

Terrorism and Trade: Does the Neighbor Hurt?

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Abstract

In this paper, we study the impact of transnational terrorism diffusion on security and trade. We set a simple theoretical model predicting that the closer a country to a source of terrorism, the higher the negative spillovers on its trade. The idea is that security measures, which impede trade, are directed both against the source country of terror and its neighbor countries where terrorism may diffuse. We also demonstrate that in contrast countries located far from terror could benefit from an increase in security by trading more. Taken to the test, we empirically document these predictions. We find (1) a direct negative impact of transnational terrorism on trade; (2) an indirect negative impact emanating from terrorism of neighbor countries; and (3) that trade is increasing with remoteness to terror. These results are robust to various definitions of the neighborhood (ie. adjacent, linguistic, religious and geographical).

Keywords: Terrorism, trade, security.

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1 Introduction

In the last two decades, many terrorist organizations, like Al-Qaeda or the Taliban, have been extending their network beyond their original territory. They attend countries that are sometimes located thousands of miles away. As an example, Al-Qaeda recently extended its network in North Africa. Thus, the Salafist Group for Preaching and Combat (SGPC) in Algeria and the Libyan Islamic Fighting Group in Lybia have decided to join the Al-Qaeda network in the name of a global Jihad. The

SGPC has even changed his name to ‘Al-Qaeda in the Islamic Maghreb’, announcing its willingness to extend its activities to the rest of the Maghreb countries [see Steinberg and Werenfels (2007)].

International links among terrorist groups have not been limited to the Arab World, however. In order to gain visibility and logistical support, local groups in Non-Arab countries are increasingly being linked to the Al-Qaeda network. For instance, Chechen groups are known to be closely linked to Al-Qaeda.¹ Muslim’s groups in the Philippines, such as that of Abu Sayyaf, are also being part of the network. Very recently, an Uzbek group, a sort of joint venture of Al-Qaeda and the Taliban, has expanded its activities across borders to reach Turkey where a new terrorist cell, the Islamic Jihad Union, is now being active. The Turkish cell’s aim is to recruit nationals and emigrants in other European countries for Al-Qaeda’s global Jihad [see Steinberg (2008)].

In this paper, we study the impact of the spatial diffusion of transnational terrorism on security measures and international trade. As terrorist threats become global, so are the security measures designed at the borders. For instance, the Homeland Security Bill voted by the American congress will impose by 2012 100% scanning of containers in foreign ports bound to the US. This global measure is supposed to affect all exporting countries to the US alike. However, some of the global measures taken by the US following 9/11 might distort relative costs of trade. In particular, the Customs Trade Partnership Against Terrorism (C-TPAT) and Container Security Initiative (CSI) have been implemented to insure faster customs clearing at the US entry for safer companies. But safer companies are those which can bear the additional fixed cost to comply with these measures. These firms are more usually found in developed countries rather than in developing countries.

Other more targeted measures, directed against particular countries, are also at work. For instance, the differences in the number of nonimmigrant visa issuance after 9/11 reveal distortive measures of security. In 2002, almost all of the countries experienced reductions in visa allowances but some communities have been clearly

¹See Weisman’s article in the New York Times (March 2003).

more affected than others [Cainkar (2004)].² Moreover, the US State Department's country reports, made publicly available, about the risk of traveling abroad reveal different beliefs of US authorities on the degree of threat in a particular country or region of the world.³ The latest figures in US authorities' view tend to support the idea that, countries hosting terrorist organizations or their cells, should be watched more carefully. Security measures might thus create a distortion against these countries ending-up in less trade with the United States.

This paper is the first to our knowledge that examines the interplay between security policy, terrorist network formation and international trade. Many papers have been written on the relationships between trade and terrorism [see Mirza and Verdier (2008) for a survey]. Less papers have been investigating the relationship to security *per se*. Though not directly related to terrorism, Anderson and Marcouiller (1997) and (2002) focus on the impact of insecurity on trade. In a former paper, Mirza and Verdier (2006) account theoretically and empirically on the endogeneity between security, trade and terrorism. But they view terrorism threat as being confined in one source country at a time. This paper allows instead for terrorist organization to diffuse across countries.

We set a simple theoretical model of endogenous spatial diffusion of transnational terrorism and security, embedded into a standard trade model. First, we model the interaction between security authorities and terrorist organizations. On the one hand, the 'headquarter' of a terrorist organization in a country, say 0, can settle a terrorist cell in a potential source country of terrorism. From this cell it can attack the interests of a third country, say U. The ability to settle a cell abroad depends on fixed costs that are increasing with distance to the headquarter. On the other hand, authorities of country U draw expectations on the efficiency of the terrorist organization. They set optimal security measures against potential source countries of terrorism where harmful cells can be settled. From this game, we obtain that

²On average, Europeans and Asians experienced a 15- and 23-percent decrease, respectively. The figures are much higher for Muslim countries with a 40-percent decrease and large variance: from a tiny 1% drop for Eritrea to - 67% for Saudi Arabia.

³These reports are country specific. For every country in the world, information on security, safety and crimes are released to inform US citizens about the degree of threat. See <http://travel.state.gov/travel/>. However, a closer look at these reports reveal that the recommendations concerning some countries are region specific.

the diffusion of terrorism are conditional upon the distance to the headquarter, the efficiency of the terrorist organization and the optimal level of security.

Second, we find that the diffusion of terrorism has implications for trade between country U and potential source countries of terrorism. The model predicts that the closer a country to the headquarter, the higher the level of security directed against that country and the lower its trade with country U. However, the model also predicts that under some circumstances, some ‘safe’ countries (i.e located far enough from the headquarter) could instead improve their trade with country U. The logic is very similar to that of Anderson and Van Wincoop (2003) whereby higher barriers to trade (here, higher security measures) set against some unsafe source countries of terrorism improve the relative prices of safe ones, and thus increases their trade with country U.

We next take our model to the test by using a large data set of US bilateral imports at the product level and terrorist incidents against the US on the 1993-2002 period. The main reason of using disaggregate trade data is to avoid endogeneity between trade and terrorism. In fact, trade at the aggregate level, by shifting resources across sectors, might favor in turn terrorism through changes in the opportunity costs of engaging in terrorist activities (Anderson (2008) and Mirza and Verdier (2006)).

For terrorist incidents, we use the ITERATE data set which reports transnational terrorist activities [Mickolus *et al.* (2003)]. ITERATE is an event-based data set that provides information on the date and country of localization of the incidents, as well as the country of first nationality of the terrorists and of the victims. We pick the incidents that are directed towards the United States as the main target, via its representative authorities, its army or its civilians anywhere in the world. In order to test our theoretical predictions, let the country of the 1st nationality of terrorists be the headquarter country of the terrorist organization, ie. country 0. Then, we investigate whether closeness to country 0 is detrimental to trade with the US.

The results tend to support our theoretical predictions. We document (1) a direct negative impact of transnational terrorism on trade of the source country of terror;

(2) an indirect negative impact emanating from terrorism of neighborhood countries. We find that both impacts are of similar magnitude. Finally, we document that trade is increasing with remoteness to terror. These results appear to be robust to various definitions of the neighborhood (ie. adjacent, linguistic, religious and geographical).

The paper is structured as follows. In section 2, we set a simple theoretical model of endogenous transnational terrorism, spatial diffusion and security, embedded into a standard trade model. In section 3, we explain the empirical strategy. In section 4, we present data on trade and terrorism. In section 5, we take the model to the test and present the benchmark econometric results and robustness checks.

2 A simple model of Trade, Diffusion of Terrorism and Security

In this section we present the basic elements of a simple model of trade, diffusion of transnational terrorism and security. There are three types of countries that are engaged in international trade. First, there is the US (indexed by U) that is going to be the target of transnational terrorism. Second, there is a continuum of countries of mass 1 (indexed by z) and located on the segment $[0, 1]$ that are potential sources of terrorism against the US (country U). Finally, there is the rest of the world with whom the US is trading (indexed by R).

