents the model and analysis, and Section 3 contains concluding remarks.

## 2 A COMPETITIVE MODEL OF TRADE AND TERRORISM

Let us consider a world economy with two nations, *A* and *B*. Perfectly competitive firms in each of these nations produce homogeneous goods,  $x_1$  (good 1) and  $x_2$  (good 2).<sup>4</sup> Moreover, both of these nations may be subjected to terrorist attacks that disrupt the production process. For simplicity of exposition, we make some assumptions that are not critical to our main points. First, we assume that terrorist attacks are exogenous in the sense that we do not model

their supply, nor do we consider how counterterrorism policies may reduce their impact. Second, the only impact that we consider here is on the production process.<sup>5</sup> Finally, we assume that the production of good 1 is adversely influenced by terrorism, while good 2 is immune to it.<sup>6</sup> For example, say good 1 is a manufactured good, while good 2 is a non-manufactured primary product. The manufacturing sector tends to locate in more visible urban or semi-urban areas that attract more attention from terrorist groups, thereby rendering its production process relatively more vulnerable to terrorism.<sup>7</sup> Both goods are produced using labor and capital, for which  $w$  and  $r$  are their respective factor prices. Firms in sector 1 use labor ( $L_1$ ) and capital ( $K_1$ ) to produce output  $x_1$  with a constant returns to scale (CRS) technology,  $F^1(L_1, K_1)$ . A fraction  $1 - \phi(T)$  of output of good 1 is lost due to terrorism-related disruptions, indexed by  $T$ , such that

$$(1) \quad x_1 = \phi(T)F^1(L_1, K_1), 0 < \phi \leq 1, \phi'(T) < 0, \phi(0) = 1.$$

In equation (1),  $\phi'(T) < 0$  implies that more terrorism results in a greater fraction of the good being destroyed.<sup>8</sup> Good 2 is not affected by terrorism; so, denoting labor and capital use in sector 2 by  $L_2$  and  $K_2$ , respectively, we have

$$(2) \quad x_2 = F^2(L_2, K_2),$$

where  $F^2(L_2, K_2)$  is a standard CRS production function. We do not need to make any particular factor intensity assumptions for the purpose of this paper, except that the two sectors have different capital-to-labor ratios.

Let good 2 be the numeraire good, while the price of good 1 is  $p_1$ . The first-order conditions for profit maximization of competitive firms in the two sectors yield the familiar equalities between factor prices and the respective values of marginal products<sup>9</sup>:

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

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

These equations may be written, respectively, as

$$(4a) \quad P_1 F_L^1(L_1, K_1) = w = F_L^2(L_2, K_2), P_1 \equiv p_1\phi(T) = P_1(p_1, T),$$

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

Equations (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 maximization problem (noting that  $p_2 = 1$ )<sup>10</sup>:

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

where  $\bar{L}$  and  $\bar{K}$  are the national labor and capital endowments, respectively. If we suppress factor endowments, the revenue function corresponding to equation (5) and its partial derivatives with respect to output prices are

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

Note from equation (6) that while  $R_2(\cdot)$  yields the supply of good 2,  $R_1(\cdot)$  is the supply of good 1 before the fraction  $1 - \phi$  of the good is lost to terrorism-related damages. Accordingly, the actual terrorism-depleted relative supply of good 1 in terms of good 2 may be represented as

$$(7) \quad \frac{x_1}{x_2} = \frac{\phi(T)F^1(\cdot)}{F^2(\cdot)} = \frac{\phi(T)R_1(P_1, 1)}{R_2(P_1, 1)} = \phi(T)\rho[P_1(p_1, T)] \equiv X(p_1, T),$$

where  $\rho(P_1) \equiv \frac{R_1(P_1, 1)}{R_2(P_1, 1)}$ . Standard properties like homogeneity of the revenue function of degree one in prices and also convexity of the revenue function in prices imply that  $\rho'(P_1) > 0$ . Using equations (4a) and (7), we have

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

Equations (7) 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.