2.1 Trade

Each country (ie. U , $z \in [0, 1]$ and R) produces differentiated goods under increasing returns. The utility of a representative agent in country U has a standard Dixit-Stiglitz form:

$$U_U = \left[n_U x_{UU}^{(1-1/\sigma)} + \int_0^1 n_z x_{Uz}^{(1-1/\sigma)} dz + n_R x_{UR}^{(1-1/\sigma)} \right]^{1/(1-1/\sigma)}$$

where n_U , n_z and n_R are respectively the number of varieties produced in country U , $z \in [0, 1]$, and R . x_{Uj} is country U demand for a variety of country $j \in \{U, z \in [0, 1], R\}$. All goods produced in j are demanded in the same quantity by symmetry and $\sigma > 1$ is the elasticity of substitution. In country U , this helps define

a usual consumer price index:

$$P_U = \left(n_U p_U^{1-\sigma} T_{UU}^{1-\sigma} + \int_0^1 n_z p_z^{1-\sigma} T_{Uz}^{1-\sigma} dz + n_R p_R^{1-\sigma} T_{UR}^{1-\sigma} \right)^{1/(1-\sigma)}$$

where p_j is the mill price of products made in $j \in \{U, z \in [0, 1], R\}$ and T_{Uj} are the usual iceberg trade costs between country U and country j . If one unit of good is exported from country j to country U only $1/T_{Uj}$ units are consumed. Trade costs depend on geographical distance, trade restrictions and will also be assumed to depend on security measures (more on this below). As is well known the value of demand by country U from country j is given by

$$m_{Uj} = n_j E_U \left[\frac{p_j T_{Uj}}{P_U} \right]^{1-\sigma} \quad \text{for } j \in \{U, z \in [0, 1], R\} \quad (1)$$

where E_U is total expenditure of country U .

There is only one factor of production: labor in quantity L_U in country U , L_R in country R and $L_z = L$ for all countries $z \in [0, 1]$. In each country, the different varieties are produced under monopolistic competition and the entry cost to produce in a monopolistic sector is supposed to be 1 unit of a freely tradable good which is chosen as world numeraire. This good is produced in perfect competition. This in turn fixes the wage rate to its labor productivity $a = 1$ which is assumed to be the same across all countries and across sectors under perfect and imperfect competition (for simplicity). Given this, standard mark-up conditions from profit maximization by firms give that mill prices in the monopolistic competitive sector are identical and equal to the mark up $\sigma/(\sigma - 1)$ times marginal costs (also equal to 1). On the supply side, free entry implies that $n_j = L_j/\sigma$ with L_j the number of workers available for production in country $j \in \{U, z \in [0, 1], R\}$. In equilibrium, the indirect utility of the representative consumer in country U is:

$$W_U = W_U(\mathbf{T}_U) = \frac{E_U}{\frac{\sigma}{\sigma-1} (\sigma)^{\frac{1}{\sigma-1}}} \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right)^{1/(\sigma-1)}$$

with \mathbf{T}_U the vector $\{T_{Uj}\}_{j \in \{U, z \in [0, 1], R\}}$ of bilateral iceberg costs.

As is well known from this simple model, one gets bilateral imports of country U from country j as proportional to :

$$m_{Uj} = L_j E_U T_{Uj}^{1-\sigma} P_U^{\sigma-1} \quad (2)$$

2.2 Terrorism and Security

- **Terrorist behavior and diffusion:**

We assume that at $z = 0$ is located the headquarter of a transnational organization A (see Figure 1). The terrorist organization A is acting like a multinational network in the following way. In each potential source country $z \in [0, 1]$, there is the possibility to implement a terrorist cell to gear an attack from country z against country U (ie. the US). We consider that each cell once implemented benefits from the same technology of terrorism as the headquarter (this is in a sense the intangible specific asset of the international terrorist network). However to capture the decentralized organizational feature of such networks, we consider that cell is maximizing her objective function independently from the other cells in the network. This objective function of a particular cell is to get visibility (which help her capture or enjoy particular political or economic rents). More precisely a terrorist cell in country $z \in [0, 1]$ maximizes

$$\text{Max}_R \Pi(R_z, S_z) V - \theta R_z \quad (3)$$

where $\Pi(R_z, S_z)$ is the probability of success of a terrorist act against country U launched from country z . It depends positively on the amount of resources R_z invested by the terrorist cell and negatively on security measures S_z implemented by the government of country U against country z . θ is the marginal resource cost of the terrorist network. As said, it is a specific characteristic of the terrorist organization A . V is the perceived visibility gain enjoyed by the terrorist cell when terrorism is successful.

We introduce a spatial dimension by assuming that in order to implement a cell in country z , we assume that A has to spend a fixed organizational resource cost $F(z)$ that depends positively on the distance between country $z = 0$ and country at distance z (ie. $F'(z) > 0$, $F(0) = 0$, and $\lim_{z \rightarrow 1} F(z) = +\infty$). We assume that the terrorist cell will be implemented in country z if and only if the expected net

rent from terrorism is larger than the fixed implementation cost of the cell, namely:
 $Max_{R_z} [\Pi(R_z, S_z) V - \theta R_z] \geq F(z)$.

We consider a specific parametric form for the probability of success $\Pi(R, S)$. More precisely, as in Anderson and Marcouiller (2002) we take a simple asymmetric contest success function :

$$\Pi(R, S) = \frac{\varphi R}{\varphi R + S}$$

with the technological parameter $\varphi > 0$ reflecting the relative efficiency of terrorism compared to security.

Denoting $R'_z = \varphi R_z$, the solution of (3) gives immediately the reaction curve of the terrorist group in country z given a certain level of security S_z imposed by country U on that country:

$$\begin{aligned} R'_z = R(S_z, \theta) &= \sqrt{\frac{\varphi S_z V}{\theta}} - S_z \text{ for } S_z \leq \bar{S}(z, \theta) = \left[\sqrt{V} - \sqrt{F(z)} \right]^2 \frac{\varphi}{\theta} \text{ (terrorism)} \\ &= 0 \quad \text{for } S_z > \bar{S}(z, \theta) \end{aligned}$$

(terrorism) takes into account the fact that a terrorist cell is implemented in country z if and only if $Max_{R_z} [\Pi(R_z, S_z) V - \theta R_z] \geq F(z)$. The shape of the reaction curve is depicted in figure 2. When the security level S_z imposed by country U against country z is below a certain threshold $\bar{S}(z, \theta)$, the transnational terrorist organization chooses to diffuse and to implement a cell in country z , engaging resources locally $R_z = R(S_z, \theta)/\varphi$ in terrorism. Above the threshold $\bar{S}(z, \theta)$, there is no transnational terrorism diffusion to country z and $R_z = 0$.

- **Security behavior by the US:**

The government of country U is concerned both by the economic welfare of the representative consumer $W_U(\mathbf{T}_U)$ and about the expected social cost of terrorism imposed on citizens of that country. To fix ideas, consider that he maximizes

$$G_U = \text{Log}W_U(\mathbf{T}_U) - E(C)$$

where $E(C)$ is the expected cost of terrorism in country U . We assume that, be-

cause of pervasive problems of asymmetric information, the government of country U , when deciding his security level S_z against a potential source country $z \in [0, 1]$, does not know the true value of the marginal resource cost θ of the terrorist organization A . He has beliefs on this parameter summarized by the density function $f(\theta)$ defined on an interval $[\underline{\theta}, \bar{\theta}]$. Also, the decision by the US government on security measures S_z is made simultaneously with the decision of all terrorist cells in the various countries $z \in [0, 1]$. Given this, and an expectation of terrorist activity in country z , $R_z^e(\theta)$,

$$E(C) = E_\theta \left[\int_0^1 \Pi(R_z^e(\theta), S_z) dz \right] C$$

where $E_\theta(\cdot)$ reflects the expectation operator of government of country U on the level of terrorist resource $R_z^e(\theta)$ undertaken in country z .