We characterize the demand side by assuming a nation's preferences can be captured by a representative consumer with homothetic preferences. Consumption expenditure minimization by this consumer, at a price vector  $(p_1, p_2 = 1)$  to achieve a certain utility level  $u$ , yields the consumer's expenditure function,  $E(p_1, 1, u)$ . Standard properties of an expenditure function yield the Hicksian demand function for good  $i$  as  $E_i(p_1, 1, u)$ . Given that monotonic transformations preserve ranking, there is no loss in generality if we use a homogeneous of degree one utility function for the representative consumer to denote its homothetic preferences. This expenditure function can be expressed as  $E(p_1, 1, 1)u$ . Accordingly, the relative Hicksian demand for good 1,  $RD$ , can be written as

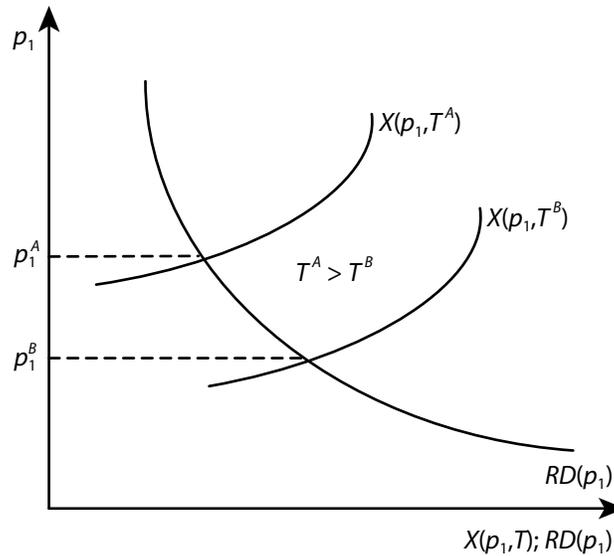
$$(9) \quad \frac{E_1(p_1, 1, u)}{E_2(p_1, 1, u)} = \frac{E_1(p_1, 1, 1)u}{E_2(p_1, 1, 1)u} = \frac{E_1(p_1, 1, 1)}{E_2(p_1, 1, 1)} = RD(p_1),$$

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

### 2.1 Effect of Terrorism on Trade

Let us assume that the two nations,  $A$  and  $B$ , are identical in all respects except for having different potential levels of terrorism. This is a reasonable assumption since nations are targeted differently owing to their foreign policy, their location, their counterterrorism actions, and their vulnerabilities (Enders and Sandler, 2006; Savun and Phillips, 2009). Let the incidence of terrorism in nation  $j$  be  $T^j$ . Given identical preferences and technology, the two nations share the same functional forms for relative demand and the relative supply of good 1.

**Figure 1**  
**Effect of Terrorism on Autarky Prices**



In autarky, each nation's relative demand for good 1 has to match its relative supply of good 1; hence, we have

$$(10a) \quad X(p_1, T^A) = RD(p_1) \text{ and}$$

$$(10b) \quad X(p_1, T^B) = RD(p_1).$$

**Proposition 1**

The nation experiencing more terrorism imports the terrorism-susceptible good and exports the terrorism-immune good.

**Proof:** If  $T^A > T^B$ , then  $X(p_1, T^A)$  must be less than  $X(p_1, T^B)$  at any  $p_1$  (see equation (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. This establishes that the nation less impacted by terrorism has a comparative advantage in producing good 1, the terrorism-susceptible good. Consequently, this less-impacted nation will export good 1 and import the terrorism-immune good 2. ■

**Comment:** Greater incidence of terrorism in country A causes greater disruptions in the production of good 1, thus shrinking its relative supply of good 1 to a greater extent than in nation B. Given identical relative demand in the two nations, the relative scarcity of the good in nation A makes the good more expensive in A, compared with B under autarky. In turn, under free trade, the nations can enjoy gains from trade when nation A exports good 2 and imports good 1.

## 2.2 The Trading Equilibrium

Under free trade, the global supply of good 1 must equal the global demand for good 1 at the market-clearing equilibrium price. By Walras's law, the market for good 2 also clears at this equilibrium price. Note that the supply of good 1 in nation  $j$  is  $\phi(T^j)R_1[P_1(p_1, T^j), 1]$ , while at a utility level  $u^j$ , its demand for good 1 is  $E_1(p_1, 1, u^j)$ . Thus, aggregating the demand and supply in the two nations gives the market-clearing condition for good 1 under free trade as

$$(11) \quad \phi(T^A)R_1[P_1(p_1, T^A), 1] + \phi(T^B)R_1[P_1(p_1, T^B), 1] = E_1(p_1, 1, u^A) + E_1(p_1, 1, u^B).$$

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

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

$$(12b) \quad exp_2^j = R_2[P_1(p_1, T^j), 1] - E_2(p_1, 1, u^j).$$

If nation  $j$  is an exporter (importer) of good  $i$ , then  $exp_i^j$  is positive (negative). Now, each nation's consumption spending must equal its production revenues.<sup>11</sup> Thus,

$$(13a) \quad E(p_1, 1, u^j) = R[P_1(p_1, T^j), 1], \quad j = A, B.$$

Recalling that  $E(p_1, 1, u) = E(p_1, 1, 1)u$ , we can express equation (13a) as

$$(13b) \quad u^j = \frac{R[P_1(p_1, T^j), 1]}{E(p_1, 1, 1)} = u^j(p_1, T^j), \quad u_{p_1}^j = \frac{exp_1^j}{E(p_1, 1, 1)} > 0, \text{ if and only if } exp_1^j > 0, \text{ and}$$

$$u_{T^j}^j = \frac{p_1 R_1[P_1(p_1, T^j), 1] \phi'(T^j)}{E(p_1, 1, 1)} < 0, \quad j = A, B.$$

The term  $u_{p_1}^j$  is positive if and only if nation  $j$  is an exporter of good 1 because, *ceteris paribus*, a rise in the price of good 1 is a terms-of-trade gain (loss) for nation  $j$  if it is an exporter (importer) of good 1. On the other hand,  $u_{T^j}^j$  is unambiguously negative because either nation, *ceteris paribus*, loses productive capacity when the incidence of terrorism rises in that nation.

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

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

The proof for equation (14) follows standard methods and is available on request. If the international equilibrium is stable in the sense that the price of good 1 must rise whenever its global demand exceeds its global supply, then a terrorism-induced reduction in the supply of good 1 in either of the two nations must raise the world price of good 1. In turn, this implies that terrorism, regardless of its location, must improve the terms of trade of the nation exporting good 1.

**Proposition 2**

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

**Proof:** Using equations (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

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

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

$$(15b) \quad \frac{\partial u^B}{\partial T^A} = u_{p_1}^B \frac{\partial p_1}{\partial T^A} > 0 \text{ and } \frac{\partial u^B}{\partial T^B} = u_{p_1}^B \frac{\partial p_1}{\partial T^B} + u_{T^B}^B > 0 \text{ if and only if } u_{p_1}^B \frac{\partial p_1}{\partial T^B} > |u_{T^B}^B|.$$

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

**Comment:** A rise in terrorism in nation *A* adversely affects its well-being in two ways. First, there is the direct loss in income due to terrorist attacks at given terms of trade. Second, nation *A* suffers from a rise in its import price due to a fall in the supply of the terrorism-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* experiences 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, nation *A* will suffer welfare loss because its only consequence 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 equation (14) is

$$(16) \quad p_1 = p_1(T^A, T^B, T^C, \dots), \frac{\partial p_1}{\partial T^j} > 0, j = A, B, C, \dots$$

Following Proposition 1, the nation with the highest (lowest) terrorism 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 are 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  $\frac{\partial p_1}{\partial T^j} = 0$ . The trade balance for nation  $j$  requires that the sum of the value of its net exports equals zero, so that

$$(17) \quad \exp_2^j = -p_1 \exp_1^j = p_1 \text{imp}_1^j,$$

where  $\text{imp}_i^j$  is the volume of net import of good  $i$  for nation  $j$ . Given  $p_1$ , we can use either  $\exp_2^j$  or  $\text{imp}_1^j$  as a measure of the volume of trade. Now, the following holds:

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

**Proposition 3**

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

**Proof:** Differentiating equation (18) and using equations (4a) and (13b), we get

$$(19) \quad \frac{d\exp_2^j}{dT^j} = R_{21} p_1 \phi'(T^j) - E_2(p_1, 1, 1) u_{T^j}^j > 0, \text{ because } R_{21} < 0. \text{ }^{12}$$

If  $j$  is a net exporter of good 2,  $\exp_2^j > 0$ , then  $\frac{d\exp_2^j}{dT^j} > 0$  so that its exports of good 2 and, hence, its imports of good 1 must both rise. If, however, it is a net importer of good 2, then  $\exp_2^j = -\text{imp}_2^j < 0$  and  $\frac{d\exp_2^j}{dT^j} > 0 \Rightarrow \frac{d\text{imp}_2^j}{dT^j} < 0$ . The last inequality establishes the second part of the proposition. ■

**Comment:** The first term on the right-hand side of equation (19) is the increase in nation  $j$ 's supply of good 2 when terrorism reduces net returns in  $j$ 's sector 1 and causes a resource inflow to its sector 2. The second term is the reduction in  $j$ 's demand for good 2 through the income effect as income falls from terrorism-related damages to  $j$ 's productive capacity. The rise in production of good 2 and the fall in its demand must increase  $j$ 's net export of good 2 when this country experiences more terrorism. Consequently, if nation  $j$  is an exporter of good 2, terrorism raises its exports and the volume of trade rises. But, if it is an importer of good 2, the rise in good 2's production and fall in the good's demand must reduce import demand. In this case, terrorism reduces  $j$ 's trade volume.