Security measures $\{S_z\}_{z \in [0,1]}$ against terrorists involve trade costs.⁴ Imposing security measures against people and goods from country z are likely to increase transactions costs on trade flows (security checks, time delays, restrictions on passports of business people, various immigration controls) and we simply pose that

$$T_{Uz} = T(S_z) \text{ with } T'(\cdot) \geq 0, T''(\cdot) > 0 \text{ and } T'(0) = 0$$

According to the type θ of the terrorist organization, country U 's problem is simply:

$$Max_{S_z} \text{Log} W_U(\mathbf{T}_U) - E_\theta \left[\int_0^1 \Pi(R_z^e(\theta), S_z) dz \right] C \quad (\text{US})$$

Given that the equilibrium wage is 1 and the labour force available for production in country U is L_U , country U 's expenditure on consumption goods are written as $E_U = L_U$. Neglecting constant terms, the problem (US) can be rewritten as:

$$\begin{aligned} Max_S G(S, R^e(\cdot)) &= Max_S \frac{1}{\sigma - 1} \text{Log} \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right) \\ &\quad - C \int_{\underline{\theta}}^{\bar{\theta}} \left[\int_0^1 \frac{\varphi R_z^e(\theta)}{\varphi R_z^e(\theta) + S_z} dz \right] f(\theta) d\theta \end{aligned}$$

⁴In doing so, we neglect the budgetary costs of security measures on the welfare of the US citizen and concentrate only on the economic distortional costs of security measures. As well, the reader will also notice that in our formulation of the equilibrium number of varieties produced in any country z , we neglected the effect of the resource cost of terrorism activity on the labor force of that country. In most cases, this is reasonable as the labor force engaged into terrorist activity in any country z is certainly a small fraction of the total active labor force of that country.

Using Fubini's theorem, this can be rewritten as:

$$\begin{aligned} \text{Max}_S G(S, R^e(\cdot)) &= \text{Max}_S \frac{1}{\sigma-1} \text{Log} \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right) \\ &\quad - C \int_0^1 \left[\int_{\underline{\theta}}^{\bar{\theta}} \frac{\varphi R_z^e(\theta)}{\varphi R_z^e(\theta) + S_z} f(\theta) d\theta \right] dz \end{aligned}$$

It is easy to see that the first order condition in S_z of this problem writes as:

$$\frac{L T_{Uz}^{-\sigma}}{\tilde{T}^{1-\sigma}} \frac{dT_{Uz}}{dS_z} = C \int_{\underline{\theta}}^{\bar{\theta}} \left[\frac{\varphi R_z^e(\theta)}{[\varphi R_z^e(\theta) + S_z]^2} \right] f(\theta) d\theta \quad (4)$$

where \tilde{T} is just a trade friction cost index proportional to the aggregate price index of country U :

$$\tilde{T}^{1-\sigma} = \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right)$$

The left hand side of equation (4) is the marginal cost $MC(S_z, \tilde{T})$ of security measures of security S_z applied against country z . It is simply the marginal distortion cost of imposing security controls and measures on bilateral trade flows between country U and z . $MC(S_z; \tilde{T})$ is increasing in S_z when $T_{Uz}(\cdot)$ is convex enough in S_z . We noted also its dependence on the aggregate trade friction cost index \tilde{T} of country U . The larger this index, the larger the volume of trade that country U imports from country z and the more costly it is at the margin to impose trade frictions between country U and z . Hence the larger the marginal cost $MC(S_z, \tilde{T})$ of security measures S_z between U and z .⁵

We look for a Bayesian Nash equilibrium of the terrorist-security game as described above. More precisely a Bayesian Nash equilibrium

$$(S^N, R^N(\theta)) = \left(\{S_z^N\}_{z \in [0,1]}, \{R_z^N(\theta)\}_{z \in [0,1]} \right)$$

is, for each country $z \in [0, 1]$, a security level S_z^N and terrorist activity function $R_z^N(\cdot)$ defined on $[\underline{\theta}, \bar{\theta}]$ and characterized by the following conditions:

$$S^N = \text{Arg max}_S W(S, R^N(\cdot))$$

⁵Note that \tilde{T} is also endogenous in the model as, in turn, it depends on the level of security measures imposed on all countries $z \in [0, 1]$.

$$\begin{aligned}
R_z^N(\theta) &= R(S_z^N, \theta) = \frac{1}{\varphi} \left[\sqrt{\frac{\varphi V}{\theta}} \sqrt{S_z^N} - S_z^N \right] \text{ for } \theta \text{ such that } S_z^N \leq \bar{S}(z, \theta) \\
&= 0 \text{ for } \theta \text{ such that } S_z^N > \bar{S}(z, \theta)
\end{aligned}$$

Given that $\bar{S}(z, \theta) = \left[\sqrt{V} - \sqrt{F(z)} \right]^2 \frac{\varphi}{\theta}$, we can rewrite these conditions as:

$$S^N = \underset{S}{\text{Arg max}} \left[\begin{aligned} &\frac{1}{\sigma-1} \text{Log} \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right) \\ &- C \int_0^1 \left[\int_{\underline{\theta}}^{\theta_z^N} \frac{\varphi R_z^N(\theta)}{\varphi R_z^N(\theta) + S_z} f(\theta) d\theta \right] dz \end{aligned} \right] \quad (5)$$

$$\begin{aligned}
R_z^N(\theta) &= R(S_z^N, \theta) = \frac{1}{\varphi} \left[\sqrt{\frac{\varphi V}{\theta}} \sqrt{S_z^N} - S_z^N \right] \text{ for } \theta < \theta_z^N \\
&= 0 \text{ for } \theta \geq \theta_z^N
\end{aligned} \quad (6)$$

and the equilibrium threshold θ_z^N for all $z \in [0, 1]$ is defined by:

$$\theta_z^N = \tilde{\theta}(S_z^N, z)$$

where the threshold function

$$\tilde{\theta}(S, z) = \text{Max} \left[\text{Min} \left(\frac{\left[\sqrt{V} - \sqrt{F(z)} \right]^2 \varphi}{S}; \bar{\theta} \right); \underline{\theta} \right]$$

is defined for all distance z such that $\sqrt{V} - \sqrt{F(z)} \geq 0$ (ie. $z \leq \tilde{z} = F^{-1}(V)$), taking into account that $\tilde{\theta}(S, z)$ takes values in the interval $[\underline{\theta}, \bar{\theta}]$. For $z \geq \tilde{z}$, it is never optimal for a transnational terrorist organization to diffuse to country z and we simply pose in that case $\tilde{\theta}(S, z) = \underline{\theta}$.

For a given threshold θ_z , the first order condition of problem (5) writes as:

$$MC(S_z, \tilde{T}) = C \int_{\underline{\theta}}^{\theta_z} \frac{\varphi R_z^N(\theta)}{[\varphi R_z^N(\theta) + S_z]^2} f(\theta) d\theta$$

Substituting (6) we get

$$MC(S_z, \tilde{T}) = C \int_{\underline{\theta}}^{\theta_z} \left(\frac{\sqrt{\theta}}{\sqrt{\varphi V}} \frac{1}{\sqrt{S_z}} - \frac{\theta}{\varphi V} \right) f(\theta) d\theta \quad (7)$$

This is illustrated in figure 3a). The RHS of (7) is the marginal benefit of security $RM(S_z)$. It is a decreasing function of S_z and is shifted up with the threshold θ_s . In other words, the larger the set of parameters θ such that transnational terrorism diffuses to country z , the larger the marginal gain to impose security against that country. Simple inspection shows that equation (7) has a unique solution $S_z = \tilde{S}(\theta_z, \tilde{T})$ which is increasing in the threshold θ_z and decreasing in \tilde{T} and such that $\tilde{S}(\theta, \tilde{T}) = 0$.

A Bayesian Nash equilibrium (S_z^N, θ_z^N) of the terrorism-security game is then characterized by the set of equations such that for all $z \in [0, 1]$:

$$\begin{aligned} S_z^N &= \tilde{S}(\theta_z^N, \tilde{T}) \\ \theta_z^N &= \tilde{\theta}(S_z^N, z) \end{aligned}$$

and

$$\tilde{T}^{1-\sigma} = \left(L_U T_{UU}^{1-\sigma} + L \int_0^1 T(S_z^N)^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} \right)$$

Remembering the definition of $\tilde{\theta}(\cdot, \cdot)$, we get easily the following proposition:

Proposition 1. *There is a unique Nash Bayesian equilibrium of the security-terrorist game such that:*

- i) For $z \geq \tilde{z}$, there is no diffusion of transnational terrorism and no security measure applied against country z (ie. $R_z^N(\theta) = 0 \forall \theta \in [\underline{\theta}, \bar{\theta}]$, $\theta_z^N = \underline{\theta}$ and $S_z^N = 0$).*
- ii) For $z < \tilde{z}$, there is a unique threshold $\theta_z^N \in]\underline{\theta}, \bar{\theta}]$ such that transnational terrorism diffuses to country z if and only if the terrorist resource cost θ is less than θ_z^N . The level of security applied against country z is S_z^N and the level of terrorist activity engaged in country z is:*

$$\begin{aligned} R_z^N(\theta) &= R(S_z^N, \theta) = \frac{1}{\varphi} \left[\sqrt{\frac{\varphi V}{\theta}} S_z^N - S_z^N \right] && \text{for } \theta < \theta_z^N \\ &= 0 && \text{for } \theta \geq \theta_z^N \end{aligned}$$

- iii) The equilibrium expected probability of occurrence of a terrorist action originating from country z is given by : $\Pi_z = 0$ for $z \geq \tilde{z}$ and*

$$\Pi_z = \int_{\underline{\theta}}^{\theta_z^N} \left(1 - \sqrt{\frac{\theta}{\varphi V}} \sqrt{S_z^N} \right) f(\theta) d\theta / \text{for } z \leq \tilde{z}.$$

The characterization of the Nash Bayesian equilibrium is illustrated in Figure

3b) for $z < \tilde{z}$. The security curve $S = \tilde{S}(\theta_z, \tilde{T})$ is an upward sloping curve of the threshold θ_z , as the larger the threshold θ_z below which transnational terrorism diffuses, the larger the benefits of security measures imposed by country U against country z . The threshold curve $\theta_z = \tilde{\theta}(S_z, z)$ on the other hand is decreasing in S_z . A larger level of security against country z reduces the profitability of implementing a terrorist cell in that country. This requires a higher level of efficiency (ie. lower value of θ) of the terrorist organization to be able to do so. The intersection of these two curves give a solution $S_z = S(\tilde{T}, z)$ and $\theta_z = \tilde{\theta}(\tilde{T}, z)$. Inspection shows that $S(\tilde{T}, z)$ is decreasing in \tilde{T} while $\tilde{\theta}(\tilde{T}, z)$ is increasing in \tilde{T} . From this, it follows that

$$L_U T_{UU}^{1-\sigma} + L \int_0^1 T(S_z)^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} = L_U T_{UU}^{1-\sigma} + L \int_0^1 T(S(\tilde{T}, z))^{1-\sigma} dz + L_R T_{UR}^{1-\sigma} = H(\tilde{T})$$

is an increasing function of \tilde{T} . Now the equilibrium value of \tilde{T} has to satisfy the following equation

$$\tilde{T}^{1-\sigma} = H(\tilde{T}) \tag{8}$$

The LHS of this equation is a decreasing function of \tilde{T} (for $\sigma > 1$) going from $+\infty$ to 0 as \tilde{T} goes from 0 to $+\infty$. As $H(\tilde{T})$ is an increasing function of \tilde{T} with $H(0) \geq 0$ and $\lim_{\tilde{T} \rightarrow \infty} H(\tilde{T}) > 0$, it follows that equation (8) has a unique solution \tilde{T}^* . Substitution gives immediately $S_z^N = S(\tilde{T}^*, z)$ and $\theta_z^N = \tilde{\theta}(\tilde{T}^*, z)$ for $z < \tilde{z}$.

We can derive now our two main comparative statics: a) how does distance to terrorism influences terrorism diffusion, bilateral security and trade flows across countries? b) how an exogenous shock on security measures (due to the occurrence of increased terrorist action against the US or a higher sensitivity of the US to terrorism) affects trade flows across countries?

Simple inspection of Figure 3b) shows immediately how the equilibrium outcome varies with the distance z between country z and the location of the terrorist organization.

Proposition 2. *Whenever transnational terrorism diffuses, (ie. for $z < \tilde{z}$), we get that: i) θ_z^N is a decreasing function of z , ii) S_z^N is a decreasing function of z .*

Hence both the incentives for diffusion of transnational terrorism and the level

of security applied to country z tend to decrease with the distance z to the terrorist organization headquarters.

The effect of terrorism on trade flows between country U and country z is easily deduced from the equation characterizing trade flows between U and z :

$$m_{Uz} = \frac{LL_U T (S_z^N)^{1-\sigma}}{(\tilde{T}^*)^{1-\sigma}} \quad (9)$$

It is easily verified that:

Proposition 3. m_{Uz} is strictly increasing in z for $z < \tilde{z}$ and $m_{Uz} = cte$ for $z \geq \tilde{z}$ (ie. is unaffected by terrorism).

Proposition (3) basically says that transnational terrorism has some local negative spillover effects on trade flows between countries U and z , the closer the location of country z to the terrorist organization headquarters in 0. These comparative statistics are summarized in Figure 4.

Hence both the incentives for diffusion of transnational terrorism and the level of security applied to country U tend to decrease with the distance z to the terrorist organization headquarters. As a matter of fact, as distance increases the organizational cost to implement a terrorist cell, the perceived probability of diffusion of transnational terrorist activity is also lower. This in turn reduces the level of bilateral security imposed by the target country U .

Consider now the effect of an exogenous shock such as an increase in C , the cost of terrorism in country U . As can be seen on (7), this will increase the value of bilateral security $S = \tilde{S}(\theta_z, \tilde{T})$. In turn it can be shown that the equilibrium value S_z^N for $z < \tilde{z}$ will increase while it will remain constant $S_z^N = 0$ for $z \geq \tilde{z}$. The trade friction cost index \tilde{T}^* is also shifted out. The effect on the volume of trade is described in Figure 5. The security function S_z^N rotates around point $z = \tilde{z}$ (recall that \tilde{z} is independent from C).

Two effects can be distinguished on trade volumes. First, because the multilateral friction cost index \tilde{T}^* is shifted up, all countries benefit from a positive multilateral trade resistance effect that tend to increase their import volume m_{Uz} to country U . On the other hand, countries with $z < \tilde{z}$ also suffer from increased bilateral security measures which penalize their trade with U . It follows that trade with country U will

increase for countries with $z \geq \tilde{z}$, as they only face the positive multilateral effect. On the other hand, countries close to $z = 0$ will face a decrease in their volume of trade with U (ie. m_{U0} goes down), as such countries are more affected by the negative bilateral effect than the positive multilateral effect of increased security.⁶ The effect on trade volume is therefore illustrated in the second quadrant of Figure 5. For countries z close enough to the terrorist organization (ie. $z \leq \hat{z} < \tilde{z}$), the volume of trade with country U is smaller after the shift in C , while for countries further away from U , (ie. $z > \hat{z}$) their volume of trade is positively affected. The preceding discussion can be summarized in the following proposition:

Proposition 4. *An exogenous increase in the cost of terrorism C reduces trade flows m_{Uz} with country U for countries such that $z \leq \hat{z}$ and increases m_{Uz} for countries such that $z \geq \hat{z}$.*

3 Testable implications and empirical strategy

Before turning to the empirical implications of the model, recall that we retain the US as the targeted country U . The US appears to be a very good case study since it has been the main target of transnational terrorism for more than 40 years (around 45% of terrorist incidents have targeted the US in recent years), and is associated with the largest variation across source countries of terrorism. The model first predicts that the incentives for diffusion of transnational terrorism against the US and the level of security applied by the US to a given country z tend to decrease with the distance to the terrorist organization headquarters. Besides, the model predicts that (1) the closer the location of country z to the location of the terrorist organization, the higher negative spillovers it bares on its trade. However, (2) some ‘safe’ countries, ie. located far enough from the terrorist organization, could instead improve their trade with country U . Since we are here mainly concerned about the analysis of the interplay between trade patterns and terrorism activity, the two latter predictions represent our main testable implications. We will test below these implications with a large data set of trade relationships and terrorist incidents against the US on the 1993-2002 period.