### 3 CONCLUDING REMARKS

The paper establishes a Heckscher-Ohlin-type result that nations that are more susceptible to terrorism are likely to import goods that are more subject to terrorism-related disruptions and to export other goods. This insight also suggests that there is no reason to believe that terrorism necessarily reduces trade. While higher trading costs tend to reduce trade, changes in production patterns, as well as incomes of nations, can lead to general-equilibrium reallocations that can raise trade. Therefore, whether terrorism reduces or raises trade is a context-specific issue.

Our welfare analysis shows that, while terrorism is necessarily welfare reducing for a nation that imports the greater terrorism-impacted good, the exporting nation may or may not be worse off because of potential gains from trade. If, indeed, a nation does not directly suffer from terrorist attacks, then it must gain (lose) due to terms-of-trade effects of terrorism if it is an exporter (importer) of the terrorism-disrupted good. In turn, this may make international coordination in counterterrorism policies more difficult to achieve because nations that gain from terrorism will have no incentive to participate in such an international coalition. This is discouraging because international coordination has been difficult to achieve under the best of circumstances as nations are reluctant to coordinate on security measures that could jeopardize their autonomy (Enders and Sandler, 2012, Chapter 6). ■

## NOTES

- <sup>1</sup> Transnational terrorist incidents are associated with just over one death per incident on average, and there are from 200 to 500 such incidents a year (Enders and Sandler, 2012). Of course, the four hijackings on September 11, 2001 (henceforth 9/11) is an exception with close to 3,000 fatalities. The relatively few high-profile incidents in the recent news give a misleading impression of death and destruction.
- <sup>2</sup> These studies directly compare the economic impacts of wars and terrorism. To our knowledge, there are no studies that contrast the economic effect of terrorism with that of crime, the latter of which is not politically motivated. Obviously, crime is far more prevalent in societies than terrorism. Crime is often motivated by personal economic gain, and in these cases will be opportunistically targeted at less-protected individuals or property for maximal economic benefits. Terrorism is usually motivated by ideologies and targeted at nations, authorities, and individuals opposed to that ideology. So, if the symbolic or advertisement value of a terrorist attack is large, it may be optimal to engage in it, even when there are small odds of success and only modest economic damage is inflicted. Accordingly, airports or public buildings are more vulnerable to terrorism, while less-protected urban areas in the United States are more vulnerable to crime.
- <sup>3</sup> See Egger and Gassebner (2015), who find no terrorism impact within 1.5 years of an attack.
- <sup>4</sup> Until Section 2.1, we do not need to distinguish between the two nations because the same model applies to both.
- <sup>5</sup> Terrorism is a multi-faceted issue that may affect both producers and consumers. Its incidence is also generally endogenous to a nation's policymakers through proactive counterterrorism policies against the perpetrators or through defensive counterterrorism policies. The latter policies reduce the damage from attacks or deflect such attacks abroad. In economics and political science, there is a large and emerging literature on this topic. See Enders and Sandler (2012), who offer a comprehensive discussion of the literature. For an explicit treatment of counterterrorism policies and their impact on decisionmaking by a terrorist organization, see, e.g., Bandyopadhyay and Sandler (2014a).
- <sup>6</sup> This assumption is not critical and can be easily relaxed. All that is required to establish the results that follow is that sector 1 is more vulnerable to terrorism compared with sector 2, such that the supply of good 1 relative to the supply of good 2 is negatively impacted by terrorism.
- <sup>7</sup> As discussed earlier, terrorists typically tend to target more-prominent urban areas to achieve maximum publicity for their attacks. Relatively urban and industrial sectors are higher-value targets compared with rural agricultural areas. Indeed, Bandyopadhyay, Sandler, and Younas (2016) find that terrorism has more severe negative effects on trade in manufactured goods compared with primary products.
- <sup>8</sup> This is a particular conceptualization of how terrorism-related production disruptions may be manifested, where one of the two goods is more susceptible to such disruptions. One interpretation is that factors are used to produce a unit of output, part of which is damaged or lost before being sold to a consumer. An alternative characterization is that labor and capital become proportionally less productive due to terrorism, such that each unit of labor and capital effectively becomes  $\phi (< 1)$  units. Because of constant returns to scale, this yields the same production function as described in equation (1).

- <sup>9</sup> When we use subscripts in function notations, they refer to partial derivatives with respect to the respective argument of the function.
- <sup>10</sup> For details on the properties of revenue functions used in trade theory, see Dixit and Norman (1980).
- <sup>11</sup> This is equivalent to assuming trade is balanced in the sense that, at the world equilibrium price, the value of exports of both nations equals the value of their imports.
- <sup>12</sup> Convexity and homogeneity properties of the revenue function ensure that  $R_{21} < 0$ .

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