⁶This can be shown when the transport cost function $T(S)$ is convex enough in S .

These testable implications require first giving an empirical content to the theoretical concept of distance z , between the country 0, hosting the terrorist organization headquarter, and the country z , hosting the terrorist cell. We consider a broad interpretation of this distance using four main characteristics: geographical distance, contiguity, language and religion. Geographical distance is a continuous variable while the other variables are discrete, however. We benefit from both types of variables. The discrete measures allow first to construct different degrees of closeness to the terrorist organization. We argue that the shortest distance is obtained here when both countries share a border, an official (or primary) language and a religion.⁷ In contrast, the distance is the largest when both countries do not share any of the above mentioned characteristics. In between, we may define various combinations of characteristics and different degrees of closeness.

Table 1 presents here the distribution of the neighboring relationships between countries 0 and z according to two alternative definitions. The left part of Table 1 retains the broad definition of z , with the shortest distance. The right part uses a more strict definition based on the sharing of only one common characteristic, namely contiguity. Using the broad definition, the left part reports that 117 countries have no close neighbors, while 69 countries have at least one. In the extreme case, one country, Saudi Arabia, exhibits the shortest distance with six different countries, with whom it shares a border, a language and a religion, ie. Qatar, Kuwait, Jordan, Oman, United Arab Emirates and Yemen. In the right part of Table 1, we use a more strict definition and get accordingly a much larger number of close neighboring countries. In this case, 43 countries have no contiguous neighbors (ie. island countries and/or distinct statistical territories like French Reunion in the Indian Ocean). In the extreme case, one country, China, has 14 different contiguous neighbors. Considering these two different definitions, we expect higher negative local spillovers on trade using the broad definition of the distance z .

To test the prediction that closeness to country 0 is detrimental to trade with

⁷Information on border and language are from CEPII. Information on religion come from Alesina *et al.* (2003). See appendix B for details. Concerning religion, we consider here that two countries share a religion when a common religion is practised by at least 50% of the population in each country. Our results appear to be robust to the use of a different threshold, namely 10 and 20%. They can be asked upon request.

Table 1: Distribution of close neighbors across observed countries

Broad definition ^a			Strict definition ^b		
# of close neighbors	Freq. of countries	in %	# of close neighbors	Freq. of countries	in %
0	117	62.90	0	43	23.12
1	22	11.83	1	18	9.68
2	25	13.44	2	28	15.05
3	10	5.38	3	25	13.44
4	9	4.84	4	28	15.05
5	2	1.08	5	20	10.75
6	1	0.54	6	9	4.84
Total	186		7	7	3.76
			8	3	1.61
			9	3	1.61
			13	1	0.54
			14	1	0.54
			Total	186	

Notes: ^a denotes a broad definition of z based on the sharing of three common characteristics: contiguity, language and religion. ^b denotes a strict definition of z based on the sharing of one common characteristic, namely contiguity.

the US, we construct a variable, labeled *neighbors incid_j*. This variable sums the number of terrorist incidents perpetrated by the closest neighbor(s) of a given country z against the US in a particular year. Using this variable we capture the idea that increasing the proximity to countries perpetrating terrorist incidents increases the probability to host a terrorist cell. This variable is built for different degrees of proximity of the neighboring countries. Thus, using a broad definition of the distance z , in 2002, Saudi Arabia's closest neighbors perpetrated 9 terrorist incidents against the US. We will below incorporate this variable in our trade specification.

Nevertheless, the distance factor z is continuous in our theory. It says that the closer to the headquarter a country is, the more negative are the spillovers on its trade. This prediction can be tested more precisely by making use of our geodesic distance variable. Hence, we define a 'distance to terrorism' variable. Thus, for each year of observation, we compute the average distance of a given country z to source countries of terrorism against the US, weighted by their corresponding share in total

incidents. More formally we compute:

$$\text{dist terror}_{Uz} = \sum_h (w_h) \cdot \text{dist}_{zh}$$

where w_h is the share of country h incidents against the country U (ie. the US). This variable has the interesting feature to resemble to that of a market potential variable in the trade literature. It says that the more centrally located to the source of incidents a country is, the higher its potential to host incidents itself. In order to simplify the interpretation of the econometric results however, and allow for a more direct comparison with the discrete variables, we define instead a measure of closeness to terrorism that is basically the inverse of the latter. That is: $\text{close terror}_{Uz} = 1/\text{dist terror}_{Uz}$.

Equation (2) defines a gravity-like model of trade. It relates trade between the US, labeled U , and country z to the economic sizes of both countries L_z and E_U , the bilateral trade costs T_{Uz} and the importing price index P_U . We now fit the equation to the data. First, we discard importing country-variable controls, such as economic size and price index, since in our data the importing country is always the US and these variables only have time-series variation. We capture such time-series variation by allowing for year specific effects in trade. Second, we proxy the number of workers available for production in the exporting country z , L_z , by the gross domestic product Y_z . Then, we decompose Y_z in population (N_z) and GDP per capita (Y/N_z), to control, respectively, for size and development differences across exporting countries. Third, we use disaggregated trade data to cope with differences in specialization between developing and developed exporting countries. Using trade data at the product level allows to control for the relative specialization of countries which may be correlated both with bilateral trade and terrorism activities (see section 4). Fourth, we posit that trade costs (T_{Uz}) are a log-linear function of various observable factors. We assume two different log-linear functions based on the two definitions of the closeness to the terrorist organization: discrete ($T_{d,Uz}$) and continuous ($T_{c,Uz}$):

$$T_{d,Uz} = \text{dist}_{Uz}^\delta \exp\{\gamma_1 \text{lang}_{Uz} + \gamma_2 \text{contig}_{Uz} + \gamma_3 \text{incid}_{Uz} + \gamma_4 (\text{neighbors incid})_{Uz}\}, \quad (10)$$

and

$$T_{c,Uz} = \text{dist}_{Uz}^\delta \exp\{\gamma_1 \text{lang}_{Uz} + \gamma_2 \text{contig}_{Uz} + \gamma_3 \text{incid}_{Uz}\} (\text{close terror})_{Uz}^{\gamma_4}, \quad (11)$$

where, as in many empirical applications, dist_{Uz} is bilateral distance, lang_{Uz} and contig_{Uz} are two dummy variables indicating, respectively, whether the US shares a common language and a border with the exporting country z . According to our theoretical setting, trade costs are also induced by the counter-terrorism measures implemented by the US government against the country z . Such measures are largely unobservable but are positively correlated with the international terrorism activity. Consequently, we proxy the US security measures with the numbers of incidents of country z against the US (incid_{Uz}). Concerning the closeness to the terrorist organization, we retain two different forms: (i) the number of incidents of country z 's closest neighbors against the US (neighbors incid) $_{Uz}$ in the discrete function ($T_{d,Uz}$) and (ii) the inverse of the average distance to source countries of terrorism against the US, weighted by their corresponding share in total incidents (close terror) $_{Uz}$ in the continuous function ($T_{c,Uz}$). Finally, we benefit from the multiplicative form of equation (2) to operate a log-linear transformation of the model.

Assume that the year and product observed are represented by t 's and s ' subscripts respectively. Now, dropping the country U subscripts for notational convenience while considering all possible countries j with $j \in \{z, R\}$ that are exporting to U , we obtain two slightly different estimated equations using the discrete version of trade costs:

$$\begin{aligned} \ln(m_{jst}) &= \ln(N)_{jt} + \ln(Y/N)_{jt} + \alpha_1 \ln(\text{dist})_j + \alpha_2(\text{lang})_j + \alpha_3(\text{contig})_j \\ &+ \beta_1(\text{incid})_{jt} + \beta_2(\text{neighbors incid})_{jt} + \rho_t + \rho_s, \end{aligned} \quad (12)$$

and the continuous version:

$$\begin{aligned} \ln(m_{jst}) &= \ln(N)_{jt} + \ln(Y/N)_{jt} + \alpha_1 \ln(\text{dist})_j + \alpha_2(\text{lang})_j + \alpha_3(\text{contig})_j \\ &+ \beta_1(\text{incid})_{jt} + \beta_2 \ln(\text{close terror})_{jt} + \rho_t + \rho_s, \end{aligned} \quad (13)$$

where in both equations m_{jst} is an $J \times 1$ vector with row j equal to US imports

from country j in a given year t for a given product s ; ρ_t is a year fixed effect capturing time-series variation of the US country-variable controls; ρ_s denotes product fixed effects; $\alpha_1 = (1 - \sigma)\delta$, $\alpha_2 = (1 - \sigma)\gamma_1$, $\alpha_3 = (1 - \sigma)\gamma_2$, $\beta_1 = (1 - \sigma)\gamma_3$, and $\beta_2 = (1 - \sigma)\gamma_4$. β_1 and β_2 are here our coefficients of interest. They are expected to be both negative: an increase in the number of incidents, perpetrated by country j or its neighbors (in the continuous or discrete version), increases security measures (to prevent from potential future incidents), which leads to a decrease in US imports.

4 Trade and transnational terrorism data

Bilateral imports of the United States at the product level (SITC4), for the 1993-2000 period, come from the NBER World Trade Data. The data provide only values of flows that exceed 100,000\$ per year, however. This may induce a selection bias, since part of our exporters j are developing countries that export little of many products and more significantly of a very few set of particular products. Thus, neglecting small amounts could result in an over-representation of products of specialization in the dataset. To deal with this problem, we complete the NBER dataset with the FLUBIL trade dataset from the French National Institute (INSEE), reporting flows over 1,000\$. FLUBIL is basically an updated version of the OECD dataset on bilateral trade flows where some aggregation check-ups and minor corrections have been undertaken. It also completes the NBER dataset as it runs until 2002.

Our variables of terrorist incidents come from the ITERATE dataset set-up by Mickolus, Sandler, Murdock and Flemming (2003) which reports transnational terrorist activities.⁸ ITERATE is an event-based dataset that provides information on the date, country of localization of the attack, the country of 1st nationality of terrorists (source country or headquarter country) and the country of 1st nationality of victims (targeted country). It lists all of the incidents in the world that have been reported in the medias since 1968 onwards. We are mainly interested in those

⁸ITERATE defines terrorism acts as “the use, or threat of use, of anxiety-inducing, extra-normal violence for political purposes by any individual or group, whether acting for or in opposition to established governmental authority, when such action is intended to influence the attitudes and behavior of a target group wider than the immediate victims and when, through the nationality or foreign ties of its perpetrators, its location, the nature of its institutional or human victims, or the mechanics of its resolution, its ramifications transcend national boundaries.”

attacks where the US has been the main target, via its representative authorities, its army or its civilians anywhere in the world. Appendix 1 provides more details about the ITERATE dataset. We use these data to construct the terrorism variables of interest, in particular $(\text{incid})_{jt}$, $(\text{neighbors_incid})_{jt}$ and $(\text{close_incid})_{jt}$.

The sources of the rest of the variables that are used (ie. traditional gravity and control variables), are listed in the appendix 2 of the paper.

5 Empirical results

5.1 Benchmark results

In Table 2, we report results for the specifications (12) and (13), using different definitions and measures of closeness to the terrorist organization. The first five columns depict results where we use a discrete measure and specification (12), while in the ensuing column we use a continuous measure and specification (13). All specifications include a full set of year-specific and product-specific (4-digit) dummies that are not reported in the table. Standard errors are clustered at the country j -year level to address potential problems of heteroskedasticity and autocorrelation in the error terms.

Before proceeding to the analysis of the terrorist incidents variables, notice that, in all regressions, the traditional gravity estimates, like economic size, distance, contiguity and common language, appear with the expected signs. The results show that increases in exporter country per capita income and population promote exports to the US with elasticities close to one as predicted by the model.⁹ The estimate of contiguity reveals a much stronger effect than in the literature [around 0.5 after 1990; see Disdier and Head(2008)]. This could be due to the nature of our sample which considers the US as the sole importer. Thus, the estimate of contiguity captures the preferential North American Free Trade Agreement treatment as well as the impact of the unobservable affinities between the US and the adjacent countries. In our sample, accounting for contiguity seems crucial and avoids biasing the

⁹Instead of GDP per capita and population, we used two alternative methods to capture the economic size effect of the exporting country: (i) GDP and (ii) GDP per capita and GDP, respectively. None of these alternative methods changes the results on the incident variables.

other estimates. For instance, omitting to control for contiguity, which is negatively correlated with distance to the US, would lead to downward the negative distance coefficient. Controlling for contiguity, the elasticity of trade to distance is negative but with a much lower estimate than in the literature [around a mean elasticity of 0.9; see Disdier and Head (2008)]. On the other hand, in line with the literature, the share of the English language increases trade with the US.

Table 2: Closeness of the neighbors and trade (discrete version)

Dependent variable	ln(US imports)				
	(1)	(2)	(3)	(4)	(5)
Definition of Closeness	Contiguous	Linguistic	Religious	Contiguous & Linguistic	Contiguous & Linguistic & Religious
ln(Population) _{jt}	0.859 ^a (0.017)	0.855 ^a (0.017)	0.856 ^a (0.017)	0.857 ^a (0.017)	0.850 ^a (0.014)
ln(GDP/Pop) _{jt}	0.850 ^a (0.014)	0.848 ^a (0.014)	0.856 ^a (0.014)	0.849 ^a (0.014)	0.857 ^a (0.017)
ln(Distance) _j	-0.205 ^a (0.048)	-0.208 ^a (0.048)	-0.223 ^a (0.050)	-0.210 ^a (0.048)	-0.210 ^a (0.048)
Contiguity _j	2.004 ^a (0.109)	2.038 ^a (0.111)	2.001 ^a (0.110)	1.997 ^a (0.109)	1.999 ^a (0.109)
English Language _j	0.325 ^a (0.045)	0.340 ^a (0.045)	0.325 ^a (0.044)	0.324 ^a (0.045)	0.323 ^a (0.045)
# of Incidents _{jt}	-0.010 ^b (0.005)	-0.010 ^b (0.005)	-0.011 ^b (0.005)	-0.010 ^b (0.005)	-0.010 ^b (0.005)
# of Incidents of Neighbors_{jt}	-0.005 ^b (0.002)	-0.005 ^b (0.002)	-0.003 ^b (0.002)	-0.010 ^a (0.003)	-0.010 ^a (0.003)
Fixed Effects:					
Year	yes	yes	yes	yes	yes
Product (4-digit)	yes	yes	yes	yes	yes
Adj. R^2	0.38	0.38	0.38	0.38	0.38
# of Observations	324383	324383	324383	324383	324383

Notes: In parentheses: heteroskedastic-robust standard errors, clustered by country j and year. ^a and ^b denote significance at the 1% and 5% level respectively. Constant and fixed effects are not reported.

As expected, we find a negative effect of the terrorist incidents of the exporting country on US imports. In all regressions, the semi-elasticities of the number of terrorist incidents of country j are statistically significant. On average, exports to the US decrease by about 1 percent for every additional terrorist incident against the US. Is this effect economically significant? What does represent an additional

terrorist incident against the US? To help with the interpretation of the results, and to compare the effects of this particular variable with the other estimated coefficients, we compute standardized (beta) coefficients from the estimates of Table (2). These are the regression coefficients obtained by standardizing all variables to have a mean of 0 and standard deviation of 1. It follows, in column (1), that a one standard-deviation increase in the number terrorist incidents decreases US imports by .0097 standard deviation. In absolute value, it appears that this standardized effect is much more smaller than the effect of the traditional gravity variables: .46 for population, .382 for GDP per capita, -.038 for distance, .127 for contiguity and .044 for common English language. This low standardized coefficient suggests that an additional terrorist incident leads to an economically significant effect but its occurrence is not widespread.

Our theory predicts negative local spillovers on trade with the US, when close exporting country's neighbors hurt the US. Empirical results of Table 2 basically confirm this prediction. In columns (1) to (5), we find negative semi-elasticities of trade to the number of incidents of the exporting country's neighbors. For instance, in column (1), we find that on average exports to the US decrease by 0.5 percent for every additional terrorist incident perpetrated by the exporting country's neighbors against the US.

Additionally, theory predicts that the closer the location of the exporting country to the terrorist organization is, the higher the negative local spillover effects on trade. Empirically, the comparison of the first three columns with the ensuing columns (4) and (5) highlights higher estimates of the semi-elasticities when considering a more strict definition of the neighborhood. Thus, it appears that the more common characteristics neighbors share, the shorter is the distance to terrorist incidents and the bigger is their effects on US imports. It seems in fact reasonable to consider that neighbors are closer when they share a border and a language (column 4) compared to the simple share of a border (column 1). From the former to the latter definition, the semi-elasticity is doubled. It means that on average exports to the US decrease by 1 percent for every additional terrorist incident of the contiguous and linguistic neighbors. Interestingly, considering the additional share of religion

in column (5) does not inflate our estimate of interest ($\widehat{\beta}_2$). This finding is in line with the smaller effect of the neighbors' incidents when considering only the religious closeness (column 3).¹⁰ A reasonable explanation of this result could be related to the fact that a given country could share the religion of a 'terrorist country' while being geographically far remote, with a corresponding low probability to host a terrorist cell.

The discrete measure offers us a comparison between the situations where countries share or not some closeness characteristics. However, the differences of ($\widehat{\beta}_2$) across regressions (1) to (5) are probably not statistically significant despite more precise estimates ($p < 0.01$) and higher magnitudes of the coefficients in columns (4) and (5). To test more neatly our main theoretical prediction, we use a continuous variable of closeness of the terrorist incidents, called *close terror*. The result reported in Table 3, shows that a one-percent increase of the closeness to the terrorist incidents against the decreases US imports by 0.5 percent. This effect is economically and statistically highly significant. In contrast, we may wonder if 'safe' countries (ie. located far from terror) could benefit from an increase in security. To test this part of proposition 4, we decompose in column (2), the *close terror* variable in three categories. Each category represents one-third of the observations: the dummy *close 1* equals one for the farthest countries to terror; the dummy *close 2* is omitted and represents the group of comparison and the dummy *close 3* equals one for the closest countries to terror. Based to the group of comparison, we find as expected a significant positive estimate for the farthest countries to terror and a significant negative estimate for the closest countries to terror.

5.2 Robustness checks

In this section, we investigate the robustness of our results first with respect to the addition of new controls, and then to alternative definitions of the neighborhood.

¹⁰For the sake of comparison, notice that $\widehat{\beta}_2$ is -.007 ($p < 0.01$) when considering contiguous and religious neighbors and -.005 ($p < 0.05$) when considering linguistic and religious neighbors. Again, the effect is smaller when retaining religion in the definition of the closeness of the neighbors.

Table 3: Closeness of the neighbors and trade (continuous version)

Dependent variable	ln(US imports)	
	(1)	(2)
Definition of closeness	Geographic	Geographic
ln(Population) _{jt}	0.857 ^a (0.017)	0.857 ^a (0.017)
ln(GDP/Pop) _{jt}	0.862 ^a (0.014)	0.867 ^a (0.014)
ln(Distance) _j	-0.266 ^a (0.049)	-0.269 ^a (0.050)
Contiguity _j	1.829 ^a (0.118)	1.783 ^a (0.121)
English Language _j	0.280 ^a (0.048)	0.288 ^a (0.049)
# of Incidents _{jt}	-0.013 ^b (0.005)	-0.013 ^b (0.005)
ln(Close terror) _{jt}	-0.539 ^a (0.093)	
Close Terror 1 _{jt}		0.252 ^a (0.062)
Close Terror 2 _{jt}		Omitted category
Close Terror 3 _{jt}		-0.159 ^b (0.065)
Fixed Effects:		
Year	yes	yes
Product (4-digit)	yes	yes
Adj. R^2	0.38	0.38
# of Observations	324383	324383

Notes: In parentheses: heteroskedastic-robust standard errors, clustered by country j and year. ^a and ^b denote significance at the 1% and 5% level respectively. Constant and fixed effects are not reported.

Additional controls Table 4 deals with a first set of robustness checks. We first attempt to control for omitted characteristics of the exporting country in specifications (12) and (13). The objective, here, is to isolate all the forces that affect both bilateral trade and terrorism incidents. A solution to capture time-independent idiosyncrasies of the exporters would be to introduce into the regression country j dummies. However, our variables of incidents are country j -specific and are thus a linear combination of the country dummy variables. Hence, introducing the incident variables and country- j fixed effects would introduce perfect multicollinearity into the regressions. We alleviate this problem by adding a set of income group dummies (line I), following the World Bank’s definition: HOECD (High Income OECD); HOTH (High Income Others); MIDUP (Upper Middle Income); MIDLW (Lower Middle Income) and LOW (Low Income). We next try to control for the political connections between the US and the exporting country (line II). Controlling for this bilateral affinity seems important since strong political connections with the US may offset the negative local spillovers of closeness of the terrorist organizations. To proxy the political links between the US and a given exporting country, we use and introduce in specifications (12) and (13) the correlation between countries’ positions during votes on resolutions in the General Assembly of the United Nations. This correlation is based on the roll-call votes and computed annually (see appendix B).

Table 4 presents the results of the introduction of the two additional controls using three different measures of the neighborhood: a discrete measure based on contiguity (column 1), a discrete measure based on the share of a border, a language and a religion (column 2) and a continuous measure (column 3). To save space, we only present the estimates of $\hat{\beta}_1$ and $\hat{\beta}_2$. The estimated coefficients of the other variables remained unchanged and can be asked for upon request.¹¹ Concerning the $\hat{\beta}$ s, results are not sensitive to the additional controls. They are little changed compared to those of Table 2: we still find local negative spillovers related to the closeness of the terrorist incidents of the neighbors.

¹¹Two sets of results related to the additional controls are worth mentioning. For simplification, let’s consider one regression, say column (3). First, the UN vote correlation variable exhibits a positive and significant estimate (0.477 with $p < 0.01$). Second, the base group income (LOW) exports significantly less to the US than the High Income OECD countries, the High Income Others and the Lower Middle Income countries, respectively.

Table 4: Incidents of Neighbors estimates and additional controls

	Definition of Closeness	(1)	(2)	(3)
		Contiguous	Contiguous & Linguistic & Religious	Geographic
Type of Robustness	Variables			
(I) Income Group _{<i>j</i>} Dummies	# of Incidents _{<i>jt</i>}	-0.012 ^{<i>b</i>} (0.006)	-0.012 ^{<i>b</i>} (0.006)	-0.014 ^{<i>b</i>} (0.006)
	# of Incidents of Neighbors_{<i>jt</i>}	-0.005 ^{<i>b</i>} (0.002)	-0.010 ^{<i>a</i>} (0.002)	
	ln(Closeness of Incidents) _{<i>jt</i>}			-0.556 ^{<i>a</i>} (0.095)
	Adj. <i>R</i> ² # of Observations	0.38 324383	0.38 324383	0.39 324383
(II) United Nations Vote Correlation with the US _{<i>jt</i>}	# of incidents _{<i>jt</i>}	-0.008 ^{<i>b</i>} (0.004)	-0.009 ^{<i>b</i>} (0.004)	-0.011 ^{<i>b</i>} (0.005)
	# of Incidents of Neighbors_{<i>jt</i>}	-0.005 ^{<i>b</i>} (0.002)	-0.009 ^{<i>b</i>} (0.003)	
	ln(Closeness of Incidents) _{<i>jt</i>}			-0.675 ^{<i>a</i>} (0.098)
	Adj. <i>R</i> ² # of Observations	0.39 312377	0.39 312377	0.39 312377

Notes: In parentheses: heteroskedastic-robust standard errors, clustered by country *j* and year. ^{*a*} and ^{*b*} denote significance at the 1% and 5% level respectively. Constant and fixed effects are not reported. See text for details about the definition of closeness of the incidents neighbors.

Alternative definitions of the neighborhood Table 5 deals with a second set of robustness checks with respect to alternative definitions of the neighborhood. We first consider incidents of the exporting country and the neighbors lagged over three and five years, respectively (lines I and II). Then, we use the number of victims of the incidents instead of the number of incidents (line III). We expect incidents with high number of victims to affect even more current security measures and thus bilateral US imports. In line (IV), we check if the effect of the incidents of the close neighbors is not driven by a particular neighbor perpetrating a relatively high number of incidents against the US. Thus, we divide the number of incidents by the number of close neighbors to get the number of incidents by neighbor.

Table 5 presents the results of the above sensitivity tests. As in Table 4, we only report the estimates of $\hat{\beta}_1$ and $\hat{\beta}_2$.¹² Our main results remain unchanged when we lag the incidents over three (line I) or five years (line II). We still find local negative spillovers. In line (III), we get the estimates of the $\hat{\beta}$ s in terms of victims. In all regressions, the semi-elasticities of the number victims of the terrorist incidents of country j against the US are statistically and economically significant. On average, exports to the US decrease by about 9 percent for every one hundred additional US victims. We also find significant negative semi-elasticities of trade to the number of victims of the exporting country's neighbors. For instance, in column (1), we find that on average exports to the US decrease by 3 percent for every one hundred US victims killed by the exporting country's neighbors. Finally, in line IV, we find that the negative local spillovers are not driven by a particular neighbor. In fact, we get higher estimates for the number of incidents by neighbor.

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¹²The estimated coefficients of the other variables remained unchanged compared to Table 2 and can be asked for upon request.

Table 5: Incidents of Neighbors_{jt} estimates and alternative definitions

	Definition of Closeness	(1)	(2)	(3)
		Contiguous	Contiguous & Linguistic & Religious	Geographic
Type of Robustness	Variables			
(I) Incidents Lagged over Three Years	# of Incidents _j	-0.008 ^a (0.002)	-0.008 ^a (0.002)	-0.013 ^a (0.003)
	# of Incidents of Neighbors_j	-0.006 ^a (0.001)	-0.009 ^a (0.001)	
	ln(Closeness of Incidents)_j			-0.941 ^a (0.113)
	Adj. R^2 # of Observations	0.38 324383	0.38 324383	0.39 324383
(II) Incidents Lagged over Five Years	# of incidents _j	-0.006 ^a (0.002)	-0.006 ^a (0.002)	-0.014 ^a (0.002)
	# of Incidents of Neighbors_j	-0.005 ^a (0.001)	-0.008 ^a (0.001)	
	ln(Closeness of Incidents)_j			-1.509 ^a (0.149)
	Adj. R^2 # of Observations	0.38 324383	0.38 324383	0.39 324383
(III) Victims (# 100) of Incidents	# of Victims _{jt}	-0.090 ^a (0.018)	-0.090 ^a (0.018)	-0.088 ^a (0.018)
	# of Victims of Neighbors_{jt}	-0.030 ^a (0.010)	-0.036 ^a (0.010)	
	ln(Closeness of Victims)_{jt}			-0.277 ^a (0.060)
	Adj. R^2 # of Observations	0.38 324383	0.38 324383	0.38 324383
(IV) # Incidents by Neighbor	# of Incidents _{jt}	-0.010 ^b (0.005)	-0.010 ^b (0.005)	
	# of Incidents of Neighbors_{jt}	-0.020 ^a (0.007)	-0.014 ^a (0.004)	
	Adj. R^2 # of Observations	0.38 324383	0.38 324383	

Notes: In parentheses: heteroskedastic-robust standard errors, clustered by country j and year. ^a and ^b denote significance at the 1% and 5% level respectively. Constant and fixed effects are not reported. See text for details about the definition of the closeness of the incidents neighbors.

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A Appendix. ITERATE database of transnational terrorism

The ITERATE dataset, reporting transnational terrorist activities from 1968 onwards, is set-up by Mickolus, Sandler, Murdock and Flemming (2003). Some issues are worth mentioning, regarding the source and the target country respectively.

The source country We first look at the source of the incidents and their place of location. Before going into details, note that the country of source might not be the country of location of the incidents. We identify the source country by the first nationality of the terrorist group, while the country of location is the country where the act has been observed in the ITERATE dataset.

Around half of the countries in the world have been at the source of at least one terrorist incident from 1968 onwards. In terms of numbers, Mirza and Verdier (2006) report that the first 10 source countries of terror (ie. Columbia, Turkey, Iran, Lebanon, Cuba, Spain, Greece, Philippine, Great-Britain and Peru) have been perpetrated about 200 incidents each during the period 1968-1993. However, it is worth mentioning that one third of total incidents have been perpetrated by unknown groups, to which no source have been associated.

The target country The country is coded as target when it is that of the main nationality of the victims. Nearly 80% of the victims are associated with only one nationality over the whole period, which is why one could assign in a relatively confident way only one target country to an incident. It is important to note here that victims, in ITERATE, are defined as “those who are directly affected by the terrorist incident by the loss of property, lives, or liberty.” Thus, when an US embassy is hit without casualties, in say an African country, the US is then coded as the target country.

The US is by far the country that is most hit by terrorism attacks over the period, before France, Israel and Great Britain. Besides, the distribution of incidents across targeted countries does not change much over time [see Mirza and Verdier, (2006)]. Moreover, the distribution of incidents against the US is spread over a large

sample of source countries. Mirza and Verdier (2006) report that among the top 65 biggest ‘bilateral’ incidents (ie. between source and target countries) one third of the bilateral incidents involve the US as a target country. This is obviously not the case for Israel, France or Great Britain which are associated with at most 3 countries in the top 65. Thus, due of the large variability of incidents against the US, this makes cross-country studies related to the US as a target country easily implementable.

B Appendix. Sources of data

Variables	Dataset	Dimensions	Source
Terrorism incidents	ITERATE dataset	Origin, Target and Location Countries* and time	Mickolus <i>et al.</i> (1982)
US bilateral imports	NBER World trade dataset (Feenstra and Lipsey) and Flubil-INSEE dataset	Country Pairs, SITC4 and time	www.nber.org; francoise.legallo@insee.org
GDP, GDP per capita	World Development Indicators (Worldbank)	Countries and time	www.worldbank.org/data
Distance, Contiguity, English Common Language	CEPII (Paris)	Country pairs	www.cepii.fr
UN vote correlation	Votes in the United Nations General Assembly	Country and year	www9.georgetown.edu (Erik Voeten)
Religious Fractions		Country data (only one observed year by country, generally between 1980 and 2001)	Alesina <i>et al.</i> (2003)

* ‘Origin’ (resp. ‘Target’) is the country of first nationality of terrorist group (resp. Human and Physical victims).